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DHANALAKSHMI SRINIVASAN
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COURSE PLAN

Subject code: CS8603	**Branch/Year/Sem/Section: B.E CSE/III/VI**
Subject Name: Distributed Systems	**Batch:2017-2021**
Staff Name: Dr.H.ABDUL SHABEER	**Academic year:2019-2020**

COURSE OBJECTIVE

1. To understand the foundations of distributed systems.
2. To learn issues related to clock Synchronization and the need for global state in distributed systems.
3. To learn distributed mutual exclusion and deadlock detection algorithms.
4. To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.
5. To learn the characteristics of peer-to-peer and distributed shared memory systems

TEXT BOOK:

T1. Kshemkalyani, Ajay D., and Mukesh Singhal. Distributed computing: principles, algorithms, and systems. Cambridge University Press, 2011

T2. George Coulouris, Jean Dollimore and Tim Kindberg, ―Distributed Systems Concepts and Design‖, Fifth Edition, Pearson Education, 2012

REFERENCES:

R1. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.

R2. Mukesh Singhal and Niranjan G. Shivaratri. Advanced concepts in operating systems. McGraw-Hill, Inc., 1994.

R3. Tanenbaum A.S., Van Steen M., ―Distributed Systems: Principles and Paradigms‖, Pearson Education, 2007

R4. Liu M.L., ―Distributed Computing, Principles and Applications‖, Pearson Education, 2004.

R5. Nancy A Lynch, ―Distributed Algorithms‖, Morgan Kaufman Publishers, USA, 2003.

WEB RESOURCES

W1: http://nptel.ac.in.

W2: http://www.cdk5.net/wp/references

TEACHING METHODOLOGIES:

- BB - BLACK BOARD
- VIDEO - VIDEO TUTORIAL
- PPT - POWER POINT PRESENTATION

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CS8603 DISTRIBUTED SYSTEMS L T P C 3 0 0 3

UNIT I INTRODUCTION 9

Introduction: Definition –Relation to computer system components –Motivation –Relation to parallel systems – Message-passing systems versus shared memory systems –Primitives for distributed communication –Synchronous versus asynchronous executions –Design issues and challenges. A model of distributed computations: A distributed program –A model of distributed executions –Models of communication networks –Global state – Cuts –Past and future cones of an event –Models of process communications. Logical Time: A framework for a system of logical clocks –Scalar time –Vector time – Physical clock synchronization: NTP.

UNIT II MESSAGE ORDERING & SNAPSHOTS 9

Message ordering and group communication: Message ordering paradigms –Asynchronous execution with synchronous communication –Synchronous program order on an asynchronous system –Group communication – Causal order (CO) - Total order. Global state and snapshot recording algorithms: Introduction –System model and definitions –Snapshot algorithms for FIFO channels

UNIT III DISTRIBUTED MUTEX & DEADLOCK 9

Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport‘s algorithm – Ricart-Agrawala algorithm – Maekawa‘s algorithm – Suzuki–Kasami‘s broadcast algorithm. Deadlock detection in distributed systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp‘s classification – Algorithms for the single resource model, the AND model and the OR model.

UNIT IV RECOVERY & CONSENSUS 9

Checkpointing and rollback recovery: Introduction – Background and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Coordinated checkpointing algorithm – Algorithm for asynchronous checkpointing and recovery. Consensus and agreement algorithms: Problem definition – Overview of results – Agreement in a failure – free system – Agreement in synchronous systems with failures.

UNIT V P2P & DISTRIBUTED SHARED MEMORY 9

Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays – Chord – Content addressable networks – Tapestry. Distributed shared memory: Abstraction and advantages – Memory consistency models –Shared memory Mutual Exclusion.

1. At the end of the course, the student will be able to:

CO47.1	Elucidate the foundations and issues of distributed systems
CO47.2	Understand the various synchronization issues and global state for distributed systems.
CO47.3	Understand the Mutual Exclusion and Deadlock detection algorithms in distributed systems
CO47.4	Describe the agreement protocols and fault tolerance mechanisms in distributed systems.
CO 47.5	Describe the features of peer

2. **Course Outcome (CO) Assessment:**

CO	Knowledge Level	Internal Test		
		1	2	3
CO1	K2			
CO2	K2			
CO3	K2			
CO4	K2			
CO5	K3			
CO6	K2			

Cognitive Domain:

K1- Remember; K2- Understand; K3-Apply; K4- Analyse;K5- Evaluate; K6-Create

3. **Programme Outcomes**

Students graduating from Electrical and Electronics Engineering should be able to:

PO1	Engineering knowledge	Strong foundation in core Computer Science and Engineering, both theoretical and applied concepts
PO2	Problem analysis	Identify, Formulate, Ability to apply knowledge of mathematics, science and engineering to real-life problem solving and reaching validated conclusions related to computer science.
PO3	Design/development of solutions	Ability to analyze, design, model, and develop complex software and information management systems that meet the specified needs with appropriate consideration for the public health and Safety and the cultural societal and

		environmental considerations.
PO4	Conduct investigations of complex problems	Ability to use research– based knowledge and study methods including analysis, design , coding implementation, testing and interpretation of data, to provide valid Conclusions
PO5	Modern tool usage	Convention of recent techniques, modern engineering and IT tools 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 Computer Science and engineering Practice.
PO7	Environment and sustainability	Understanding the impact of Computer Science and Engineering solutions in the societal and human context.
PO8	Ethics	Understand and apply professional ethical responsibility
PO9	Individual and team work	Ability to function effectively within teams in Software projects.
PO10	Communication	Ability to communicate effectively, both in writing and oral makes effective presentations to provide and obtain clear instructions
PO11	Project management and finance	Demonstrate knowledge and understanding of the engineering 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.

4**. Programme Specific Outcomes**

After the successful completion of the U.G. programme in Computer Science and Engineering, Graduates will be able to:

PSO1:	Foundation of mathematical concepts: To use mathematical methodologies to crack problem using suitable mathematical analysis, data structure and suitable algorithm.
PSO2:	Foundation of Computer System: The ability to interpret the fundamental concepts, methodology of computer systems and to understand the functionality of hardware and software aspects.
PSO3:	Foundations of Software development: The ability to grasp the software development lifecycle and methodologies of software systems. Possess competent skills and knowledge of software design process.

5. **CO-PO Mapping Table:**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	3	2	2
CO4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	2
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	2	2
Weighted average	3	2	1	1	-	-	-	-	-	-	-	-	3	2	2

TOTAL: 45 PERIODS

Topic No	Topic Name	Books For reference	Page No	Teaching Methodology	No of periods required	Cumulative periods
UNIT I	**INTRODUCTION**					**(9)**
1.	Definition –Relation to computer system components	T1	1-4	BB	1	1
2.	Motivation –Relation to parallel	T1	13-21	BB	1	2
3.	Message-passing systems versus shared memory systems –Primitives for distributed communication	T1	24-37	BB	1	3
4.	Synchronous versus asynchronous executions – Design issues and challenges.	T1	37-48	BB	1	4
5.	A distributed program ,A model of distributed executions ,Models of communication networks	T1	48-58	BB	1	5
6.	Global state – Cuts –Past and future cones of an event – Models of process communications	T1	58-67	BB	1	6
7.	A framework for a system of logical clocks	T1	68-77	BB	1	7
8.	Scalar time –Vector time	T1	78-84	BB	1	8
9.	Physical clock synchronization: NTP.	T1	97-105	BB	1	9

LEARNING OUTCOME:

At the end of unit , the students will be able to

- Know the fundamentals of Distributed system.
- Understand the concept of message passing.
- Define the Distributed Computations.

UNIT II	**MESSAGE ORDERING & SNAPSHOTS**				**(9)**	
1	Message ordering paradigms	**T1**	121-127	BB	1	10
2	Asynchronous execution with synchronous communication	T1	128-135	BB	1	11
3	Synchronous program order on an asynchronous system	T1	136-142	BB	1	12
4	Group communication	T1	143-152	BB	1	13
5	Causal order (CO)	T1	153-160	BB	1	14
6	Global state and snapshot recording algorithms: Introduction	T1	171-180	BB	1	15
7	System model and definitions	T1	182-187	BB	1	16
8	Total order	T1	188-195	BB	1	17
9	Snapshot algorithms for FIFO channels	T1	196-199	BB	1	18

LEARNING OUTCOME:

At the end of unit , the students will be able to

- Understand the concept of message ordering
- Define Casual order
- Gain the knowledge about Snapshot

UNIT – III	**DISTRIBUTED MUTEX & DEADLOCK**					
1	Distributed mutual exclusion algorithms: Introduction	T1	205-209	BB	1	19
2	Preliminaries – Lamport‘s algorithm	T1	300-302	BB	1	20
3	Ricart-Agrawala algorithm	T1	303-305	BB	1	21
4	Maekawa‘s algorithm – Suzuki–Kasami‘s broadcast algorithm.	T1	306-308	BB	1	22
5	Deadlock detection in distributed	T1	309-315	BB	1	23

6	System model – Preliminaries	T1	316-319	BB	1	24
7	Models of deadlocks – Knapp's classification	T1	320-328	BB	1	25
8	Algorithms for the single resource model	T1	329-335	BB	1	26
9	the AND model and the OR model	T1	355-365	BB	1	27

LEARNING OUTCOME:

At the end of unit , the students will be able to

- Understand the concept of mutual algorithm.
- Gain knowledge about Deadlock.
- Define Distributed Mutex.

UNIT IV	**RECOVERY & CONSENSUS**					**(9)**
1	Checkpointing and rollback recovery: Introduction	T1	366-371	BB	1	28
2	Background and definitions – Issues in failure recovery	T1	371-375	BB	1	29
3	Checkpoint-based recovery – Log-based rollback recovery	T1	376-384	BB	1	30
4	Coordinated checkpointing algorithm	T1	385-387	BB	1	31
5	Algorithm for asynchronous checkpointing and recovery.	W1	….	BB	1	32
6	Consensus and agreement algorithms: Problem definition	W1	….	BB	1	33
7	Overview of results	W1	….	BB	1	34
8	Agreement in a failure	W1	….	BB	1	35
9	free system – Agreement in synchronous systems with failures.	W1	….	BB	1	36

LEARNING OUTCOME:

At the end of unit , the students will be able to

- Understand the concept of failure recovery.
- Known about consensus.

UNIT V	**P2P & DISTRIBUTED SHARED MEMORY**					
1	Peer-to-peer computing and overlay graphs: Introduction	T1	402-410	BB	1	37
2	Data indexing and overlays	T1	415-418	BB	1	38
3	Content addressable networks	T1	419-425	BB	1	39
4	Tapestry.	T1	426-430	BB	1	40

5	Distributed shared memory	W1	….	BB	1	41
6	Abstraction and advantages	T1	452-460	BB	1	42
7	Memory consistency models	W1	….	PPT	1	43
8	Shared memory Mutual Exclusion	W2	….	PPT	1	44
9	Chord	W1	….	PPT	1	45

LEARNING OUTCOME:

At the end of unit , the students will be able to

- Understand the concept of Distributed System.
- Known about P2P
- Gain knowledge about Distributed Shared memory

COURSE OUTCOME

At the end of the course, the student should be able to:

 Elucidate the foundations and issues of distributed systems
 Understand the various synchronization issues and global state for distributed systems.
 Understand the Mutual Exclusion and Deadlock detection algorithms in distributed systems
 Describe the agreement protocols and fault tolerance mechanisms in distributed systems. Describe the features of peer-to-peer and distributed shared memory systems

CONTENT BEYOND THE SYLLABUS

- Stream oriented Communication
- Hadoop Installation

CONTINUES INTERNAL ASSESSMENT DETAILS

ASSESMENT NUMBER	I	II	MODEL
(UNIT)	(1st & 2nd units)	(3rd & 4th units)	(units 1-5)

ASSIGNMENT DETAILS

ASSIGNMENT NUMBER	I	II	III
TOPIC NUMBER FOR REFERENCE	(1st & 2nd units)	(3rd & 4th units)	(units 1-5)
DEAD LINE			

ASSIGNMENT NUMBER	BATCH	DESCRIPTIVE QUESTIONS/TOPIC (Minimum of 8 Pages)
I	1	1. Explain in detail about Message passing system 2. Explain in detail about Models of communication networks 3. Design issues and challenges
II	1	1. Ricart-Agrawala algorithm 2. Models of deadlocks 3. Distributed mutual exclusion algorithms

III	1	1. Peer-to-peer computing 2. Consensus and agreement algorithms 3. Distributed shared memory

PREPARED BY **VERIFIED BY**

Mr.Dr.H.ABDUL SHABEER, AP/CSE **HOD/CSE**

APPROVED BY

PRINCIPAL