Strathmore
UNIVERSITY

SCHOOL OF COMPUTING AND ENGINEERING SCIENCES
BACHELOR OF SCIENCE IN COMPUTER NETWORKS AND CYBER SECURITY
CNS 2203: DATA NETWORK DESIGN AND MANAGEMENT II
END OF SEMESTER EXAMINATION
DATE: 14th December 2023 **Time:15:30-17:30 hrs.**

Instructions

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

Examine the topology in **Figure Q.p1** below. You will use it to answer several questions in this exam.

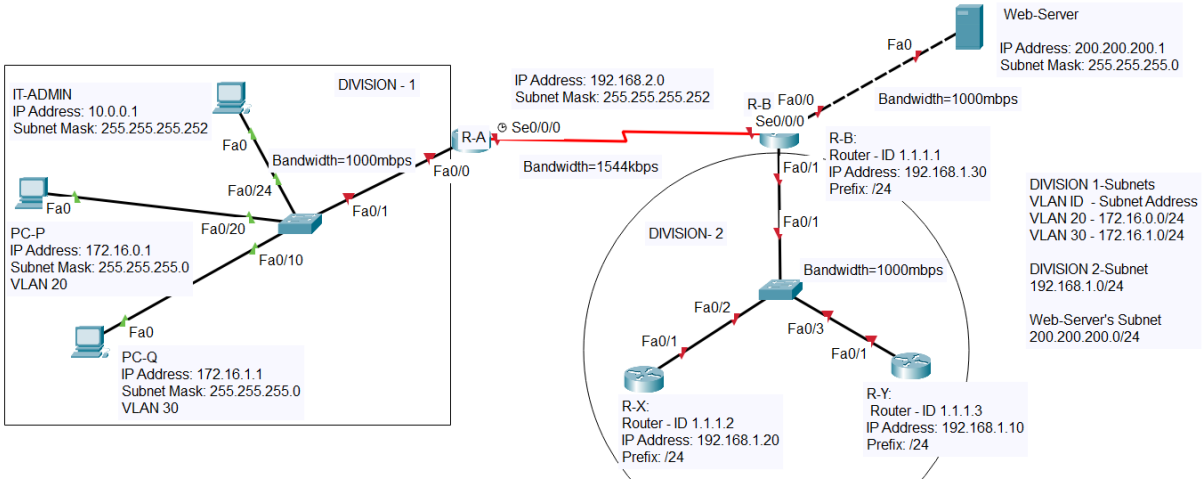

Figure Q.p1

Question One [30 marks]

a) The default Open Shortest Path First Protocol (OSPF) network type is set based on the media used for the connection and can be changed independently of the actual media type used.

i. Identify and briefly describe the TWO OSPF network types represented in **Figure Q.p1.** As part of your answer point out where these network types exist on the topology above**. [3 marks]**

ii. In one of the OSPF network types, DR-BDR elections are necessary to control flooding of link state packets (LSPs). Briefly describe the DR-BDR election process**. [3 marks]**

iii. Examine Division-2 in **Figure Q.p1.** What routers will be chosen as the Designated Router (DR), Backup Designated Router (BDR), and DROther? **[1 ½ marks].** Justify your answer **[1 ½ marks].** *You may state assumptions made if any.*

b) Refer to **Figure Q.p1**. Write the sequence of commands that you would use to enable OSPF on the routers in Division-2. *Assume that all interface addresses have been configured with IP addresses, masks and no shut down*.
***Hint**: You will place your commands starting with the prompts below (include the prompts in your answer).*

```
R-B (config) #
R-B (config-router) #

R-X (config) #
R-X (config-router) #

R-Y (config) #
R-Y (config-router) #
```

[6 marks]

c) OSPF supports hierarchical routing and hence can be implemented in two ways: single area OSPF and multi-area OSPF. Explain THREE benefits of implementing multi-area OSPF. **[3 marks]**

d) Routing metrics play an important role in the routing process.
   i. Calculate the OSPF metric to move data from a device in Division-1 to the Web-server. Assume a reference bandwidth of 10^9bps. *Show your working* **[2 marks]**
   ii. Calculate the Router information Protocol (RIP) metric to move data from a device in Division-1 to the Web-server. *Show your working.* **[1 mark]**
   iii. Comment on the answers in i. and ii. above. **[1 mark]**

e) OSPFv2 supports both plain text and cryptographic authentication (MD-5 and HMAC-SHA) but it is not enabled by default. Giving TWO reasons explain why the network administrator of the network in **Figure Q.p1** should consider configuring cryptographic authentication**. [2 marks]**

f) Cloud computing and virtualization have become an important consideration in many networks today. The terms "cloud computing" and "virtualization" are often used interchangeably; however, they mean different things.
   i. Explain the difference between the two terms. **[2 marks]**
   ii. Explain any FOUR benefits of network virtualization **[4 marks]**

Question Two [15 marks]

a) At the heart of all routing protocols are THREE main components: a routing algorithm, data structures and protocols messages. Briefly describe these components and give an example of each. **[3 marks]**

b) A good network implementation should ensure that there are no routing loops.
   i. What are routing loops? Explain. *Include a well labelled diagram to help you illustrate your answer.* **[2 marks]**
   ii. Explain TWO causes of routing loops. **[2 marks]**
   iii. What is the impact of routing loops networks? Explain. **[2 marks].**

c) The router information protocol (RIP) was one of the earliest protocols to be implemented over the internet.

i. Highlight any TWO situations in which it would be ideal to configure RIPv2 on any given network topology. **[2 marks]**

ii. Explain any FOUR differences between RIPv2 and OSPFv2. **[4 marks]**

Question Three [15 marks]

Network Address Translation (NAT) is an important network layer IP service that can be implemented in different ways.

a) What was the motivation behind the creation of NAT? Explain. **[1 mark]**

b) Identify and describe any THREE forms of NAT implementation. *You answer should include, a mention of the type of NAT, a brief description and one scenario where the identified NAT can be applied.* **[9 marks]**

c) Explain any THREE drawbacks of NAT **[3 marks]**

d) Consider the topology in **Figure Q.p1.** Assume R-B is our NAT server. Write the sequence of commands that you can use to define the local interface (i.e., inside facing) and the global interface (i.e., outside facing). Assume that all the other NAT mapping parameters have been already configured (defined).

Hint: *your sequence of commands will start from here and you will need 4 commands in total. Include the router prompts in your answer.*

```
R-B (config)#
R-B (config-if) #
```
[2 marks]

Question Four [15 marks]

Access controls are important for any networks' security. Access Control Lists (ACLs) are a tool used to provide a mechanism to filter packets getting in or out of a network.

a) Classify ACLs into TWO broad categories and briefly describe each category. **[4 marks]**

b) Using a well labelled flow chart diagram explain how ACLs work. **[5 marks]**

c) Refer to the topology in **Figure Q.p1**

i. Write an ACL for Division-1 that will do the following**:**

— Allow all devices in VLAN 20 access to web services on the web-server but deter all other devices in Division-1

— Deter all devices in VLAN 20 access to the LAN on Division-2 but allow devices in VLAN 30 access to devices on Division-2

Assume that all router interfaces and routing is configured and the entire network topology is operational.

Hint: *You will start your commands at the prompt:* `R-A(config)#`

Include the above router prompt in your answer. **[4 marks]**

ii. Write the sequence of commands that you would use to assign the ACL to the appropriate router interface for execution. Ensure that your ACL commands do not interfere with the inter-vlan routing in Division-1

Hint: *Here are the router prompts that you will need:*

```
R-A (config)#
R-A (config-if) #
```
[2 marks]

Question Five [15 marks]

a) Assume that you are the network administrator at Strathmore University. Some students studying from the Student Centre have been complaining about the loss of network connection for the past three hours. All users on the wireless LAN in student centre cannot access the internet and other network resources. Their wireless devices reconnect to the wireless LAN when they move away from the Student Centre to work from other spaces such as the library and STM Building. Staff on the wired LAN in the offices at the Student Centre do not have this challenge. Only those trying to use WiFi from the offices are affected.

You have been tasked to troubleshoot the network and fix the problem.

i. What is troubleshooting? **[1 mark]**
ii. Briefly highlight any FIVE steps that you would follow in trying to solve the problem in the scenario above**.** *You may state assumptions made if any***. [5 marks]**
iii. Identify any THREE troubleshooting tools/commands that you would use and explain how you would use them. **[3 marks]**

b) Network automation enables efficiency in network management Briefly describe the following types of network automation:

i. Script-driven network automation **[1 mark]**
ii. Software-based network automation **[1 mark]**
iii. Intent-based network automation **[1 mark]**

c) Explain any THREE benefits of network automation **[3 marks]**