



Business & Computing Examinations (BCE) LONDON (UK)

Routing Programme Analysis & Occupational Outlook

The development of BCE programmes include extensive market research from the following sources:

- Data from BCE Centre Annual Reports.
- Enquiries received from different stakeholders.
- Email survey from statutory consultees and stakeholder bodies.
- Questionnaire survey from BCE learners.
- Input received during Approved Centres and Corporate companies training seminar.
- BCE discussions and feedback from potential employers.

BCE learners are 18+, classified as follows:

- Holders of General Certificate of Secondary Education (GCSE) intending to obtain a programme for employment or further education.
- Those already in employment furthering their knowledge for promotion or to venture into new fields.
- Corporate Companies approaching BCE directly or Approved Centres for in-house training.
- Those looking for career change.
- Mature adults with no formal programmes.

Guided Learning Hours is the entire notional learning hours representing estimate of total amount of time reasonably required for learners to achieve necessary level of attainment for the award of a programme.

Activities that contribute to guided learning hours include:

- Guided Learning
- Independent and unsupervised research/learning
- Unsupervised compilation of a portfolio of work experience
- Unsupervised e-learning
- Unsupervised e-assessment
- Unsupervised coursework
- Watching a pre-recorded podcast or webinar
- Unsupervised work-based learning

Activities that contribute to Guided Learning include:

- Classroom-based learning supervised by a Tutor
- Work-based learning supervised by a Tutor
- Live webinar or telephone tutorial with a Tutor in real time
- E-learning supervised by a Tutor in real time
- Forms of assessment

Level 5 Diploma in IP Routing (141 Credits)

Routing is the process of moving data from one point to the other using networking software and hardware (routers and switches). – The programme focuses on initial router and switch configuration, Cisco IOS Software management, routing protocol configuration, TCP/IP, and access control lists (ACLs). Learners will develop skills on how to configure a router, manage Cisco IOS Software, configure routing protocol on router interfaces, and set the access lists to control access to routers.

Why does the programme exist – Routers and switches are the most important networking hardware. Without routers, there would be not internet! The connection of LANs and WANs is at the core of commercial and personal businesses.

How it fits into the larger programme – In today's world, companies cannot function without the internet. 80% of daily transactions are internet based and only 20% of information is produced internally, this makes IP Routing programme a necessity and in demand.

For whom it was designed – This programme is designed for learners who complete the Certificate in Networking, Diploma in PC Engineering & Structured Cabling, Certificate/Diploma in Unix; Diploma in Windows Networking or holders of equivalent programme.

How it will benefit learners – A combination of knowledge in Networking and IP Routing make learners highly qualified and skilled, enhancing the chances of getting employment.

Units:

- Technological Elements of Networks
- Internet Infrastructure
- IP Routing Technology
- Connecting Routing Devices
- Introduction to Telecommunications

[This programme is about Cisco basics. However, unlike well-known Microsoft products, Cisco hardware is not common to the ordinary person. Why is this? Have you ever seen a Cisco router/switch in a high street shop? This is one reason most think Cisco programme is different. All the above five units are meant to make one understand Cisco networking by viewing all routing technology through different angles – from routing in Windows (platform most familiar to many – until the point one realises they are looking at the same things and it is not thatdifferent!]

Technological Elements of Networks – it is impossible to visualise how one can be a Network Engineer without understanding underlying networking hardware, the technology involved, different types of networks, and what happens behind the scenes (as far as data transmission technology is concerned).

Internet Infrastructure – Without routers, there would be *no* Internet [full stop/period]! The Internet is largest network in the world and nobody owns it. But if network engineers who configure small to large independent networks [which end up forming the Internet] do not build long lasting, secure infrastructures – this largest network would be catastrophic!

IP Routing Technology - an umbrella term for the set of protocols that determine the path that data follows in order to travel across multiple networks from its source to its destination. Data is routed from its source to its destination through a series of routers, and across multiple networks. IP Routing protocols enable routers to build up a forwarding table that correlates final destinations with next hop addresses.

Connecting Routing Devices - There are several varieties of Cisco routers and switches. This programme relevant router models are the 2900, 3900, 7500, and 12000 series. Switch modes are the 3850, 4500, 6500 and 6800 series. Cisco routers enable the transportation and delivery of data over the internet. The switch connections all local LAN computers and hardware to the router.

Introduction Telecommunications – Internet and Telecommunication works hand in hand. Most importantly, today’s technology integrates voice and data into one.

Unit	Pre-requisite	Core-requisite	Total Programmes Time	Number of Credits
Technological Elements of Networks	Knowledge in Windows Operating System.	A pass or better in Certificate in Networking or equivalence.	200	20
Internetwork Infrastructure	Knowledge in Windows Operating System.	A pass or better in Certificate in Networking or equivalence.	240	24
IP Routing Technology	Knowledge in Windows Operating System.	A pass or better in Certificate in Networking or equivalence.	240	24
Connecting Routing Devices	Knowledge in Windows Operating System.	A pass or better in Certificate in Networking or equivalence.	300	30
Introduction to Telecommunications	Knowledge in Windows Operating System.	A pass or better in Certificate in Networking or equivalence.	220	22
Coursework (Project) for all units			210	21

Rules of combination:	All units are mandatory
Age Group:	18+
Programme Type:	Vendor/Industry

Business & Computing Examinations (BCE)

Technological Elements of Networks Learning Hours Information Sheet

Unit Titles	Credits	Notional Learning Hours					
		Guided / Contact Learning	Independent Learning	Research Activities / Group Work	Assessment (self/class)	Coursework	Total
01 Network classifications and characteristics	2.0	8	6	2	2	2	20
02 OSI layers	2.0	8	6	2	2	2	20
03 Ethernet network architecture	2.0	8	6	2	2	2	20
04 Network operating system features	2.0	8	6	2	2	2	20
05 Network protocols	2.0	8	6	2	2	2	20
06 Functional Network Connectivity (FNC)	2.0	8	6	2	2	2	20
07 Distributed and centralised computing	2.0	8	6	2	2	2	20
08 Network security policies and procedures	2.0	8	6	2	2	2	20
09 Network security tools	2.0	8	6	2	2	2	20
10 Network print configuration	2.0	8	6	2	2	2	20
	20.0	80					200

Internetwork Infrastructure Learning Hours Information Sheet

Unit Titles	Credits	Notional Learning Hours					
		Guided / Contact Learning	Independent Learning	Research Activities / Group Work	Assessment (self/class)	Coursework	Total
01 Connectivity and internetwork devices	2.0	8	6	2	2	2	20
02 LAN technologies, protocols and standards	2.0	8	6	2	2	2	20
03 WAN technologies, topologies and protocols	2.0	8	6	2	2	2	20
04 Internet Protocol	2.0	8	6	2	2	2	20
05 Data Link Layer	2.0	8	6	2	2	2	20
06 Routing technologies	2.0	8	6	2	2	2	20
07 Network management tools and technologies	2.0	8	6	2	2	2	20
08 Voice and data integration	2.0	8	6	2	2	2	20
09 Wireless technologies	2.0	8	6	2	2	2	20
10 Network security technologies	2.0	8	6	2	2	2	20
11 Quality of Service (QoS) technologies	2.0	8	6	2	2	2	20
12 Network caching technologies	2.0	8	6	2	2	2	20
	24.0	96					240

IP Routing Technology Learning Hours Information Sheet

Unit Titles	Credits	Notional Learning Hours					
		Guided / Contact Learning	Independent Learning	Research Activities / Group Work	Assessment (self/class)	Coursework	Total
01 OSI layer model	2.0	8	6	2	2	2	20
02 Internet Protocol (IP)	2.0	8	6	2	2	2	20
03 IP routing process	2.0	8	6	2	2	2	20
04 Routing table functionality	2.0	8	6	2	2	2	20
05 Routing algorithms	2.0	8	6	2	2	2	20
06 Windows and Cisco routing environments	2.0	8	6	2	2	2	20
07 Routing Information Protocol (RIP)	2.0	8	6	2	2	2	20
08 Interior Gateway Routing Protocol (IGRP)	2.0	8	6	2	2	2	20
09 Enhanced Interior Gateway Routing Protocol (EIGRP)	2.0	8	6	2	2	2	20
10 Open Shortest Path First (OSPF)	2.0	8	6	2	2	2	20
11 Border Gateway Protocol (BGP)	2.0	8	6	2	2	2	20
11 Multipath routing	<u>2.0</u>	<u>8</u>	<u>6</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>20</u>
	24.0	96					240

Connecting Routing Devices Learning Hours Information Sheet

Unit Titles	Credits	Notional Learning Hours					
		Guided / Contact Learning	Independent Learning	Research Activities / Group Work	Assessment (self/class)	Coursework	Total
01 Network topology	2.0	8	6	2	2	2	20
02 TCP/IP	2.0	8	6	2	2	2	20
03 IP Addressing	2.0	8	6	2	2	2	20
04 Cisco router interfaces	2.0	8	6	2	2	2	20
05 Configuring Cisco router interfaces	2.0	8	6	2	2	2	20
06 Configuring Routing Information Protocol (RIP)	2.0	8	6	2	2	2	20
07 Configuring Interior Gateway Routing Protocol (IGRP)	2.0	8	6	2	2	2	20
08 Configuring Enhanced Interior Gateway Routing Protocol (EIGRP)	2.0	8	6	2	2	2	20
09 Configuring Open Shortest Path First (OSPF)	2.0	8	6	2	2	2	20
10 Configuring Network Address Translation (NAT)	2.0	8	6	2	2	2	20
11 Configuring Access Control Lists	2.0	8	6	2	2	2	20
11 Layer 2 switching	2.0	8	6	2	2	2	20
12 Configuring layer 2 switching	2.0	8	6	2	2	2	20
13 Spanning Tree Protocol (STP)	2.0	8	6	2	2	2	20
14 Virtual LAN (VLAN), VLAN Trunking Protocol (VTP) and Inter-VLAN routing	2.0	8	6	2	2	2	20
15 WAN terminology, connection technologies and protocols	<u>2.0</u>	<u>8</u>	6	2	2	2	<u>20</u>
	30	120					300

Introduction to Telecommunication Learning Hours Information Sheet

Unit Titles	Credits	Notional Learning Hours					
		Guided / Contact Learning	Independent Learning	Research Activities / Group Work	Assessment (self/class)	Coursework	Total
01 Telecommunication technologies	2.0	8	6	2	2	2	20
02 Telecommunication protocols and processes	2.0	8	6	2	2	2	20
03 Data communication standards	2.0	8	6	2	2	2	20
04 Telecommunication inter-connections	2.0	8	6	2	2	2	20
05 Digital data transmission	2.0	8	6	2	2	2	20
06 Synchronous digital hierarchy	2.0	8	6	2	2	2	20
07 ITU-T standards	2.0	8	6	2	2	2	20
08 Layer 2 and layer 3 routing	2.0	8	6	2	2	2	20
09 High-speed optical transmission systems	2.0	8	6	2	2	2	20
10 Voice over Packet networks	2.0	8	6	2	2	2	20
11 Mobile and wireless protocols	2.0	8	6	2	2	2	20
	22.0	88					220

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

Studying routing and switching allow learners to learn the basic function of networks and communications, giving them essential skills to plan, coordinate, and execute various security measures and procedures. The routing and switching programme also make use of the principles of LAN/WAN, routers, switches and other information technologies to build and maintain networks. Network engineer specialists can work in a variety of attractive positions and may also choose to specialise in their field.

Why does the programme exists – The programme focuses on development of knowledge and skills needed in setting up and configuring routers and switches. The internet created a new online/commercial system for different groups/interests. The improvement in technology regarding communication is a linchpin of international business. The ability to instantaneously communicate with a manager in China to install software from London, for example, allow companies to expand overseas. This is all possible because of multicasting – configured through routers and switches – yet there are very few Routing and Switching Engineers!

How it fits into the larger programme – Routers and switches are complicated network hardware equipment, yet their use is utterly important. Moving data locally, nationally and internationally is the norm in today's information world, hence knowledge of routing and switching hardware cannot be over stated.

For whom it was designed – The Level 6 Advanced Diploma in Routing & Switching is suitable for learners who have completed the Level 5 Diploma in IP Routing.

How it will benefit learners – Becoming a Network Engineer is only one option after completing the programme. There are many opportunities for skilled routing and switching personnel. Learners trained in these effective technological skills remain competitive and enable organisations to operate smoothly in the current business environment.

Units:

- Advanced IP Routing
- Switching
- Advanced LAN, WAN & Switching Configuration
- Telephone Signalling Systems Technologies
- Fibre Optic Technology

Advanced IP Routing – analysing major routing protocols, including EIGRP, OSPF, IS-IS and BGP. The advanced IP routing also looks at configuring routers routing between different protocols and IPv6.

Switching - A switch is used in a wired network to connect Ethernet cables from a number of devices together. The switch allows each device to talk to the others. (Switches are not used in networks with only wireless connections, since network devices such as routers and adapters communicate directly with one another, with nothing in between). Although one can use the ports on the back of a router or modem to connect a few Ethernet devices together, depending on the model, switches have a number of advantages: (i) switches allow dozens of devices to connect; (ii) switches keep traffic between two devices from getting in the way of other devices using the same network; (iii) switches allow control of who has access to various parts of the network; (iv) switches allow one to monitor usage; (v) switches allow communication (within a network) that's even faster than the Internet; (vi) high-end switches have pluggable modules to tailor them to network needs.

Advanced LAN, WAN & Switching Configuration– Knowledge on setting up internal and external connections and the security aspects is vital. $\frac{3}{4}$ of an organisation's communications is with external entity, hence if routing and switching hardware are not designed and configured efficiently, organisation's communication with the outside world will not be possible; leading to losses. Network Engineers need to be able to monitor, control and analyse a routed network. Networks go down, hardware fail and security needs to be maintained.

Telephone Signalling Systems Technologies – as seen above, $\frac{3}{4}$ of the organisation information is with the outside world and this done through telephones, hence knowledge of the telephone signalling technologies should be on the forefront. The programme looks at the telephone signalling protocols and how they are implemented.

Fibre Optic Technology – copper has limitations, hence the world has a newer and better technology; *fiber*. Like it or not, fibre technology is important in networking.

Unit	Pre-requisite	Core-requisite	Total Programmes Time	Number of Credits
Advanced IP Routing	Networking knowledge.	A pass or higher in Diploma in IP Routing or equivalence.	220	22
Switching	Networking knowledge.	A pass or higher in Diploma in IP Routing or equivalence.	220	22
Advanced LAN, WAN & Switching Configuration	Networking knowledge.	A pass or higher in Diploma in IP Routing or equivalence.	320	32
Telephone Signalling System Technologies	Networking knowledge.	A pass or higher in Diploma in IP Routing or equivalence.	220	22
Fibre Optic Technology	Networking knowledge.	A pass or higher in Diploma in IP Routing or equivalence.	220	22
Coursework (Project) for all units			310	31

Rules of combination:	All units are mandatory
Age Group:	19+
Programme Type:	Vendor/Industry

Advanced IP Routing Learning Hours Information Sheet

Unit Titles		Credits	Notional Learning Hours					
			Guided / Contact Learning	Independent Learning	Research Activities / Group Work	Assessment (self/class)	Coursework	Total
01	Routing principles	2.0	8	6	2	2	2	20
02	Configuring EIGRP routing	2.0	8	6	2	2	2	20
03	Configuring OSPF routing	2.0	8	6	2	2	2	20
04	OSPF NBMA environment	2.0	8	6	2	2	2	20
05	Network redundancy considerations	2.0	8	6	2	2	2	20
06	IP multicast application	2.0	8	6	2	2	2	20
07	Policy based routing	2.0	8	6	2	2	2	20
08	Implementing IP Routing	2.0	8	6	2	2	2	20
09	BGP design and implementation	2.0	8	6	2	2	2	20
10	Configuring policy control in BGP	2.0	8	6	2	2	2	20
11	Broadband connectivity	2.0	8	6	2	2	2	20
		22.0	88					220

Switching Learning Hours Information Sheet

Unit Titles		Credits	Notional Learning Hours					
			Guided / Contact Learning	Independent Learning	Research Activities / Group Work	Assessment (self/class)	Coursework	Total
01	Multilayer switching	2.0	8	6	2	2	2	20
02	Switch block devices and connectivity	2.0	8	6	2	2	2	20
03	Ethernet Broadcast Domain	2.0	8	6	2	2	2	20
04	VLAN implementation	2.0	8	6	2	2	2	20
05	Spanning Tree Protocol (STP)	2.0	8	6	2	2	2	20
06	Inter-VLAN routing	2.0	8	6	2	2	2	20
07	Configuring multilayer switch route processor	2.0	8	6	2	2	2	20
08	Fault tolerance vs high availability	2.0	8	6	2	2	2	20
09	Multicast routing protocols	2.0	8	6	2	2	2	20
10	Configuring IP multicast routing	2.0	8	6	2	2	2	20
11	Access control policy	2.0	8	6	2	2	2	20
		22.0	88					220

Advanced LAN, WAN & Switching Configuration Learning Hours Information Sheet

Unit Titles	Credits	Notional Learning Hours					
		Guided / Contact Learning	Independent Learning	Research Activities / Group Work	Assessment (self/class)	Coursework	Total
01 Internetwork hardware and software components	2.0	8	6	2	2	2	20
02 LAN technology Ethernet standards	2.0	8	6	2	2	2	20
03 WAN functions and protocol technologies	2.0	8	6	2	2	2	20
04 Frame Relay network terminology	2.0	8	6	2	2	2	20
05 Voice over technology solutions	2.0	8	6	2	2	2	20
06 Integrated Services Digital Network (ISDN) concepts	2.0	8	6	2	2	2	20
07 Asynchronous Transfer Mode (ATM) technology	2.0	8	6	2	2	2	20
08 Transporting non-routable protocols	2.0	8	6	2	2	2	20
09 Network Time Protocol (NTP) implementation	2.0	8	6	2	2	2	20
10 Cisco Catalyst Intelligent Ethernet Switches	2.0	8	6	2	2	2	20
11 Policy based routing	2.0	8	6	2	2	2	20
12 Multicast network design	2.0	8	6	2	2	2	20
13 Quality of Service (QoS) technology and implementation	2.0	8	6	2	2	2	20
14 Reservation Setup Protocol (RSVP)	2.0	8	6	2	2	2	20
15 Congestion management	2.0	8	6	2	2	2	20
16 BGP configuration	<u>2.0</u>	<u>8</u>	<u>6</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>20</u>
	32.0	128					320

Telephone Signalling System Technologies Learning Hours Information Sheet

Unit Titles	Credits	Notional Learning Hours					
		Guided / Contact Learning	Independent Learning	Research Activities / Group Work	Assessment (self/class)	Coursework	Total
01 Telephony signalling protocols	2.0	8	6	2	2	2	20
02 Public Switched Technology Network (PSTN)	2.0	8	6	2	2	2	20
03 Out-of-band signalling	2.0	8	6	2	2	2	20
04 Signalling network architecture	2.0	8	6	2	2	2	20
05 SS7 Link types	2.0	8	6	2	2	2	20
06 SS7 framework architecture	2.0	8	6	2	2	2	20
07 SS7 standards	2.0	8	6	2	2	2	20
08 SS7 protocol stack	2.0	8	6	2	2	2	20
09 Basic call setup	2.0	8	6	2	2	2	20
10 Intelligent network systems	2.0	8	6	2	2	2	20
11 Next Generation Networks (NGN)	2.0	8	6	2	2	2	20
	22.0	88					220

Fibre Optic Technology Learning Hours Information Sheet

Unit Titles	Credits	Notional Learning Hours					
		Guided / Contact Learning	Independent Learning	Research Activities / Group Work	Assessment (self/class)	Coursework	Total
01 Optical fiber technologies	2.0	8	6	2	2	2	20
02 Fiber performance specification	2.0	8	6	2	2	2	20
03 Why fiber is used by many telecommunications companies	2.0	8	6	2	2	2	20
04 Fiber connector structure	2.0	8	6	2	2	2	20
05 Splicing	2.0	8	6	2	2	2	20
06 Fiber Optic Test Procedures	2.0	8	6	2	2	2	20
07 Optical Network Design Implementation	2.0	8	6	2	2	2	20
08 Optic fiber standards	2.0	8	6	2	2	2	20
09 Shielded and unshielded twisted cables	2.0	8	6	2	2	2	20
10 Fiber deployment	2.0	8	6	2	2	2	20
11 Wireless design	2.0	8	6	2	2	2	20
	22.0	88					220