National University of Sciences & Technology (NUST)
School of Electrical Engineering and Computer Science (SEECS)
Department of Computing (Software Engineering)

CS-332 Distributed Computing			
Course Code:	CS-332	**Semester:**	7th
Credit Hours:	3+1	**Prerequisite Codes:**	CS-330 or Equivalent
Instructor:	Dr. Asad W. Malik	**Class:**	BESE-5
Office:	A - 108	**Telephone Ext:**	2126
Lecture Days:		**E-mail:**	asad.malik@seecs.edu.pk
Class Room:	SEECS, IAEC	**Consulting Hours:**	Tuesday 11:00 - 13:00 OR by appointment
Lab Engineer:	Khurram Altaf	**Lab Engineer Email:**	khurram.altaf@seecs.edu.pk
Knowledge Group:	CS Core	**Updates on LMS:**	Once or twice per week

Course Description:

This course introduces and familiarizes students to the design and implementation of distributed systems. The course will cover both theoretical and practical aspects of distributed systems.

Course Objectives:

The objective of this course is to familiarize students with the most important design issues in distributed computing, including performance, consistency, fault tolerance, availability, and consensus. The course will also cover several applications of distributed computing in depth, including distributed file systems, peer-to-peer systems, parallel and distributed simulation. At the end of this course, students should be able to design, implement and simulate distributed systems.

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**PLO**	**BT Level***
1. Design distributed protocols.	PLO-1	C-5
2. Point out possible flaws of an existing distributed system	PLO-2	C-4
3. Explain how existing distributed systems work	PLO-4	C-2
4. Develop distributed applications/systems	PLO-5	C-5

* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain

PLOs/CLOs	**CLO1**	**CLO2**	**CLO3**	**CLO-4**
PLO 1 (Engineering Knowledge)	X			
PLO 2 (Problem Analysis)		X		

PLO 3 (Design/Development of Solutions)				
PLO 4 (Investigation)			X	
PLO 5 (Modern tool usage)				X
PLO 6 (The Engineer and Society)				
PLO 7 (Environment and Sustainability)				
PLO 8 (Ethics)				
PLO 9 (Individual and Team Work)				
PLO 10 (Communication)				
PLO 11 (Project Management)				
PLO 12 (Lifelong Learning)				

Course Assessment (In accordance with NUST statutes)

Assessments		
Quizzes:	10%	Theory portion
Assignments:	10%	
OHT-1:	15%	
OHT-2:	15%	
Final	50%	
Labs:	70%	Lab portion
Project:	30%	
Total (100%)	Theory (75%) + Lab (25%)	

Books:

Text Book: Distributed Systems, Principles and Paradigms by Tanenbaum, Van Steen, Second Edition, ISBN-978-81-203-3498

Reference Books:

Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore, and Tim Kindberg, Addison Wesley, 5th edition, 2012.

Distributed Systems, An algorithmic approach, Sukumar Ghosh, Chapman & Hall/CRC Computer and Information Science Series, ISBN 10:1-58488-564-5

Parallel and distributed simulation systems, Richard Fujimoto, ISBN 0-471-18383-0

Week	Lecture Topic
01	Introduction to Distributed Systems Issues and Challenges
02	Inter-Process Communication
03	Physical and Logical Clocks
04	Peer-to-Peer Systems
05	Introduction to Distributed Simulations
06	OHT-1
07	Discrete Event Simulations and Challenges
08	Conservative & Optimistic Simulation Models
09	Global Virtual Time – Algorithms
10-11	Amazon Web Services a. Identity Access Management b. Simple Storage Service: S3 c. S3 Storage Classes d. CloudFront e. EC2 f. EC2 Snapshot g. EC2 Load balancer h. EC2 Auto scaling
12	OHT-2
13	Fault Tolerant Systems
14	Distributed File Systems
15	Project Presentations
16	Project Presentations
17	Revision
18	**End Semester Exam**

Lab Experiments	
01	Multithreaded Programming
02	UDP Socket Application
03	Multithreaded TCP Socket Application
04	Remoting/ RabbitMQ
05	Window Communication Foundation – I
06	Window Communication Foundation – II
07	OpenMPI based programming assignment
08	MPI based programming assignment
09	JADE based programming assignment
10	Mutual Exclusion Algorithm
11	Implementing a Leader selection Protocol
12	Peer-to-Peer algorithms: Network Simulator – I
13	Implementation of Load balancer in DC: Network Simulator – II

Tools / Software Requirement	Microsoft Visual Studio 2012, Ubuntu Linux, C/C++, Java SE, OpenMPI, MPI
Quiz Policy:	The quizzes may be unannounced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures
Assignment Policy	The course website and the Piazza class forum will be the primary source for announcements and submitting assignments
Lab Conduct	The labs will be conducted for three hours every week. In most cases, a lab handout will be given in advance. The lab handouts will also be placed on LMS. One submission per group will be required. However, students may also be evaluated by oral viva during the lab
Plagiarism	Collaboration and group work is encouraged but each student is required to submit his/her own contribution(s). You must cite and acknowledge all sources of information (including copy-pasted code) in your assignments. Cheating and plagiarism will not be tolerated and will lead to strict penalties including zero marks in assignments as well as referral to the SHOD/Dean for appropriate action(s).