ITT Technical Institute

IT370

Advanced Routing and Switching I

Onsite Course

SYLLABUS

Credit hours: 4

Contact/Instructional hours: 50 (30 Theory Hours, 20 Lab Hours)

Prerequisite(s) and/or Corequisite(s):

Prerequisite: IT320 WAN Technology and Application or equivalent

Course Description:

This course studies how to design and implement IP networks using scalable routing protocols such as OSPF, EIGRP and BGP. How to troubleshoot and manage networks running such protocols will also be studied.

Syllabus: Advanced Routing and Switching I

Instructor:	_____
Office hours:	_____
Class hours:	_____

Major Instructional Areas

1. Introduction to scalable networks
2. Basics of Enhanced Interior Gateway Routing Protocol (EIGRP)
3. Information on the Open Shortest Path First (OSPF) routing protocol in a single area and OSPF network topologies
4. Fundamentals of OSPF multiple-area networks
5. Essentials of the Integrated Intermediate System-to-Intermediate System (IS-IS) routing protocol
6. Routing features of Cisco Internetwork Operating System (IOS) devices
7. Basic concepts and commands of Border Gateway Protocol (BGP)
8. Description and use of multicasting
9. Features of Internet Protocol version 6 (IPv6)

Course Objectives

1. Analyze routing components in scalable networks.
2. Describe the functions of important routing algorithms.
3. Describe the types of network addresses and their uses in networking.
4. Describe the two categories of routing protocols.
5. Configure and troubleshoot EIGRP.
6. Configure and troubleshoot OSPF in a single area.
7. Configure and troubleshoot OSPF across multiple areas.
8. Configure and monitor BGP.
9. Configure route filters and route maps.
10. Configure and troubleshoot Integrated IS-IS.
11. Configure and troubleshoot Integrated Internet Group Management Protocol (IGMP).
12. Describe the need for and functions of IPv6 addressing and protocols.

SCANS Objectives

SCANS is an acronym for Secretary's Commission on Achieving Necessary Skills. The committee, created by the National Secretary of Labor in the early 1990s, created a list of skills and competencies that the committee feels are necessary for employees to function in a high-tech job market.

1. Acquire and evaluate information.
2. Demonstrate an understanding of how technological systems work and operate.

3. Demonstrate an understanding of technological systems.
4. Demonstrate an understanding of how the structure of a technological system relates to goals.
5. Demonstrate competence in selecting technology and determining desired outcomes and applicable constraints.
6. Demonstrate competence in applying technology to a task.
7. Work cooperatively with others, contributing to the group with ideas, suggestions, and effort.
8. Employ computers to acquire, organize, analyze, and communicate information.

Course Outline

Note: All graded activities, except the Project, are listed below in the pattern of <Unit Number>.<Assignment Number>. For example, Lab 1.1 refers to the 1st lab activity in Unit 1.

Unit	Activities

1—Scalable Networks	• Content Covered:
	CCNP BSCI Official Exam Certification Guide:
	  ○ Chapter 1, "Network Design"
	  ○ Chapter 2, "IP Address Planning and Summarization"
	• Assignments: 1.1
	• Labs: 1.1-1.2

2—EIGRP	• Read from *CCNP BSCI Official Exam Certification Guide*:
	  ○ Chapter 3, "EIGRP Principles"
	  ○ Chapter 4, "Scalable EIGRP"
	• Assignments: 2.1
	• Labs: 2.1-2.2

3—OSPF Single Area and Network Topologies	• Read from *CCNP BSCI Official Exam Certification Guide*:
	  ○ Chapter 5, "Understanding Simple Single-Area OSPF"
	  ○ Chapter 6, "OSPF Network Topologies"
	• Assignments: 3.1
	• Labs: 3.1

4—OSPF Multiple Areas and Advanced Topics	• Read from *CCNP BSCI Official Exam Certification Guide*:
	  ○ Chapter 7, "Using OSPF Across Multiple Areas"
	  ○ Chapter 8, "OSPF Advanced Topics"
	• Assignments: 4.1
	• Labs: 4.1
	• Quizzes: 4.1
	• Course Project: Part 1

5—IS-IS	• Read from *CCNP BSCI Official Exam Certification Guide*:
	  ○ Chapter 9, "Fundamentals of the Integrated IS-IS Protocol"
	  ○ Chapter 10, "Configuring Integrated IS-IS"
	• Assignments: 5.1
	• Labs: 5.1

6—Cisco IOS Routing Features	• Read from *CCNP BSCI Official Exam Certification Guide*:
	  ○ Chapter 11, "Implementing Redistribution and Controlling Routing Updates"
	  ○ Chapter 12, "Controlling Redistribution with Route Maps"
	  ○ Chapter 13, "Dynamic Host Control Protocol"
	• Assignments: 6.1
	• Labs: 6.1-6.2

7—BGP	• Read from *CCNP BSCI Official Exam Certification Guide*:

Unit	Activities
	o Chapter 14, "BGP Concepts" o Chapter 15, "BGP Neighbors" o Chapter 16, "Controlling BGP Route Selection" • Assignments: 7.1 • Labs: 7.1 • Quizzes: 7.1 • Course Project: Part 2
8—Multicasting	• Read from *CCNP BSCI Official Exam Certification Guide*: o Chapter 17, "What Is Multicasting?" o Chapter 18, "IGMP" o Chapter 19, "Configuring Multicast" • Assignments: 8.1 • Labs: 8.1-8.2
9—IPv6	• Read from *CCNP BSCI Official Exam Certification Guide*: o Chapter 20, "Introduction to IPv6 and IPv6 Addressing" o Chapter 21, "IPv6 Routing Protocols, Configuration, and Transitioning from IPv4" • Assignments: 9.1 • Labs: 9.1-9.2
10—Final Course Lab Project	• Labs: 10.1 • Course Project: Part 3
11—Course Review and Final Exam	• Final Exam

Instructional Methods

This course introduces knowledge and competencies that map to the objectives of the Cisco Certified Networking Professional (CCNP) Building Scalable Cisco Internetworks (BSCI) exam. The course is designed to promote a variety of teaching strategies that support the outcomes described in the course objectives and foster higher cognitive skills.

This course employs learning and evaluation strategies such as assignments, labs, quizzes, a course project, and a final exam. Units 1-9 will have homework assignments. Units 1-10 will have lab exercises to provide hands-on knowledge about the concepts covered. A quiz each in Units 4 and 7 will help reinforce learning. The course project will have three components: documentation, presentation, and demonstration. The final exam in Unit 11 will evaluate understanding of all the concepts covered in this course.

Instructional Materials and References

Student Textbook Package
• Stewart, Brent D., and Clare Gough. *CCNP BSCI Official Exam Certification Guide*. 4th ed. Indianapolis, IN: Cisco Press, 2008.
• Boson™ NetSim for CCNP 7.0 software

Equipment and Tools

• A computer for each student that has Microsoft Windows XP with HyperTerminal
• Six Cisco 2600 series routers with:

- o   Router 1 (Top): 1 Ethernet and 2 serial interfaces
    - o   Router 2: 1 Ethernet and 1 serial interface
    - o   Router 3: 1 Ethernet and 1 serial interface
    - o   Router 4: 1 Ethernet and 8 serial interfaces
    - o   Router 5: 1 Ethernet and 1 serial interface
    - o   Router 6 (Bottom): 1 Ethernet and 2 serial interfaces
- Two Cisco switches, 3550 series
- Five RJ-45 to RJ-45 rollover console cables
- Five RJ-45 to DB-9 serial connectors
- Five pairs of V.35 male and female adapter cables (Data Terminal Equipment (DTE) and Data Communications Equipment (DCE))
- Eight straight-through cables
- A Windows XP computer with 128 megabytes (MB) of RAM and at least 1 gigabyte (GB) of free hard disk space to be used as a Trivial File Transfer Protocol (TFTP) server
- A long straight-through patch cable to connect the TFTP server to one of the switches
- Boson™ NetSim for CCNP 7.0—CCNP router configuration simulation software—for each student
- Cisco TFTP server software for the TFTP server PC

References

ITT Tech Virtual Library

Log on to the ITT Tech Virtual Library at http://www.library.itt-tech.edu/ to access online books, journals, and other reference resources selected to support ITT Tech curricula.

Books

You may click "Books" or use the "Search" function on the home page to find the following books.

- Books 24x7>
    - o   Brenton, Chris, and Bob Abuhoff. *Mastering Cisco Routers*. 2nd ed. Alameda, CA: Sybex Inc., 2002.

- Ebrary>
    - o   Parkhurst, William R. *Cisco Router OSPF: Design & Implementation Guide*. New York: The McGraw-Hill Companies, 2000. (Note: Please type the first three words of the book title when searching for this book on the ITT Tech Virtual Library).
    - o   Pasricha, Harpreet, and Dattakiran Jagu. *Designing Networks with Cisco*. Hingham, MA: Charles River Media, Inc., 2004.
    - o   Sackett, George. *Cisco Router Handbook*. New York: McGraw-Hill Professional Book Group, 1999.

Other References

The following resources may be found **outside** of the ITT Tech Virtual Library, whether online or in hard copy.

Web sites

- Behavior of RIP and IGRP When Sending and Receiving Updates
http://www.cisco.com/warp/public/105/54.pdf (accessed September 15, 2008).
        This document explains the series of actions taken by Routing Information Protocol (RIP) and IGRP when they send or receive routing updates.

- BGP Best Path Selection Algorithm

http://www.cisco.com/warp/public/459/25.pdf (accessed September 15, 2008).
This document explains the BGP best path algorithm that decides the best path to install in the IP routing table and to use for traffic forwarding.

- BGP Case Studies
http://www.cisco.com/warp/public/459/bgp-toc.pdf (accessed September 15, 2008).
This document contains five BGP case studies.

- BGP: Frequently Asked Questions
http://www.cisco.com/warp/public/459/bgpfaq_5816.pdf (accessed September 15, 2008).
This document contains frequently asked questions about BGP.

- Cisco—An Introduction to IGRP
http://www.cisco.com/warp/public/103/5.pdf (accessed September 15, 2008).
This document introduces IGRP.

- Cisco—OSPF Neighbor States
http://www.cisco.com/warp/public/104/13.pdf (accessed September 15, 2008).
This document describes each OSPF neighbor state in detail.

- Cisco—Sample Configuration for iBGP and eBGP With or Without a Loopback Address
http://www.cisco.com/warp/public/459/23.pdf (accessed September 15, 2008).
This document provides sample configurations for iBGP and eBGP, both with and without a loopback address, used to perform interdomain routing in Transmission Control Protocol (TCP)/Internet Protocol (IP) networks.

- Cisco—Subnet Zero and the All-Ones Subnet
http://www.cisco.com/warp/public/105/40.pdf (accessed September 15, 2008).
This document discusses subnet zero and the all-ones subnet and their uses.

- Cisco—Why Don't RIPv1 and IGRP Support Discontiguous Networks?
http://www.cisco.com/warp/public/105/55.pdf (accessed September 15, 2008).
This document describes why RIPv1 and IGRP do not support discontiguous networks and how you can resolve this issue.

- Configuring EIGRP
http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/np1_c/1cprt1/1c eigrp.pdf (accessed September 15, 2008).
This chapter describes how to configure EIGRP.

- Configuring Integrated IS-IS
http://www.cisco.com/univercd/cc/td/doc/product/software/ios113ed/113ed_cr/np1_c/1cisi s.pdf (accessed September 15, 2008).
This document describes how to configure Integrated IS-IS as an IP routing protocol.

- Configuring Policy-Based Routing
http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fqos_c/fqcprt1/ qcfpbr.pdf (accessed September 15, 2008).
This document describes the tasks for configuring policy-based routing (PBR) on a router.

- Designing Large-Scale Stub Networks with ODR
http://www.cisco.com/warp/public/105/39.pdf (accessed September 15, 2008).

This document explains how large-scale stub networks can be designed by using On-Demand Routing (ODR).

- EIGRP Frequently Asked Questions
http://www.cisco.com/warp/public/103/eigrpfaq.pdf (accessed September 15, 2008).
This document contains frequently asked questions about EIGRP.

- How NAT Works
http://www.cisco.com/warp/public/556/nat-cisco.pdf (accessed September 15, 2008).
This document explains how Network Address Translation (NAT) functions to let a device such as a router act as agent between a public and private network.

- Introduction to EIGRP
http://www.cisco.com/warp/public/103/1.pdf (accessed September 15, 2008).
This document introduces the IGRP suite of routing protocols.

- Introduction to Intermediate System-to-Intermediate System Protocol
http://www.cisco.com/warp/public/cc/pd/iosw/prodlit/insys_wp.pdf (accessed September 15, 2008).

This document explains the IS-IS routing protocol.

- IP Addressing and Subnetting for New Users
http://www.cisco.com/warp/public/701/3.pdf (accessed September 15, 2008).
This document provides basic information to configure your router for routing IP, such as how addresses are broken down and how subnetting works.

- IS-IS Multi-Area Support
http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t5/ismarea.pdf (accessed September 15, 2008).
This document describes multi-area IS-IS support for ISO Connectionless Network Service (CLNS).

- OSPF Commands
http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/np1_r/1rprt1/1rospf.pdf (accessed September 15, 2008).
This document provides commands to configure and monitor the OSPF routing protocol.

- OSPF Design Guide
http://www.cisco.com/warp/public/104/1.pdf (accessed September 15, 2008).
This document examines how OSPF works and how it can be used to design and build large and complicated networks.

- OSPF: Frequently Asked Questions
http://www.cisco.com/warp/public/104/9.pdf (accessed September 15, 2008).
The document addresses frequently asked questions associated with OSPF.

- OSPF Neighbor Problems Explained
http://www.cisco.com/warp/public/104/29.pdf (accessed September 15, 2008).
This document explains common problems with getting OSPF neighbors to become fully adjacent.

- OSPF Overview
http://www.cisco.com/application/pdf/en/us/guest/tech/tk480/c1550/ccmigration_09186a0080187c6d.pdf (accessed September 15, 2008).
This PowerPoint presentation provides an overview of the OSPF routing protocol.

- Policy-Based Routing
http://www.cisco.com/en/US/products/ps6599/products_white_paper09186a00800a4409.shtml (accessed September 15, 2008).
This document discusses the Cisco IOS software policy-based routing feature and addresses policy-based routing and its benefits.

- Redistributing Routing Protocols
http://www.cisco.com/warp/public/105/redist.pdf (accessed September 15, 2008).
This document explains factors to be considered for the redistribution of routing protocols.

- Route-Maps for IP Routing Protocol Redistribution Configuration
http://www.cisco.com/warp/public/459/route-map_bestp.pdf (accessed September 15, 2008).
This document describes commands to configure route-maps that are applied with the redistribute command of dynamic routing protocols. This document also includes tips on route-map functions and advice on when route-map configuration is most beneficial.

- Routing Basics: A Technical Overview
http://www.cisco.com/en/US/netsol/ns339/ns392/ns399/ns400/networking_solutions_white_paper0900aecd802d548f.shtml (accessed September 15, 2008).
This article introduces the underlying concepts widely used in routing protocols.

- Sample Configuration for BGP with Two Different Service Providers (Multihoming)
http://www.cisco.com/warp/public/459/27.pdf (accessed September 15, 2008).
BGP is a key protocol used to achieve Internet connection redundancy. When you run BGP with more than one service provider, you run the risk of your autonomous system (AS) becoming a transit AS, causing Internet traffic to pass through your AS and potentially consume all of the bandwidth and resources of your router's CPU. This document addresses this issue, with appropriate configuration examples.

- Sample Configuration for Removing Private AS Numbers in BGP
http://www.cisco.com/warp/public/459/36.pdf (accessed September 15, 2008).
This document shows sample configurations for the removal of private AS numbers from outgoing eBGP updates.

- Troubleshooting BGP
http://www.cisco.com/warp/public/459/bgp_trouble_main.pdf (accessed September 15, 2008).

This document provides troubleshooting information for common problems with BGP.

- Troubleshooting EIGRP
http://www.cisco.com/warp/public/103/trouble_eigrp.pdf (accessed September 15, 2008).
This document provides troubleshooting information for common problems with EIGRP.

- Troubleshooting Flapping BGP Routes (Recursive Routing Failure)
http://www.cisco.com/warp/public/459/bgp-rec-routing.pdf (accessed September 15, 2008).

This document describes how to troubleshoot flapping BGP routes caused by recursive routing failure.

- Understanding Route Aggregation in BGP
http://www.cisco.com/warp/public/459/aggregation.pdf (accessed September 15, 2008).

This document illustrates how BGP allows the aggregation of specific routes into one route.

- Verifying NAT Operation and Basic NAT Troubleshooting
http://www.cisco.com/warp/public/556/13.pdf (accessed September 15, 2008).
This document demonstrates how to verify NAT operation using tools available on Cisco routers, how to perform basic NAT troubleshooting, and how to avoid common mistakes when troubleshooting NAT.

- What Is Administrative Distance?
http://www.cisco.com/warp/public/105/admin_distance.pdf (accessed September 15, 2008).
This document explains administrative distance, a measure of a routing protocol's reliability.

All links to Web references outside of the ITT Tech Virtual Library are always subject to change without prior notice.

Course Evaluation and Grading

Evaluation Criteria Table

The final grades will be based on the following categories:

CATEGORY	WEIGHT
Assignments	20%
Quizzes	15%
Labs	30%
Course Project	15%
Final Exam	20%
Total	**100%**

Note: Students are responsible for abiding by the Plagiarism Policy.

Grade Conversion Table

The final grades will be calculated from the percentages earned in the course, as follows:

A	90–100%	4.0
B+	85–89%	3.5
B	80–84%	3.0
C+	75–79%	2.5
C	70–74%	2.0
D+	65–69%	1.5
D	60–64%	1.0
F	<60%	0.0

(End of Syllabus)