Part B – Essay

[*Answer only* ***Four*** *questions*]

(1) A three inputs (A, B, C) logic circuit functions as follows. The logic output (Z) is determined based on the following logic conditions.

- If input C is logic 1 (one), Z will have the logic value of (A .B)'.
- If input C is logic 0 (zero), Z will have the logic value (A + B)'.

1. Give the truth table to represent the above circuit function. **(4 marks)**
2. Write down a Sum Of Products (SOP) expression by using the truth table given in question 1 above. **(1 mark)**
3. Write down a Product Of Sums (POS) expression by using the truth table given in question 1 above. **(1 mark)**
4. Simplify the Sum Of Products expression given in question 2 above by using Boolean algebra. **(4 marks)**
5. Draw a logic circuit for the simplified Boolean expression in question 4 above by using only NAND gates. **(5 marks)**

(2) Assume that a foreign school has decided to donate 100 computers to Bandaranayake College. School administration decides to deploy them in 5 computer labs together with 107 (including 5 servers) computers already available in the school. According to the existing building facilities, the computers will be deployed into the labs as follows.

[Lab 1 – 100, Lab 2 – 60, Lab 3 – 25, Lab 4 – 10, Lab 5 – 12]

The network administrator of the IT section decided to organize the above 5 labs as 5 subnets using the IP address 192.168.100.0/24.

1. Copy down the following table format into the answer sheet and fill in the necessary details. **(5 marks)**

A	B	C	D	E	F
Lab 1					
Lab 2					
Lab 3					
Lab 4					
Lab 5					

Table headings:

- A – Subnet
- B – Network Address / Net ID
- C – Usable IP address range of the subnet
- D – Broadcast Address
- E - New subnet mask
- F – Maximum number of hosts that can be deployed in the subnet

2. Network admin decides to use network switches to connect the computers without using any network hubs. State the main advantage of using a network switch over the network hub. **(4 marks)**

3. Some of the educational software will be installed into one computer and it will be deployed in Lab 1 to make them accessible for the users of other subnets. What type of a server should be used for the above purpose? **(1 mark)**

4. It is required to deny the users landing on some websites which will be accessed via the proposed Lab 1 Internet connection. Propose a suitable server that will help achieve this purpose. **(1 mark)**

5. School students are encouraged to develop websites and host their websites on a special computer deployed in Lab 1. What type of a server is required to achieve this requirement? **(1 mark)**

6. To set up the above networking environment, state how and where should the public and private IP addresses be used? **(2 marks)**

7. State the protocol that should be used for public – private IP address translation. **(1 mark)**

(3) Assume that there is a byte addressable digital computing device running multiple programs at the same time. The available computer architecture helps using virtual memory concept to achieve this purpose. Virtual memory size is 2^{20} bytes and it uses 512 bytes pages. Also assume that the computer has only 256KB physical memory.

{*Note: Generic answers will not be considered for marking*}

1. How many bits are used for the page address/page number and page offset respectively? **(1 x 2 = 2 marks)**
2. How many bits are required for the physical memory address? **(1 mark)**

- User has started a spreadsheet program (Ps) and a video editing program. (Pv). A few selected fields of the page tables of Ps & Pv are shown in the figures below.

Page table of program Ps

Page Number	Frame Number	Present/Absent bit
0	0	0
1	0	0
2	11	1
3	10	1
4	0	0
5	0	0
6	15	1
7	0	0

Page table of program Pv

Page Number	Frame Number	Present/Absent bit
0	0	0
1	16	1
2	13	1
3	0	0
4	0	0
5	20	1
6	14	1
7	12	1

Notes:

- *Both page number & frame number are indicated as decimal.*
- *The Present/Absent bit indicates the validity of the entry. If this bit is 1, the entry is valid and the page is loaded into the main memory. If it is 0, then the relevant virtual page is not in the main memory.*

3. Calculate the total physical memory size used for both programs at running time, according to the page table information provided. **(2 marks)**
4. CPU wants to access the virtual memory address 1000 (decimal) of program Pv.
   a. Write down the virtual memory address in binary format, generated by CPU. **(1 mark)**
   b. Write down the physical address in binary format, by referring to the page table information above. **(1 mark)**
   c. Write down the frame number which the above page is mapped to. **(2 marks)**
5. CPU wants to access the virtual memory address 800_{10} of program Ps. By referring to the page table details given above, write down the process to be followed by the operating system so that CPU can access the byte of the relevant page. **(2 marks)**
6. Write down one known advantage of using a page table in managing processes. **(2 marks)**
7. Write down two major advantages of using the virtual memory concept in a single processor computer. **(2 marks)**

(4) The following paragraph contains the facts observed while analyzing Gampaha Municipal Council library information system. Read it and draw a Context Diagram by using correct symbols and terminology. Note that only those who live within Gampaha municipal council area are eligible to get the library membership. **(15 marks)**

An applicant who wants to get the library membership has to obtain the relevant application form from the library receptionist after enquiring the membership registration details. He/she has to obtain a proof of residency letter from Grama Niladhari and produce it to the library with the duly completed application form. All the received applications will be placed in a received applications tray. The membership selection committee will get the application details and select the qualified applicants. If the application is selected, it is stored in a selected applications tray. Receptionist will use the information stored in the selected applications tray and a membership registration request letter will be posted to the applicant. Rejected applications will be posted to the applicant by the receptionist together with a letter of rejection.

The applicant has to pay the membership fee at the cashier's counter. After receiving the payment receipt from the cashier, it should be submitted to the registration counter for the membership registration. Upon the registration of the applicant, a membership card will be issued to the newly registered **member** and the membership details will be recorded in the member registration book. A member who makes a loan request to the Book Lending counter has to produce the membership card as well. After verifying the member by referring to the member registration book, the Book Lending Counter will lend the requested book to the member, together with book return details. The membership card will be retained in a membership card tray.

The receptionist regularly checks the overdue loans and sends reminding letters to the relevant members. Upon the return of a borrowed book (book return), overdue charges (if any) will be calculated and a fine payment request will be made to the member. After the fine payment, fine payment receipt will be issued together with the retained membership card if the member is not going to borrow the books again. Fine details will be recorded in a book which will be used later to prepare monthly fine revenue report to be sent to the Accounts Department of the municipal council.

(5)

1. Define the term "Big Data". **(2 marks)**
2. Name and describe two data validation methods you have leant in the syllabus. **(2 marks)**
3. Classify the computers based on technology, purpose and size. **(1x3 = 3 marks)**
4. State the purposes of using OMR, OCR and MICR in the data processing life cycle. **(1x3 =3marks)**
5. Draw and label the "fetch execute cycle" correctly. **(2 marks)**
6. Describe the importance of "stored program concept" used in modern computers. **(1.5 marks)**
7. Describe one major usage of cache memory and main memory used in a personal computer. **(1.5 marks)**