UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

Second Year Examination – Semester I – 2018

SCS2101– Data Structures and Algorithms III

TWO (2) HOURS (For Part A & B)

PART B

To be completed by the candidate

Examination Index No: .....

Important Instructions to candidates:

1. The medium of instruction and questions is **English**.
2. Note that questions appear on both sides of the paper. If a page or a part of the question paper is not printed, please inform the supervisor immediately.
3. Write your index number on each and every page of the question paper.
4. This paper has **04** questions across **Part A** and **Part B in 23 pages**.
5. Students are required to answer both **Part A** and **Part B** in **two hours**.
6. Answer **ALL** questions. There are **02** questions in **Part A (Question Numbers 1-2 & Page Nos 1 to 12)** and **02** questions in **Part B (Question Number 3-4 & Page Nos 13 to 23)** of the paper.
7. **Part A** of the paper contains **50 marks** and **Part B** of the paper will total to **50 marks**.
8. Any electronic device capable of storing and retrieving text including electronic dictionaries and mobile phones are **not allowed**.
9. **Non-Programmable** calculators are **allowed.**

For Examiner's use only

Question No	Marks
3	
4	
Total	

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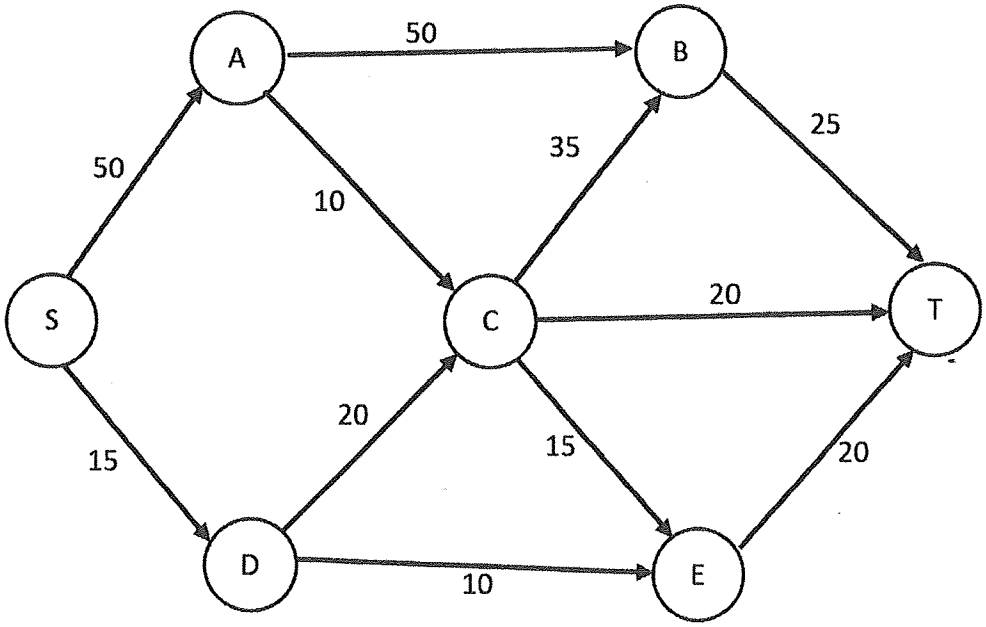
3. (a). Following graph illustrates a flow network. Node S is the source and T is the sink.



Calculate the maximum flow of the network using Ford-Fulkerson method. (Clearly illustrate execution of the algorithm by drawing both the graph and its residual graph at each step)

[15 marks]

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(b). i. Rabin Karp Algorithm uses a hash function to find matches and at each matching point it requires to check whether it is a fake match (hash value is equal but the string is not the same as pattern). Consider the text T and pattern P given below. If Rabin Karp matcher is working with modulo 11, identify and list down each sub-string and index at which all fake matches occur.
$T = 3141592653589793$
$P = 26$

[5 marks]

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ii. Show how to extend the Rabin-Karp method to handle the problem of looking for a given $m \times m$ pattern in an $n \times n$ array of characters. (The pattern may be shifted vertically and horizontally, but it may not be rotated.)

[5 marks]

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4. (a). The government of Pinland has ordered its Treasury to take a loan for development purposes. The loan (*Total lent amount*) should be greater than or equal to 100 $MillionDollars\ (MD)$ and less than or equal to 300 MD. The Treasury has called for bids from a list of trusted financial companies (lenders) given below:

- Ronaldo's Kindness (RK)
- Endless Witcheries (EW)
- Lionel Escapades (LE)

Each bid by lenders contains their interest rate per year and the maximum principal amount which they can afford to lend. (Interest is calculated as Simple Interest and the whole load is to be paid completely by one year).[$SimpleInterest = Interestrate \times PrincipalAmount$]

Due to the corruption of the government of Pinland, these lenders are paying a commission to a corrupted minister. The amount of commission given by a lender is a percentage of the principal amount of money being lent to the government by the lender.
Additionally, the corrupted secretary of the Treasury is also taking a 0.25% from the total lent amount, for himself.

Following table shows bidding details:

Bids and Commission			
Lender Name	Interest rate per year	Maximum amount affordable to company (MD)	Commission for minister
Ronaldo's Kindness (RK)	5%	110	0.5%
Endless Witcheries (EW)	12%	300	3%
Lionel Escapades (LE)	4%	90	1%

The Treasury can take loan from several lenders at the same time and the *total lent amount* is the sum of principal amount taken from each lender.

Example: $50MD$ from RK , $25MD$ from EW, $25MD$ from LE

Total lent amount is $50 + 25 + 25 = 100MD$

Total interest is $50 \times 0.05 + 25 \times 0.12 + 25 \times 0.04 = 6.5MD$

In order to avoid attention, the secretary decides that the *total interest* (the sum of interest paid for each lender per year) should be less than or equal to a 5% of the *total amount lent.*

The secretary is the person who decides the amount of loan taken from each lender. Therefore, he wants to maximize the amount of money received by him and his friendly corrupted minister.

You are the financial assistant of the secretary. You are asked to calculate the amount of credit which is to be taken by each lender to achieve the above maximization. (Although you are a good person, you have no option but to help your boss)

i. Formulate the above problem by **only** considering the information given above. (Clearly specify the meaning of variables you use and state any assumptions you make)

[8 marks]

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ii. Using your knowledge on Linear Programming, convert the formulated problem above into the standard form.

[2 marks]

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(b). Following is a linear programme of variables x_1,x_2,x_3 in a slack form (Z is the objective functions). Solve this linear programme using simplex method and provide the setting of values for x_1,x_2,x_3 which maximizes Z. Show each step clearly.

$Z = 3x_1 + 2x_2 + x_3$

$x_4 = 4 - x_1 + x_2 - x_3$

$x_5 = 6 - 2x_1 - x_2 - 3x_3$

$x_6 = 3 + x_1 - 2x_3$

$x_7 = 8 - x_1 - x_2 - x_3$

$x_1, x_2, x_3, x_4, x_5, x_6, x_7 \geq 0$

[15 marks]

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