

School of Computing and Information Sciences

Course Title: Cloud Infrastructure and Services

Date: 12/24/2023

Course Number: CTS-4375

Number of Credits: 3

Subject Area: Systems	Subject Area Coordinator: Gregory Reis email: gmuradre@fiu.edu
Catalog Description: Helps students develop deep technical expertise in cloud computing and prepares them for a Solutions Architect certification exam with a major cloud provider.	
Textbook: None – Public information reading suggestions plus instructor created content	
References: "AWS Certified Solutions Architect Study Guide with 900 Practice Test Questions: Associate (SAA-C03) Exam (4 th Edition)", Ben Piper, David Clinton. ISBN-10: 1119982626. ISBN-13: 978-1119982623. Sybex.	
Prerequisites Courses: (CTS-3145 or equivalent cloud certification) and (CGS-4285 or CNT-4713 or equivalent course)	
Corequisites Courses: None	

Type: Elective for CS (Systems), IT (System Network), & CY Majors

Prerequisites Knowledge:

- Basic Programming Knowledge
- Networking, Security & Operating System Knowledge (Linux & Windows)
- Basic Cloud Computing Knowledge

Course Outcomes:

1. Recognize the business essentials required to implement and support a cloud deployment. [Remembering]
2. Explain the technical essentials of a specific provider's cloud environment (e.g., Management console, networking/compute/storage/database options, etc.). [Understanding]
3. Demonstrate how to plan and design a specific provider's cloud architecture (e.g., Identifying architectural options, making architectural decisions based on business requirements, Incorporating best practices, etc.). [Understanding]
4. Implement a solution to a specific provider's cloud infrastructure using automation including monitoring, ongoing maintenance, and cost estimations. [Applying]
5. Apply cybersecurity best practices in cloud deployments. [Applying]
6. Compare and contrast the many disaster recovery & resiliency options in the cloud. [Analyzing]

School of Computing and Information Sciences
CTS-4375
Cloud Infrastructure and Services

Association between Student Outcomes and Course Outcomes

BS in Computing: Student Outcomes	Course Outcomes
1) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.	1, 2, 3, 4, 5, 6
2) Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.	1, 3, 4, 5, 6
3) Communicate effectively in a variety of professional contexts.	4, 5
4) Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.	
5) Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.	4, 5
Program Specific Student Outcomes	
6) Apply computer science theory and software development fundamentals to produce computing-based solutions. [CS]	
6) Apply security principles and practices to maintain operations in the presence of risks and threats. [CY]	5, 6
6) Use systemic approaches to select, develop, apply, integrate, and administer secure computing technologies to accomplish user goals. [IT]	1, 2, 3, 4, 5, 6

Assessment Plan for the Course and how Data in the Course are used to assess Student Outcomes

Student and Instructor Course Outcome Surveys are administered at the conclusion of each offering, and are evaluated as described in the School's Assessment Plan:
<https://abet.cis.fiu.edu/>

School of Computing and Information Sciences
CTS-4375
Cloud Infrastructure and Services

Outline

Topic	Lecture Hours	Outcome
<ul style="list-style-type: none"> • Cloud Architecting Overview <ul style="list-style-type: none"> • The “Well Architected Framework” • Best Practices in cloud architecting • AWS Global Infrastructure 	2	1,3
<ul style="list-style-type: none"> • Storage, Compute & Database cloud options <ul style="list-style-type: none"> • Object, file & volume storage • IaaS options • RDBMS, NoSQL & Graph DB options 	6	2,3,4
<ul style="list-style-type: none"> • Networking in the cloud <ul style="list-style-type: none"> • Virtual private cloud options • Peering networks • Integrating with private networks 	6	2,3,4
<ul style="list-style-type: none"> • Security in the cloud <ul style="list-style-type: none"> • Accounts, groups, and roles • Security policies • Federation 	6	2,3,4,5
<ul style="list-style-type: none"> • Implementing Elasticity, High Availability, & Monitoring in the cloud <ul style="list-style-type: none"> • Scaling Compute & Databases • Designing for High Availability • Implementing Monitoring 	6	2,3,4,6
<ul style="list-style-type: none"> • Automation & Content Caching <ul style="list-style-type: none"> • Using Cloud vendor specific IAC tools (e.g., CloudFormation, Beanstalk) • Edge Caching • Database Caching 	6	2,3,4,6
<ul style="list-style-type: none"> • Building decoupled microservice applications <ul style="list-style-type: none"> • Decoupling strategies • Queuing & Notifications • Container options • Functions as a service • API Gateway 	6	2,3,4,6
<ul style="list-style-type: none"> • Planning for a disaster <ul style="list-style-type: none"> • Disaster recovery planning strategies • Disaster recovery patterns 	2	2,3,4,6

Learning Outcomes: (Familiarity → Usage → Assessment)

Pervasive Themes in IT:

1. Explain how the components of an IT system interrelate. [Assessment]
2. Explain how and why complexity occurs in IT. [Familiarity]
3. Manage complexity in an information technology environment by applying best practices and using appropriate technologies and methodologies. [Familiarity]

School of Computing and Information Sciences
CTS-4375
Cloud Infrastructure and Services

IAS Fundamental Aspects:

1. Give examples of how IT system components (e.g., servers, routers, people, software) can be countermeasures, vulnerabilities, and also threats. [Assessment]
2. Explain and give examples of why information assurance and security must be "built in" to design and architecture from the beginning to be most effective. [Familiarity]
3. Describe a disaster recovery scenario. [Familiarity]

Security Mechanisms (Countermeasures):

1. Explain the three key factors involved in authentication and how they are used to verify identity and grant access to a system. [Assessment]
2. Explain the process and value of two-factor authentication. [Familiarity]
3. Explain the differences between symmetric and asymmetric cryptosystems, e.g., number of keys required, the types of algorithms used, etc. [Assessment]
4. Explain how public key infrastructure (PKI) works. [Familiarity]

Information Management Concepts and Fundamentals

1. Explain the role of data, information, and databases in organizations. [Familiarity]
2. Explain basic issues of data retention, including the need for retention, physical storage, security. [Familiarity]
3. Explain why data backup is important and how organizations use backup and recovery systems. [Assessment]

Managing the Database Environment:

1. Explain the concept of database security. [Familiarity]
2. Explain the concept of replication as it pertains to distributed databases. [Familiarity]
3. Describe the concept of web services and the role of SOAP. [Assessment]

IPT Intersystem Communications

1. Describe and contrast the different types of architectures for integrating systems. [Familiarity]
2. Describe the purpose of message and queuing services and how they work and list the protocol used by one messaging service (e.g., JMS). [Assessment]

Computing Infrastructures:

1. Classify and describe the various types of servers and services required within organizations. [Assessment]

Foundations of Networking:

1. Demonstrate the ability to solve basic problems and perform basic troubleshooting operations on LANs and connected devices. [Usage]
2. Describe and explain why different technologies are deployed in different contexts of networking, such as topology, bandwidth, distance, and number of users. [Familiarity]

Operating Systems:

1. Describe the advantages and issues associated with virtualization. [Assessment]

School of Computing and Information Sciences
CTS-4375
Cloud Infrastructure and Services

2. Explain the value of fault tolerance for disaster recovery. [Usage]

Administrative Activities:

1. Describe the need for managing IT resources. [Assessment]
2. Identify situations in which administrative activities are required. [Assessment]

Administrative Domains:

1. Describe the responsibilities common to the various administrative domains.
[Assessment]
2. Describe the responsibilities unique to each of the various administrative domains. [Assessment]
3. Identify responsibilities in each domain that support activities in other domains.
[Familiarity]

Organizational Context:

1. Outline the basic parts of a typical IT environment. [Familiarity]

School of Computing and Information Sciences
CTS-4375
Cloud Infrastructure and Services

Course Outcomes Emphasized in Laboratory Projects / Assignments

	Outcome	Number of Weeks
1	Complete vendor-provided labs Outcomes: 2,3,4,5,6	10
2	Graded quizzes on each section	12
3	Group project to deploy cloud solution	3
4	Multiple certification exam preparation practice tests near semester end – certification attainment part of grade	4

Oral and Written Communication: Group project presentation

Social and Ethical Implications of Computing Topics: No significant coverage

Theoretical Contents

1.	Network architecture and network design
2.	Authentication/authorization methods
3.	Server virtualization
4.	Cloud concepts (service models, deployment models, security, automation, business justification)
5.	Storage and database models

Problem Analysis Experiences

1.	Identify potential issues with cloud deployments
2.	Optimize cloud architectures to meet business needs

Solution Design Experiences

1.	Build cloud infrastructure
2.	Deploy applications on cloud infrastructure

School of Computing and Information Sciences
CTS-4375
Cloud Infrastructure and Services

The Coverage of Essential & Supplementary IT Domains¹

Knowledge Unit	Topic	Lecture Hours
ITS-VSS-04	Server Virtualization	3
ITS-VSS-05	Network Virtualization	4
ITS-VSS-08	Storage Virtualization	4
ITS-CCO-01	Cloud computing perspectives & impact	2
ITS-CCO-02	Cloud computing concepts and fundamentals	2
ITS-CCO-03	Cloud computing Security and data considerations	6
ITS-CCO-04	Using cloud computing applications	3
ITS-CCO-05	Cloud computing architecture	7
ITS-CCO-06	Development in the cloud	4
ITS-CCO-07	Cloud computing infrastructure and data	5

¹See *Information Technology 2017 - Curriculum Guidelines for Baccalaureate Degree Programs in Information Technology*; by Association for Computing Machinery (ACM), IEEE Computer Society; cf. Essential & Supplementary IT Domains, pages 51 & 52. Available at: <https://www.acm.org/binaries/content/assets/education/curricula-recommendations/it2017.pdf>

School of Computing and Information Sciences
CTS-4375
Cloud Infrastructure and Services

Potential Grading Format

- **Completion of AWS Cloud Solutions Architecture course (20%)** – This would only be a completion %, not grading the assignments, however, labs must be completed successfully. This is viewable through Canvas.
- **Quizzes on each major section (8 of them) (30%)** – These could be open book on Canvas and then reviewed in class to reinforce the lectures.
- **Group project to deploy multi-layered application in a cloud environment (20%)** – Can use AWS Academy Lab environment.
- **Certification Exam (30% - 100 points)** – These could be graded as follows:
 - o 50 points for registering and taking the certification exam.
 - o 0-50 on a sliding scale depending on certification exam score.
 - 720+ Certification achieved – 50 points.
 - 700-719 – 40 points
 - 670-699 – 30 points
 - 620-669 – 20 points
 - 570-619 – 10 points
 - Below 570 – 0 points
- No Final Exam

Grading Scale

Letter	Range%	Letter	Range%	Letter	Range%
A	95 or above	B	83 - 86	C	70 - 76
A-	90 - 94	B-	80 - 82	D	60 - 69
B+	87 - 89	C+	77 - 79	F	59 or less