



**education**

Department:  
Education  
REPUBLIC OF SOUTH AFRICA

# **NATIONAL CERTIFICATE (VOCATIONAL)**

## **SUBJECT GUIDELINES**

# **DATA COMMUNICATION AND NETWORKING**

## **NQF Level 4**

September 2007



# **DATA COMMUNICATION AND NETWORKING – LEVEL 4**

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## INTRODUCTION

### A. What is Data Communication and Networking

Data Communication and Networking is the scientific and engineering discipline concerned with communication between computer systems. Such networks involve at least two computers, which can be separated by a few centimeters (e.g. via Bluetooth) or thousands of kilometers (e.g. via the Internet). Computer networking is sometimes considered a sub-discipline of telecommunications.

Data Communication and Networking provides students with basic and complex concepts related to computer networking, and designing and installation of local area computer networking.

### B. Why is the subject important in the Information Technology programme?

Data Communications and networking provides the student with an understanding of how computer information networks affect our daily lives.

### C. The link between the Learning Outcomes for Data Communication and Networking and the Critical and Developmental Outcomes

The student will be able to identify and solve problems, collect, analyse, organise, and critically evaluate information that is related to systems development. The student will also be demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

### D. Factors that contribute to achieving the Data Communication and Networking learning outcomes

- Analytical and logical ability
- Keen powers of observation
- Transferring of skills from familiar to unfamiliar situations
- Meticulous attention to detail
- Interest in computers and related topics

## 1 DURATION AND TUITION TIME

This is a one year instructional programme comprising 200 teaching and learning hours. The subject may be offered on a part-time basis provided all of the assessment requirements are adhered to.

Course preparation should consider students with special education needs.

## 2 SUBJECT LEVEL OUTCOME

- Explain the principles of data communications and networking

## 3 ASSESSMENT REQUIREMENTS

### 3.1 Internal assessment (50 percent)

#### 3.1.1 Theoretical Component

The theoretical component will form 30 percent part of internal assessment.

Internal assessment of the theoretical component of Data Communications and Networking Level 4 will take the form of observation, class questions, group work, (informal group competitions with rewards), individual discussions with students, class, topic and semester tests, internal examinations. Daily observation can be made when marking exercises of the previous day and dealing with class questions.

Assignments, case studies and tests can be done at the end of a topic. Tests and internal examinations must form part of internal assessment.

#### 3.1.2 Practical component

The practical component will form 70percent part of internal assessment.

Practical components include applications and exercises. All practical components must be indicated in a Portfolio of Evidence (PoE).

Internal assessment of the practical component of Data Communication and Networking Level 4 will take the form of assignments, practical exercises, case studies, practical examination in a simulated business environment.

Students may complete practical exercises on a daily basis. Assignments and case studies can be done at the end of a topic. The practical examination can form part of internal assessment.

- **Some examples of practical assessments include, but are not limited to:**
  - Presentations (lectures, demonstrations, group discussions and activities, practical work, observation, role play, self activity, judging and evaluation)
  - Use of aids
  - Exhibitions
  - Visits
  - Guest speaker presentations
  - Research
  - Task performance in a simulated/structured environment

- **Definition of the term “Structured environment”**

“Structured environment” for the purposes of assessment refers to an actual or simulated workplace, or workshop environment. It is advised that a practicum room is available on each campus for practical assessment.

- **Evidence in practical assessments**

All evidence pertaining to evaluation of practical work must be reflected in the student's PoE. The assessment instruments used for the purpose of conducting such assessments must be part of the evidence contained in the PoE.

### 3.1.3 Processing of internal assessment mark for the year

A year mark out of 100 is calculated by adding the marks of the theoretical component and the practical component of the internal continuous assessment.

### 3.1.4 Moderation of internal assessment mark

Internal assessment is subjected to both internal and external moderation procedures as contained in the *National Examinations Policy for FET College Programmes*.

## 3.2 External assessment (50 percent)

A national examination is conducted annually in October or November by means of a paper set externally and marked and moderated internally.

Details in respect of external assessment are contained in the *Assessment Guidelines: Data Communications and Networking (Level 4)*.

## 4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
1. Principles of computer networks	10%
2. Synchronous / asynchronous communication of computers	10%
3. Computer network architectures and standards	10%
4. Computer network communication	10%
5. Computer cabling	10%
6. Install a local area network (LAN)	10%
7. Install networked computer application software	10%
8. Principles of supporting LAN users	10%
9. Support a local area computer network	10%
10. Compare WAN with LAN	10%
<b>TOTAL</b>	<b>100</b>

## 5 CALCULATION OF FINAL MARK

Continuous assessment: Student's mark/100 x 50/1 = a mark out of 50 (a)

Theoretical examination mark: Student's mark/100 x 50/1 = a mark out of 50 (b)

**Final mark: (a) + (b) = a mark out of 100**

All marks are systematically processed and accurately recorded to be available as hard copy evidence for, amongst others, purposes of moderation and verification, as well as for purposes of reporting.

## 6 PASS REQUIREMENTS

The student must obtain at least fifty (50) percent in ICASS and fifty percent (50) in the examination.

## 7 SUBJECT AND LEARNING OUTCOMES

On completion of Data Communication and Networking Level 4 the student should have covered the following topics:

- Topic 1: Principles of computer networks
- Topic 2: Synchronous / asynchronous communication of computers
- Topic 3: Computer network architectures and standards
- Topic 4: Computer network communication
- Topic 5: Compute cabling
- Topic 6: Install a local area network (LAN)
- Topic 7: Install networked computer application software
- Topic 8: Principles of supporting local area network users
- Topic 9: Support a local area computer network
- Topic 10: Compare WAN with LAN

### 7.1 Topic 1: Principles of computer networks

**7.1.1 Subject Outcome 1:** Describe data communication.

#### Learning Outcomes

The student should be able to:

- Explain the roles of key elements in data communication.
- Explain the difference between local area and wide area networks.

**7.1.2 Subject Outcome 2:** Demonstrate knowledge of main features of Local Area Networks (LAN).

#### Learning Outcomes

The student should be able to:

- Identify the uses of LANs with respect to current practice.
- Identify the main types of LAN media.
- Describe the main LAN configurations.
- Describe LAN bandwidth.
- Describe LAN protocols.

**7.1.3 Subject Outcome 3:** Demonstrate knowledge of main features of Wide Area Networks (WAN).

#### Learning Outcomes

The student should be able to:

- Explain the uses of WANs with respect of current practice.
- Explain the uses, hardware requirements and advantages of WANs.

### 7.2 Topic 2: Synchronous/ asynchronous communication of computers

**7.2.1 Subject Outcome 1:** Describe past, present and emerging developments in data communication.

#### Learning Outcomes

The student should be able to:

- Explain the origin of current data communication.
- Describe taxonomy of current systems.
- Identify trends from emerging developments in data communications

**7.2.2 Subject Outcome 2:** Describe synchronous and asynchronous data communication.

#### Learning Outcomes

The student should be able to:

- Outline the characteristics of each form of data communication.
- Explain the features of data communications equipment with respect to synchronous and asynchronous data communication.

**7.2.3 Subject Outcome 3:** Describe communication with computers using telephone networks.

**Learning Outcomes**

The student should be able to:

- Distinguish types of telephone network services and outline their features and costs.
- Outline the functions of telephone network components.
- Explain the types of problems encountered in digital transmission.
- Describe the options available as distance increases.

**7.2.4 Subject Outcome 4:** Describe synchronous and asynchronous communication with computers.

**Learning Outcomes**

The student should be able to:

- Describe the interface of the physical layer for synchronous and asynchronous communication.
- Describe the application and operation of protocols.
- Describe the delays incurred in transmissions.
- Describe the operation of link control protocols.

**7.3 Topic 3: Computer network architectures and standards**

**7.3.1 Subject Outcome 1:** Describe computer network types and standards.

**Learning Outcomes**

The student should be able to:

- Distinguish types of networks.
- Compare network topologies.
- Describe and distinguish features of node addressing methods.
- Describe the standards for industry network architectures.

**7.3.2 Subject Outcome 2:** Explain local and wide area network architectures.

**Learning Outcomes**

The student should be able to:

- Describe channel utilisation techniques and their features.
- Compare the principles of access protocols.
- Identify the purpose of LAN components.
- Describe network configurations and installation issues.

**7.3.3 Subject Outcome 3:** Explain WAN architectures.

**Learning Outcomes**

The student should be able to:

- Identify switching techniques.
- Compare switching techniques.
- Describe WAN management issues.

**7.4 Topic 4: Computer network communication**

**7.4.1 Subject Outcome 1:** Explain computer network transmission security and integrity problems and solutions.

**Learning Outcomes**

The student should be able to:

- Describe current problems.
- Identify the requirements to address the problems.
- Explain the strategies to address the problems and provide examples used in the industry.



**7.4.2 Subject Outcome 2:** Describe public switching computer network protocols.

**Learning Outcomes**

The student should be able to:

- Describe the features of typical data link protocols.
- Describe the features of a data link protocol.
- Describe the features of a network layer protocol.

**7.4.3 Subject Outcome 3:** Monitor a computer network.

**Learning Outcomes**

The student should be able to:

- Describe monitoring of computer network using computer network monitoring tools.
- Describe activities by means of a report.
- Identify common network problems.

**7.5 Topic 5: Computer cabling**

**7.5.1 Subject Outcome 1:** Describe past, present and emerging developments in computer cabling.

**Learning Outcomes**

The student should be able to:

- Explain the origin of current computer cabling systems with an outline of past developments.
- Describe the taxonomy of current cabling systems.
- Identify and project trends from emerging developments in computer cabling.

**7.5.2 Subject Outcome 2:** Describe termination methods for computer cabling.

**Learning Outcomes**

The student should be able to:

- Describe the characteristics of each method.
- Explain the features of each method with respect to synchronous and asynchronous data communication.

**7.6 Topic 6: Install a Local Area Network**

**7.6.1 Subject Outcome 1:** Review the design and installation plan of a local area computer network.

**Learning Outcomes**

The student should be able to:

- Identify and explain the feasibility of the network design and installation plan.
- Explain the procedures to ensure that the final outcome meets user requirements.

**7.6.2 Subject Outcome 2:** Install local area computer network devices.

**Learning Outcomes**

The student should be able to:

- Explain how to ensure that the device completes the manufacturer's diagnostic tests free of errors.
- Explain how to ensure that the devices are located and interconnected according to the manufacturer's specifications and network design.
- Explain how to ensure that the devices are configured and customised according to the network design and the manufacturer's specifications.

### **7.6.3 Subject Outcome 3:** Install local area computer network system and application software.

#### **Learning Outcomes**

The student should be able to:

- Explain how to ensure that the manufacturer's guidelines are followed.
- Explain how to ensure that the software operates according to manufacturer's specification.
- Explain how to ensure that the software is configured and customised according to network designs.
- Explain how to ensure that the software performs according to the network design.

### **7.6.4 Subject Outcome 4:** Test the installation of a local area computer network.

#### **Learning Outcomes**

The student should be able to:

- Explain how testing will ensure that the network operates according to manufacturer's and installation specifications.
- Explain how testing procedures meet the manufacturer's guidelines.
- Explain how to record testing results according to the installation specifications.

### **7.6.5 Subject Outcome 5:** Gain user acceptance for the installation of a local area computer network.

#### **Learning Outcomes**

The student should be able to:

- Explain how the manufacturer's supplied operating procedures will allow the user to begin operating the network.
- Explain how training and support options allow the user to obtain training and support.
- Explain how the installation and installation specifications allows the user to check that the installation has been completed.

## **7.7 Topic 7: Install networked computer application software**

### **7.7.1 Subject Outcome 1:** Plan the installation of networked computer application software.

#### **Learning Outcomes**

The student should be able to:

- Identify and explain the feasibility of the network application specification.
- Specify milestones and estimate the time and resources required for the installation.
- Explain how to ensure that the installation is scheduled to minimise disruption to the users.
- Explain how to ensure that a risk analysis identifies the tasks which are vulnerable to standard risks.
- Identify measures to be taken to minimise risk, and the contingency measures to be adopted in the event of a risk manifesting itself.
- Explain how a review procedure will be adopted to ensure that the final outcome meets the user requirements.

### **7.7.2 Subject Outcome 2:** Install networked computer application software.

#### **Learning Outcomes**

The student should be able to:

- Explain how to ensure that the software operates according to the publisher's specifications.
- Explain how to ensure that the software is configured and customised according to the installation specification.
- Explain how to ensure that the software operates according to installation specifications.
- Explain how to ensure that the pre-installation environment is restored in the event of an unsuccessful installation.

**7.7.3 Subject Outcome 3:** Test the installation of networked computer application software.

**Learning Outcomes**

The student should be able to:

- Explain how testing will ensure that the network operates according to manufacturer's and installation specifications.
- Explain how testing procedures meet the manufacturer's guidelines.
- Explain how to record testing results according to the installation specifications.

**7.7.4 Subject Outcome 4:** Accomplish user acceptance for the installation of networked computer application software.

**Learning Outcomes**

The student should be able to:

- Explain how the manufacturer's supplied operating procedures will allow the user to begin the network application.
- Explain how training and support options allow the user to obtain training and support.
- Explain how the installation and installation specifications allows the user to check that the installation has been completed.
- Explain how to ensure that documentation is completed according to the publisher's and organisation requirements.

**7.8 Topic 8: Principles of support local area network users**

**7.8.1 Subject Outcome 1:** Demonstrate the use of LAN.

**Learning Outcomes**

The student should be able to:

- Demonstrate how user utilities are operated to perform user tasks according to the manufacturer's specifications.
- Describe the structure of the network access security system.
- Explain and demonstrate how print queues are managed according to manufacturer's specifications

**7.8.2 Subject Outcome 2:** Install a single user computer application software package.

**Learning Outcomes**

The student should be able to:

- Explain how to perform installation according to manufacturer's specifications.
- Explain how to configure installations according to specifications.
- Explain how to prepare documentation according to industry recommended practice.
- Explain how to ensure that the installation site is left clean and tidy according to industry recommended practice.

**7.8.3 Subject Outcome 3:** Customise a local area network user interface.

**Learning Outcomes**

The student should be able to:

- Explain how to prepare a log in script.
- Explain how to create a menu according to organisation's specifications.
- Explain how to ensure that documentation is completed according to industry recommended practice.

#### **7.8.4 Subject Outcome 4:** Connect a LAN workstation.

##### **Learning Outcomes**

The student should be able to:

- Explain how to ensure that the workstation is linked to a LAN according to manufacturer's specifications.
- Explain how to ensure that connection automates log in procedures in accordance with the manufacturer's specifications.
- Explain how to ensure that the connection resolves procedural problems encountered by users accessing the network.
- Explain how to ensure that the connection completes documentation according to industry recommended practice.

#### **7.9 Topic 9: Support a local area computer network**

##### **7.9.1 Subject Outcome 1:** Maintain the performance of a local area computer network.

##### **Learning Outcomes**

The student should be able to:

- Explain how monitoring and tuning of the network ensures operation and performance meets the manufacturer and organisation specifications.
- Explain how network performance problems are resolved according to organisation specifications.
- Explain how to ensure that accurate and up-to-date documentation is maintained of network resource utilisation.

##### **7.9.2 Subject Outcome 2:** Execute procedures on a local area computer network.

##### **Learning Outcomes**

The student should be able to:

- Explain how to ensure that computer output is produced according to specifications.
- Identify procedure messages during execution, and the actions taken according to organisation specifications.
- Identify problems with procedures, and action taken according to organisation specifications.
- Identify potential improvements to procedures, and action taken according to organisation specifications.
- Explain how to start-up and shutdown the network in accordance with the manufacturer's and organisation specifications.

##### **7.9.3 Subject Outcome 3:** Administer security systems for a local area network.

##### **Learning Outcomes**

The student should be able to:

- Identify security exposures and violations and action taken according to organisation policies, procedures and requirements.
- Explain how to make back-ups according to the organisation policies, procedures and specifications.
- Explain how to provide access to the network according to organisation policies, procedures and specifications.

##### **7.9.4 Subject Outcome 4:** Maintain the supply of consumables for a LAN.

##### **Learning Outcomes**

The student should be able to:

- Explain how to forecast the rate of use of computer system consumables, using measurement of historical rates of use, and anticipated events.
- Explain how to establish and maintain supply agreements so that the consumable supplies are available to meet demand.
- Explain how forecasted demand meets stocks of consumable supplies.
- Explain how to avoid overstock of consumable supplies.

### **7.9.5 Subject Outcome 5: Plan capacity for a LAN.**

#### **Learning Outcomes**

The student should be able to:

- Explain how to include a forecast based documentation of current network utilisation, historical growth and future plans.
- Explain how to include recommendations for network changes that allow the network to meet the future capacity requirements.
- Explain and identify the feasibility of the recommendations.
- Compare actual resource usage with forecast usage according to organisation requirements.

### **7.9.6 Subject Outcome 6: Maintain the availability of a LAN.**

#### **Learning Outcomes**

The student should be able to:

- Explain how to ensure the availability and accessibility of the network according to organisation requirements.
- Explain how to resolve network availability problems according to organisation requirements.

### **7.9.7 Subject Outcome 7: Manage changes to a LAN.**

#### **Learning Outcomes**

The student should be able to:

- Explain how to ensure that the management plan of a proposed change predicts the impact and risks to the organisation associated with the change.
- Explain how the management plan ensures that the proposed change establishes when the change should occur to minimise the impacts and risks.
- Explain how the contingency plan will allow the network to be restored to a status acceptable to the user in the event of the problems with the change.
- Explain how testing will establish the success of installation and of the changes according to user and organisation requirements.
- Explain how to notify people affected by the change to minimise disruption to their activity.

## **7.10 Topic 10: Compare WAN with LAN**

### **7.10.1 Subject Outcome 1: Explain wide area computer networks.**

#### **Learning Outcomes**

The student should be able to:

- Identify the components of a WAN and outline their purpose.
- Identify the purpose of a WAN.
- Identify and compare WAN configurations.
- Identify and compare WAN protocols.
- Identify and compare WAN transport media.

### **7.10.2 Subject Outcome 2: Evaluate a wide area computer network.**

#### **Learning Outcomes**

The student should be able to:

- Identify the method of implementation of a WAN.
- Distinguish categories of the network components, the functions and examples.
- Identify and explain the features and constraints of the network from a functional perspective.
- Propose and compare alternative network designs

### **7.10.3 Subject Outcome 3:** Explain network administration.

#### **Learning Outcomes**

The student should be able to:

- Identify the tasks involved in network administration and outline their requirements.
- Explain how response times are affected for a range of factors.
- Outline the principles of network interconnections.
- Outline and explain network security administration procedures.
- Describe how to complete network administration documentation.

## **8 RESOURCE NEEDS FOR THE TEACHING OF DATA COMMUNICATION AND NETWORKING – LEVEL 4**

### **8.1 Physical resources**

The following teaching aids should be made available, if possible

- Lecture room
- Computer (ntNetworking) laboratory
- 3 students per networked computer
- 1 server for every 4 networked computers
- 1 laser-networked printer per server
- Hub
- Switches
- Network cables
- Network connectors
- RJ45 connectors
- Network box
- Routers
- Cutters
- Crimpers
- External HDD / mini HDD / tape driver / flash disks / DVD / CD / teacher's backup server

### **8.2 Human resources**

- The facilitator must have a technical support related qualification specialising in hardware and software Level 5.
- It will be an advantage if the facilitator has declared competence as assessor and/or moderator.
- Training in Outcomes Based Education.

### **8.3 Other resources**

- File per learner for PoE
- Technicians toolkit
- Job card booklet