Computer Science and Information Systems Department
First Semester 2018-2019 Course Handout (Part II)

# ADVANCED OPERATING SYSTEMS
# COURSE NO. : CS G623

Date: 02/08/2018

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## SCOPE AND OBJECTIVES

Over the last two decades considerable amount of research has been done in "Distributed OS". The aim of this course is to introduce the design and implementation issues of Distributed OS. Distributed OS's work in an environment where we have independent machines (both hardware and software) connected with each other over a computer network. Distributed OSs have at their center the reasoning that you should use faster machines for more tasks that need speed, and slower ones for the tasks that don't. Also, central to the design of distributed OS's is making this design transparent to the user. A Distributed OS makes a Distributed System a virtual uni-processor system. The distributed OS to be studied in this course is *microkernel* based. It's just that the user level processes that are separated from the kernel can run on remote machines. Few case studies like Sun NFS, V-System, Condor, Sprite, IVY, Vector Clocks, Causal ordering, Agreement protocols, Mutual Exclusion, Distributed file systems etc. shall be discussed and also implemented as part of the coding assignments.

## TEXT BOOK

T1 M. Singhal & N. Shivaratri, "Advanced Concepts in Operating Systems: Distributed, Database and Multiprocessor Operating Systems", Tata McGraw Hill, 2015.

## REFERENCE BOOKS

R1 Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems Principles and Paradigm," 2nd Edition, Pearson

R3 George Coulouris, Jean Dollinmore, Tim Kindberg, Gordon Blair "Distributed Systems-Concepts and Design," 5th Edition, Pearson

R3 John Bloomer, "Power Programming with RPC," O'Reilly & Associates, Inc

IEEE/ACM Research papers uploaded on course website on nalanda

## PLAN OF STUDY

| S.No. | Learning objectives | TOPIC | Chapter (Book) | #Lec |
|---|---|---|---|---|
| 1 | To learn the usage of various Advanced OSs. | Review of concepts of O.S. Overview of Advanced O.S: Design approaches, Why to study AOS? Types of Advanced OS. | Chapter 1 (T1) | 2 |
| 2 | Review of Computer networks. | Architecture: Motivation, Issues, | Chapter 4 | 2 |

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| | | Communication Networks, Communication Primitives. | (T1) | |
| 3 | Need of Logical clocks an d how can they help solve the problem of non-availability of hardware clock synchronization approaches | Theoretical Foundations: Limitations, Lamport's logical clock, vector clock, causal ordering, global state, Cuts. | Chapter 5 (T1) | 2 |
| 4 | Understand and learn ways of inter-process communication | Techniques of IPC; Sun RPC: programming and implementation; Case study | (R3) | 2 |
| 5 | Ways to serialize access to concurrent resource requests will be discussed using various approaches and their need to DS building. | Distributed Mutual Exclusion: Lamport, Recart-agrawala, and Maekawa's algorithms; Suzuki-kasami broadcast algorithm, and Raymond's tree based algorithm . | Chapter 6 (T1) | 2 |
| 6 | Few research papers on D ME from various publications. | Recent Research on DME | IEEE/ACM Research Papers | 2 |
| 7 | Why deadlocks are seen as challenges in DS building? How to handle those without using shared variables like Semaphores as is done in Multi-user OS? | Distributed Deadlock Detection: Resource Vs. Communication deadlock, Strategies to handle deadlock, Ho-Ramamoorthy, Path-Pushing, Edge-Chasing, Diffusion Computation-based algorithms. | Chapter 7 (T1) | 2 |
| 8 | Importance of Consensus in DSs and different ways to implement those in a DS | Agreement Protocols: System model, Classification of agreement problems, Solutions to Byzantine Agreement (BA) problems. | Chapter 8 (T1) | 3 |
| 9 | Few research papers on BA from various publications. | Recent Research on Consensus/ Agreement | IEEE/ACM Research Papers | 1 |
| 10 | How to access files from different machines running heterogeneous OSs in a transparent manner? | Distributed File Systems: Mechanisms for building DFSs, Design Issues, Sun DFS, Sprite DFS, and Hadoop DFS. | Chapter 9 (T1) | 3 |
| 11 | Few research papers on DFS from various publications. | Recent Research on DFS | IEEE/ACM | 2 |
| 12 | Need of transferring a job from one machine to another an d various ways of doing so will be learnt in this part. | Distributed Scheduling: Issues in Load Distribution, Components of a load distribution algorithm, Load Distribution Algorithms, V-system, Sprite, and Condor. | Chapter 11 (T1) | 3 |
| 13 | Few research papers on Distributed scheduling from various publications like Map reduce from Hadoop. | Recent Research on Distributed Scheduling | IEEE/ACM Research Papers | 2 |
| 14 | How to combine the storage power of several RAMs to realize a single RAM of larger size? | Distributed Shared Memory: Algorithm s for implementing DSMs, Memory Coherence, and Coherence Protocols, IVY. | Chapter 10 (T1) | 3 |

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| 15 | How to handle failures an d different ways of recovering the distributed computations? | Recovery: Classification of failures, Synchronous and Asynchronous Check pointing and Recovery. | Chapter 12 (T1) | 3 |
| 16 | Why should we make our DS a fault tolerant and their impact? | Fault Tolerance: Commit Protocols, Voting Protocols, Failure Resilient Processes. | Chapter 13 (T1) | 2 |
| 17 | Application and research t rends | Recent Research in Distributed OS | IEEE/ACM Research Papers | 2 |
| 18 | To study the Access control mechanisms in DS | Protection and Security: Access Matrix Model, Implementation of access matrix, Unix, and Amoeba. | Chapter 14 (T1) | 2 |

**EVALUATION SCHEME**

| S No. | Component & Nature | Duration | Weightage | Date and Time |
|---|---|---|---|---|
| 1. | Assignment (Open Book) | * | 10% | * |
| 2. | Mid-semester Test (Closed Book) | 90 mins | 25% | 9/10 11:00 - 12:30 PM |
| 3. | Surprise Quizzes (Closed Book) – (Total 4 ) | 20 mins each | 15% | * |
| 3. | Term paper presentation | 15 mins (presentation) + 5 mins (Q/A) | 10% | * |
| 4. | Comprehensive Exam<br>(20% OB and 20% CB) | 3 hrs | 40% | 1/12 AN |

Coding Assignments for the course will be based on the design aspects of various components of Distributed Operating Systems like RPC, distributed middleware, agreement protocols, logical clock implementations, distributed file systems, distributed shared memory, and distributed scheduling or load balancing etc. Plagiarism in any form will be reported to the Dean Instruction Division.

**NOTICES**

All notices related to the course will be displayed on the CSIS Notice Board, and / or course nalanda website.

**MAKE-UP**

- Permission of the Instructor-in-Charge is required to take a make-up

- Make-up applications must be given to the Instructor-in-charge personally.
- A make-up test shall be granted only in genuine cases where - in the Instructor's judgment – the student would be physically unable to appear for the test.
- Requests for make-up for the comprehensive examination – under any circumstances – can only be made to Dean, Instruction Division.

**CHAMBER CONSULTATION HOUR**

Tuesday 4-5 PM, Room number 6120-K

Instructor-in-charge, CS G623