

This document will receive modifications
during the first weeks of classes.

Syllabus

CSCI 5160: Intro To Enterprise Networks Spring 2025, 3 credits, Jan – May 2025

Class meeting times: Tuesday/Thursday 9.05 am-10.30 am

Class meeting location: ECEE 283

INSTRUCTOR INFORMATION

Name: Jose Santos

Email: jose.santos@colorado.edu

Office Location: ECEE 275A

Office Hours: T/R TBD

TEACHING ASSISTANTS INFORMATION

Name: Aibol Kemeldinov

Email: aibol.kemeldinov@colorado.edu

Office Hours: TBD

COURSE INFORMATION

Fit within the curriculum:

Course description and prerequisites: This course provides direct experience with telecommunications functions and equipment through experiments and demonstrations. Students work individually on a set of network equipment to learn the fundamental techniques of voice and data switching, and the fundamental functions of data networking and services. Each experiment is designed to focus on some particular aspect of system management, development, maintenance, or troubleshooting for either enterprise telecommunications customers or telecommunication service providers. Procedures require the use of actual commercial equipment and services and observation using packet analyzers including wire-shark and reporting of behavior and performance compared to specified requirements. The midterms and the final exams are designed to reflect the real-world networking scenarios encompassing the technologies learnt through theory and lab practical.

TEXTBOOKS AND MATERIALS

Required text:

Wendell Odom, CCNA Routing and Switching 200-125 Official Cert Guide Library [Note: contains ICND1 and ICND2 in it] (recommended) (Ask TA if you need the book)

ISBN-13: 978-1587205811

ISBN-10: 1587205815

Edition: 1st

Or

[CCNA 200-301 Official Cert Guide, Volume 1, 2nd Edition](#)

Wendell Odom, CCIE No. 1624.

ISBN-13: 978-0-13-822963-4

ISBN-10: 0-13-822963-5

Other supplemental materials:

Empson, CCNA Portable Command Guide, 2nd Edition

ISBN-13: 978-1587201936

COURSE OUTCOMES

Upon completion of this course, students are able to:

- Explain basic concepts in the design and implementation of network solutions for enterprise connectivity, including:
 - o Switching Architecture

- o WiFi integration
 - o Routing and Traffic engineering
 - o WAN Private site-to-site interconnectivity
 - o Network Security and VPN Services
 - o Public Internet Access
- Identify and explain the internal logical operation of Routers, Switches and Access Points in different deployment scenarios
- Ethernet
 - o Configure and verify
 - VLAN across multi-hop topologies
 - Trunking Protocols
 - Layer 2 discovery protocols
 - Etherchannel variants
 - MAC-based filtering solutions
 - Integration of WiFi services to Ethernet backhaul
 - Multi-layer switching
 - o Describe the basic operation of STP and Rapid STP Protocol
 - Root Bridge selection
 - Port states
 - Protocol convergence
- IP
 - o Configure and verify IPv4 and IPv6 addressing and subnetting
 - o Interpret the information contained in a routing table
 - Prefix / Mask / Metric / Next Hop / Exit interface
 - o Configure and Verify
 - Static routing
 - Dynamic Routing
 - RIPv2 /RIPnG
 - EIGRP
 - OSPFv2 / OSPFv3
 - First hop redundancy Protocols
 - HSRP
 - SNAT
 - Routing Multi-tenancy
 - Virtual Routing and Forwarding (VRF)
 - Services
 - DHCP Server, Client and Relay
 - NTP Server and Client
 - Remote Management via SSH and Telnet
 - Network Address Translation (NAT) and its variants
 - Packet filtering via Access Control Lists (ACLs)
 - o Compare and Explain different IPv6 address types
 - o Compare and Explain different IPv6/IPv4 Tunneling techniques
 - Configure and verify

- ISATAP, 6to4, GRE and Teredo
- IPSec
 - o Explain the operation of IPSec protocol and its configuration requirements
 - Phase 1, Phase 2, DH, Transform Sets
 - o Configure and Verify
 - Tunnel Based IPsec tunneling (GW to GW)
 - Remote Access IPSec tunneling (Host to GW)
 - Routing and Tunneling over IPSec
 - o Explain the operation of DMVPN
- MPLS
 - o Explain the operation of MPLS Label Distribution Protocols (LDP and RSVP)
 - o Explain the operation of CSPF within MPLS TE
 - o Configure and Verify
 - LDP deployment within a single carrier
 - MPLS TE deployment across a multi-hop network
 - End to End Routing Overlays
- Network Implementation
 - o Design, build and execute custom topologies and forwarding paths
 - Protocol metric override
 - Metric/Timer manipulation
 - Integration of different Ethernet and IP Technologies
 - Master/ Standby pre-selection for controlled failover
 - o Demonstrate network implementation skills
 - Ability to configure multi-vendor equipment
 - Ability to use network diagnostic tools to troubleshoot network problems
 - o Troubleshooting
 - Diagnose and fix multi-layer network problems and failures

Brief list of topics to be covered

- Ethernet Switching (VLAN, Spanning Tree, Layer 2 security, RSTP, Wireless LANs)
- Efficient IP addressing designs (CIDR, VLSM)
- LAN Routing (RIP, OSPF, Static, NAT/PAT, ACL)
- Multi-tenancy and Load balancing (Virtual routing forwarding (VRF), HSRP, SNAT)
- VPN architectures (IPsec)
- IP next generation (IPv6) and transition methods (ISATAP, 6to4, GRE, and Teredo tunnels)

GRADING AND ASSIGNMENTS

There are no attendance credits for this course. There will be 8-10 lab assignments programming assignments, 8-10 quizzes, and 2 exams (midterm and final exams). Lab reports are due a week after lab completion time. There is no credit for assignments turned in late. All written exams and quizzes are in-class and closed books. Practical exams are open book and other printed resources.

Both Midterm and Final exams contain equally a written and a practical component. Each exam will account for 35% of the final grade.

Exams (40 points – 20 points each)

There will be 2 exams. The Midterm written exam will be taken on XX/YY during the class and the Final written exam will be taken on XX/YY from 7:30 pm to 9:00 pm in the classroom.

Practical exams will be implemented in the lab and will be graded via direct interview. The Midterm will cover materials from the first 5 lab experiments. The final will cover the remaining lab material learned from the course, along with a few of the topics already covered in the Midterm.

Weekly lab assignments will be graded based on the lab report (see table below for their respective grade weight)

Both Practical and Lab experiments are executed and graded as a team effort, with all the students receiving a common grade. In situations where a teammate does not want to contribute equal effort, the Instructor will reserve the right to further reduce the grade obtained.

No Extra Credit Assignments

We do not offer any extra credit assignments.

GRADING

The following grade scale will be used (grades will NOT be curved):

A = 95.0 - 100.0

A- = 90.0 - 94.9

B+ = 87.0 - 89.9

B = 83.0 – 86.9

B- = 80.0 – 82.9

C+ = 77.0 – 79.9

C = 73.0 – 76.9

C- = 70.0 - 72.9

D+ = 67.0 – 69.9

D = 63.0 – 66.9

D- = 60.0 – 62.9

F = < 60.0

Grading

Assessment for grades is based on four categories:

Refer grading policy for details:

- Laboratory reports (write-ups) - 10%
- Pop Quizzes - 20%
- Midterm exam - 35%
 - o Midterm written exam - 15%
 - o Midterm Practical exam - 20% (5% report 15% exam)

- Final exam - 35%
 - o Final Written Exam - 15%
 - o Final Practical Exam - 20% (5% report 15% exam)

USING CANVAS AND OTHER TECHNOLOGIES

Information regarding homework, exams, and other important course-related announcements will be posted on a class webpage on Canvas (<http://canvas.colorado.edu>). You are expected to check the webpage on a regular basis (at least 2-3 times every week).

This course requires the use of tools such as Putty, SolarWinds, Filezilla, IOS, JunOS, and Wireshark which are currently not fully accessible to users using assistive technology. In addition, students must be able to interconnect electronic components of both low and high voltage in a lab environment, as well as be able to observe operational status of electronic components both visually and electronically. If you use assistive technology to access the course material, please contact your faculty member immediately to discuss.

Please note: Lab experiments require on average 6-8 hours of additional work beyond the lecture time.

Week	Lecture	Reading Assignment due
Pre-Class 01/21 (Lab 0)	Course Introduction	Review Syllabus of Data Communications 1 Read Chapters 1,2,3,4,5 of ICND1 (200-125) Chapters 1,2,3 (Same Content – 200-301)
01/28 (Lab1)	LAN Switching – Basics of VLANs, VTP	<p><u>Prepare chapters</u></p> <p>Chapters - 4,5,6,8,9 ISBN-13: 978-0-13-822963-4 CCNA 200-301 Official Cert Guide, Volume 1, Second Edition</p> <p>ICND1 - 6,7,8,9,10, ICND2 – 1,2,3 (200-125) Chapters – 4,5,6,7,8,9 (200-301) Review Ethernet Technologies at https://www.routeralley.com/guides/ethernet.pdf</p> <p>Password Recovery https://www.cisco.com/c/en/us/support/docs/switches/catalyst-2950-series-switches/12040-pswdrec-2900x1.html#topic1</p>

		<p>Review Configuration Samples for VLANs at https://www.cisco.com/c/en/us/td/docs/routers/connectedgrid/switch_module_swcg/cgr-esm-configuration/config_vlans.html</p> <p>Review Configuration Samples for VTP at https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst2960/software/release/12-2_53_se/configuration/guide/2960scg/swvtp.html</p>
During Lab Sessions	IP Addressing and STP Class	<p><u>Prepare chapters</u></p> <p>Chapters - 10,11,12,13,14 ISBN-13: 978-0-13-822963-4 CCNA 200-301 Official Cert Guide, Volume 1, Second Edition</p> <p>ICND 1 –19,20,21, Appendix D, E, F, G, H, I Chapter 10,11,12,13,14 (200-301)</p> <p>IP Addressing and STP recitation will be conducted by one of the Student Assistants</p>
	LAN Switching- STP, RSTP, PVST, Portfast, Etherchannel, SPAN (Contd.)	<p>Research lab objective: How to run per-VLAN STP (have a different root bridge for each VLAN)</p> <p>Multilayer Switching (3550/3560) https://www.cisco.com/c/en/us/support/docs/lan-switching/inter-vlan-routing/41260-189.html</p>
02/04 (Lab 2)	Wireless Networking & IP Addressing	<p><u>Prepare Chapters</u></p> <p>For IPv4 Subnetting - ICND 1 - 11, 12, 13, 14 Read Wireless Tutorials and Lab2 writeup</p> <p>Read topics on latest Wireless LAN technologies (802.11n, 802.11ac, 802.11af) focusing on differences, data rate compatibility, operating frequencies and ranges. Also read https://www.electronics-notes.com/articles/connectivity/wifi-ieee-802-11/802-11af-white-fi.php https://www.cisco.com/c/dam/en/us/products/collateral/wireless/aironet-3600-series/wireless-aironet-3600-series-white-paper-c11-713103.pdf</p>
02/11 (Lab 3)	Routing Lab – Static Routing, RIP and EIGRP Routing	<p><u>Prepare chapters</u></p> <p>Chapters - 16,17,18 ISBN-13: 978-0-13-822963-4 CCNA 200-301 Official Cert Guide, Volume 1, Second Edition</p> <p>For configuring routing – ICND 1 – 15,16,17,18</p>

		<p>For Troubleshooting IPv4 routing and OSPF – ICND 2 – 4,5,8,11 Configuring RIP, refer https://www.cisco.com/c/en/us/td/docs/ios/12_2/ip/configuration/guide/fipr_c/1cfrip.html</p> <p>Why doesn't RIP and IGRP support dis -contiguous networks? Refer to for understanding https://www.cisco.com/c/en/us/support/docs/ip/interior-gateway-routing-protocol-igrp/13724-55.html?referring_site=bodynav</p> <p>Why don't RIP and IGRP support variable length subnet mask? Refer to for understanding https://www.cisco.com/c/en/us/support/docs/ip/ip-routed-protocols/13722-ripv1-support-vlsm.html?referring_site=bodynav</p>
02/18 (Lab 4)	OSPF and Redistribution	<p>Chapters - 21,22,23 ISBN-13: 978-0-13-822963-4 CCNA 200-301 Official Cert Guide, Volume 1, Second Edition</p> <p>OSPF and configuration, refer https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/iproute_ospf/configuration/15-mt/iro-15-mt-book/iro-cfg.html</p> <p>Good document to understand how a packet traverses a router with multiple services enabled (NAT/IPSEC/ACL/QoS/ Routing) https://www.cisco.com/c/en/us/support/docs/ip/network-address-translation-nat/6209-5.pdf</p> <p>For Redistribution refer https://www.cisco.com/c/en/us/support/docs/ip/enhanced-interior-gateway-routing-protocol-eigrp/8606-redist.html</p>
03/04 (Lab 5)	NAT, Access Lists, NTP	<p><u>Prepare chapters</u> ICND 1 – 22, 23, 24 Appendix J Configuration Examples ACL at https://www.cisco.com/c/en/us/support/docs/security/ios-firewall/23602-confaccesslists.html</p>
	HSRP, Stateful NAT, VRF	<p>Introduction to VRF lite refer http://packetlife.net/blog/2009/apr/30/intro-vrf-lite/</p>
03/09	Mid Term review and practice week	
03/18	Mid Term Practical Examinations	Batches and Slots to be decided later

04/08 (Lab 6)	IPSec VPN's	<p><u>Prepare chapter</u> ICND 2 – Chapter 15 Read: IPSec intro reading at https://www.cisco.com/c/en/us/td/docs/net_mgmt/vpn_solutions_center/2-0/ip_security/provisioning/guide/IPsecPG1.html Configuring IPSec at https://www.cisco.com/c/en/us/td/docs/security/asa/asa72/configuration/guide/conf_gd/ike.pdf Configuration examples: (look for IP sec on Router to Router) at https://www.cisco.com/c/en/us/tech/security-vpn/ipsec-negotiation-ike-protocols/tech-c/configuration-examples-list.html</p> <p><u>Prepare chapters</u> ICND 1 – 28-32, Appendix J & K ICND 2 – 22-25</p>
04/15 (Lab 7)	MPLS and RSVP	<p><u>Prepare chapters</u> ICND 2 – 12,13,14 For MPLS basics refer http://mplstutorial.com/mpls-basics For MPLS Traffic Engineering refer https://www.networkcomputing.com/networking/mpls-traffic-engineering-tunnel-setup/442703769</p> <p>Troubleshooting MPLS Traffic Engineering Tunnels at https://www.cisco.com/c/dam/en/us/products/collateral/ios-nx-os-software/multiprotocol-label-switching-archive/prod_white_paper0900aecd803128b9.pdf</p>
04/22 (Lab 8)	IPv6	<p><u>Prepare chapters</u> ICND 1 – 28-32, Appendix J & K ICND 2 – 22-25</p>
04/27	IPv6 (Contd.)	Final Practice Week
04/29		Final Practical
05/04	Finals Week	Final Written