Title (Units): **COMP7940 Cloud Computing (3,2,1)**

Course Aims: The objective of this course is to examine techniques underlying the design and engineering of distributed systems and cloud computing systems. Students will also acquire hands-on experience in cloud computing software. Upon completion, students will understand the ICT infrastructure for cloud computing, master the information and communication technology skills for cloud applications, and comprehend how cloud computing could realize efficient use of resources and green computing.

Prerequisite: Basic concepts on data communications

Course Intended Learning Outcomes (CILOs):
Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
	Knowledge
1	Describe system models for distributed and cloud computing.
2	Explain the design principles of computer clusters and data centers.
3	Describe and distinguish different virtualization techniques.
4	Explain cloud-enabling technologies, cloud mechanisms, and cloud architectures.
	Professional Skill
5	Use cloud computing software to solve real problems.
	Attitude
6	Solve problems and exhibit self-learning abilities in distributed and cloud computing.

Calendar Description: This course introduces the techniques underlying the design and engineering of distributed systems and cloud computing systems. Topics include cloud and distributed system models, computer clusters, virtualization, cloud storage and data centers, cloud-enabling technologies, cloud mechanisms, and cloud architectures. Students will also acquire hands-on experience in cloud programming and software.

Teaching and Learning Activities (TLAs):

CILOs	Type of TLA
1-4	Students will learn various design principles in distributed and cloud computing via lectures and assignments.
5, 6	Students will acquire hands-on experience in cloud computing software via lectures and machine problems.

Assessment:

No.	Assessment Methods	Weighting	CILOs to be addressed	Description of Assessment Tasks
1	Continuous Assessment	40%	1-6	Tests and machine problems are designed to test and evaluate the student's understanding in distributed and cloud computing as well as the ability in using cloud computing software to solve real problems.
2	Examination	60%	1-4	Final examination questions are to evaluate learning outcomes in the knowledge domain. Questions are to test students' thorough understanding on the principles of distributed and cloud computing.

Assessment Rubrics:

	Excellent (A)	Good (B)	Satisfactory (C)	Marginal Pass (D)	Fail (F)
Describe the various design issues in distributed systems and cloud computing platforms	Fully understand all the design issues	Understand most of the design issues	Sufficiently understand the design issues	Understand a minimum set of design issues	Does not understand most of the issues
Describe the design principles of computer clusters for scalable computing	Fully understand the design principles of computer clusters	Understand most of the design principles of computer clusters	Sufficiently understand design principles of computer clusters	Understand a minimum set of design principles of computer clusters	Does not understand most of the design principles of computer clusters
Describe the principles and techniques of virtualization of IT resources and data centers	Fully understand the principles and techniques of virtualization of IT resources and data centers	Understand most of the principles and techniques of virtualization of IT resources and data centers	Sufficiently understand the principles and techniques of virtualization of IT resources and data centers	Understand a minimum set of the principles and techniques of virtualization of IT resources and data centers	Does not understand most of the principles and techniques of virtualization of IT resources and data centers
Explain cloud-enabling technologies, cloud mechanisms, and cloud architectures	Fully explain cloud-enabling technologies, cloud mechanisms, and cloud architectures	Explain most of cloud-enabling technologies, cloud mechanisms, and cloud architectures	Sufficiently explain cloud-enabling technologies, cloud mechanisms, and cloud architectures	Explain a minimum set of cloud-enabling technologies, cloud mechanisms, and cloud architectures	Does not explain most of cloud-enabling technologies, cloud mechanisms, and cloud architectures
Use cloud computing software to solve problems	Demonstrate a high degree of effectiveness and correctness in using cloud computing software for problem solving	Demonstrate a considerable degree of effectiveness and correctness in using cloud computing software for problem solving	Demonstrate a considerable degree of correctness in using cloud computing software for problem solving	Demonstrate some degree of correctness in using cloud computing software for problem solving	Does not have the ability to correctly use cloud computing software for problem solving

Course Content and CILOs Mapping:

Content		CILO No.
I	Concepts and Models of Distributed System and Cloud Computing	1, 2, 4
II	Computer Clusters for Scalable Computing	2
III	Cloud-Enabling Technologies	2, 4
IV	Virtual Machines and Virtualization	3, 5
V	Cloud Computing Mechanisms and Architectures	3, 4
VI	Cloud Programming and Software	5, 6

References:

- Dan C. Marinescu, Cloud Computing: Theory and Practice, 3rd Edition, Morgan Kaufmann, 2022
- Gabriel N. Schenker, Learn Docker – Fundamentals of Docker 19.x -Second Edition, 2020
- Thomas Erl, and Eric Monroy, Cloud Computing: Concepts, Technology, Security, and Architecture, Pearson, 2023.
- Roy H. Campbell, Kevin A. Kwiat and Charles A. Kammhoua, Assured Cloud Computing, 1st Edition, Wiley-IEEE Computer Society Press, 2018

Course Content:

Topic

I. Concepts and Models of Distributed System and Cloud Computing
   A. Basic Concepts and Terminology
   B. System Models for Distributed System and Cloud Computing (SaaS/PaaS/IaaS, Public/Private/Hybrid Cloud)
   C. Concurrency in the Cloud
   D. Speedup and Load Balancing

II. Computer Clusters for Scalable Computing
   A. Clustering for Massive Parallelism
   B. Computer Clusters and MPP Architectures
   C. Design Principles of Computer Clusters
   D. Cluster Job and Resource Management

III. Cloud-Enabling Technologies
   A. Networking Technology for Cloud Computing
   B. Storage Technology for Cloud Computing
   C. Big Data and Data Streaming
   D. Storage Technology Case Studies (e.g. Google File System, NoSQL)

IV. Virtual Machines and Virtualization
   A. Levels of Virtualization
   B. Virtual Machine
   C. Containers and Orchestration
   D. Case Studies (e.g. Hyper-V, Docker, Kubernetes)

V. Cloud Computing Mechanisms and Architectures
   A. Specialized Cloud Mechanisms
   B. Cloud Management Mechanisms
   C. Cloud Security Mechanisms for Private and Public cloud
   D. Cloud Computing Architectures

VI. Cloud Programming and Software
   A. Basic Programming in Distributed Environments
   B. Services and Service Oriented Architecture
   C. Case Studies (e.g., Google App Engine, Amazon Web Services)
   D. Setting up and Administering Cloud Computing Software for Problem Solving