# TCN 4212 – RVC Telecommunications Network Analysis and Design Spring 2018 Syllabus

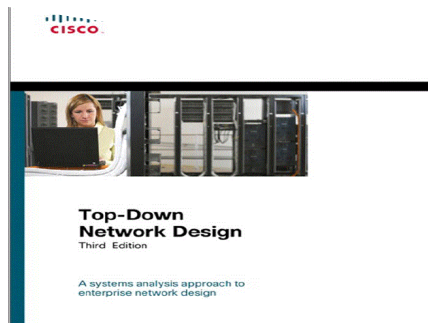*Updated: 02-2018*

**The face-to-face section of this course (TCN 4212-U01B) meets in room EC 3239 every Saturday 8:00 Am – 12:30 PM All online students are encouraged to visit whenever they can.**

## REQUIRED TEXT:

**Pricilla Oppenheimer. *Top-Down Network Design*, *Third Edition*, Ciscopress.com (2016), ISBN-13:978-1587202834**



## COURSE WEBSITE & MATERIALS
All course materials i.e., syllabus, book content, assignments, handouts, and project materials will be available on the blackboard site at http://online.fiu.edu

## INSTRUCTOR
Stylianos Drakatos, PhD, PMP
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Skype account "**sdrakatos**"

## COURSE DESCRIPTION
The goal of the course is to teach the introductory concepts and principles in telecommunication

networks, especially Internet, and how to apply those concepts in network system engineering synthesis,

analysis, and evaluation of computer communication networks. The course will present various aspects of telecommunication networking, with an emphasis on Top-Down Network Analysis and Design will be discussed using industry case studies. The industry Systems Development Life Cycles methodology as well as the Plan Design Implement Operate Optimize (PDIOO) Cisco Methodology for network design will be used.

## COURSE OBJECTIVES
Upon successful completion of readings, exercises, labs, and assignments, the student will be able to:

### PART 1: IDENTIFY CUSTOMER NEEDS
- Relate the business goals with the technical goals, constraints and tradeoffs
- Analyze networks based on functionality, capacity, performance, availability, scalability, affordability, security and manageability
- Use technology and information resources to research issues in network architecture and analysis.
- Use the industry Systems Development Life Cycles methodology as well as the Plan Design Implement Operate Optimize (PDIOO) Cisco Methodology for network design
- Summarize among scalability, availability, performance security, manageability, usability, adaptability, and affordability as they relate to internetworking product selection.
- Evaluate existing Internet work in terms of its infrastructure, logical structure, physical structure, addressing and naming, wiring and media, architectural and environmental constraints, and health.
- Evaluate the flow, load, behavior, and Quality of Service (QoS) requirements of network traffic.

### PART 2: LOGICAL NETWORK DESIGN
- Design a network topology to include hierarchy, redundancy, modularity, and security.
- Design a systematic network architecture plan in accordance with network design steps.
- Assign and design models for addressing and naming to include a central or distributed authority, public or private addressing, and static or dynamic addressing.
- Compare and contrast the selection of switching and routing protocols to include interior versus exterior protocols, RIP, RIP2, EIGRP, OSPF, and BGP.
- Create a network security plan inclusive of identifying and analyzing network assets, security risks, security requirements, and security policy.
- Develop network management strategies to include resource monitoring and data collection and interpretation.
- Describe processes that address performance, fault, configuration, security, and accounting management.
- Summarize network management architecture and monitoring strategies to include management protocols and tools.

## PART 3: PHYSICAL NETWORK DESIGN

- Compare and contrast the selection of technologies and devices for campus and enterprise networks that include remote access networks, WANs, service providers, end user remote access devices, central site remote access devices, VPN concentrators, and routers.

## PART 4: TESTING, OPTIMIZING, AND DOCUMENTING YOUR NETWORK DESIGN

- Develop network design testing procedures through services, tools, and testing scripts.
- Describe optimal network design for critical business applications to include effective use of bandwidth and satisfying Quality of Service (QoS) requirements.
- Develop a comprehensive network design document.


## CURRICULUM OBJECTIVES TARGETED

- Ability to apply knowledge of mathematics, science, and engineering
- Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability,
- Ability to identify, formulate, and solve engineering problems
- Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- Critical thinking and effective communication skills.


## UNIVERSITY'S CODE OF ACADEMIC INTEGRITY

Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas, and community service. All students should respect the right of others to have an equitable opportunity to learn and honestly to demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational Mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook. More information can be found at

http://academic.fiu.edu/academic_misconduct.html

**DEPARTMENT REGULATIONS CONCERNING INCOMPLETE GRADES**

To qualify for an Incomplete, a student:

1. Must contact (e.g., phone, email, etc.) the instructor or secretary before or during missed portion of class.
2. Must be passing the course prior to that part of the course that is not completed
3. Must make up the incomplete work through the instructor of the course
4. Must see the Instructor. All missed work must be finished before last two weeks of the following term.

**University policies on sexual harassment, and religious holidays, and information on services for students with disabilities**

Please visit the following websites:
http://academic.fiu.edu/
http://drc.fiu.edu

**POLICIES**

- **Academic Misconduct:** For work submitted, it is expected that each student will submit their own original work. Any evidence of duplication, cheating or plagiarism will result at least a failing grade for the course.

- **Unexcused Absences:** Two unexcused absences are permitted during the term. More than two will result in the loss of points from your final grade. (1 point per absence above two, 3 points per absence above 5).

- **Excused Absences:** Only emergency medical situations or extenuating circumstances are excused with proper documentation. After reviewing documentation you are required to email a description of the excuse and absence dates as a written record to kaleemf@fiu.edu.

- **On Time:** As in the workplace, on time arrival and preparation are required. Two "lates" are equivalent to one absence. (Leaving class early is counted the same as tardy.)

- **Deadlines:** Assignments are due at the beginning of the class period on the date specified. Assignments submitted late (within 1 week) will receive half credit.
  To get assistance try to see me by an appointment.
  Students are encouraged to ask questions and to discuss course topics with the instructor and with each other.

- **Any work submitted should display Panther ID number and should be signed, as the students' own work, and that no unauthorized help was obtained.**

Cell phones, communicators, MP3 players, head sets are not allowed to be used in the class.

- **DO NOT** send assignments by email.
- Instructor reserves right to change course materials or dates as necessary.

## EXAM POLICY

1. Make sure to complete the assigned homework in order to do well in the exam.
2. All exams are closed book and closed notes.
3. Use of any electronic device with keyboard is prohibited. This also applies to cellphones with messaging system.
4. No discussion is permitted during the exams.
5. Instructor is not compelled to give credit for something he cannot read or follow logically.
6. Cheating is considered as a serious offense. Students who are caught will receive the appropriate consequences.

## COURSE ASSIGNMENTS DESCRIPTION

This course is 8 weeks long. Coursework is divided into weekly modules with corresponding assignments/assessments and you are expected to complete all activities within each module. Coursework includes discussions (blackboard discussion forum), one group project (not required for summer short term), quizzes and two exams. Each assignment will be done individually; the assignments will be submitted through Assignment Dropbox. A rubric will be posted along with each assignment.

## LAB ASSIGNMENT MOTIVATION

Since communication Networks have become too complex for traditional analytical methods to provide an accurate understanding of system behavior, network simulators are used. In simulators, the computer network is typically modeled with devices, links, applications etc. and the performance is analyzed. Next, a network emulator allows users to introduce real devices and applications into a test network (simulated) that alters packet flow in such a way as to mimic the behavior of a live network. Live traffic can pass through the simulator and be affected by objects within the simulation. The typical methodology is that real packets from a live application reach the emulation server (where the virtual network is simulated). The real packet gets modulated into a simulation packet. The Simulation packet gets demodulated into real packet after experiencing effects of loss, errors, delay, jitter etc., thereby transferring these network effects into the real packet. Thus it is as-if the real packet flowed through the real networks but in reality it flowed through the simulated network. Emulation is widely used in the design stage for validating communication networks prior to deployment. The GNS3 software provides both network simulation and emulation and is an excellent platform for students to get real exposure to network analysis and design.

## LAB GROUP ASSIGNMENT (30% OR 30 POINTS)

(This paragraph is also listed and updated as part of the course content on the black board)

Before you work on the lab assignment/s your team needs to install first the GNS3 network simulation software as well as set up and import into GNS3 at least one virtual machine. By itself this is a challenging pre-assignment activity that needs team collaboration and communication skills, inside the Lab resources folder (you'll find in the blackboard course content), where you will find the installation guide and videos. Your deliverable due is a word file with the first page listing the name of your team and your team members. Make sure you include the key project management sections we've mentioned in class i.e., Project motivation, goals and description, main part, conclusion and lessons learned. For all TCN courses, the Electrical and Computer Engineering department also provides a complete lab facility for your use on the third floor.

## EXAMS AND QUIZZES (60% OR 60 POINTS)

There will a midterm exam for a total of 30% of the overall grade and a final exam for a total of 30% of the overall grade. You will find a preparation guide for each of these two exams in the week 4 and week 7 folders respectively. Depending on the length of the term, there will be one quiz and you will have 30 minutes to complete them, open notes (face-to-face sections). For dates when the exams and quiz will be available please see the Course Calendar section of your syllabus or the "Assessments" area of your course.

## PARTICIPATION & DISCUSSION FORUM / CONFERENCES (10% OR 10 POINTS)

Participation in this course is defined as proactive discussion in the general discussion forum and the classroom. You should actively reflect on weekly readings and develop original ideas in your responses. You are expected to demonstrate critical thinking and your understanding of the content in the assigned readings and class presentation as they relate to the issues identified in the discussion. Some examples of class contributions are: significantly improve one of the instructor's chapter notes, and assist the whole class by posting solutions (or explanations) to other students' questions, and participation in the topics conferences treads posted. Note: setting up or becoming a member of a work team so considered minimum class participation and earns only 25% of the total participation points (2.5 points).

## METHODOLOGY

Cisco press text readings, lectures, discussion, cases and homework assignments. Additionally, to the class experience students further practice collaboration and communication skills using the discussion forums and conferences on the supportive Blackboard course setup. Industry case studies are presented and analyzed in class mainly from Level 3 and Cisco industry telecommunication networks world leaders.

Additionally, the professor's own industry selected consulting assignments are presented for students practice with solutions to real industry scenarios.

**COURSE SCHEDULE (More details on weekly activities are shown on the black board weekly schedule.)**

# Module 1
# Introduction - Business Goals and Networking Technologies Alignment

**Week 1: March 5<sup>th</sup> &**
**Week 2: March 12<sup>TH</sup>**

**Module Learning Objectives:**

- Introductions, syllabus and schedule discussion, class expectation

- Project Management essentials review

- Relate the business goals with the technical goals, constraints and tradeoffs

- Analyze networks based on functionality, capacity, performance, availability, scalability, affordability, security and manageability

- Documentation and users training start from day one and are both considered being network project cross-life activities; documents are created and updated throughout Network design project life-cycle.

**Topics & Reading:**

Primary text: Part I - Identifying Your Customer's Needs and Goals. Review chapter 1 (Analyzing Business Goals and Constraints) and chapter 2 (Analyzing Technical Goals and Tradeoffs). Chapter 14 (Documenting the Network Design) is read from day one and used for crating documentations throughout the course.

**Assignments:**
- Group teams formation and project topic discussion
- **Lan assignment-preparation start getting familiar with the GNS3 network simulation software inside the folder Lab resources**

# Module 2
## Network Analysis -Existing Network Architecture & Infrastructure

**Week 3: March 19<sup>th</sup>**

**Module Learning Objectives:**

- Practice with calculations and different scenarios on scalability, availability, performance security, manageability, usability, adaptability, and affordability as they relate to internetworking product selection,

- Use industry cases to evaluate existing Internet work in terms of its infrastructure, logical structure, physical structure, addressing and naming, wiring and media, architectural and environmental constraints, and health.

- Learn how to apply the PM process groups for your network design & analysis project

- Differentiate between the Network design and analysis project life cycle phases and the project Management process Groups used to manage the project.

**Topics & Reading:**

Primary text: Part I - Identifying Your Customer's Needs and Goals. Review chapter 3 (Characterizing the Existing Internetwork), and chapter 4 (Characterizing Network Traffic).
- Binomial and Normal Distribution statistical and mathematical tools for network analysis & design.
- Level 3 video for Cloud Computing and Network
  Cloud Computing - Whiteboard Video ( https://www.youtube.com/watch?v=mUCTwhjQNOI )

**Assignments:**

**Group Project Status**

- **Lab assignment – GNS3 software installation on your system, should have been completed by now. Post any comments i.e., issues you had and how you resolved them on the discussion board Lab Conference thread**


**\* For the face –to-face section we may choose to have a quiz this week**

# Module 3
# Logical Network Design – Network Topology

**Week 4: March 26<sup>th</sup> &**
**Week 5: April 2<sup>nd</sup>**

**Module Learning Objectives:**

- Design a network topology to include hierarchy, redundancy, modularity, and security.

- Design a systematic network architecture plan in accordance with network design steps.


**Topics & Reading:**

Primary text: Part II – Logical Network Design. Review chapter 5 (Network Topologies).

- **Midterm exam preparation guide review**
- **Level 3 extreme networks design video (How you connect to the cloud matters pdf)**


**Assignments:**
- **Lab team assignment** – main lab assignment is posted inside the Lab resources folder. Your deliverable should be a word document with inserted capture from your lab work and is due by the end of Week-5. Make sure the first page clearly lists your name and names of your team members

- **Midterm exam**

  *- For the fully online students the exam date is shown on the blackboard*
  *- For the face-to-face section students the date is the Saturday of week 4.*


**MID-TERM exam information:** Midterm exam covers chapters 1, 2, 3, 4, 5 and 14 (documentation). Questions are a combination of T/F, essay, some engineering calculations, and multiple choice types.

**There is a midterm exam guide posted on the blackboard for your preparation (a must to practice with prior to taking the exam)**

# Module 4
# Logical Network Design –Addressing, Routing, Network Security & Management

**Week 6: April 9<sup>th</sup>**

**Module Learning Objectives:**

- Assign and design models for addressing and naming to include a central or distributed authority, public or private addressing, and static or dynamic addressing.

- Compare and contrast the selection of switching and routing protocols to include interior versus exterior protocols, RIP, RIP2, EIGRP, OSPF, and BGP.

- Create a network security plan inclusive of identifying and analyzing network assets, security risks, security requirements, and security policy.

- Develop network management strategies to include resource monitoring and data collection and interpretation.

- Describe processes that address performance, fault, configuration, security, and accounting management.

- Summarize network management architecture and monitoring strategies to include management protocols and tools.

**Topics & Reading:**

Primary text: Part II – Logical Network Design. Review chapter 6 (IP Addressing), chapter 7 (Routing protocols), 8 (Developing Network Security Strategies-light coverage), and chapter 9 (Developing Network Management Strategies-light coverage).

**Industry cases and links to review:**
- **Cisco (Cisco Data Center Network Architecture and Solutions Overview pdf)**
- **Level 3 Enhanced Management Questions and Answer**

# Module 5
# Physical Network Design –Enterprise Networks and WAN technologies

**Week 7: April 16<sup>th</sup>**

**Module Learning Objectives:**
- Compare and contrast the selection of technologies and devices for campus and enterprise networks that include remote access networks, WANs, service providers, end user remote access devices, central site remote access devices, VPN concentrators, and routers.
- Gain industry experience by reviewing and analyzing Cisco small networks case review

**Topics & Reading:**

Primary text: Part III – Physical Network Design. Review chapter 10 (Selecting Technologies and Devices for Campus Networks), and chapter 11 (Selecting Technologies and Devices for Enterprise Networks).

**Assignments:**
- Cisco Physical network design case review
- Course objectives review
- Final exam study guide review

# Module 6
# Testing & Optimization the Network Design

**Week 8: April 23<sup>rd</sup>**

**Module Learning Objectives:**
- Develop network design testing procedures through services, tools, and testing scripts.
- Describe optimal network design for critical business applications to include effective use of bandwidth and satisfying Quality of Service (QoS) requirements.
- Develop cross life-cycle processes i.e., a comprehensive network design document, and users documentation.
- Apply Project management closing process group activities

**Topics &Reading:** Primary text: Part IV – Testing, Optimizing, & Documenting. Review chapter 12 (Testing the Network Design), and chapter 13 (Optimizing the Network Design)

**Assignments:**

- **Final Exam**

**Final exam information:** Final exam covers chapters 6, 7, 8, 10 (light reading), and 11 (light reading). Questions are a combination of T/F, essay, some engineering calculations, and multiple choice types.

**\* There is a final exam guide posted on the blackboard for your preparation (a must to practice with prior to taken the exam)**

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## GRADING

**Grades will be assessed as follows:**                      **weight**

Group Lab assignment                                          30%
Online discussion forum and conferences participation        10%

Quiz   (To be announced)

Midterm Exam                                                 30%

Final Exam                                                   30%

**Total**                                                    **100%**


**Tentative Grading Scale**

| A  | 100-95 | B+ | 86-89 | C+ | 76-79 | D+ | 66-69 | F | 0-59 |
|----|--------|----|-------|----|-------|----|-------|---|------|
| A- | 90-94  | B  | 83-85 | C  | 73-75 | D  | 63-65 |   |      |
|    |        | B- | 80-82 | C- | 70-72 | D- | 60-62 |   |      |