Strathmore
UNIVERSITY

STRATHMORE UNIVERSITY
SCHOOL OF COMPUTING AND ENGINEERING SCIENCES
BACHELOR OF SCIENCE IN COMPUTER NETWORKS AND CYBER SECURITY
END OF SEMESTER EXAMINATION
CNS 3101 – WAN TECHNOLOGIES

DATE: 26 July, 2023 Time: 2 Hours

Instructions

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

QUESTION ONE

a. With reference to American standards describe the channels found in the design of BRI and PRI ISDN [**4 Marks**]

b. Calculate the effective bit rate of VT2 in STS-1 signal. [**2 Marks**]

c. Explain two differences between Asymmetric Digital Subscriber Line (ADSL) and Very high-bit-rate Digital Subscriber Line (VDSL) [**2 Marks**]

d. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates R1 = 500 Kbps, R2 = 2 Mbps, and R3 = 1 Mbps.
   i. Assuming no other traffic in the network, what is the data-rate for the file transfer? Explain your answer [**2 Marks**].

   ii. Suppose the file is 4 million bytes. How long will it take to transfer the file to Host B? [**2 Marks**].

e. Explain why ATM transport would be preferred over IP transport for SCADA applications. [**2 Marks**]

f. Describe the design of Active Optical Network (AON) and explain key differences with Passive Optical Network (PON) [**3 Marks**]

g. Discuss three considerations an Internet Service Provider (ISP) would use to decide on adopting underground or overhead cabling when setting up a fibre optic network, [**5 Marks**]

h. Using a diagram, describe how Dynamic Bandwidth Allocation (DBA) is achieved in Broadband PON (BPON) technology [**5 Marks**]

i. In the operation of TDM Passive Optical Networks, explain the concept of 'Ranging' [**3 Marks**]

(Total: 30 Marks)

QUESTION TWO

a. Draw and explain a network diagram that shows the components of an ADSL connection from a home to the Internet. [**5 Marks**]

b. In the operation of ADSL, describe how Carrierless Amplitude Phase (CAP) modulation and Discrete Multi-tone (DMT) modulation operate [**5 Marks**]

c. Using a protocol header diagram illustrate differences between User-to-Network Interface (UNI) and Network-to-Network Interface (NNI) of ATM cells [**5 Marks**]

(Total: 15 Marks)

QUESTION THREE

a. State and explain characteristics of Fabry-Petro (FP) laser diodes and also those of Distributed Feedback (DFB) laser diodes. Specify which one is likely to be assigned to the OLT and which to the ONU. [**3 Marks**]

b. List the downstream and upstream data rates for BPON, EPON and GPON [**3 Marks**]

c. Illustrate using a diagram the *Tree with Redundant Trunk* architecture of an Ethernet Passive Optical Network (EPON) [**3 Marks**]

d. List three kinds of information carried by upstream BPON PLOAM cells. [**3 Marks**]

e. Name three types of BPON grants and explain their uses [**3 Marks**]

(Total: 15 Marks)

QUESTION FOUR

a. BPON uses ranging to achieve equidistance between the OLT and all ONUs, using a diagram illustrate how PLOAN cells are used to perform the ranging process.
[**5 Marks**]

b. In Broadband Passive Optical Networks (BPON), with reference to Traffic containers discuss two approaches used in upstream Dynamic Bandwidth Allocation (DBA).
[**5 Marks**]

c. With the aid of a diagram, explain how the MPCP bandwidth assignment mode operates.
[**5 Marks**]
(Total: 15 Marks)

QUESTION FIVE

a. Using a diagram illustrate the structure of a SONET STS-1 frame [**4 Marks**]

b. Calculate the data rate of an STS-1 frame. [**2 Marks**]

c. What are the values of pointer bytes H1 and H2 if an SPE starts at byte 420?
[**2 Marks**]

d. Using a diagram explain the concept of negative justification in SONET [**3 Marks**]

e. A stream of data is being carried by STS-l frames. If the data rate of the stream is 49.540 Mbps, how many STS-l frames per second must let their H3 bytes carry data? Note: Consider existence of transport and path overhead only [**2 Marks**]

f. A stream of data is being carried by STS-l frames. If the data rate of the stream is 49.530 Mbps, how many frames per second should leave one empty byte after the H3 byte? Note: Consider existence of transport and path overhead only [**2 Marks**]
(Total: 15 Marks)