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

ECX3233 - Communications & Information Technology

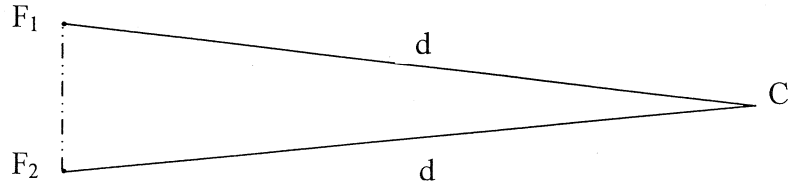
FINAL EXAMINATION 2014/15

Date: 28th August 2015 Time: 09.30 hrs – 12.30 hrs

Answer four questions including question 1. Write your answers clearly. Write all relevant intermediate steps when answering question 2.

1)

a) Scenario:



As shown in above diagram, two hungry frogs F_1 and F_2 are staying on a horizontal floor. A small creature **C** is at a distance ***d*** from each frog *(d is a positive integer and d >20)*. The creature starts making periodical squeals, one at a time. Then the frogs start jumping along the two lines F_1C and F_2C to capture the creature. Each frog makes one jump against each squeal where F_1 jumps first and then jumps F_2. For each frog, the length of each individual jump (l) and the total distance travelled at a certain time (s) are as follows:

Frog	l	S
F_1	2	s_1
F_2	$vol/2 + 0.5$	s_2

where ***vol*** is the creature squeal volume, a random value of 1, 2, 3 or 4.

If at any instance where $s_2 = s_1$, F_2 jumps additional **1** unit before the next squeal.
The frog who first satisfies the condition given below, can capture the creature immediately. Then it becomes the holder of creature and so ends the scenario.
Condition:

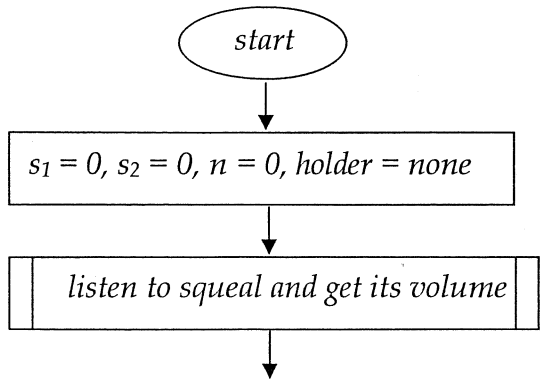
for F_1; $s_1 >= d-2$
for F_2; $s_2 >= d-2.5$

Draw a flowchart to demonstrate the algorithmic logic of this scenario, assuming no clash among the frogs. Your flowchart should output the following in its final step;

- *holder*
- total number of squeals made by creature before it is caught (n)

Use the same set of flowcharting symbols agreed when doing your assignments. State assumptions.

Hint: You may start with the steps shown in the following diagram. You need to apply a looping mechanism. ***Squeal*** *is the high-pitched cry or noise made by the creature.*



(30 Marks)

b) Consider an ISA of a hypothetical microprocessor with an accumulator (**Acc**) and three registers R1..R3. At the initial state, R1,R2 and R3 contain the three values v_1, v_2 *and* v_3 respectively. Assuming that v_2 is less than v_3, write a piece of assembly code to do the following task

Task: Find out whether v_1 is in the range of values between v_2 and v_3. If v_1 satisfies the condition, calculate v_1-v_2 and store it as new v_1. Halt the operation.

Given the following set of instructions,

Instruction	**Description**
SUB R_i	Subtracts register_content from Acc_content
MOV R_i	Moves register_content to Acc.
STO R_i	Stores Acc_content in to a register
CMP R_i	Compares Acc_content with register_content
HLT	Halt the operation
JL label	Branching to given_label, if Acc_content is less on comparison
JG label	Branching to given_label, if Acc_content is greater on comparison

(10 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) 100 (ii) 0.405 (Truncate answer at 3rd bit after binary point)

(03 Marks)

b)

(i) Calculate the decimal equivalent of 101001.11_2 *(02 Mark)*

(ii) Convert $B6D_H$ to Binary and hence find its Octal equivalent *(02 Marks)*

(iii) Calculate the value of p where $123_p = 1B_H$ *(02 Marks)*

c) Perform the following binary arithmetic operations;

(i) 100011 - 1101 *(03 Marks)*

(ii) 1011011 ÷ 111 (perform long division) *(03 Marks)*

d) Perform 5-15 by using 2's complement technique. *(05 Marks)*

3)

a) Draw a segment of a bus network including following three nodes. Show the two bus terminators clearly.

- a Mail Server
- a network printer
- a hub carrying two PCs where one PC has a printer

(06 Marks)

b) Write the topmost two layers in the ISO/ OSI reference model.

(02 Marks)

c) Write the two major responsibilities of the network layer of ISO/ OSI.

(04 Marks)

d) .57.1 and .59.3 denote the 3rd and 4th numbers of two 32-bit IP addresses respectively.
Perform necessary binary conversions and operations to find out whether these IPs are on the same subnet. The subnet mask is 255.255.248.0.
(*Hint: considering the last 16 bits is adequate in writing the answer*)

(08 Marks)

4)

a) Classify the system software into three major types.
Explain the function of each of above by using the key terms *H/W, user, interface, interaction.*

(06 Marks)

b) A hypothetical file system specifies only two operations *read* and *write*. The types of users are *owner, group* and *company*. Find the size of protection mask for this system. Draw the mask and label it.

(06 Marks)

c) Declare a 2D array in *Pascal* format to represent the telephone call data in following table;

	Phone 1	Phone 2	Phone 3
toLand	10	88	16
toMobitel	**52**	6	22
toDialog	3	17	105
IDD	2	1	5

Write a *Pascal* statement to assign the data shown in Bold (i.e 52) to appropriate array element.

(06 Marks)

d) Write two main mathematical entities that are manipulated mostly using arrays when programming.

(02 Marks)

5)

a) Draw a clearly labelled block diagram of a basic communication system and explain the function of each component. *(04 Marks)*

b) A certain communication system consists of two amplifiers and two attenuators in cascade as shown in Figure Q5.1. Calculate the power output in *dBm* for an input power of *1W*. *(04 Marks)*

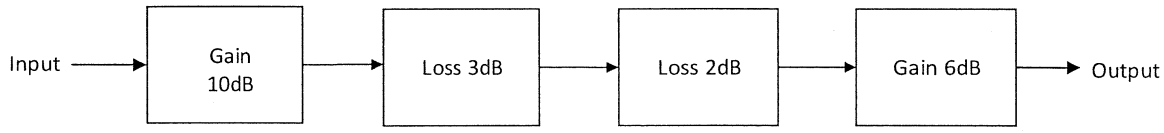


Figure Q5.1

c)

(i) Compare and contrast amplitude modulation (AM) with frequency modulation (FM).

(04 Marks)

(ii) Using proper waveform diagrams clearly explain the importance of modulation index in AM. *(04 Marks)*

(iii) Let $S(t) = A_c [1 + \mu m(t)] \cos(\omega_c t)$ be an AM modulated signal. Let the signal $m(t)$ has a spectrum shown in Figure Q5.2. Draw the frequency domain representation for the signal $S(t)$.
Clearly label all the components. *(04 Marks)*

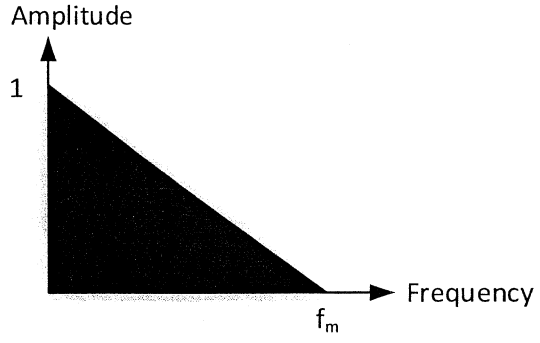


Figure Q5.2