PURPOSE
An introduction to the knowledge of networking for the small office, home office (SOHO) market and the ability to work in small businesses or organizations with networks that have fewer than 100 nodes.

LEARNING TIME

<table>
<thead>
<tr>
<th>Contact hours</th>
<th>Self-directed</th>
<th>Total Hours</th>
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<tbody>
<tr>
<td>75</td>
<td>75</td>
<td>150</td>
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OWNING PROGRAMME
MN4458 – MIT Diploma in Electronic & Computer Engineering

PREREQUISITE
Nil

CO-REQUISITE
Nil

CONTENT
♦ Network terminology and Network protocols
♦ Local-area networks (LANs), Wide-area networks (WANs)
♦ Open System Interconnection (OSI) model
♦ Cabling and tools
♦ Routers and Router programming
♦ Ethernet
♦ Internet Protocol (IP) addressing
♦ Network standards
♦ In addition, the course provides instruction and training in the proper care, maintenance, and use of networking software, tools, and equipment.

LEARNING OUTCOMES

On the successful completion the student should be able to:

1. **Apply basic techniques required to network a PC.**
   1.1 A PC is connected to the Internet via a Local Area Network.
   Range: PC basics, NIC card, modem, high speed vs dialup internet connection, TCP/IP configuration, ping connectivity, web browser, troubleshooting connections
   1.2 Networking maths is applied.
   Range: binary presentation of data, bits and bytes, base10 vs base2 number systems, hexadecimal, conversion between binary, hex and decimal systems, four octet dotted decimal representation of 32 bit binary numbers, boolean logic, IP addresses and network masks

2. **Describe fundamental Networking principles.**
   2.1 Basic networking terminology is explained
   Range: data networks, network devices, topology, protocols, local area networks (LANs), wide area networks (WANs), metropolitan area networks (MANs), storage area networks (SANs), virtual private networks (VPNs), intranets and extranets.
   2.2 The importance of Bandwidth is explained.
   Range: analogies to bandwidth, measurement, limitations, throughput, data transfer calculation, digital vs analog bandwidth.
2.3 The use of Networking Models is described.
   Range: using 'layers' to describe data communications, the OSI layered model, peer to peer communications, TCP/IP model, detailed encapsulation process.

3 Distinguish and use networking media
3.1 Copper media is used
   Range: electrons, voltage, resistance, impedance, current, circuits, cable specification and termination, coaxial cable, STP cable, UTP cable.

3.2 Optical media is used
   Range: spectrum, models of light, reflection, refraction, total internal reflection, single-mode vs multi-mode fibre, other optical components, signals and noise in optical fibres, installation, testing and care of optical fibre.

3.3 Wireless media is used
   Range: Standards, organisations, wireless devices and topologies, how wireless LANs communicate, authentication and association, signals and noise on a WLAN, wireless security.

4 Apply signalling theory to cable testing.
4.1 Basic physics is applied to Frequency-based Cable Testing
   Range: sine waves and square waves, exponents and logarithms, decibels, time and frequency signals, analogue and digital signals in time and frequency, noise in time and frequency, bandwidth.

4.2 The effects of signals and noise on networking media is explained
   Range: signalling over copper and fibre optic cabling, attenuation and insertion loss on copper media, sources of noise on copper media, types of crosstalk, cable testing standards, test parameters, time-based parameters, testing optical fibre.

5 Cable Local and Wide Area Networks.
5.1 LANs are Cabled
   Range: LAN physical layer, Ethernet media and connector requirements, connection media, UTP implementation, repeaters, hubs, wireless, bridges, switches, host connectivity, peer-to-peer, client-server.

5.2 WANs are Cabled
   Range: WAN physical layer, WAN serial connections, connecting routers to: serial, ISDN BRI, DSL and cable connections, console connections.

6 Explain Ethernet Fundamentals
6.1 Ethernet structure and standards are described
   Range: IEEE Ethernet naming rules, Ethernet and the OSI model, naming, layer 2 framing, Ethernet frame structure, Ethernet frame fields.

6.2 Ethernet operation is explained
   Range: MAC rules and collision detection/backoff, Ethernet timing, interframe spacing and backoff, error handling, types of collisions, Ethernet errors, FCS and beyond, Ethernet auto-negotiation, link establishment and full/half duplex.

7 Identify characteristics of Ethernet Technologies
7.1 10 Mbps and 100 Mbps Ethernet are described.
   Range: 10 Mbps Ethernet, 10BASE5, 10BASE2, 10BASE-T, 10 BASE-T wiring and architecture, 100 Mbps Ethernet, 100BASE-TX, 100BASE-FX, fast Ethernet architecture.

7.2 Gigabit and 10 Gigabit Ethernet are described.
   Range: 1000 Mbps Ethernet, 1000BASE-T, 1000BASE-SX, 1000BASE-LX, Gigabit Ethernet architecture, 10-Gigabit Ethernet, 10-Gigabit Ethernet architectures, future of Ethernet.

8 Explain Ethernet switching techniques.
8.1 basic Ethernet switching principles is explained.
   Range: Layer 2 bridging, Layer 2 switching, switch operation, latency, switch modes, spanning-tree protocol.
8.2 Collision domains and broadcast domains are distinguished.
   Range: shared media environments, collision domains, segmentation, layer 2 broadcasts, broadcast domains, intro to data flow, network segments.

8.3 TCP/IP Protocol Suite and IP addressing are described.
   Range: history and future of TCP/IP, application layer, transport layer, internet layer, network access layer, the OSI model vs the TCP/IP model, internet architecture.

9 Describe and apply the TCP/IP model

9.1 IP addressing is explained.
   Range: IP address structure, decimal and binary conversion, IPv4 addressing, class A B C D and E addresses, reserved IP addresses, public and private IP addresses, intro to subnetting, IPv4 vs IPv6.

9.2 How to obtain an IP address is explained.
   Range: obtaining an internet address, static assignment of an IP address, RARP IP address assignment, BOOTP IP address assignment, DHCP IP address assignment, problems in address resolution, address resolution protocol (ARP).

10 Explain routing fundamentals and subnetting.

10.1 Routed Protocol operation is explained
   Range: routable vs routing protocols, IP as a routed protocol, packet propagation and switching with a router, connectionless and connection-oriented delivery, anatomy of an IP packet.

10.2 IP routing protocol operation is explained.
   Range: routing overview, routing vs switching, routed vs routing, path determination, routing tables, routing algorithms and metrics, IGP and EGP, link state vs distance vector, routing protocols.

10.3 The mechanics of subnetting is explained.
   Range: classes of network IP addresses, reason for subnetting, establishing and applying the subnet mask, subnetting class A and B networks, calculating the resident subnetwork through ANDing

11 Describe the TCP/IP Transport and Application Layers.

11.1 Basic operation of the TCP/IP transport layer is explained.
   Range: flow control, session establishment, maintenance, and termination, three-way handshake, windowing, acknowledgement, TCP, UDP, Port numbers.

11.2 The TCP/IP Application layer and some of its protocols are described
   Range: function of the application layer, DNS, FTP and TFTP, HTTP, SMTP, SNMP, Telnet.

12 Demonstrate participation in activities that develop their personal generic capabilities.

12.1 Different forms of communication have been used

12.2 A high standard of ethical behaviour was evident

12.3 Interpersonal skills were practised

12.4 Teamwork was evident through peer to peer interaction

ASSESSMENT CRITERIA

The Generic capabilities are assessed formally through written work and formatively through class activities. Students are expected to behave in a professional manner at all times, to be culturally sensitive in their interactions with other people. All work submitted for marking that was performed in an uncontrolled assessment environment is accompanied with a cover sheet declaring that this is the students own work.

Each Learning Outcome will be assessed by a selection of: :

♦ Laboratory exercises
♦ Cisco on-line tests for each topic module
♦ Cisco on-line final theory exam
Case study group project

A final practical skills examination where application of skills must be demonstrated. The Generic capabilities are assessed formally through written work and formatively through class activities. Students are expected to behave in a professional manner at all times, to be culturally sensitive in their interactions with other people. All work submitted for marking that was performed in an uncontrolled assessment environment is accompanied with a cover sheet declaring that this is the students own work.

EVIDENCE OF ACHIEVEMENT

Case Study pass/fail
Quizzes (on-line multi-choice) 9 / 11 passed
Practical Skills Test pass/fail
Examination (on-line multi-choice) pass/fail

LEARNING AND TEACHING STRATEGIES

Tutorials
Lectures
Case studies
Laboratory exercises
Student presentations

LEARNING AND TEACHING RESOURCES

Required text: Cisco on-line curriculum
Course notes
Exemplars
Blackboard
Computer software
Library databases and the Internet

IPENZ GRADUATE ATTRIBUTES

<table>
<thead>
<tr>
<th>Graduate Attributes</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>Knowledge of Engineering Sciences</td>
<td>1 - 11</td>
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<tr>
<td>Problem Analysis</td>
<td>4</td>
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<tr>
<td>Design/ development of solutions</td>
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<tr>
<td>Investigation</td>
<td>4</td>
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<tr>
<td>Modern Tool Usage</td>
<td>1 - 11</td>
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<tr>
<td>Individual and Team work</td>
<td>12</td>
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<tr>
<td>Communication</td>
<td>12</td>
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<td>The Engineer and Society</td>
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<tr>
<td>Ethics</td>
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<td>Environment and Sustainability</td>
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<tr>
<td>Project Management and Finance</td>
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<td>Life long learning</td>
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