SIR C.R.REDDY COLLEGE OF ENGINEERING, ELURU

DEPARTMENT OF INFORMATION TECHNOLOGY

COURSE HANDOUT

SUBJECT: DISTRIBUTED SYSTEMS

CLASS: IV/IV B.Tech. I SEMESTER, A.Y.2022-23

INSTRUCTOR: SMT.G.KRISHNAVENI

Course Handout Index

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College Vision & Mission

Vision: To emerge as a premier institution in the field of technical education and research in the state and as a home for holistic development of the students and contribute to the advancement of society and the region.

Mission: To provide high quality technical education through a creative balance of academic and industry oriented learning; to create an inspiring environment of scholarship and research; to instill high levels of academic and professional discipline; and to establish standards that inculcate ethical and moral values that contribute to growth in career and development of society in general.

Department Vision & Mission

Vision: To be a premier department in the region in the field of Information Technology through academic excellence and research that enable graduates to meet the challenges of industry and society.

Mission: To Provide dynamic teaching-learning environment to make the students industry ready and advancement in career; to inculcate professional and leadership quality for better employability and entrepreneurship; to make high quality professional with moral and ethical values suitable for industry and society.

Program Educational Objectives (PEOs)

PEO1: Solve real world problems through effective professional skills in Information Technology industry and academic research.

PEO2: Analyze and develop applications in Information Technology domain and adapt to changing technology trends with continuous learning.

PEO3: Practice the profession in society with ethical and moral values.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, society, and environmental considerations.

PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in society and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1: Design Skill: Design and develop softwares in the area of relevance under realistic constraints.

PSO2: New Technology: Adapt new and fast emerging technologies in the field of Information Technology.

JNTUK Academic Calendar

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Directorate of Academic Planning
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA-533003, Andhra Pradesh, INDIA
(Established by AP Government Act No. 30 of 2008)

Lr. No. DAP/AC/IV Year /B. Tech/B. Pharmacy/2022 *Date 25.06.2022*

Dr. KVSG Murali Krishna,
M.E, Ph.D.,
Director, Academic Planning
JNTUK, Kakinada

To
All the Principals of Affiliated Colleges,
JNTUK, Kakinada.

Academic Calendar for IV Year - B. Tech/B. Pharmacy for the AY 2022-23

I SEMESTER			
Description	**From**	**To**	**Weeks**
Commencement of Class Work	**04.07.2022**		
I Unit of Instruction	04.07.2022	27.08.2022	8W
I Mid Examinations	29.08.2022	03.09.2022	1W
II Unit of Instructions	05.09.2022	29.10.2022	8W
II Mid Examinations	31.10.2022	05.11.2022	1W
Preparation & Practicals	07.11.2022	12.11.2022	1W
End Examinations	14.11.2022	26.11.2022	2W
Commencement of II Semester Class Work	**05.12.2022**		
II SEMESTER			
I Unit of Instructions	**05.12.2022**	28.01.2023	8W
I Mid Examinations	30.01.2023	04.01.2023	1W
II Unit of Instructions	06.01.2023	01.04.2023	8W
II Mid Examinations	03.04.2023	08.04.2023	1W
Preparation & Practicals	10.04.2023	15.04.2023	1W
End Examinations	17.04.2023	29.04.2023	2W

Director, 25/6/22
Academics & Planning,
JNTUK.

Director
Academic Planning
JNTUK Kakinada

Copy to the Secretary to the Hon'ble Vice Chancellor, JNTUK
Copy to Rector, Registrar, JNTUK
Copy to Director Academic Audit, JNTUK
Copy to Director of Evaluation, JNTUK

Department Academic Calendar

Department of Information Technology
IV/IV B.Tech Academic Calendar for 2022-23

2022-23	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M
Jul 22						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Aug 22		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					
Sep 22					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
Oct 22							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Nov 22			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30					
Dec 22					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
Jan 23	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
Feb 23				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28						
Mar 23				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31			
Apr 23							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
May 23		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					
Jun 23					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			

List of Holidays			
July 10: Bakrid	Oct 9: Maulud Nabi	Mar 22 : Ugadhi	Mid exams
Aug 9:Moharum	Oct 24 : Diwali	Mar 30: Srirama navami	End Examinations
Aug 15:Independence day	Dec 25 :Christmas	Apr 5: Babu Jagjivan Ram Jayanti	Commencement of Class work
Aug 31:Ganesh Chaturdi	Jan 14-16: sankranti	Apr 7: Good friday	Workshops
Oct 2: Gandhi jayanthi	Jan 26:Republic Day	Apr 14:Ambetkar Jayanthi	Department fest/Elite
Oct 5: Vijayadasami	Feb 18 :Sivaratri	Jun 29: Bakrid	**HoD**
	Mar 8 : holi		**Department of IT**

Course Description

This is a graduate course that develops a familiarity with distributed file systems. Describes important characteristics of distributed systems and the salient architectural features of such systems. Describe the features and applications of important standard protocols which are used in distributed systems. Gaining practical experience of inter-process communication in a distributed environment. Able to understand the agreement protocols and fault tolerance mechanisms in distributed systems.

Course Objectives

This course aims at training students to master the:

- To understand the foundations of distributed systems.
- To learn issues related to clock Synchronization and the need for global state in distributed systems.
- To learn distributed mutual exclusion and deadlock detection algorithms.
- To understand the significance of agreement fault tolerance and recovery protocols in distributed systems.

- To learn the characteristics of peer –to –peer and distributed shared memory systems.

Course Outcomes

Students are able to

CO No's	Cos	Level
CO1	Elucidate the foundations and issues of distributed systems.	L2
CO2	Illustrate the various synchronization issues and global state for distributed systems.	L3
CO3	Illustrate the Mutual Exclusion and Deadlock detection algorithms in distributed systems.	L3
CO4	Describe the agreement protocols and fault tolerance mechanisms in distributed systems.	L2
CO5	Describe the features of peer-to-peer and distributed shared memory systems.	L2

Lesson Plan

S. No	Unit	Topic	Teaching Aids	CO
1	I	Cos and definition and importance of Ds	BB	CO1
2		Relation to computer system components, Motivation	BB	CO1
3		Relation to parallel systems, Message-passing systems versus shared memory systems,	BB	CO1
4		Primitives for distributed communication, executions	BB	CO1
5		Synchronous versus asynchronous executions	BB	CO1
6		Design issues	PPT	CO2
7		challenges of distributed system	PPT	CO1
8		A distributed program	PPT	CO2
9		A model of distributed executions	BB/PPT	CO2
10		Models of communication networks, Global state	BB	CO2
11		Cuts of a distributed system	BB	CO2
12		Models of process communications.	BB	CO2
13		Logical Time: A framework for a system of logical clocks, Scalar time, Vector time, Physical	BB	CO2

14	II	Message ordering paradigms	BB	CO1
15		Asynchronous execution with synchronous communication,	BB	CO1
16		Asynchronous execution with synchronous communication	BB	CO1
17		Synchronous program order on an asynchronous system	BB	CO1
18		Synchronous program order on an asynchronous system	BB	CO1
19		Message arrival vs. Delivery		CO2
20		A-execution deadlocks when using synchronous primitives	BB	CO1
21		Algorithm for binary rendezvous	BB	CO2
22	**II**	Bagrodia's algorithm	BB	CO2
23		Uses and characterizations of Causal order (CO)	BB	CO1
24		Causal order	BB	CO2
		Optimal KS algorithm	BB	CO2
25		Total message order	BB/PPT	CO2
26		Three phase algorithm	BB	CO2
27		Global state and snapshot recording algorithms	BB/PPT	CO2
28		Chandy Lamport Algorithm	BB/PPT	CO2
29	III	Introduction to Mutual exculsion	BB	CO2
30		Lamport's algorithm	BB	CO3
31		Ricart-agrawala algorithm	BB	CO3
32		Maekawa's algorithm	BB/PPT	CO3
33		Maekawa's algorithm handles deadlocks	BB	CO3
34		Suzuki-kasami's broadcast algorithm	BB/PPT	CO3
35		Deadlock detection in distributed systems system model	BB/PPT	CO3
36		Issues in Deadlock Detection	BB/PPT	CO3

37		Single source model And model, OR model	BB/PPT	CO3
38		Knapp's classification	BB	CO3
39		Diffusing computations based algorithms	BB	CO3
40		Mitchell and Merritt's algorithm for the single resource Model	BB	CO3
41		Merritt's algorithm	BB	CO3
42		Chandy-misra-haas's for and model	BB	CO3
43		Chandy-misra-haas distributed deadlock detection Algorithm for or model	BB	CO3
44	IV	*Log-based* rollback recovery checkpoint	BB	CO4
45		Consistent global state, Different types of messages	BB	CO4
46		Issues in failure recovery	BB/PPT	CO4
47		Checkpoint-based recovery	BB	CO4
48		Non-blocking Check pointing	BB/PPT	CO4
49		Communication-induced Check pointing	BB	CO4
50		Deterministic and Non-deterministic events	BB	CO4
51		Koo-Toueg coordinated check pointing algorithm	BB	CO4
52		Juang-Venkatesan algorithm for asynchronous check pointing and recovery	BB	CO4
53		Byzantine agreement tree algorithm: exponential (synchronous system) *Recursive formulation*	BB	CO4
54		The Phase King Algorithm	BB	
55	V	Introduction – Data indexing	BB	CO5
56		Introduction – Data indexing	BB	CO5
57		Chord explanation	BB/PPT	CO5
58		Content Addressable Network (CAN)	BB	CO5
59		Tapestry concept and routing table	BB/PPT	CO5
60		Distributed Shared Memory Abstractions	BB	CO5

61		Memory consistency models	BB	CO5
62		Linearizability: Implementation	BB	CO5
63		Causal Consistency	BB	CO5
64		Weak consistency	BB	CO5
65		Lamport's WRWR mechanism and fast mutual exclusion	BB	CO5

Evaluation Pattern

S. No	Components	Internal	External	Total
1	Theory	25	75	100
2	Engineering Graphics/Design/Drawing	25	75	100
3	Practical	20	30	50
4	Mini Project/Internship/Industrial Training/ Skill Development programmes/Research Project	-	50	50
5	Project Work – Part I	20	30	50
5	Project Work – Part II	60	90	150

Marks Range Theory (Max – 100)	Marks Range Lab (Max – 75)	Letter Grade	Level	Grade Point
≥ 90	≥ 67	O	Outstanding	10
≥80 to <90	≥60 to <67	S	Excellent	9
≥70 to <80	≥52 to <60	A	Very Good	8
≥60 to <70	≥45 to <52	B	Good	7
≥50 to <60	≥37 to <45	C	Fair	6
≥40 to <50	≥30 to <37	D	Satisfactory	5
<40	<30	F	Fail	0
			Absent	0

Timetable

Day/Time	**09.00-09.50**	**09.50-10.40**	**11.00-11.50**	**11.50-12.40**	**01.40-02.30**	**02.30-03.20**	**03.20-04.10**	**04.10-05.00**
Mon						DS-B		
Tue		DS-B		DS-A			IPR	
Wed	DS-A							

Thu	DS-B				DS-A		IPR	
Fri		DS-A					DS-B	
Sat		DS-B		DS-A	**********			

Unit wise Questions

Unit I

1. Define distributed system. List out the characteristics of distributed systems. How to relate the computer system components in distributed environment. (1.1 & 1.2)
2. Describe the motivations of implementing distributed systems. (1.3)
3. Describe the parallel systems with examples. (1.4)
4. Differentiate message passing and shared memory and how they emulate (1.5)
5. Describe the primitives of distributed computing (1.6)
6. Differentiate sync and asynchronous execution with example. (1.7)
7. Explain the Design issues and challenges of distributed computing. (1.8)
8. Discuss the model of distributed execution. (1.10)
9. Explain global states with example. (1.12)
10. What is cut and past, future cones of an event in distributed systems (1.13 &1.14)
11. Explain Logical clocks with example.(1.16 &1.17)
12. Discuss scalar time and its properties. (1.18)
13. Discuss Vector time(1.19)
14. Explain physical clock synchronization with example (1.20)

Unit II

1. Explain Asynchronous execution with synchronous communication
2. Discuss Synchronous program order on an asynchronous system
3. Explain the Algorithm for binary rendezvous (or) Bagrodia's Algorithm.
4. Discuss the Raynal–Schiper–Toueg algorithm (RST) (2.5.1)
5. Explain group communication in detail.
6. Explain Optimal KS Algorithm for CO: (2.5.2)

7. Explain the distributed algorithm to implement total order and causal order of messages (or) Three-phase Algorithm
8. Explain Snapshot algorithms for FIFO channels or Chandy Lamport Algorithm

Unit III

1. Explain the Lamport's algorithm.
2. Discuss Ricart-Agrawala algorithm.
3. Explain Maekawa's algorithm.
4. Explain Suzuki–Kasami's broadcast algorithm.
5. How to detect Deadlock in distributed systems. Explain the system model
6. Discuss the Models of deadlocks
7. Explain the Knapp's classification.
8. Discuss the Algorithm for the single resource model.(**MITCHELL AND MERRITT'S ALGORITHM**
9. Discuss the Algorithm the AND model . (**CHANDY-MISRA-HAAS'S)**

Unit IV

1. Explain the following

    1. Local checkpoint 2. Consistent System states

2. Explain different types of messages with neat diagram.

3. Explain the issues in failure recovery.

4. Explain about Checkpoint-based recovery.

5. Explain about Communication-induced checkpointing.

6. Explain about Log-based rollback recovery.

7. Explain about pessimistic logging.

8. Explain about optimistic logging.

9. Explain about causal logging.

10. Explain about Koo-Toueg coordinated checkpointing algorithm.

11.Explain Juang-Venkatesan algorithm for asynchronous checkpointing algorithm.

12.Explain Manivannan-Singhal quasi-Synchronous checkpointing algorithm.

13 Explain about underlying assumptions of agreement algorithms.

14. Explain the Byzantine agreement problem.

15.Explain consensus algorithm for crash failures.

16.Explain consensus algorithm for Byzantine failures in synchronous system.

17.Explain Phase-king algorithm for consensus in synchronous system.

Unit 5

1. Explain Napster P2P system.

2. Explain about Distributed indexing.

3. Explain about unstructured overlays.

4. Explain Replication strategies.

5. Explain the implementation of Replication strategies.

6. Explain the functionality of Chord protocol.

7. Explain about content addressable networks.

8.Explain about content addressable networks initialization.

9.Explain CAN routing.

10.Explain CAN maintenance.

11.Explain CAN optimizations.

12. Explain Tapestry P2P overlay network.

13.Explain about overlay and routing in Tapestry network.

14. Explain object publication and object search process in Tapestry network.

15.Explain Node insertion and deletion in Tapestry network.

16. challenges in P2P system design other than overlays

Distributed shared memory

1.Explain Abstraction and advantages of Distributed shared memory.

2.Explain Memory consistency models.

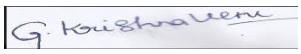
3.Explain the Implementation of sequential consistency model.

4.Explain about causal consistency model.

5.Explain about processor consistency model.

6.Explain about Lamport's bakery algorithm.

7.Explain the hardware support for mutual exclusion.



Signature

(G.Krishnaveni)