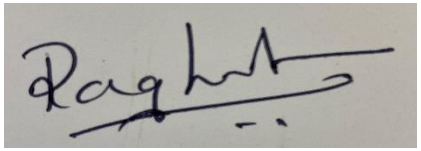
Manipal School of Information Sciences (MSIS)

Manipal Academy of Higher Education, Manipal

Master of Engineering - ME (Embedded Systems)

Course File

Course Name	:	Data Structures and Algorithms
Course Code	:	ESD 5102
Academic Year	:	**2023 – 24**
Semester	:	**I**
Name of the Course Instructor	:	Dr. Raghavendra Prabhu
Name of the Program Coordinator	:	Dr. B Dinesh Rao



Signature of Programme coordinator with date

Signature of Course Coordinator with date

Content

Program Education Objectives (PEOs)

The overall objectives of the Learning Outcomes-based Curriculum Framework (LOCF) for **ME (Embedded Systems)**, program are as follows.

PEO No.	Education Objective
PEO 1	Enable to draw upon fundamental and advanced knowledge to apply analytical and computational approaches to solve technological problems in embedded systems.
PEO 2	Introduce state of art technologies in the area of embedded systems and inculcate ethical practices to make industry-ready professionals.
PEO 3	Promote scientific and societal advancement through research and entrepreneurship.

Program Outcomes (POs)

By the end of the postgraduate program in cloud computing, graduates will be able to:

PO1	An ability to independently carry out research /investigation and development work to solve practical problems.
PO2	An ability to write and present a substantial technical report/document
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO4	Ability to develop and implement embedded systems requirements based on theoretical principles and practical knowledge.
PO5	Ability to demonstrate knowledge of the underlying principles and evaluation methods for analyzing and decision-making.

1. Course Plan

1.1 Primary Information

Course Name	**:**	Data Structures and Algorithms
L-T-P-C		3-0-0-3
Contact Hours	**:**	36 Hours
Pre-requisite	**:**	C Programming

1.2 Course Outcomes (COs), Program outcomes (POs) and Bloom's Taxonomy Mapping

CO	At the end of this course, the student should be able to:	No. of Contact Hours	Program Outcomes (PO's)	BL

CO1	**Analyse** recursive programs, time complexity and space complexity	2	PO1	4
CO2	**Apply** programing concepts to implement data structure like linked lists, stack, queues, binary search tree, Graph and hashtable	20	PO3	3
CO3	**Analyse** sorting and searching algorithms	6	PO4	4
CO4	**Analyse** Greedy algorithms, backtracking and dynamic programming	8	PO5	4

1.3 Assessment Plan

Components	**Internal Test 1**	**Internal Test 2**	**Flexible Assessments (2 – 3 in number)**	**End semester/ Makeup examination**
Duration	90 minutes	90 minutes	To be decided by the faculty.	180 minutes
Weightage	0.2	0.2	0.1	0.5

Typology of questions	Applying; Analyzing.	Applying; Analysing.	Applying; Analyzing.	Applying; Analyzing.
Pattern	Answer all 5 questions of 10 marks each. Each question may have 2 to 3 parts of 3/4/5/6/7 marks.	Answer all 5 questions of 10 marks each. Each question may have 2 to 3 parts of 3/4/5/6/7 marks.	**Assignment:** (Solve problems by designing the data structure and functionalities for a given set of problems)[To be decided by the faculty. May be Assignments, Problem solving, etc.]	Answer all 10 full questions of 10 marks each. Each question may have 2 to 3 parts of 3/4/5/6/7 marks.
Schedule	As per academic calendar.	As per academic calendar.	**Assignment submission:** November 2023	As per academic calendar.
Topics covered	Array list, linked list, stack, queue, trees	searching, sorting, hashtable, graph, greedy algorithms		Comprehensive examination covering the full syllabus. Students are expected to answer all questions.

1.4 Lesson Plan

L. No.	TOPICS	Course Outcome Addressed
L0	Course delivery plan, Course assessment plan, Course outcomes, Program outcomes, CO-PO mapping, reference books	---
L1	Time complexity, Space complexity	CO1
L2	Analysis of recursive function	CO1

L3	Introduction to stack and heap memory	CO1
L4	Array list: defining the data structure and code organisation	CO2
L5	Array List: Writing functionalities and testing	CO1
L6	Array List: Solving problems	CO1
L7	Linked List: Insert at beginning and end	CO1
L8	Linked list: search, max min problem	CO1
L9	Linked list: insert in between, intersection	CO2
L10	Linked List: Deletions	CO2
L11	Stack: array and linked list	CO2
L12	Queue, circular queue: array and linked list	CO2
L13	Binary tree – properties and insertion, traversal	CO2
L14	Binary search tree – properties, insert, traversal	CO2
IT1	Internal test 1	CO1 & CO2
L15	Binary search tree- deletion	CO2
L16	Sorting: bubble, selection, insertion	CO3
L17	Sorting: Quick sort	CO3
L18	Sorting: Merge sort	CO3
L19	Sorting: Heap Sort	CO3
L20	Searching: linear and binary	CO3
L21	Hash table: closed hashing	CO2
L22	Hash Table: open hashing	CO2

L23	Hash table: problem solving	CO2
L24	Graph: properties, adjacency matrix	CO2
L25	Graph: Adjacency list	CO2
L26	Graph: BFS, DFS	CO2
L27	Greedy algorithm: Knapsack, optimal storage on tapes	CO4
L28	Greedy algorithm: Minimum spanning tree - Prims algorithm, Kruskal's Algorithm	CO4
L29	Greedy: Dijktras algorithm	CO4
L30	Revision	CO4
IT2	Internal test 2	CO2, CO3, CO4
L31	Back tracking: Nqueens problem	CO4
L32	Back tracking: sum of subset	CO4
L33	Dynamic programing: Matrix chain multiplication	CO4
L34	Dynamic programming: All pair shortest path	CO4
L35	Revision	-
L36	Revision	-

1.5 References

1. Introduction to Algorithms - Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest. MIT Press.
2. Data Structures and Algorithms - Aho, Hopcroft and Ulmann. Pearson Publishers.
3. Data Structures and Algorithms in Python - Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. John Wiley & Sons.

1.6 Other Resources (Online, Text, Multimedia, etc.)

1. Web Resources: Blog, Online tools and cloud resources.
2. Journal Articles.

1.7 Course Timetable

1st Semester Data Structures and algorithms				Room: LG1 LH 10				
	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5
MON								
TUE	Data Structures							
WED			Data Structures Lab					

THU	Data Structures							
FRI								
SAT	Data Structures							

1.8 Assessment Plan

COs		**Marks & Weightage**				
CO No.	CO Name	IT-1 (Max. 50)	IT-2 (Max. 50)	Assignment (Max. 10)	End Semester (Max. 100)	CO wise Weightage
CO1	**Analyse** recursive programs, time complexity and space complexity	10	-	-	10	**0.31**
CO2	**Apply** programing concepts to implement data structure like linked lists, stack, queues, binary search tree, Graph and hashtable	40	30	5	50	**0.27**
CO3	**Analyse** sorting and searching algorithms	-	20	5	10	**0.23**
CO4	**Analyse** Greedy algorithms, backtracking and dynamic programming	-	-	-	30	**0.19**
	Marks (weightage)	**0.2**	**0.2**	**0.1**	**0.5**	**1.0**

Note:

- In-semester Assessment is considered as the Internal Assessment (IA) in this course for 50 marks, which includes the performances in class participation, assignment work, class tests, mid-term tests, quizzes etc.
- End-semester examination (ESE) for this course is conducted for a maximum of 100 and the same will be scaled down to 50.
- End-semester marks for a maximum of 50 and IA marks for a maximum of 50 are added for a maximum of 100 marks to decide upon the grade in this course.

Weightage for CO1 = (IT1 marks for CO1 / 2.5 + IT2 marks for CO1 / 2.5 + Assignment marks for CO1 + ESE marks for CO1 / 2)/100
= (25/2.5 + 0 + 0 + 20/ 2)/100 = 0.2

1.9 Assessment Details

The assessment tools to be used for the Current Academic Year (CAY) are as follows:

SI. No.	Tools (TLP)	Weightage	Frequency	Details of Measurement (Weightage/Rubrics/Duration, etc.)
1	Sessional	0.4	2	• Performance is measured using sessional attainment level. • Reference: question paper and answer scheme. • Each sessional is assessed for a maximum of 20 marks.
2	Assignments	0.1	1	• Performance is measured using assignments/quiz attainment level. • Assignments/quiz are evaluated for a maximum of 10 marks.
3	ESE	0.5	1	• Performance is measured using ESE attainment level. • Reference: question paper and answer scheme. • ESE is assessed for a maximum of 100 marks and scaled down to 50 marks.

1.10 Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5
CO1	*				
CO2			*	*	
CO3				*	
CO4				*	*
Average Articulation Level	*		*	*	*

2. Assessment Details

2.1 Student Details:

Sl. No.	Registration No.	Name	Learner Email ID
1	231039001	MEGHANA U KAUSHIK	meghanauk.3@gmail.com
2	231039002	NIRANJAN C	niranjanc2398@gmail.com
3	231039003	PRAJWAL H S	prajwalhs99@gmail.com
4	231039004	AKSHARA J M	aksharagowda144@gmail.com
5	231039005	PRATHEEK SHETTY	shettypratheek2001@gmail.com
6	231039006	ARPITHA N R	arpithanr98@gmail.com
7	231039007	PAVAN ADIGA	pavanadiga636@gmail.com
8	231039008	PRIYANKA H B	ppriyankahb@gmail.com
9	231039009	GOPICHANDAN C	gopichandan2211@gmail.com
10	231039010	SNEHA S	snehasgowda28@gmail.com

11	231039011	DHANUSH B S	dhanushbeyes@gmail.com
12	231039012	DILEEP G R	dileepreddy961@gmail.com
13	231039013	SHASHANK G NAIK	ckms4477@gmail.com
14	231039014	PRAKRATHI R SHRIYAN	prakrathi.rshriyan@gmail.com
15	231039015	KELWIN PRANEETH CRASTA	crastakelwin@gmail.com
16	231039017	SHRIVATSA MOKHASHI	shrivatsamokhashi@gmail.com
17	231039018	DEEPAK BN	deepakbn178@gmail.com
18	231039019	PRAVEEN	praveen2662hk@gmail.com
19	231039020	SAGAR RAO SALANKE P	sagarsalanke2@gmail.com
20	231039021	SUDEEP S D	281100sdsudeep@gmail.com
21	231039022	AMITH N	amithnarasimha108@gmail.com
22	231039023	AKHILA Y S	akhilayalmati@gmail.com
23	231039025	VARUN AV	varunav321@gmail.com
24	231039028	SHIVA SWAROOP GOWDA G P	shivaswaroopg@gmail.com
25	231039029	PUNITH KUMAR GS	punithrajgs97@gmail.com
26	231039030	DEEPAK	deepaknaik7473@gmail.com
27	231039032	PAVAN J	pavanjgowda21@gmail.com
28	231039033	PRIYA H M	hmpriya09@gmail.com
29	231039034	ADARSH PRABHAKAR	adarshprabhakar002@gmail.com
30			

2.2 Assessment outcomes

Sl. No.	Registration No.	Name of the Student	IT-1 (50)	IT-2 (50)	Assignment (10)	ESE (100)
1	231039001	MEGHANA U KAUSHIK				
2	231039002	NIRANJAN C				
3	231039003	PRAJWAL H S				
4	231039004	AKSHARA J M				
5	231039005	PRATHEEK SHETTY				
6	231039006	ARPITHA N R				
7	231039007	PAVAN ADIGA				
8	231039008	PRIYANKA H B				
9	231039009	GOPICHANDAN C				
10	231039010	SNEHA S				
11	231039011	DHANUSH B S				
12	231039012	DILEEP G R				
13	231039013	SHASHANK G NAIK				
14	231039014	PRAKRATHI R SHRIYAN				

15	231039015	KELWIN PRANEETH CRASTA				
16	231039017	SHRIVATSA MOKHASHI				
17	231039018	DEEPAK BN				
18	231039019	PRAVEEN				
19	231039020	SAGAR RAO SALANKE P				
20	231039021	SUDEEP S D				
21	231039022	AMITH N				
22	231039023	AKHILA Y S				
23	231039025	VARUN AV				
24	231039028	SHIVA SWAROOP GOWDA G P				
25	231039029	PUNITH KUMAR GS				
26	231039030	DEEPAK				
27	231039032	PAVAN J				
28	231039033	PRIYA H M				
29	231039034	ADARSH PRABHAKAR				
30						

2.3 Analysis of Assessment outcomes

Learning Level	Number of Students			% of Students		
	IT-1	IT-2	End Semester	IT-1	IT-2	End Semester
High Achievers						
Medium Achievers						
Low Achievers						

2.4 Attainment of Course Outcomes (Direct)

Attainment through Formative Assessment

SI. No.	Course Outcomes	Target	Attainment
1	CO1	2	
2	CO2	2	
3	CO3	2	
4	CO4	2	

2.5 Attainment of Course Outcomes (Indirect): Course End Survey (CES) Questionnaire

Considering your in-class and out-of-class experiences, please rate your ability to do the following:

CO	At the end of this course, the student should be able to:	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
		1	2	3	4	5
CO1	**Analyse** recursive programs, time complexity and space complexity					
CO2	**Apply** programing concepts to implement data structure like linked lists, stack, queues, binary search tree, Graph and hashtable					
CO3	**Analyse** sorting and searching algorithms					
CO4	**Analyse** Greedy algorithms, backtracking and dynamic programming					

2.6 Attainment of Course Outcomes (Indirect): Analysis

SI. No.	Course Outcomes	Course End Survey (CES) Attainment
1	CO1	
2	CO2	
3	CO3	
4	CO4	

Course End Survey Example: For a question related to CO1 from 30 responses (5-point Likert's scale):

Attainment Level 1: 50% students rated more than or equal to 60% of maximum marks

Attainment Level 2: 60% students rated more than or equal to 60% of maximum marks

Attainment Level 3: 70% students rated more than or equal to 60% of maximum marks

3. CO-PO Assessment

	PO Assessment (Direct)					PO Assessment (Indirect)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	*					*				
CO2			*	*				*	*	
CO3				*					*	
CO4				*	*				*	*
Average										

Note:
*** please enter actual attainment values**
Direct Attainment = Average (PO_i). Example: PO4 = Average (2.02, 1.73, 2.05) = 1.93
Indirect Attainment = Average (PO_i). Example: PO4 = Average (2.02, 1.73, 2.05) = 1.93

4. Observations and Comments

4.1 Observations from Course Coordinator based on the direct and indirect assessments

SI. No.	Course Outcomes	Target (X)	A: Direct Attainment Weightage (80%)	B: Indirect Attainment Weightage (20%)	Combined Attainment Y= (A+B)	Gap (Y-X)	Action Proposed to bridge the Gap	Revision of target wherever achieved
1	CO1	2						
2	CO2	2						
3	CO3	2						
4	CO4	2						
5	CO5	2						

4.2 Comments/Suggestions by the Course Coordinator

SI. No.	Comment/Observations	Suggested Actions
1.		