Level 6 Advanced Diploma in Routing & Switching (112)
151 Credits

Unit: Advanced IP Routing **Exam Paper No.:** 1	**Guided Learning Hours:** 220 **Number of Credits:** 22
Prerequisites: Networking knowledge.	**Corequisites:** A pass or higher in Diploma in IP Routing or equivalence.
Aim: This unit continues from **IP Routing Technology** and **Connecting Routing Devices** units covered in Diploma in IP Routing. Learners learn to use VLSM, private addressing, and NAT to optimise IP address utilisation. The majority of the unit content relate to implementing the RIPv2, EIGRP, OSPF, IS-IS, BGP routing protocols, and important techniques used for route filtering and route redistribution. The unit focus on development of knowledge and skills needed to manage Internet Protocol (IP) traffic and access, designing Wide Area Networks (WANs), understanding scalable internetworks and Quality of Service (QoS), configuring advanced routing protocols (Routing Internet Protocol version 2 [RIPv2], Border Gateway Protocol [BGP], Enhanced Interior Gateway Routing Protocol [EIGRP], Open Shortest Path First [OSPF]), performing advanced IP addressing (Network Address Translation [NAT] and Variable Length Subnet Masking [VLSM]).	
Required Materials: Recommended Learning Resources.	**Supplementary Materials:** Lecture notes and tutor extra reading recommendations.
Special Requirements: The unit requires a combination of lectures, demonstrations, discussions, and hands-on labs.	
Intended Learning Outcomes:	**Assessment Criteria:**
1 The fundamental principles of routing; the differences between static and dynamic routing.	1.1 Describe IPv4 1.2 Describe IPv6 1.3 Compare and contrast IPv4 and IPv6 1.4 Describe classful and classless routing protocols 1.5 Describe advantages and disadvantages of classless routing 1.6 Describe advantages and disadvantages of classful routing 1.7 Define link state routing 1.8 Describe the difference between distance vector and link state protocols 1.9 Define VLSM 1.10 Describe route summarisation
2 The operation, configuration, tuning of RIP version 1 and 2; the RIP evolvement from a classful routing protocol to a classless routing protocol.	2.1 Analyse and identify the operation of RIP 2.2 Demonstrate configuration of RIP version 1 2.3 Demonstrate configuration of RIP version 2 2.4 Describe RIP parameters for tuning timers, controlling broadcasts and routes 2.5 Demonstrate configuration of default routes 2.6 Demonstrate RIP redistribution 2.7 Demonstrate RIP route filtering 2.8 Demonstrate controlling RIP route updates
3 Interior Gateway Routing Protocol (IGRP) features and differences from other	3.1 Describe IGRP timers, metrics and mechanics

distance vector protocols.	3.2 Demonstrate IGRP configuration 3.3 Describe IGRP parameters for tuning timers, controlling broadcasts, load-sharing and controlling route updates 3.4 Demonstrate configuration of default route 3.5 Demonstrate configuration of route filtering 3.6 Demonstrate configuration of unequal-cost load sharing
4 Enhanced Interior Gateway Routing Protocol (EIGRP) neighbour discovery/recovery; Reliable Transport Protocol (RTP), DUAL finite-state machine and protocol-dependent modules routing technologies; configuring; enabling EIGRP routing protocol and description of EIGRP commands.	4.1 Describe EIGRP features and implementation 4.2 Define how EIGRP maintain routes 4.3 Identify how EIGRP support summarisation 4.4 Explain how EIGRP operates in NBMA 4.5 Describe the advantages of EIGRP 4.6 Describe EIGRP configuration process 4.7 Describe EIGRP adjustment tuning parameters and route filtering 4.8 Describe redistribution in EIGRP 4.9 Describe EIGRP route summarisation 4.10 Describe EIGRP default route injection 4.11 Describe EIGRP stub routing 4.12 Describe EIGRP equal and unequal-cost load balancing 4.13 Demonstrate EIGRP route redistribution configuration and summarisation configuration 4.14 Demonstrate EIGRP default route ,route stub, route manipulation and route filtering configuration
5 Open Shortest Path (OSPF); OSPF enhancements over distance vector protocols and OSPF configuration; configuring OSPF in a single-area; the characteristics; features and description of OSPF commands.	5.1 Describe OSPF features; how OSPF discover and maintain routes 5.2 Demonstrate how to configure OSPF in a single area 5.3 Configure OSPF default routing 5.4 Demonstrate how to configure OSP on NBMA 5.5 Configure OSPF in multiple-area and analysing issues associated with interconnecting multiple areas. 5.6 Describe the different types of areas 5.7 Describe how OSPF operates in multi-area NBMA environment 5.8 Demonstrate how to configure multi-area OSPF network 5.9 Describe the steps OSPF goes through when building a routing table 5.10 Outline how OSPF operates over the different types of links and the types of LSAs propagated from one area to another 5.11 Describe OSPF design considerations before implementation 5.12 Outline the types of OSPF stub areas 5.13 Analyse OSPF parameters for tuning timers, controlling broadcasts, routing

	updates and link-state propagation 5.14 Describe OSPF flooding, route filtering, route redistribution, summarisation and authentication 5.15 Analyse demand circuits and OSPF backup 5.16 Demonstrate OSPF virtual links 5.17 Demonstrate configuration of multiple OSPF areas and types, authentication, path manipulation and default routing 5.18 Demonstrate configuration of OSPF multiple area routing, redistribution and summarisation
6 Understand IP multicast application, network infrastructure and client devices.	6.1 Describe multicast deployment 6.2 Explain multicast advantages and disadvantages 6.3 Identify multicast applications 6.4 Describe multicast address structure 6.5 Describe Internet Group Management Protocol (IGMP) 6.6 Explain multicast distribution trees 6.7 Demonstrate multicast routing implementation 6.8 Describe Protocol-Independent Multicast (PIM)
7 The controlling of routing updates, traffic paths, protocols and the different types of IP access lists ; the concept of using multiple routing protocols; access-list and how they will be able to communicate.	7.1 Define route update 7.2 Describe route distribution 7.3 Describe network redundancy 7.4 Demonstrate configuring offset and access control lists 7.5 Define policy based routing 7.4 Describe how access lists operate 7.5 Describe access lists, wildcard masks and binary maths 7.6 Describe how access lists filter routes and deny network virtual terminal access 7.7 Describe the implementation of Extended IP Access Lists 7.8 Describe dynamic access lists 7.6 Describe named access lists 7.9 Demonstrate the configuration of access lists and named access lists 7.10 Demonstrate the configuration of Dynamic Access Lists and Traffic filters using named access lists.
8 The BGP protocol, terminology, operation and analysing the I-BGP and E-BGP sessions; BGP features, operation and demonstrate BGP design and implementation.	8.1 Define BGP and the I-BGP protocol 8.2 Describe the E-BGP protocol 8.3 Explore BGP routing tables 8.4 Analyse BGP messages 8.5 Describe the BGP finite-state machine operation 8.6 Analyse BGP path attributes 8.7 Describe BGP route reflectors and confederations 8.8 Describe BGP route selection process 8.9 Describe how BGP policy-based routing functions within an AS

9 Scalability challenges and concerns associated with both internal and external BGP.	8.10 Describe how to configure internal and external BGP 8.11 Identify sychronisation in BGP 9.1 Explain and configure BGP router reflectors 9.2 Describe and configure policy control in BGP using prefix lists 9.3 Demonstrate how to configure multiple ISPs using BGP 9.4 Describe BGP redistribution
Methods of Evaluation: A 3-hour essay written paper with 5 questions, each carrying 20 marks. Candidates are required to answer all questions. Candidates also undertake project/coursework in Advanced IP Routing with a weighting of 100%.	

Recommended Learning Resources: Advanced IP Routing

Text Books	• CCNP 1: Advanced Routing Lab Companion. ISBN-10: 158713134X • IP Routing Protocols - RIP, OSPF, BGP, PNNI & Cisco routing protocols by Uyless N Black. ISBN-10: 0130142484 • Advanced Routing: Techniques for Better Woodworking by Nick Engler ISBN-10: 0762101970
Study Manuals 	BCE produced study packs
CD ROM 	Power-point slides
Software 	Cisco IOS