



Strathmore
UNIVERSITY

STRATHMORE UNIVERSITY
FACULTY OF INFORMATION TECHNOLOGY
BACHELOR OF SCIENCE IN COMPUTER NETWORKS AND CYBERSECURITY
END OF SEMESTER EXAMINATION
CNS 2106 – NETWORK PROGRAMMING

DATE: 19th December, 2023

Time: 10.30 - 12.30

Instructions

1. This examination consists of **FIVE** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

QUESTION ONE

- a. Name three ways to support SSH authentication and explain how they work. **[3 Marks]**
- b. Give the name of a Linux server software application that can be used to offer the following networking services, and give the full path of the directory where its configuration files are stored. HTTP Web service, DNS, DHCP **[6 Marks]**
- c. Explain the difference between the following access control configuration settings in the */etc/ssh/sshd_config* file: *AllowUsers jones* and *AllowUsers jones@10.10.1.1* **[2 Marks]**
- d. Give the names of two Linux text processing tools that can be used to extract the word **John** from the following sentence: *My name is John Doe from Nairobi.* **[2 Marks]**
- e. Give the full file path and name of the Linux configuration file used for the following:
 - i. Storing the computer name **[1 Mark]**
 - ii. Static IP addresses and other IP configuration settings **[1 Mark]**
- f. If an attacker has been attempting a brute force attack on an SSH server, in which file would you look for logs of the attempts? **[2 Mark]**
- g. Using the Cron syntax *Min (0-59) Hour (0-23) Dom (1-31) Mon (1-12) Dow (0-6)*, where **Monday is day 0**, create a Cron job that will shut down a Linux server at 11.59 PM on Sunday. **[3 Marks]**

- h. Using octal codes write the command to set the permissions of a file named MyFile.txt so that Owner can read and write, Group can read, and Others have no access permissions. [2 Marks]
 - i. Write a BASH command or set of commands that use *tail* and *head* to display the fifth line on a text file Mytext.txt that has fifteen lines of text. [2 Marks]
 - j. Write a BASH command that will count the number of words in the file in (i) [2 Marks]
 - k. Nagios is a software application used for monitoring and generating alerts about events in network systems and devices. Describe the components of Nagios architecture. [4 Marks]
- (Total: 30 Marks)**

QUESTION TWO

- a. Create the design of a network with a master server and a slave. The master server stores email inboxes for all system users. Using Cron, rsync and BASH do the following:
 - i. Describe the full process of migrating system users from the master server to the slave. [5 Marks]
 - ii. Define a backup schedule that will incrementally save user emails on the slave server every 15 minutes. [2 Marks]
 - b. To support the design in (2a), describe the process of configuring SSH public key authentication to enable root user on the master server access slave server and transfer files. Your answer should state all affected files on each server. [5 Marks]
 - c. Explain the setting and respective system file that should be made to prevent system users (except root and administrator) on master server in (2a) from accessing a running BASH commands on the terminal. [3 Marks]
- (Total: 15 Marks)**

QUESTION THREE

- a. Write a Linux command that will assign an **extra (alias)** IP address (10.20.113.45/24) to the network card eth0 [2 Marks]
- b. Linux iptables uses four tables
 - i. Give names of chains and function of each chain in the *filter* table. [3 Mark]
 - ii. Give names and function of each chain in the *nat* table. [3 Marks]
- c. Give names of two fields in an IP packet or TCP segment that can be matched by iptables rules. [2 Marks]

- d. Explain how a network engineer can use *iptables* to spoof the IP address of another computer in order to pass IP address based access control rules of a remote server and be able to establish an SSH session.

[5 Marks]

(Total: 15 Marks)

QUESTION FOUR

- a. Using an *sed* BASH tool, write the Linux command that will replace every occurrence of the word *my* with *your* in a text file named Myfile.txt and explain the command's syntax

[4 Marks]

- b. Given the following string "*Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday*", write a BASH script to loop through and print each word. When printing *Friday*, the script should also print, "*The weekend is about start*".

[8 Marks]

- c. Show an example of a WHILE loop in BASH

[3 Marks]

(Total: 15 Marks)

QUESTION FIVE

Using a diagram, explain how you would design a small Internet Service Provider (ISP) network that will achieve the following.

- i. Utilise one public IP address to provide Internet access to 20 users
- ii. Measure internet usage per user
- iii. Block internet access for users who reach a 10 Gb data allowance in a month
- iv. Send an email at 00H30 everyday notifying each user of their day's data bandwidth usage and Internet quota balance
- v. Send an SMS to alert the ISP's network engineer whenever there is a problem with the network e.g. failure of the uplink or key services required by the users

Draw a diagram of the ISP network that shows the full architecture, and use the architecture to explain how you will meet the requirements above. Note: number your answers accordingly.

[15 Marks]

(Total: 15 Marks)