ILLINOIS TECH | College of Computing

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From: Department of Information Technology and Management
To: Undergraduate Studies Committee

## Proposed Bachelor of Science in Cloud Computing degree and Co-Terminal Pairing

Attached is a proposal for an undergraduate transfer degree to be titled Bachelor of Science in Cloud Computing, to be offered through the Coursera online learning platform (www.coursera.org). The program is designed to equip students with any Associate's degree or 61 hours of studies for a new career in the burgeoning area of cloud computing. Although other universities currently offer computing degrees on Coursera, including the University of Illinois Urbana-Champaign, Penn, Arizona State, and University of London, this will be the first undergraduate degree in cloud computing on the platform. Packaging of courses for delivery will be funded by Coursera.

Submitted simultaneously with this proposal is a proposal for a graduate degree to be offered on Coursera, the Master of Cloud Computing. We are concurrently proposing a Co-Terminal degree pairing between the undergraduate and graduate degrees in cloud computing, creating a program of unparalleled depth and breadth. The proposal for this Co-Terminal degree pairing is attached as well.

Both proposals have been unanimously approved by the faculty of the Department of Information Technology and Management.

Ray Trygstad

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# BACHELOR OF SCIENCE IN CLOUD COMPUTING

## Program Educational Objectives

At the conclusion of their studies, graduates of this degree should be able to:

- Problem solve, create, and effectively communicate innovative answers to provide cloud-based technology solutions for the problems of business, industry, government, non-profit organizations, and individuals
- Perform requirements analysis, design and administration of secure cloud-based systems conforming to policy and best practices, and monitor and support continuing development of relevant policy and best practices as appropriate
- Apply current industry, technical, and mathematical concepts and practices in cloud computing and recognize the need to engage in continuing professional development

## Transfer Admission Requirements

Admitted transfer students are expected to have satisfied the following Illinois Institute of Technology Core Curriculum requirements prior to admission. If not, the student must complete them while working on the ITM degree. The degree requires a minimum of 127 credit hours including transfer and coursework completed at Illinois Tech. A maximum of 68 applicable credit hours of transfer credit is permitted from a two-year college.

### Basic Writing Proficiency Requirement

Students must take the Illinois Tech English Proficiency Examination before beginning classes at the university. Within their first year at the university, students who do not pass the Illinois Tech English Proficiency Examination must demonstrate basic writing proficiency by passing a composition course at Illinois Tech.

### Introduction to the Profession

Two credit hours; this requirement is waived for transfer students.

### Computer Science

Two credit hours of computer programming, may be satisfied by taking ITM 313.

### Humanities and Social Sciences

Nine credit hours. Humanities include literature, philosophy (except logic), and history. Social or behavioral sciences typically include anthropology, geography, political science, psychology, sociology, and economics. Studies must include a minimum of three credit hours in humanities and three credit hours in the social sciences.

### Free or Technical Electives

33 credit hours of approved courses. Students should contact the Office of Undergraduate Academic Affairs for additional information.

### Mathematics

Five to six credit hours: one course in discrete mathematics, and one course in statistics.

### Natural Science or Engineering

Ten to eleven credit hours of natural science or engineering courses. Relevant science courses include physics, chemistry, astronomy, biology, or engineering graphics. Two sequential courses must be from the same field and one must be from another field. In some cases, certain technology courses might be applied to this requirement. See Illinois Tech Core Curriculum section.

## Program Requirements

Transfer students are expected to take 66 credit hours at Illinois Institute of Technology and transfer 61 credit hours to complete the bachelor's degree for a total of 127 credit hours. This includes 16 information technology courses for a total of 48 credit hours in the major. An additional 18 credit hours outside the major must be taken at Illinois Institute of Technology in order to satisfy the remaining Core Curriculum requirements. These include four 300/400-level humanities and social or behavioral science electives and two IPRO courses. Two social or behavioral science electives must be from the same field and one must be from a different field; lower level social or behavioral science electives count towards this requirement. The computer science general education requirement may be satisfied by completion of ITM 311. Students who wish to complete their undergraduate studies in less than five semesters of full-time study at Illinois Institute of Technology are strongly urged to include at least nine credit hours of courses transferable as required or elective ITM courses among their free or technical electives.

All students must complete a minimum of 36 credit hours of courses with a significant written and oral communication component, identified with a (C) in the bulletin; 12 credit hours of (C)-coded courses must be taken in the major.

A maximum of nine credit hours of ITM graduate courses taken as an undergraduate may be applied to the Master of Information Technology and Management degree, and any graduate courses taken to fulfill undergraduate degree requirements may not also be applied to a graduate degree unless the student is enrolled in a co-terminal or accelerated master's degree program.

# Required Courses

| Code | Title | Credit Hours |
|---|---|---|
| **Courses Transferred** | | **(61)** |
| (or taken at Illinois Tech) | | 61 |
| **Humanities Electives** | | **(6)** |
| 300/400-level courses | | 6 |
| **Social Sciences Electives** | | **(6)** |
| 300/400 level courses | | 6 |
| PSYC 301 is recommended | | |
| **Interprofessional Projects** | | **(6)** |
| See Illinois Tech Core Curriculum, section E | | 6 |
| **ITM Requirements** | | **(48)** |
| ITM 301 | Intro OS and Hardware I | 3 |
| ITM 313 | Intro to Open Source Application Development | 3 |
| ITMD 321 | Data Modeling and Applications | 3 |
| ITMD 361 | Fundamentals of Web Development | 3 |
| ITMD 413 | Open Source Programming | 3 |
| ITMM 471 | Project Management for ITM | 3 |
| ITMO 340 | Intro to Data Networks & the Internet | 3 |
| ITMO 356 | Intro to Open Source Operating Systems | 3 |
| ITMO 444 | Cloud Computing Technologies | 3 |
| ITMO 454 | Operating System Virtualization | 3 |
| ITMO 463 | Cloud: Software as a Service | 3 |
| ITMO 464 | Cloud: Platform as a Service | 3 |
| ITMO 465 | Cloud: Infrastructure as a Service | 3 |
| ITMS 448 | Cyber Security Technologies | 3 |
| ITMS 464 | Cloud Computing Security | 3 |
| ITMT 430 | System Integration | 3 |
| **Total Credit Hours** | | **127** |

**Certification Mapping** (note: mapping may be loose or tight)

| Course # | Course Title | Industry Certification |
|---|---|---|
| ITM 301 | Intro OS and Hardware I | CompTIA A+ - Exam Core 1 220-1101 (tight) |
| ITM 313 | Intro to Open Source Application Development | Python Institute PCEP™ – Certified Entry-Level Python Programmer (loose) |
| ITMD 321 | Data Modeling and Applications | Oracle Certified Professional, MySQL 5.7 Database Administrator (loose) |
| ITMD 361 | Fundamentals of Web Development | CIW Site Development Associate (loose) |
| ITMD 413 | Open Source Programming | Python Institute PCAP™ – Certified Associate in Python Programming (loose) |
| ITMM 471 | Project Management for ITM | CompTIA Project + (loose) |
| ITMO 340 | Intro to Data Networks & the Internet | CompTIA Network+ (tight) |
| ITMO 356 | Intro to Open Source Operating Systems | CompTIA Linux+ (tight) |
| ITMO 444 | Cloud Computing Technologies | AWS Certified Cloud Practitioner (loose)/CompTIA Cloud+ (tight for Coursera) |
| ITMO 454 | Operating System Virtualization | |
| ITMO 463 | Cloud: Software as a Service | (See below) |
| ITMO 464 | Cloud: Platform as a Service | (See below) |
| ITMO 465 | Cloud: Infrastructure as a Service | (See below) |
| ITMS 448 | Cyber Security Technologies | (ISC)² CISSP – Certified Information Systems Security Professional (loose) |
| ITMS 464 | Cloud Computing Security | (ISC)² Cloud Computing Security Professional (CCSP) (tight) |
| ITMT 430 | System Integration | |

**ITMO 563, ITMO 564, ITMO 565** together may incorporate all or part of these certifications, with a degree of mapping not yet determined:

Microsoft Certified: Azure Fundamentals
Microsoft Exam AZ-204: Developing Solutions for Microsoft Azure
AWS Certified Cloud Practitioner
AWS Certified Solutions Architect - Associate
AWS Certified Developer - Associate

**Degree of Mapping = Tight:** These courses have content directly mapped to certification examination criteria, but generally will include content extending beyond the criteria. In most cases students may still want to complete additional study to be prepared to pass the indicated certification examination, particularly if their grade in the course was less than an A or significant time has passed since completion of the course.

**Degree of Mapping = Loose:** These courses cover a significant portion of the material found in relevant certifications, but while some reference may have been made to relevant certification criteria in the creation of the courses, these courses are not designed or intended to specifically cover the certification examination criteria. Students completing these courses will require additional study to be prepared to pass the indicated certification examination.

# Bachelor of Science in Cloud Computing

| | | | Year 1 |
|---|---|---|---|
| **Semester 1** | **Credit Hours** | **Semester 2** | **Credit Hours** |
| ITM 301 | 3 | ITMD 321 | 3 |
| ITM 313 | 3 | ITMD 413 | 3 |
| ITMD 361 | 3 | ITMM 471 | 3 |
| ITMO 340 | 3 | ITMO 444 | 3 |
| ITMO 356 | 3 | ITMO 454 | 3 |
| Social Sciences Elective (300+) | 3 | Humanities Elective (300+) | 3 |
| | **18** | | **18** |

| | | | Year 2 |
|---|---|---|---|
| **Semester 1** | **Credit Hours** | **Semester 2** | **Credit Hours** |
| ITMO 463 | 3 | ITMO 465 | 3 |
| ITMO 464 | 3 | ITMS 464 | 3 |
| ITMS 448 | 3 | ITMT 430 | 3 |
| Social Sciences Elective (300+) | 3 | Humanities Elective (300+) | 3 |
| IPRO Elective I | 3 | IPRO Elective II | 3 |
| | **15** | | **15** |

**Total Credit Hours: 66**

## New Courses in this degree:

**ITMO 463 Cloud: Software as a Service**
*(New course)*
Software as a Service (SaaS) allows consumers to use a provider's applications running on a cloud infrastructure, accessible from client devices over a network through either a thin client interface, such as a web browser, or a program interface. Students will explore different approaches, techniques, tools and technologies to build, deploy, and manage cloud native applications.

**ITMO 464 Cloud: Platform as a Service**
*(New course)*
Platform as a Service (PaaS) allows developers to deploy onto the cloud infrastructure developer-created or acquired applications created using programming languages, libraries, services, and tools supported by the cloud provider. Students learn to develop applications and services using popular platforms and service tools, and to manage deployed applications as well as configuration settings for the application-hosting environment.

**ITMO 465 Cloud: Infrastructure as a Service**
*(New course)*
Infrastructure as a Service (SaaS) allows users to provision processing, storage, networks, and other fundamental computing resources which then allows them to deploy and run arbitrary software, which can include operating systems and applications. Students will learn how to provision, deploy and manage operating systems, storage, and deployed applications as well as virtual networking components such as switches, routers, and firewalls in a cloud environment accessible remotely through a network.

**ITMS 464 Cloud Computing Security**
*(New course; this course has already been approved departmentally)*
Students will learn how to effectively secure cloud-based services and infrastructure in an enterprise setting. Areas addressed will include design principles of secure cloud computing, data security, platform and infrastructure security, application security and the Secure Software Development Life Cycle (SDLC) and DevSecOps processes, and security operations. The course will cover legal, risk, and compliance aspects of cloud computing, all in the context of a set of industry-standard learning domains.

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# ITMO 463 SYLLABUS

**ITMO 463 Cloud: Software as a Service**

**Hours:** 3 credit hours / 45 contact hours

**Instructor:** TBA

**Textbook, title, author, and year**

a. Online readings as assigned in Coursera

**Specific course information**

a. **Catalog description:** Software as a Service (SaaS) allows consumers to use a provider's applications running on a cloud infrastructure, accessible from client devices over a network through either a thin client interface, such as a web browser, or a program interface. Students will explore different approaches, techniques, tools and technologies to build, deploy, and manage cloud native applications.
b. **Prerequisites:** ITMO 444
c. **Required.**

**Specific goals for the course**

a. **Program Educational Outcome:**
   1. Problem solve, create, and effectively communicate innovative answers to provide cloud-based technology solutions for the problems of business, industry, government, non-profit organizations, and individuals
   2. Perform requirements analysis, design and administration of secure cloud-based systems conforming to policy and best practices, and monitor and support continuing development of relevant policy and best practices as appropriate.
b. **Course Outcomes:** Each successful student will be able to use concepts of cloud computing and cloud-native applications to design and provision software as a service using standard planning methodologies to meet identified business and/or consumer needs.
c. **Course student outcomes:**
   Upon completion of this course the student should be able to do the following:
   - Define SaaS and compare it to other cloud service models
     - Identify examples of SaaS applications
     - Describe the benefits and challenges of using SaaS
   - Describe the different deployment models for SaaS (public, private, hybrid)
     - Compare the advantages and disadvantages of each deployment model
     - Choose a suitable deployment model for a given scenario
   - Describe the architectural components of a SaaS application
     - Design a basic SaaS application using multi-tenancy principles
     - Implement a simple SaaS application using a cloud platform
   - Identify the key security and compliance considerations for SaaS solutions.
     - Describe the measures that SaaS providers take to ensure security
     - Implement security measures to mitigate risks/vulnerabilities for a SaaS application
   - Explain the performance and scalability challenges of SaaS
     - Identify strategies for improving performance and scalability in a SaaS application
     - Analyze the costs and benefits of different SaaS performance and scalability optimization strategies.
     - Implement performance and scalability improvements for a SaaS application
   - Describe the challenges of integrating and interoperating with SaaS applications
     - Identify strategies for integrating and interoperating with SaaS applications
     - Implement integration and interoperability for a SaaS application
   - Describe the challenges of managing and operating SaaS applications
     - Identify strategies for managing and operating SaaS applications
     - Implement management and operations for a SaaS application
   - Explain the different pricing and licensing models for SaaS
     - Compare the advantages and disadvantages of different pricing and licensing models
     - Choose a suitable pricing and licensing model for a given scenario
   - Describe the major SaaS providers and markets
     - Compare the features and services offered by different SaaS providers
     - Evaluate the suitability of different SaaS providers for a given scenario
   - Analyze real-world case studies of SaaS implementations
     - Identify best practices and lessons learned from the case studies
     - Apply the concepts learned to a case study analysis
   - Define DevOps and its principles
     - Describe the benefits of using DevOps in SaaS development and operations
     - Implement DevOps practices for a SaaS application
   - Describe key considerations for testing and quality assurance for SaaS solutions.
     - Compare costs and benefits of different SaaS testing and quality assurance strategies.
     - Implement testing and quality assurance for SaaS solutions.
   - Identify key metrics and indicators for measuring the performance and effectiveness of SaaS solutions.
     - Analyze the costs and benefits of different SaaS metrics and monitoring strategies.
     - Develop a plan to monitor and measure SaaS solutions.

- Describe the current state and future trends of SaaS and cloud computing
  - Analyze the potential impact of these trends on the industry
  - Evaluate the opportunities and challenges that these trends present for SaaS developers and users

Topics to be covered

a. Introduction to Software as a Service (SaaS)
b. Deployment Models
c. Architecture and Design
d. Security
e. Performance and Scalability
f. Integration and Interoperability
g. Management and Operations
h. Pricing and Licensing
i. Providers and Markets
j. Case Studies
k. DevOps for Software as a Service
l. Testing and Quality Assurance
m. Metrics and Monitoring
n. Software as a Service and the Future of Cloud Computing
o. Project Presentations and Final Exam Review

# ITMO 464 SYLLABUS

**ITMO 464 Cloud: Platform as a Service**

**Hours:** 3 credit hours / 45 contact hours

**Instructor:** TBA

**Textbook, title, author, and year**

a. Online readings as assigned in Coursera

**Specific course information**

a. **Catalog description:** Platform as a Service (PaaS) allows developers to deploy onto the cloud infrastructure developer-created or acquired applications created using programming languages, libraries, services, and tools supported by the cloud provider. Students learn to develop applications and services using popular platforms and service tools, and to manage deployed applications as well as configuration settings for the application-hosting environment.
b. **Prerequisites:** ITMO 444
c. **Required.**

**Specific goals for the course**

a. **Program Educational Outcome:**
1. Problem solve, create, and effectively communicate innovative answers to provide cloud-based technology solutions for the problems of business, industry, government, non-profit organizations, and individuals
2. Perform requirements analysis, design and administration of secure cloud-based systems conforming to policy and best practices, and monitor and support continuing development of relevant policy and best practices as appropriate.

b. **Course Outcomes:** Each successful student will be able to use concepts of cloud computing and cloud-native applications to design and provision platform as a service using standard planning methodologies to meet identified business and/or consumer needs.

c. **Course student outcomes:**
Upon completion of this course the student should be able to do the following:

- Define Platform as a Service (PaaS)
  - Compare and contrast PaaS with Infrastructure as a Service (IaaS) and Software as a Service (SaaS)
  - Describe the benefits and drawbacks of using PaaS
  - List common PaaS providers and their offerings
- Explain the concept of containers and containerization
  - Describe the benefits of using containers in cloud computing
  - Compare and contrast containers with virtual machines
  - Create and run a container using Docker
- Describe the challenges of processing big data and implementing machine learning in the cloud
  - Describe the PaaS solutions for big data processing and machine learning
  - Use a PaaS provider to process big data or to implement a machine learning model
- Describe the challenges of developing and deploying mobile applications in the cloud
  - Describe the PaaS solutions for mobile application development and deployment
  - Use a PaaS provider to develop and deploy a mobile application
- Define serverless computing and its benefits
  - Compare and contrast serverless computing with traditional computing models
  - Design and implement a serverless application using a PaaS provider
- Define DevOps and its principles and describe how they apply to PaaS
  - Describe the benefits of adopting a DevOps culture
  - Describe the benefits of using PaaS for DevOps
  - Implement a continuous integration and delivery pipeline using a PaaS provider
- Explain the shared responsibility model for cloud security
  - Identify common threats and vulnerabilities in cloud environments
  - Describe the security features and controls provided by PaaS providers
  - Implement security measures, such as access controls and encryption, for a PaaS environment
- Compare and contrast the offerings of different PaaS providers, including Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform
  - Choose a suitable PaaS provider for a given scenario based on requirements and constraints
  - Migrate an application from one PaaS provider to another
- Describe the architecture and components of Cloud Foundry
  - Deploy and manage applications on Cloud Foundry
  - Integrate Cloud Foundry with external services and tools
- Describe the features and capabilities of Heroku as a PaaS provider
  - Deploy and manage applications on Heroku
  - Use Heroku add-ons and buildpacks to extend the functionality of applications
- Describe the features and capabilities of Azure App Service as a PaaS provider
  - Deploy and manage applications on Azure App Service
  - Use Azure App Service features, such as deployment slots and auto-scaling, to improve the reliability and scalability of applications
- Describe the features and capabilities of Google App Engine as a PaaS provider
  - Deploy and manage applications on Google App Engine

  - Use Google App Engine features, such as traffic splitting and versioning, to improve the reliability and scalability of applications
- Identify best practices for designing and deploying applications on a PaaS platform
  - Implement best practices, such as design patterns and architecture principles, in the development of a PaaS application
  - Evaluate the effectiveness of best practices in improving the reliability, scalability, and maintainability of a PaaS application
- Implement monitoring and logging for a PaaS application
  - Use monitoring and logging data to identify and troubleshoot issues in a PaaS application
  - Implement debugging techniques, such as remote debugging and error handling, for a PaaS applications

Topics to be covered

a. Introduction to Platform as a Service
b. Containers and Containerization
c. Platform as a Service for Big Data and Machine Learning
d. Platform as a Service for Mobile Applications
e. Serverless Computing
f. DevOps and Platform as a Service
g. Security
h. Platform as a Service Providers
i. Use PaaS: Cloud Foundry
j. Use PaaS: Heroku
k. Use PaaS: Azure App Service
l. Use PaaS: Google App Engine
m. Best Practices
n. Monitoring and Debugging
o. Course Review and Final Project

# ITMO 465 SYLLABUS

**ITMO 465 Cloud: Infrastructure as a Service**

**Hours:** 3 credit hours / 45 contact hours

**Instructor:** TBA

**Textbook, title, author, and year**

a. Online readings as assigned in Coursera

**Specific course information**

a. **Catalog description:** Infrastructure as a Service (SaaS) allows users to provision processing, storage, networks, and other fundamental computing resources which then allows them to deploy and run arbitrary software, which can include operating systems and applications. Students will learn how to provision, deploy and manage operating systems, storage, and deployed applications as well as virtual networking components such as switches, routers, and firewalls in a cloud environment accessible remotely through a network.
b. **Prerequisites:** ITMO 444
c. **Required.**

**Specific goals for the course**

a. **Program Educational Outcome:**
   1. Problem solve, create, and effectively communicate innovative answers to provide cloud-based technology solutions for the problems of business, industry, government, non-profit organizations, and individuals
   2. Perform requirements analysis, design and administration of secure cloud-based systems conforming to policy and best practices, and monitor and support continuing development of relevant policy and best practices as appropriate.
b. **Course Outcomes:** Each successful student will be able to use concepts of cloud computing and cloud-native applications to provision, deploy and manage operating systems, storage, and deployed applications as well as virtual networking components such as switches, routers, and firewalls in a cloud environment accessible remotely through a network, using standard planning methodologies to meet identified business and/or consumer needs.
c. **Course student outcomes:**
   Upon completion of this course the student should be able to do the following:
   - Define the term "Infrastructure as a Service" and distinguish it from other forms of cloud computing.
     - Describe the main features and benefits of IaaS.
     - Identify the key components of an IaaS architecture and their functions.
     - List the main providers of IaaS and compare their offerings.
     - Compare and contrast the various IaaS providers (e.g. AWS, Azure, Google Cloud)
   - Explain the concept of virtualization and how it relates to IaaS
     - Explain what containers are and how they differ from virtual machines.
     - Compare and contrast different containerization technologies, such as Docker and Kubernetes.
     - Deploy and manage a simple containerized application using a container orchestration platform (e.g. Docker, Kubernetes)
   - Explain the networking concepts and abstractions that are relevant to IaaS. (e.g. VPCs, subnets, security groups)
     - Describe the main networking options and configurations that are available in IaaS.
     - Configure network resources and connectivity in a cloud environment
     - Use load balancers and DNS to scale and secure applications in the cloud
   - Explain the storage options and abstractions that are available in IaaS. (e.g. object storage, block storage, file storage)
     - Compare and contrast the different storage options in terms of cost and performance
     - Use cloud storage APIs to store and retrieve data in a cloud environment
     - Configure storage for a cloud-based application.
   - Describe the principles of DevOps and the benefits of a DevOps culture
     - Use version control systems (e.g. Git) to manage code changes
     - Implement continuous integration/delivery pipelines using tools such as Jenkins
   - Describe factors to consider when planning a cloud migration
     - Use tools and techniques to migrate data and applications to the cloud
     - Test and validate the migration to ensure it is successful
   - Describe the various pricing models for cloud services
     - Use cost optimization techniques to reduce cloud costs
     - Use cost management tools to track and forecast cloud expenses
   - Describe the importance of monitoring and logging in the context of IaaS.
     - Describe the main types of metrics and logs that are relevant to IaaS.
     - Set up and configure monitoring and logging for a cloud-based system.
     - Use log analysis tools to troubleshoot issues in the cloud
   - Describe the shared responsibility model for security in the cloud
     - Use security best practices to secure cloud resources and applications
     - Describe the main security controls that are available in IaaS, such as security groups and encryption.
     - Implement basic security measures for a cloud-based system.

  - Implement identity and access management (IAM) in the cloud
- Describe the importance of disaster recovery and business continuity in the cloud
  - Implement disaster recovery strategies for cloud applications and data
  - Test disaster recovery plans to ensure they are effective
- Explain what serverless computing is and how it differs from traditional IaaS.
  - Describe the main features and benefits of serverless computing.
  - Use serverless platforms (e.g. AWS Lambda, Azure Functions) to build and deploy applications
  - Implement a simple serverless application using a cloud platform.
- Describe the principles of cloud-native design and how it differs from traditional application design
  - Explain what microservices are and how they differ from monolithic architectures.
  - Explain what event-driven architectures are and how they differ from traditional architectures.
  - Use cloud-native technologies (e.g. microservices, containers) to build cloud-native applications.
- Describe the various tools available for managing cloud environments
  - Use cloud management platforms (e.g. AWS CloudFormation, Azure Resource Manager) to automate cloud resource provisioning and management
  - Use tools for tracking and optimizing cloud usage and costs
- Analyze real-world examples of companies using IaaS to solve business problems
  - Evaluate the benefits and challenges of the IaaS solutions used in the case studies
  - Reflect on the key takeaways from the case studies and how they can be applied in a professional setting

Topics to be covered

a. Introduction to Infrastructure as a Service
b. Virtualization and Containers
c. Networking in the Cloud
d. Storage in the Cloud
e. DevOps and Continuous Integration/Delivery
f. Cloud Migration
g. Cloud Cost Management
h. Monitoring and Logging
i. Security in the Cloud
j. Disaster Recovery and Business Continuity
k. Serverless Computing
l. Cloud-Native Applications
m. Cloud Management Tools
n. Industry Case Studies
o. Cloud Computing Capstone Project

# ITMS 464 SYLLABUS

**ITMS 464 Cloud Computing Security**

**Hours:** 3 credit hours / 45 contact hours

**Instructor:** TBA

**Textbook, title, author, and year**

a. Online readings as assigned in Coursera

**Specific course information**

a. **Catalog description:** Students will learn how to effectively secure cloud-based services and infrastructure in an enterprise setting. Areas addressed will include design principles of secure cloud computing, data security, platform and infrastructure security, application security and the Secure Software Development Life Cycle (SDLC) and DevSecOps processes, and security operations. The course will cover legal, risk, and compliance aspects of cloud computing, all in the context of a set of industry-standard learning domains.
b. **Prerequisites:** ITMO 444
c. **Required.**

**Specific goals for the course**

a. **Program Educational Outcome:**
2. Perform requirements analysis, design and administration of secure cloud-based systems conforming to policy and best practices, and monitor and support continuing development of relevant policy and best practices as appropriate.
b. **Course Outcomes:** Each successful student will be able to design and implement security solutions for cloud computing operations in the domains of cloud concepts, architecture and design; data security; platform and infrastructure security; application security; security operations; and legal, risk and compliance.
c. **Course student outcomes:**
Upon completion of this course the student should be able to do the following:
- Recall and describe cloud computing concepts
- Describe cloud reference architecture
- Describe security concepts relevant to cloud computing
- Recall and employ design principles for secure cloud computing
- Evaluate and select cloud service providers
- Describe cloud data concepts
- Design and implement cloud data storage architectures
- Design and apply data security technologies and strategies
- Implement data discovery
- Plan and implement data classification
- Design and implement Information Rights Management (IRM)
- Draft and implement data retention, deletion and archiving policies
- Design and implement auditability, traceability and accountability of data events
- Describe cloud infrastructure and platform components
- Explain how to design a secure data center
- Analyze risks associated with cloud infrastructure and platforms
- Select, plan and implement security controls
- Plan business continuity (BC) and disaster recovery (DR)
- Explain the role of training and awareness in application security
- Describe and apply the Secure Software Development Life Cycle (SDLC) process
- Describe and apply DevSecOps in a cloud DevOps development environment
- Apply cloud software assurance and validation
- Use verified secure software
- Describe the specifics of cloud application architecture
- Design appropriate identity and access management (IAM) solutions
- Build and implement physical and logical infrastructure for cloud environment
- Operate and maintain physical and logical infrastructure for cloud environment
- Implement operational controls and standards
- Support digital forensics
- Manage communication with relevant parties
- Manage security operations
- Describe legal requirements and unique risks within the cloud environment
- Describe privacy issues
- Explain and implement audit processes
- Describe policy and compliance methodologies and required adaptations for a cloud environment
- Describe implications of cloud for enterprise risk management
- Describe outsourcing issues and cloud contract design

**Topics to be covered**

a. Cloud Computing Concepts, Architectures, and Cloud Service Providers
b. Cloud Security Concepts and Secure Design Principles
c. Cloud Data Security Concepts and Strategies
d. Data Classification, Events, and Management
e. Securing On-Premises and Remote Cloud Infrastructure
f. Cloud Security Controls
g. Business Continuity
h. Cloud Application and Access Security
i. Secure Software Development and DevSecOps
j. Cloud Infrastructure Operational Implementation and Operation
k. Digital Forensics
l. Security Operations
m. Legal and Privacy Issues in Cloud Operations
n. Compliance and Risk Management
o. Audit and Outsourcing

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## Proposed Co-Terminal Degree Pairing for the Bachelor of Science in Cloud Computing and the Cloud Computing Master's Degree for Coursera

*Proposal:* Create a pathway for students enrolled in the proposed Bachelor of Science in Cloud Computing for Coursera to complete an Accelerated Master's Program co-terminal degree pairing with the proposed master's degree in Cloud Computing for Coursera.

*Changes to the Bachelor's degree program:* While three courses taken in the graduate program can be shared into the undergraduate program, other key courses in common to both programs cannot be shared and should be taken at the master's level. These courses in the undergraduate curriculum, ITMO 463, ITMO 464, and ITMO 465, will be replaced by the following courses: ITMD 362 Human-Computer Interaction and Web Design, ITMO 441 Network Administration and Operations, and ITMO 453 Open Source Server Administration. The new course lineup for the undergraduate courses in this co-terminal degree pairing is presented below.

*Changes to the Master's degree program:* The content of the first five courses in the proposed master's degree are fulfilled in the undergraduate degree program, so substitutes for these courses, ITMD 505, ITMD 513, ITMO 504, ITMO 540, and ITMO 556 are required. This allows graduate students to take all three of the ITMO 56X Cloud courses instead of just selecting two, which requires four additional course substitutions to replace the remaining courses. The courses proposed for this purpose include ITMD 514 Programming for Data Analytics, ITMD 521 Big Data Infrastructure, ITMD 522 Data Mining and Machine Learning, and ITMD 526 Data Warehousing. The new course lineup for the graduate courses in this co-terminal degree pairing is presented below.

**Proposed Undergraduate Program Courses:**

ITM 301 Intro OS and Hardware I
ITM 313 Intro to Open Source Application Development
ITMD 321 Data Modeling and Applications
ITMD 361 Fundamentals of Web Development
ITMD 413 Open Source Programming
ITMM 471 Project Management for ITM
ITMO 340 Intro to Data Networks & the Internet
ITMO 356 Intro to Open Source Operating Systems
ITMO 444 Cloud Computing Technologies
ITMO 454 Operating System Virtualization
ITMO 463 Cloud: Software as a Service (new)
ITMO 464 Cloud: Platform as a Service (new)
ITMO 465 Cloud: Infrastructure as a Service (new)
ITMS 448 Cyber Security Technologies
ITMS 464 Cloud Computing Security (new)
ITMT 430 System Integration

**Proposed Graduate Program Courses:**

ITMO 504 Hardware and Operating System Foundations (new)
ITMD 505 Programming and Application Foundations (new)
ITMD 513 Open Source Programming
ITMO 540 Introduction to Data Networks and the Internet
ITMO 556 Introduction to Open Source Software
ITMO 554 Operating System Virtualization
ITMO 544 Cloud Computing Technologies
Select two of the following courses:
- ITMO 563 Cloud: Software as a Service (new)
- ITMO 564 Cloud: Platform as a Service (new)
- ITMO 565 Cloud: Infrastructure as a Service (new)

ITMS 564 Cloud Computing Security (new)

**Proposed Co-Terminal Undergraduate Program Courses:**

ITM 301 Intro OS and Hardware I
ITM 313 Intro to Open Source Application Development
ITMD 321 Data Modeling and Applications
ITMD 361 Fundamentals of Web Development
ITMD 362 Human-Computer Interaction and Web Design
ITMD 413 Open Source Programming
ITMM 471 Project Management for ITM
ITMO 340 Intro to Data Networks & the Internet
ITMO 356 Intro to Open Source Operating Systems
ITMO 441 Network Administration and Operations
ITMO 453 Open Source Server Administration
ITMO 544 Cloud Computing Technologies
(shared from Graduate Curriculum in place of ITMO 444)
ITMO 554 Operating System Virtualization
(shared from Graduate Curriculum in place of ITMO 454)
ITMS 448 Cyber Security Technologies
ITMS 564 Cloud Computing Security (new)
(shared from Graduate Curriculum in place of ITMS 464)
ITMT 430 System Integration

**Proposed Co-Terminal Graduate Program Courses:**

ITMD 514 Programming for Data Analytics
ITMD 521 Big Data Infrastructure (changed course title)
ITMD 522 Data Mining and Machine Learning
ITMD 526 Data Warehousing
ITMO 554 Operating System Virtualization (shared course)
ITMO 544 Cloud Computing Technologies (shared course)
ITMO 563 Cloud: Software as a Service (new)
ITMO 564 Cloud: Platform as a Service (new)
ITMO 565 Cloud: Infrastructure as a Service (new)
ITMS 564 Cloud Computing Security (new) (shared course)