NEW ZEALAND INSTITUTES OF TECHNOLOGY AND POLYTECHNIC QUALIFICATIONS IN INFORMATION & COMMUNICATIONS TECHNOLOGY

PRESCRIPTION: NW500 NETWORKING PRINCIPLES

AIM OF MODULE:	To provide students with an understanding of networking principles and the knowledge and skills required for installing and maintaining basic local area networks.
CREDITS:	14
RESTRICTIONS:	As this module has content that overlaps with the content of DC500 and NM500 students completing this module cannot be awarded a credit for either DC500 or NM500
STUDENT LEARNING HOURS:	140
CONTENT REVISED:	2010
PRESCRIPTION EXPIRY DATE:	November 2013
NOTE:	The content of this module is based on Cisco Networking Academy CCNA - Exploration 1 V4.0 course content and is cognisant of the Plan for Academy Student Success (PASS)

Level and Assessment Schedule

TOPICS	Highest Skill Level R	C	A	P	Suggested Assessment Percentage
1. The OSI 7-Layer Reference Model		*			30
2. Network Communication Principles		*			20
3. Planning and Cabling Networks			*		15
4. Ethernet		*			10
5. Basic router configuration and testing			*		10
6. Case Study				*	15
					100

LEARNING OUTCOMES

The student will:

C	1.	Describe the functions, protocols and details of Layers seven, four, three, two and one of the OSI 7-layer Model
C	2.	Describe the key features of a network and the internet and how information is transferred over networks via the internet
A	3.	Describe the topologies and physical issues associated with cabling LANs and WANs and explain the requirements for cable testing
C	4.	Explain the fundamentals and operation of Ethernet CSMA/CD and describe the various Ethernet technologies
A	5.	Investigate a Cisco routers connections, Internetwork Operating System (IOS) and Command Line interface (CLI)
P	6.	Perform a structured cabling case study and installation project

CONTENT

1. The OSI 7-Layer Reference Model

- A description of the OSI 7-layer Model includes
  - Benefits of a layered Model
  - A comparison of the OSI and TCP/IP models
  - Communication process
  - Protocol Data Units
- A description of the functions and protocols of layer seven includes:
  - The client-server model
  - Application layer protocols
    - Domain Name server DNS services
    - Hypertext transfer protocol (HTTP)
    - Email protocols: Simple Mail Transfer Protocol and POP3
    - File Transfer Protocol (FTP)
      - File sharing and SMB protocol
    - Telnet
  - Peer to Peer Networking and applications
    - Gnutella protocol
- A description of the functions and protocols of layer four includes:
  - Purpose of layer
  - Controlling conversations
    - Multiplex conversations
    - Segmenting
    - Establish session
    - Reliable delivery
    - Flow control
    - Re-ordering segments
  - Transport Control Protocol (TCP)

        - Port addressing and Segmentation
        - TCP server processes
        - TCP reliability
            - TCP windowing and acknowledgements
            - Retransmissions
        - TCP establishment and termination (3 way handshake)
        - TCP congestion control
    - User Data Protocol (UDP)
        - low overhead and reliability trade-off
        - datagram reassembly
        - server and client processes
- A description of the functions and protocols of layer three includes:
    - Layer three Functions
        - Addressing
        - Encapsulation and decapsulation
        - Routing
    - Internet Protocol version 4 (IPv4)
        - Connectionless/ best effort
        - Media independence
        - Packet header
        - Address management and Hierarchical addressing
        - Performance benefits
        - Security
    - How to address a network
        - Address structure and types
        - Binary to decimal conversions
        - Private, public, reserved and special addresses
        - Subnet masking process
        - Planning to address a network
        - Subnetting calculations
    - Testing connectivity with Ping and traceroute
    - ICMP protocol
    - Internet Service Providers (ISPs)
- A description of the functions and protocols of layer two includes:
    - Placing data on a media
    - Media Access Control (MAC) address an protocols
    - Logical vs physical topologies
    - Point to point and Multi access topologies
    - Frame fields
- A description of the functions and protocols of layer one includes:
    - Purpose and operation of the layer
    - Standards bodies
    - Fundamental principles
        - Encoding
        - Signal
        - Data carrying capacity (BW, throughput, goodput)
    - Media types
        - Copper (UTP and others)
        - Fibre
        - Wireless

        - Media connectors

2. Network Communication Principles

- A description of the elements of a network and how information is transferred includes:
    - Identifying components of the network
    - End devices and their role on the network
    - Intermediate devices and their role on the network
    - Types of Networks
        - LANs
        - WANs
        - The internet
    - Describe the architecture and uses of the internet
    - Describe current trends in Networking
    - Data network symbols
    - Familiarising with packet tracer
    - How to Communicate messages
        - Rules to govern communications
        - Network protocols and interaction between them
            - Topology independent protocols
        - Protocol suites and industry standards (IEEE and IETF)

3. Planning and Cabling Networks

- A description of consideration when planning a network includes:
    - Deciding on LAN devices
    - Cost consierations
    - Speed and Types of Ports/Interfaces
    - Expandability
    - Manageability
    - Special Features and Services
    - Four physical areas:
        - Work area
        - Telecommunications room, also known as the distribution facility
        - Backbone (Vertical) cabling
        - Distribution (horizontal) cabling
    - Media considerations
        - Types
        - Cable lengths
        - Ease of installation
        - Making utp cables
    - Deciding on the number of hosts on a network
    - Deciding on the number of networks
        - counting subnets, broadcast management, network requirements)

4. Ethernet

- An explanation of the fundamentals and operation of Ethernet will include:
  - IEEE standards and Layer 2 framing
  - Ethernet frame structure and fields
  - Media Access Control (MAC)
    - Carrier Sense Multiple Access/Collison Detection (CCSMA/CD)
  - Link establishment and full and half duplex
  - Collisions and errors
  - Use of Switches and Hubs
  - Ethernet unicast, multicast and broadcast
  - Ethernet timing
    - Latency, Timing and synchronisation,
    - Bit Time and Slot Time
    - Inter-frame spacing and back-off
    - Jam signal
  - Logical Link Control (LLC)
- A description of the various Ethernet technologies will include:
  - Fast Ethernet 100Base–X
  - Gigabit and 10 Gigabit Ethernet
  - Legacy Ethernet: 10Base5, 10Base2 and 10Base-FX
  - Future Ethernet Options

5. Basic Router Configuration and Testing

- An Investigation of Cisco routers connections will include:
  - Identifying router LAN, WAN and Management ports
  - A description of the router memory components and contents
  - Types of cables connections
  - Console connection and terminal emulation software settings
  - Telnet and Secure Shell (SSH)
- An Investigation of Cisco IOS will include:
  - A description of the router Bootup process
  - IOS Naming system
  - IOS and configuration file backup (using a TFTP Server)
- Configuration of a router using the CLI includes:
  - Modes and command prompts
    - User executive mode
    - Privileged executive mode
    - Global configuration mode
      - Interface, line and routing protocol modes
  - Using the CLI help and command buffer functions
  - Configure basic parameters
    - Hostname
    - Login banner
    - Passwords
  - Verification of configuration using some show commands

6. Case Study

- The structured cabling case study and installation project will require:
  - Materials for a structured cabling case study and installation project, appropriate to New Zealand, to be provided by the tutor. A structured

cabling case study should be completed on paper, followed by a hands-on structured cabling installation project.

- The structured cabling case study and installation project will include:
  - Structured Cabling Systems
  - Structured Cabling Standards and Codes
  - Safety
  - Tools of the Trade
  - Installation Process
  - Finish Phase
  - The Cabling Business

NOTES FOR TUTORS

A typical assessment strategy should include:

- practical skills tests
- laboratory exercises
- group activities
- progressive on-line tests (CISCO Web Portal)
- summative (final) on-line test (CISCO Web Portal)
- kinaesthetic activities

LEARNING RESOURCES

- The following links provide additional structured cabling resources:
  - http://www.ieee.org
  - http://www.tiaonline.org
  - http://www.iso.org
  - http://www.linktionary.com/linktionary.html
  - http://www.siemon.com/standards/
  - http://www.netday.org

- CISCO Networking Academy Programme:
  - Cisco Press: Network Fundamentals, CCNA Exploration Companion Guide
  - Cisco Press: Network Fundamentals, CCNA Exploration Labs and Study Guide
  - Engineering Journal and Workbook Volume 1