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| This document will receive modifications during the first weeks of classes. |  |
| Syllabus  CSCI 5160: Intro To Enterprise Networks  SPRING 2024, 3 credits, AUG – DEC  Class meeting times: Tuesday/Thursday 9-10AM  Class meeting location: ECEE 283 Instructor Information Name: Jose Santos  Email: [jose.santos@colorado.edu](mailto:jose.santos@colorado.edu)  Office Location: ECEE 275A  Office Hours: T/R TBD Teaching Assistants Information Name: Kevin Chotaliya  Email: kevin.chotaliya@colorado.edu  Office Hours: TBD  Name: Alireza Taat  Email: [alireza.taat@colorado.edu](mailto:alireza.taat@colorado.edu)  Office Hours: TBD Course Information Fit within 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  ISBN: 9780135768464  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:   + Switching Architecture   + WiFi integration   + Routing and Traffic engineering   + WAN Private site to site interconnectivity   + Network Security and VPN Services   + Public Internet Access * Identify and explain the internal logical operation of Routers, Switches and Access Points in different deployment scenarios * Ethernet   + 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   + Describe the basic operation of STP and Rapid STP Protocol     - Root Bridge selection     - Port states     - Protocol convergence * IP   + Configure and verify IPv4 and IPv6 addressing and subnetting   + Interpret the information contained in a routing table     - Prefix / Mask / Metric / Next Hop / Exit interface   + 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)   + Compare and Explain different IPv6 address types   + Compare and Explain different IPv6/IPv4 Tunneling techniques     - Configure and verify       * ISATAP, 6to4, GRE and Teredo * IPSec   + Explain the operation of IPSec protocol and its configuration requirements     - Phase 1, Phase 2, DH, Transform Sets   + Configure and Verify     - Tunnel Based IPsec tunneling (GW to GW)     - Remote Access IPSec tunneling (Host to GW)     - Routing and Tunneling over IPSec   + Explain the operation of DMVPN * MPLS   + Explain the operation of MPLS Label Distribution Protocols (LDP and RSVP)   + Explain the operation of CSPF within MPLS TE   + Configure and Verify     - LDP deployment within a single carrier     - MPLS TE deployment across a multi-hop network     - End to End Routing Overlays * Network Implementation   + 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   + Demonstrate network implementation skills     - Ability to configure multi-vendor equipment     - Ability to use network diagnostic tools to troubleshoot network problems   + 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 7:30pm to 9:00pm 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 4 lab experiments. The final will cover the remaining lab material learned from the course, along with 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%   + Midterm written exam - 15%   + Midterm Practical exam - 20% (5% report 15% exam) * Final exam - 35%   + Final Written exam - 15%   + 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. | |
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| **Week** | **Lecture** | **Reading Assignment due** |
| Pre-Class  01/18  (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) |
| 01/22  (Lab1) | LAN Switching – Basics of VLANs, VTP | Prepare chapters  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>  Password Recovery  <https://www.cisco.com/c/en/us/support/docs/switches/catalyst-2950-series-switches/12040-pswdrec-2900xl.html#topic1>    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>  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> |
| During Lab Sessions | IP Addressing and STP Class | [Prepare ch](http://www.cisco.com/en/US/prod/collateral/wireless/ps5678/ps11983/white_paper_c11-713103.html)apters  ICND 1 –19,20,21, Appendix D, E, F, G, H, I Chapter 10,11,12,13,14 (200-301)  IP Addressing and STP recitation will be conducted by one of the Student Assistants |
|  | LAN Switching-  STP, RSTP, PVST, Portfast, Etherchannel, SPAN  (Contd.) | Research lab objective: How to run per-VLAN STP (have a different root bridge for each VLAN)  Multilayer Switching (3550/3560)  [https://www.cisco.com/c/en/us/support/docs/lan-switching/inter-vlan-routing/41260-189.html](https://www.cisco.com/c/en/us/td/docs/ios/12_2/ip/configuration/guide/fipr_c/1cfrip.html) |
| 01/29  (Lab 2) | Wireless Networking & IP Addressing | Prepare Chapters  For IPv4 Sub netting - ICND 1 - 11, 12, 13, 14  Read Wireless Tutorials  [and La](http://www.wi-fiplanet.com/tutorials/article.php/1571601)b2 writeup  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/white-paper-c11-713103.pdf |
| 02/05  (Lab 3) | Routing Lab – Static Routing, RIP and EIGRP Routing | Prepare chapters  For configuring routing –  ICND 1 – 15,16,17,18  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>  Why doesn’t RIP and IGRP support dis -contiguous networks? Refer to for [un](http://www.cisco.com/en/US/tech/tk365/technologies_tech_note09186a0080093fd6.shtml?referring_site=bodynav)derstanding  <https://www.cisco.com/c/en/us/support/docs/ip/interior-gateway-routing-protocol-igrp/13724-55.html?referring_site=bodynav>  Why don’t RIP and IGRP support variable length subnet mask? Refer to for [un](http://www.cisco.com/en/US/tech/tk364/technologies_tech_note09186a0080093f1e.shtml?referring_site=bodynav)derstanding  <https://www.cisco.com/c/en/us/support/docs/ip/ip-routed-protocols/13722-ripv1-support-vlsm.html?referring_site=bodynav> |
| 02/12  (Lab 4) | OSPF and Redistribution | 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>  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>  For Redistribution refer  <https://www.cisco.com/c/en/us/support/docs/ip/enhanced-interior-gateway-routing-protocol-eigrp/8606-redist.html> |
| 02/19  (Lab 5) | NAT, Access Lists, NTP | Prepare chapters  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> |
|  | HSRP, Stateful NAT, VRF | Introduction to VRF lite refer  <http://packetlife.net/blog/2009/apr/30/intro-vrf-lite/> |
| 02/26 | Mid Term review and practice week |  |
| 03/04 | Mid Term Practical Examinations | Batches and Slots to be decided later |
| 03/11  (Lab 6) | IPSec VPN’s | Prepare chapter  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-configuration-examples-list.html>  Prepare chapters  ICND 1 – 28-32, Appendix J & K  ICND 2 – 22-25 |
| 03/18  (Lab 7) | MPLS and RSVP | Prepare chapters  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>  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 |
| 04/01  (Lab 8) | IPv6 | Prepare chapters  ICND 1 – 28-32, Appendix J & K  ICND 2 – 22-25 |
| 04/08 | IPv6 (Contd.) | Final Practice Week |
| 04/15 |  | Final Practical |
| 04/29 | Finals Week | Final Written |
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