Laboratory Manual

(Version 10.0)

for

Design and Analysis of Algorithms - Lab

(MCA-201)

MCA - III Semester

Compiled by:

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Index

List of Abbreviations

BTL	Bloom's Taxonomy Level
CE	Communication Efficacy
CICP	Conduct Investigations of Complex Computing Problems
CK	Computational Knowledge
CO	Course Outcome
DAC	Departmental Advisory Committee
DDS	Design and Development of Solutions
I&E	Innovation and Entrepreneurship
I&T	Individual & Team Work
IQAC	Internal Quality Assurance Cell
LLL	Life-Long Learning
MTU	Modern Tool Usage
PA	Problem Analysis
PE	Professional Ethics
PEO	Programme Educational Objective
PMF	Project Management and Finance
PO	Programme Outcome
SEC	Societal and Envoirnmental Concern

Declaration

Department	:	Department of Computer Science and Applications
Course, Year and the Semester to which Lab is offered	:	MCA - II Year, III Semester
Name of the Lab Course	:	Design and Analysis Lab
Course Code	:	MCA-261
Version No.	:	1.0
Name of Course/Lab Teacher(s)	:	Dr. Saumya Bansal
Laboratory Manual Committee	:	1. Dr. Anupam Baliyan, Member 2. Dr. Ritika Wason, Member 3. Mrs. Tanya Pathak Garg, Member 4. Mr. Uttam Singh Bist, Member 5. Prof. P. S. Grover, Margdarshak 6. Mr. Amit Sharma, Alumni & Industry Expert 7. Mr. Manish Kumar, Concerned Subject Teacher, Convener
Approved by	:	DAC
Approved by	:	IQAC

Signature (Course Teacher)	**Signature** (Head of Department)	**Signature** (IQAC Coordinator)

1. Vision of the Department

To become a Centre of excellence in the field of Computer Science and Applications, to contribute effectively in the rapidly changing global economy directed towards national development ensuring prosperity for the mankind.

2. Mission of the Department

M_1 To become a centre of excellence in the field of Computer Science and Applications and produce professionals as per global industry standards.

M_2 To foster innovation, entrepreneurial skills, research capabilities and bring all-round development amongst budding professionals.

M_3 To promote analytical and collaborative life-long learning skills, among students and faculty members involving all stakeholders.

M_4 To inculcate strong ethical values and professional behaviour while giving equal emphasis to social commitment and nation building.

3. Programme Educational Objectives (PEOs)

The PEOs for the MCA programme are as follows:

PEO_1 Exhibit professional competencies and knowledge for being a successful technocrat.

PEO_2 Adopt creative and innovative practices to solve real-life complex problems.

PEO_3 Be a lifelong learner and contribute effectively to the betterment of the society.

PEO_4 Be effective and inspiring leader for fellow professionals and face the challenges of the rapidly changing multi-dimensional, contemporary world.

4. Programme Outcomes (POs)

PO_1 Computational Knowledge (CK)

Demonstrate competencies in fundamentals of computing, computing specialisation, mathematics, and domain knowledge suitable for the computing specialisation to the abstraction and conceptualisation of computing models from defined problems and requirements.

PO_2 Problem Analysis (PA)

Identify, formulate, and analyze complex real-life problems in order to arrive at computationally viable conclusions using fundamentals of mathematics, computer sciences, management and relevant domain disciplines.

PO_3 Design and Development of Solutions (DDS)

Design efficient solutions for complex, real-world problems to design systems, components or processes that meet the specifications with suitable consideration to public health, and safety, cultural, societal, and environmental considerations.

PO_4 Conduct Investigations of Complex Computing Problems (CICP)

Ability to research, analyze and investigate complex computing problems through design of experiments, analysis and interpretation of data, and synthesis of the information to arrive at valid conclusions.

PO_5 Modern Tool Usage (MTU)

Create, select, adapt and apply appropriate technologies and tools to a wide range of computational activities while understanding their limitations.

PO_6 Professional Ethics (PE)

Ability to perform professional practices in an ethical way, keeping in mind cyber regulations & laws, responsibilities, and norms of professional computing practices.

PO_7 Life-Long Learning (LLL)

Ability to engage in independent learning for continuous self-development as a computing professional.

PO_8 Project Management and Finance (PMF)

Ability to apply knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.

PO_9 Communication Efficacy (CE)

Ability to effectively communicate with the technical community, and with society at large, about complex computing activities by being able to understand and write effective reports, design documentation, make effective presentations, with the capability of giving and taking clear instructions.

PO_{10} Societal and Envoirnmental Concern (SEC)

Ability to recognize and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities applicable to professional computing practices.

PO_{11} Individual & Team Work (I&T)

Ability to work in multi-disciplinary team collaboration both as a member and leader as per need.

PO_{12} Innovation and Entrepreneurship (I&E)

Ability to apply innovation to track a suitable opportunity to create value and wealth for the betterment of the individual and society at large.

5. Institutional Policy for Students' Conduct

The following guidelines shall be followed:-

5.1 All the students in their introductory Lab. shall be assigned a system, which shall be their workplace for the complete semester. Students can store records of all their Lab. assignments on their individual workstations.

5.2 Introductory Lab. shall include an introduction to the appropriate software/tool, followed by a basic Introductory Assignment having Practice Questions. All the students are expected to complete this assignment within a week time, as the same shall be assessed through a lab. test.

5.3 Each week the instructor, in parallel to respective topics covered in the theory lecture, shall assign a set of practical problems to the students in form of Assignments (A, B, C, ...). The problems in these assignments shall be divided into two parts. The first set of Problems shall be compulsory for all the students and its record need to be maintained in the Prcatical File, having prescribed format, as given in Appendix-A. All the students should get the weekly assigntment checked and signed in the Practical File by the respective teacher in the immediate succeeding week. The second set of problems are Advanced Problems and shall be optional. Student may solve these advanced problems for their further practice.

5.4 Cellular phones, pagers, CD players, radios and similar devices are prohibited in the classrooms, laboratories and examination halls.

5.5 Laptop-size computers/Tablets may be used in lectures for the purpose of taking notes or working on team-projects.

5.6 The internal practical exam shall be conducted towards the end of the semester and shall include the complete set of Lab exercises conducted as syllabus. However, students shall be assessed on continuos basis through

overall performances in regular lab. tests, both announced and surprise and viva-voce.

5.7 The respective faculty shall prepare and submit sufficient number of practical sets of computing problems to the Dean (Examinations), atleast two weeks prior to the actual exam. It is the responsibility of the faculty to ensure that a set should not be repeated for more than 5 students in a given batch.

5.8 The exam shall be of 3 hours duration where the student shall be expected to implement solutions to his/her assigned set of problems on appropriate software tools in the lab.

5.9 Once implemented, student shall also appropriately document code implemented in the assigned answer sheets, which shall be submitted at the end of the examination. All the students shall also appear for viva-voce examination during the exam.

5.10 Co-operate, Collaborate and Explore for the best individual learning outcomes but copying or entering into the act of plagiarism is strictly prohibited.

6. Learning Outcomes of Laboratory Work

The student shall demonstrate the ability to:

- ☑ Verify and implement the concepts and theory learnt in class.
- ☑ Code and use Software Tools to solve problems and present their optimal solutions.
- ☑ Apply numerical/statistical formulas for solving problems/questions.
- ☑ Develop and apply critical thinking skills.
- ☑ Design and present Lab as well as project reports.

- ☑ Apply appropriate methods for the analysis of raw data.
- ☑ Perform logical troubleshooting as and when required.
- ☑ Work effectively as a member of a team in varying roles as need be.
- ☑ Communicate effectively, both oral and written.
- ☑ Cultivate ethics, social empathy, creativity and entrepreneurial mindset.

7. Course/Lab Outcomes (COs)

CO1 Apply logical thinking to build solutions for given problems. (BTL3)

CO2 Evaluate correctness & efficiency of algorithms using inductive proofs and invariants. (BTL5)

CO3 Design and perform parameter-based analysis of the searching, sorting and tree-based algorithms. (BTL6)

CO4 Create and test optimal solutions for various problems. (BTL6)

8. Mapping of CO's with PO's

Table 1: Mapping of CO's with PO's

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓							
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓	✓	✓	✓	✓				✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

9. Course/Lab Description

Course (Lab) Title	:	Design and Analysis of Algorithms
Course (Lab) Code	:	MCA-261
Credits	:	01
Pre-requisites	:	NA
Academic Session	:	July to December
Contact Hours/Week	:	02 (01 Lab of 02 Hours/Week)
Internal Assessment	:	40 Marks
External Assessment	:	60 Marks

10. Grading Policy

Item	Points	Marks	Remarks
Programme Execution Test / Presentation / Group Discussion	20	20	Closed Book/Open Book
Practical File / Project Report	10	10	Closed Book
Viva-Voce	10	10	Closed Book
External End-Term Examinations	60	60	Closed Book (conducted and evaluated by the University)
	Total	**100**	

11. Lesson Plan

Week No.	Lab No.	Topics/Concepts to be Covered
1.	1.	Basics of Algorithms
2.	2.	Divide and Conquer Paradigm
3.	3.	Sorting
4.	4.	String Matching Concept
5.	5.	Greedy Algorithms
6.	6.	Dynamic Programming
7.	7.	Backtracking

Week No.	Lab No.	Topics/Concepts to be Covered
8.	8.	Travelling Salesman Problem
9.	9.	Graph Coloring Problem
10.	10.	Dynamic Programming
11.	11.	Dynamic Programming
12.	12.	Revision of all concepts

12. Lab Problems

***Assignment Set*:**

Problems:

P1 Write a program to implement bubble sort.

P2 Write a program to implement quick sort.

P3 Write a program to implement merge sort.

P4 Write a program to implement binary search on the given list of values.

P5 Write a program to perform radix sort on a given list of numbers.

P6 Write a program to perform bucket sort on a given list of numbers.

P7 Write a program to perform counting sort on a given list of numbers.

P8 Given two matrices, perform Strassen's matrix multiplication.

P9 To Implement Matrix Chain Multiplication.

P10 Write a program to perform a naïve string matching algorithm.

P11 Implement and analyze the disjoint data structure algorithm.

P12 Implement fractional Knapsack using Greedy approach and analyze the algorithm.

P13 To implement Huffman Coding and analyze its time complexity.

P14 Implement the Dijkstra Algorithm using Greedy and analyze the algorithm.

P15 Implement the Prims' and Kruskal Algorithm using Greedy and analyze the algorithm.

P16 Implement the Longest Common Subsequence using Dynamic Programming and analyze the algorithm.

P17 Implement Matrix Chain Multiplication using Dynamic Programming and analyze the algorithm.

P18 Implement Floyd-Warshell algorithm for a given graph.

13. Advanced Problems

***Assignment Set*:**

Problems:

A1 Write a program to solve N-QUEENS problem.

A2 Write a program to solve Sum of subsets problem for a given set of distinct numbers.

A3 Write a program to find solution for job sequencing with deadlines problem.

A4 To implement Knuth Morris Pratt algorithm

Appendix – A: Index of Lab File

Week No.	Lab. Ex. No.	Detailed Description of the Lab Exercise	Outcome Mapping		Page No./Link of Online Document	Signature of Teacher with Date
			CO	BTL		
1						
2						
3						
4						
5						
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9						

10						
11						
12						