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

ECX3233 - Communications & Information Technology

FINAL EXAMINATION 2013/14

Date: 15th August 2014 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:

A well established large scale advertising company ***add i T*** is planning to implement an annual bonus scheme for its employees as an appraisal of their contribution to the growth of the company. ***add i T*** needs a computer program to calculate the bonus payments of employees at the end of the year according to the following criteria;

Bonus payment of an employee (***bShare***) is a share of the total bonus allocation (***bAlloc***) for a certain year. *bShare* is calculated as follows:

$bShare = \mathbf{bScore} * bAlloc$

bScore of an ith employee is given by;

$bScore_i = aPara_i * jPara_i$

such that the sum of *bScores* of all employees is equal to 1.

$aPara_i$, $jPara_i$ indicate employee attendance and yearly job performance respectively.

The value of ***aPara*** can be obtained as the output of a preprocessor in which $aPara = f(\mathbf{aLevel})$.

jPara is calculated using employee job credits as,

$$jPara = \sum_{j=1}^{p} Cr_j$$

where Cr_j is the credit of jth job done by the employee. Cr_j is retrieved as an array (of size p) by using preprocessor ***Read_credit_array***.

Assuming that you are the IT specialist working for the company, design an algorithm for this task and draw your algorithm as a flow chart. Given the number of employees as ***n***.

(30 Marks)

b) Consider an ISA of a hypothetical microprocessor with an accumulator and three registers R1..R3. Re-arrange the set of assembly instructions given below to form a meaningful code to do the following task.

Task: to increment the value in register R1 until it becomes equal to the value in R2. Before each incrementing, you need to get the sum of values in R1 & R3 and store the result in R3.

Assume that the content of R2 is greater than the content of R1 at the initial state.

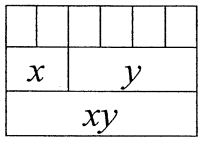
```
X:  MOV R1
    STO R1
    MOV R3
    JMP X
    SUB R2
    STO R3
    JZ Y
    ADD R1
    INC
    MOV R1
Y:
```

Instruction	Description (Acc: Accumulator)
ADD R_i	Adds a register_content to Acc_content
MOV R_i	Moves register_content to Acc.
SUB R_i	Subtracts register_content from Acc_content
STO R_i	Stores Acc_content in to a register
INC	Increments Acc_content
JMP label	Branching to given_label
JZ label	Branching to given_label, if Acc_content is zero

(10 Marks)

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

a) Given in diagram below is the format of a binary number xy having two adjacent parts x and y. x has 2 bits and y has 4 bits.



How many distinct binary values can we represent by xy ?
Justify your answer. *(02 Marks)*

b) Convert the following decimal values to binary.
(i) 98 (ii) 9.690 (Truncate answer at 3rd bit after binary point)
(03 Marks)

c) Find the following;
(i) Decimal equivalent of 100110.01_2 *(01 Mark)*
(ii) Decimal equivalent of octal value 655 *(01 Mark)*
(iii) Binary equivalent of $C08.A2_H$ *(01 Mark)*

d) Perform the following binary arithmetic operations;
(i) 10111.1 + 10110.11 *(03 Marks)*
(ii) 1101 * 1011 *(03 Marks)*

e)

(i) Represent 77 in 8 bit signed binary notation. *(01 Mark)*

(ii) Subtract 11 from -3 (i.e. -3-11) by using 2's complement technique. *(05 Marks)*

3)

a) With regard to computer networking & communications,

(i) What are the following abbreviations stand for?
NIC, DSL, OSI. *(03 Marks)*

(ii) Write an example for hostname and domain name, assumed with regard to a your own business. What is the fully qualified domain name (FQDN)? *(03 Marks)*

(iii) What is the difference between 10Base-T Ethernet and 10Base-F Ethernet? Comment on the bit rate. *(03 Marks)*

b)

(i) Write the basic rule (in terms of number of paths between any two computers) to remember in interconnecting bridges and switches in PC networks. *(02 Marks)*

(ii) Sketch a segment of PC network having the following components:
- Two hubs (Hub1, Hub2) carrying two PCs in each.
- A backbone cable deployed for the hubs and a separate server machine.

(05 Marks)

(iii) Write two advantages and two disadvantages of client-server network model. *(04 Marks)*

4)

a)

(i) Write three important characteristics of an algorithm. *(03 Marks)*

(ii) Write a case statement (Pascal/ Pseudo) to do an appropriate operation on two given numbers with one of the operators +, -, * and /. Inputs for the case statement are num1, num2 and an operator.
Remember to implement an *error case* against invalid operator as well. *(05 Marks)*

b) With regard to data structures,

(i) Write four preliminary data types. *(02 Marks)*

(ii) Write two strategies (storage schemes) used to map data structures in computer memory. Which scheme is prominent to be implemented using pointer concept in Pascal? *(03 Marks)*

c) Scenario:
Consider an old vehicle which is driven either by the owner or his driver whose name is *Mc.Driver*. Owner has no mechanical knowledge whereas the driver has a little. Assume the following events in case the vehicle stops suddenly on the way and it does not start as usual to continue the journey.

If the vehicle is **owner driven**, he **tries** to do a **push start** with the help of two youngsters. In case he **fails**, he **contacts** the **Mechanic**.
If the vehicle is **Mc.Driver driven**, what he does first is to **repeat** the following for **two times**;

- **check** the **battery wires**
- **try** a **normal start**

If he **fails**, he then **tries** to do a **push start** with the help of two youngsters. **If** he **still fails** to start the vehicle, he **contacts** the **owner**.

Neglecting any other additional logic & real situation upon such a scenario, write a nested if statement to demonstrate the logic of this scenario.
You must use the text typed in bold to come up with a meaningful and abbreviated code.
Hint: you may also need to include a repetition statement repeat..until.

(07 Marks)

5)

a) Let,

$$C(t) = 5\,Cos(200000\pi t + 100) \quad \text{and}$$
$$m(t) = A\,Sin(2000\pi t)$$

(i) Showing the important values, sketch the modulated signal waveform for an amplitude modulation of C(t) carrier with m(t). *(04 Marks)*
(ii) What is the maximum possible value of A to have a successful demodulation of this modulated signal? *(03 Marks)*
(iii) Using appropriate diagrams, clearly explain what would happen if you increase A beyond the value in (ii) above. *(03 Marks)*

b) A frequency modulated signal is given by,

$$S(t) = 10\sin[200000\pi t]\cos[t.\cos(8000\pi t)] + 10\sin[t.\cos(8000\pi t)]\cos[200000\pi t]$$

(i) Write S(t) in $A\cos[2\pi f_c + k_f\, m(t)]\, t$ form. *(05 Marks)*
(ii) Hence find the carrier and information signal waveforms. *(02 Marks)*
(iii) What is the importance of the k_f value? *(03 Marks)*