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The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: EEX3373**
Academic Year	: 2019/2020
Date	: 02nd October 2020
Time	: 0930-1230hrs
Duration	: **3 hours**

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **four (4)** questions in **three (3)** pages.
3. Answer all **four** questions.
4. Answers for each question should commence from a new page.
6. This is a Closed Book Examination.
7. Answers should be in clear handwriting.
8. Do not use red colour pens.

Answer all four questions. Write your answers clearly. Write all relevant intermediate steps when answering question 2.

1)

a) One dimensional array data structure (1D-array), is a data structure consisting of a collection of elements (values), each identified by its position in sequence.

Consider an examination of a course having three written papers, all compulsory. Assuming that each candidate has either sat all three papers or been absent, a 1D-array of integers is formed to be used as the input for the result processing program. So, the array embodies any possible combination of blocks of integer numbers *(in the following two general forms)*, depending on the numbers of present and absent candidates.

Present:

ind	m_1	m_2	m_3

Absent

ind	*-1*

Where, ***ind*** represents index number of candidate *(ind; 101<=ind<=999)*,
m_i represents marks (%) for a particular paper

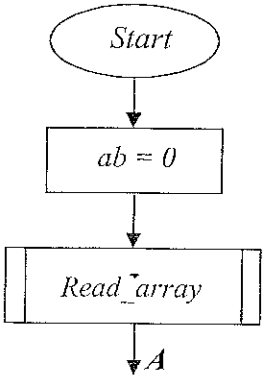
A sample pattern of the array will look like the following:

101	34	56	40			105	-1	202	48	65	33			1000

Assuming that the array ends with the special number *1000*, draw a flowchart to show the algorithmic logic of the program to perform the following tasks by processing the whole array:

i. Read numbers in the array sequentially, one at a time
ii. Count the number of absentees (*ab*)
iii. Calculate the total marks *(total)* and average mark *(avg)* of each present candidate, and display *ind, total* and *avg*
iv. Display the count of absent candidates at the last step of the algorithm.

Use the same set of flowcharting symbols accepted during your continuous assessment activities. Use the variable identifiers given within brackets as appropriate.
State assumptions if any.
Hint: You should start with the steps given in the following diagram and next construct looping mechanism(s) to complete the algorithm.



At each call, the pre-processor *Read_array*
- reads the current number from the array and outputs it as ***A***,
- increments the array index by *1*.

(28 Marks)

b) Consider an ISA of a hypothetical microprocessor with an accumulator and two registers R1, R2 and a FLAGS register [with zero flag(Z) and sign flag (S)]. Assume the values in R1, R2 be r_1, r_2 respectively. And initially, $r_1 > 0$, $r_1 <> r_2$. Write a piece of assembly codes with suitable comments to perform the following task.

Continue to repeat each of the following consecutive operations when satisfying the condition $r_2 > r_1$ (**Hint**: Check for $r_2 > r_1$ before doing each operation)

Operation 1: Replace r_1 by $2*r_1$

Operation 2: Replace r_2 by r_2-r_1

Use the following set of instructions when you are writing the assembly codes. You should start your codes with the instruction *MOV R2*.

Instruction	**Description (Acc: Accumulator)**	**Setting flags**
MOV R_i	Moves register_value R_i to Acc.	-
ADD R_i	Add register_value R_i to Acc_value	Z=1 when Acc_value=0, or otherwise Z=0. S=0 when Acc_value>0, or otherwise S=1.
SUB R_i	Subtracts register_value R_i from Acc_value	Z=1 when Acc_value=0, or otherwise Z=0. S=0 when Acc_value>0, or otherwise S=1.
HLT	Halt the operation	-
STO R_i	Writes Acc_value in to register R_i	-
JMP label	Absolute branching to a given label	-
JS label	Branch will be taken if flag S=1	-
JZ label	Branch will be taken if flag Z=1	-

(12 Marks)

2) ***Write all relevant intermediate steps when answering questions from (a) to (d)***

a) Convert the following decimal integer and fraction to binary.

i. 83 *(01 Mark)*

ii. 0.350 (Truncate answer at 4th bit after binary point) *(02 Marks)*

b) Perform the following binary arithmetic operations:

i. 110001 - 11011 *(show the borrow bits clearly)* *(02 Marks)*

ii. 10010110 ÷ 110 *(perform long division)* *(03 Marks)*

c)

i. Calculate the decimal equivalent of 101110.11_2 *(02 Marks)*

ii. Calculate the value of y in the following equation
$51_8 + 123_y - 111111_2 = 10_H$ *(03 Marks)*

iii. Convert $B79_H$ to its octal equivalent *(02 Marks)*

d) Perform -7-12 by using 2's complement techniques. *(05 Marks)*

3)

a) Explain the terms (i) circuit switching and (ii) packet switching with suitable examples. *(04 marks)*

b) IP addressing is used in computer networks to distinctly identify the networks and the devices.

i. Compare the two addressing schemes IPv4 and IPv6. *(03 marks)*

ii. Compare the bit allocations of different classes of IPv4. *(03 marks)*

c) List the main sub-systems along with the main functions of each of the sub-system in GSM cellular communication network. *(05 marks)*

d) Suppose that you have to subnet your class C network 192.168.1.0 with a subnet mask of 255.255.255.240. *(05 marks)*

i. Calculate the number of networks,
ii. Calculate the number of hosts per network,
iii. Compute the full range of the first three networks,
iv. Compute the usable address range from the networks in (iii) above.

4)

a) Describe three advantages of using optical fibre cables for broadband networks. *(03 marks)*

b) Briefly explain the seven layers of the OSI model and the main functions. *(05 marks)*

c) Explain the amplitude modulation process considering analogue sinusoidal signals with appropriate equations. *(04 marks)*

d) If there are five desktop computers to share a printer in a network, describe a suitable physical topology to connect these devices for each scenario described below.

i. Scenario 1: At a given time, only one desktop computer can communicate with the printer but able to communicate with other computers simultaneously *(04 marks)*

ii. Scenario 2: At a given time, only one desktop computer can communicate with the printer but **not** able to communicate with other computers simultaneously. *(04 marks)*