**SCHOOL OF SCIENCE AND TECHNOLOGY**

**MIS6060 DISTRIBUTED COMPUTING AND INTERNET TECHNOLOGY**

**LECTURER:** DR. PAUL OKANDA

**DAYS/TIMES:** Thursday 5.40 pm – 9 pm

**VENUE:** ICTLAB3 **CREDIT:** 3 UNITS

**OFFICE HOURS DAY/TIME:** Wednesday 10 am – 1 pm, Thursday 2 pm – 5 pm

**ROOM:** No. 3, 2nd Floor, Lillian Beam Building

**CONTACT: E-MAIL:** pokanda@usiu.ac.ke **TELEPHONE:** +254-20-360 6628

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## 1. COURSE DESCRIPTION

The purpose of this course is to study some ideas and techniques that are helpful in understanding, designing, and implementing distributed systems. It provides some practical experience of system design and concurrent programming and covers a broad range of topics related to distributed systems. Distributed systems consist of a set of PCs or workstations connected by a network, that run special software that allows for transparent sharing of the distributed computing resources and data. Topics include forms of distributed systems, Networks and protocols and Distributed file systems.

Prerequisites: None

## 2. LINK TO UNIVERSITY MISSION OUTCOMES

This course is expected to help students develop skills in higher order thinking, global understanding, and multicultural perspective in the students. It is expected to develop proficiency in literacy, prepare the student for future careers in Business and Information and Communication Technology (ICT). It will hone the ability in the learners to serve the community and culture students in ethical matters that will set them apart as Professional leaders of integrity.

## 2.1. LINKS TO SCHOOL OF SCIENCE & TECHNOLOGY MISSION OUTCOMES

This course is designed to:

- Develop competence in critical thinking, create skills, use of technology, creativity and good communication skills
- Provide service to the community: Acquire practical working experience through participation and contribution to positive/good community and societal causes
- Demonstrate preparedness for career and lifelong learning in their chosen disciplines as well as understanding of the interdisciplinary nature of knowledge.
- Demonstrate the use of qualitative and quantitative research skills in Biomedical, Communication and Information Technology
- Apply theories, concepts, and principles found in biological and physical sciences, including a thorough grounding in communication skills in multicultural & global perspectives.
- Demonstrate a thorough understanding of effective, efficient professional and ethical leadership

## 3. EXPECTED COURSE LEARNING OUTCOMES

By the end of the course students are expected to:

1. Analyze the importance of distributed computing.
2. Describe fault tolerance and security issues in distributed systems.
3. Explain the importance of file and directory services, concurrency control, replicated files.
4. Describe and evaluate Distributed System taxonomies and models.

## 4. CONTENT & CLASS SCHEDULE

### 4.1. Week 1 (A): Welcome and Overview

**Learning Outcomes:**

By the end of this week students will be expected to:

- Obtain a course outline, discuss the course syllabus and understand expectations on learning outcomes by the lecturer.

- Be clear on what the course aims to deliver and have access to all the necessary class materials, course texts and lab resources needed to successfully undertake the course.
- Familiarize themselves with the Blackboard e-learning system.
- Appreciate USIU's regulations regarding the learning environment and exams.

**Week 1 (B): Overview of Distributed Systems**

**Learning Outcomes:**

By the end of this week students will be expected to:

- Define a distributed system and explain its importance for companies and for individuals.
- Describe the goals of distributed systems and how they relate to the internet architecture.
- Define different types of distributed systems and their taxonomy.

**4.2.Week 2 : Internet Protocols**

**Learning Outcomes:**

By the end of this week students are expected to:

- Explain the uses of computer networks both for companies and for individuals, in the home/at work and while on the move.
- Define network hardware and network software and explain network protocols by which processes communicate.
- Describe protocol stacks, the origin and relevance of the 7-layer OSI model.
- Define the main role and importance of each of the layer in the OSI model.

**Class Activities:**

- Lab exercise

**4.3.Week 3: Security**

**Learning Outcomes:**

By the end of this week students will be expected to:

- Describe types of threats in distributed systems and security mechanisms.
- Discuss security concepts such as cryptography, symmetric-key algorithms, public-key algorithms and the management of public keys.

- State the role of digital signatures, communication security and authentication protocols.
- Describe security in relation to e-mail, the web and related social issues.

**Class Activities:**

- Prep for Mid Semester Exam

### 4.4.Week 4: Fault Tolerance

**Learning Outcomes:**

By the end of this week students will be expected to:

- Define fault tolerance in relation to distributed systems.
- Describe process resilience and its contribution towards the design and implementation of fault tolerant distributed systems.
- Define the distributed commit and the recovery process in as far as implementation of fault tolerant distributed systems.

**Class Activities:**

- **Assessed Lab Exercise I**

### 4.5.Week 5: Communication Systems

**Learning Outcomes:**

By the end of this week students will be expected to:

- Describe communication systems and their relevance to distributed systems.
- Define characteristics of communication systems and describe related examples.
- Discuss the process of transmitting and receiving in communication systems.
- State related information processes and issues that relate to communication systems.

**Class Activities:**

- Lab Exercise.
- **QUIZ I & ASSIGNMENT I**

### 4.6.Week 6: Naming, Consistency & Replication

**Learning Outcomes:**

By the end of this week students will be expected to:

- Define naming, naming resolution, representation and types of naming conventions in distributed systems.

- Identify and define reasons for data replication and the importance of maintaining data consistency in distributed systems.
- Discuss the role of redundancy in protecting systems against corrupted data.
- Discuss the effect of performance on scalability.
- Define consistency models and contractual obligations that govern their design and implementation.

**Class Activities:**

- Lab exercise

### 4.7.Week 7: MID-SEMESTER EXAM

### 4.8.Week 8: Client Server Architecture

**Learning Outcomes:**

By the end of this week students will be expected to:

- Define client server architecture and its components including the unique roles of the client, the server and communications networks.
- Describe different types of client-server architecture and their associated features.
- Discuss different types of servers and the role of middleware in distributed systems.

**Class Discussion:**

- **Group Project (Case Study) Discussion & Allocations**

**Class Activities:**

- Lab exercise

### 4.9.Week 9: The Google File System

**Learning Outcomes:**

By the end of this week students will be expected to:

- State the origin of the Google File System and the application motivation that inspired its design and development.
- Define the Google File System's unique platform characteristics and their role.
- Describe Google File System's design criteria and its resultant platform architecture.
- Describe Google File System's consistency model.

**Class Activities:**

- **Lab Exercise**
- **ASSIGNMENT II**

### 4.10. Week 10(A): Logical Clocks & Synchronization

**Learning Outcomes:**

By the end of this week students will be expected to:

- State the role and importance of synchronization and logical clocks in distributed systems.
- Describe methods that are used to achieve clock synchronization in distributed systems.
- Discuss the importance of synchronized clocks in distributed systems and some examples of algorithms that have been used to achieve synchronization.
- Describe the use of timestamps in various multicasting protocols and their conceptual implementation.

**Class Activities:**

- Lab exercise
- **QUIZ II**

### 4.11. Week 10(B): Distributed Lookup Services and Dynamic Hash Tables (DHTs)

**Learning Outcomes:**

By the end of this week students will be expected to:

- Discuss the origin of distributed look up services and Dynamic Hash Tables (DHTs).
- Describe the model using which distributed look up services and DHTs have been designed and implemented and discuss challenges that have resulted from their implementation.
- Discuss examples of distributed lookup services implementations, the advantages and disadvantages that result from their use.

**Class Activities:**

- **Assessed Lab Exercise II & ASSIGNMENT II**

### 4.12. Week 11: Group Communications

**Learning Outcomes:**

By the end of this week students will be expected to:

- Define group and group communication within the context a distributed systems environment.
- Discuss the role of group communication and challenges that are associated with achieving co-ordination amongst a group of processes.
- Identify and define group communication requirements in various distributed environments.
- Discuss different communication methods and their respective advantages and disadvantages.
- Describe multicast communication and implementation of various types of communication protocols that relate to it.

**Class Activities:**

- Individual and Group discussion on expectations.

### 4.13. Week 12: Distributed File Systems

**Learning Outcomes:**

By the end of this week students will be expected to:

- Define the abstraction of files by Operating Systems (OSes) and their (files) manipulation.
- Discuss the logical components of a file and file attributes.
- Discuss access methods and the major components of a file system.
- Describe various file operations and authorization services that are performed on files.
- Discuss the role of DFS replication and how its scheduling affects consistency in a distributed system.

**Class Activities:**

- Individual and Group discussion on expectations.

### 4.14. Week 13: Group Project Presentations & Final Exam Preparations

**Discussion Topics:**

- Individual/group presentations

**Class Activities:**

- Individual and Group presentations

### 4.15. Week 14: FINAL EXAMINTAION

## 5. Teaching and Learning Methodologies

Lectures, delivery through Blackboard e-learning platform, presentations by members of the class, case study discussions, tutorials, assignments, quizzes, group work, practical sessions, library, appropriate software, manual/notes. Throughout the course, skills will be developed through a combination of theoretical discussions, practical laboratory-based work, classroom based tutorial exercises and directed self-study. The general teaching/learning method is to impart these practical skills by a process of moving from an overview of what is required to a specific application of an individual skill at a higher level. Specific skills are consolidated thorough practical work. Specifically the following will augment learning:

- By carrying out a supervised mini project and presenting a report
- By lab based practical work relevant to the technology area covered in course
- By participating in case studies, ensuing classroom discussion and presentations
- By carrying out assignments requiring independent research and self-study and learning from the feedback provided by the instructor.

Weekly lecture/discussion. Lectures will be used to present and highlight the major concepts and issues in IT applications. Additional detail is provided in the Blackboard notes, readings, and other indicated sources. Where feasible and appropriate, the lecture slot may also be used for group discussion around presented themes or readings.

Students discuss concepts and themes in IT applications in some seminar sessions, and report back on their own investigations into application domains of interest to them. Where feasible, at least some of the investigation and reporting on application domains will be conducted in groups.

## 6. KEY INSTITUTIONAL ACADEMIC POLICIES

Students should note the following are key policies as outlined in the University Catalogue and Students Handbook

***1. Academic dishonesty***

a. Any intentional giving or use of external assistance during an examination without the express permission of the faculty member giving the examination.

b. **Fabrication: a**ny falsification or invention of data, citation or other authority in an academic exercise;

c. **Plagiarism: a**ny passing off of another's ideas, words, or work as one's own;

d. **Previously Submitted Work:** presenting work prepared for and submitted to another course;

***2. Class Attendance***

Students are expected to attend all classes. Upon being absent from **four** classes in a 3 unit course, the instructor will give a student an **"F"** grade for that course.

## 7. COURSE TEXT AND OTHER READINGS

**Core Text:**

- Tanenbaum, A.S., Wetherall, D.J., (2014). *Computer Networks.* 5th Edition, Upper Saddle River, New Jersey: Prentice Hall. **[35 Copies]**
- Coulouris, G.F., Dollimore, J.B., Kindberg T., (2012). *Distributed Systems, Concepts and Designs.* 5th Edition, Boston, MA; Addison Wesley **[35 Copies]**
- Comer, D.E., (2008). *Computer Networks and Internets with internet Applications.* 4th Edition, Upper Saddle River, New Jersey; Pearson **[5 Copies-Short Loan]**
- Comer, D.E., (2008). *Computer Networks and Internets with internet Applications.* 3rd Edition, Upper Saddle River, New Jersey; Pearson. **[Whole Semester Loan]**
- Comer, D.E., (2000). *Internetworking with TCP/IP Principles, Protocols and Architecture.* 5th Edition, Boston, MA; Addison Wesley **[5 Copies-Short Loan]**
- Stallings, W., (2013). *Business Data Communications.* 5th Edition, Upper Saddle River, New Jersey; Pearson. **[5 Copies-Short Loan]**
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**Recommended Reading:**

- Comer, D.E., (2009). *Computer Networks and Internets.* 5th Edition, Upper Saddle River, New Jersey: Prentice Hall. **[5 Copies-Short Loan]**

**Recommended Journals**

- International Journal of Distributed Systems and Technologies (IJDST) – http://www.igi-global.com/journal/international-journal-distributed-systems-technologies/1164
- Journal of Internet Technology – http://jit.ndhu.edu.tw/
- International Journal of Internet Protocol Technology – http://www.inderscience.com/jhome.php?jcode=IJIPT

## 8. COURSE EVALUATION

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|---|---|
| Attendance | 5% |
| Laboratory Work | 10% |
| Quizzes | 10% |
| Project | 15% |
| Assignments | 10% |

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|---|---|
| Mid-semester exam | 20% |
| Final semester exam | 30% |
| **Total** | **100%** |

**Grading**

Letter grading for distribution of marks is as follows:

| Numeric Average (100% Maximum) | Letter Grade |
|---|---|
| 90% and above | A |
| 87-89 | A- |
| 84-86 | B+ |
| 80-83 | B |
| 77-79 | B- |
| 74-76 | C+ |
| 70-73 | C |
| 67-69 | C- |
| 64-66 | D+ |
| 62-63 | D |
| 60-61 | D- |
| 0-59 | F |