EGERTON UNIVERSITY

UNIVERSITY EXAMINATIONS

NAKURU TOWN CAMPUS

FIRST SEMESTER 2011/2012

FIRST YEAR EXAMINATION FOR THE AWARD OF THE DEGREE BACHELOR OF COMPUTER SCIENCE

COMP 102: DISCRETE MATHEMATICS FOR COMPUTING

STREAM: BSC COMPUTER SCIENCE **TIME: 2 HOURS**

DAY: THURSDAY, 3.00 – 5.00 PM **DATE:** 2/5/2013

INSTRUCTIONS

(a) This paper contains FIVE Questions.

(b) You are required to answer THREE questions in all

(c) Question ONE is Compulsory

(d) Where diagrams are required they should be neatly drawn.

Question ONE: (30 marks)

(a) Let U = {a,b,c,d,e,f,g,h,i} and suppose that A = {a,b,c,d,e}, B = {d,e,f,g}, C = {e,f,g,h,i}, E = {b,d,f,h}.

(i) Form the bit array for $A \cap B$ [1 mark]

(ii) Find the cardinality of (EUF)' [1 mark]

(iii) Find the elements of CXE [1 mark]

(b) Let U = {1,2,3,4,5,6,7,8,9,10}. Find the set specified by each of the following bit strings.

(i) 1111001111 (ii) 0101111000 (iii) 1000000001 [3 marks]

(c) Let N = {2,3, 4,5,6,7,8,9,10} and define a relation R on N by writing xRy if x divides y for $x,y \in N$.

(i) Create a digraph for R

(ii) Form the matrix representation for c(i) above

(iii)Decide if the relation is an equivalence relation [4 marks]

(d) What are some of the uses of graphs(list at least four) [4 marks]

(e) Show that the hypothesis "If you send me an e-mail message, then I will finish writing the program," "If you do not send me an e-mail message, then I will go to sleep early", and "If I go to sleep early, then I will wakeup feeling refreshed" lead to the conclusion "if I do not finish writing the program, then I will wake up feeling refreshed. [6 marks]

2) Students in the school of mathematics at a university major in one of the following four areas: applied mathematics (AM), pure mathematics (PM), operations research (OR), and computer science (CS). How many students are in this school if (including joint majors) there are 23 students majoring in AM; 17 students majoring in PM; 44 in OR; 63 in CS; 5 in AM and PM; 8 in AM and CS; 4 in AM and OR; 6 in PM and CS; 5 in PM and OR; 14 in OR and CS; 2 in PM, OR and CS; 2 in AM, OR, and CS; 1 in PM, AM, and OR; 1 in PM, AM, and CS; and 1 in all four fields. [6 marks]

3) Construct a truth table for the expression $(p \vee q) \text{ W } \neg p$ [4 marks]

<u>Question Two (20 marks)</u>

a.) Define the following terms as used in graph theory

i) An n-ary tree

ii) A minimum spanning tree

iii)A circuit

iv)A maximal connected graph [2 marks each total = 8 marks] b.) Evaluate the following pre-order (PPN) expressions and produce the tree representing them.

i) -+23*-512

ii) +*--*+*432352-1-2 [3 marks each total = 6 marks]

c.) Find the transitive closure of the relation R = { (1,1), (1,2), (2,2), (3,1), (3,3) on {1,2,3} [2 marks]

d.) Let A = {1, 2, 3} , B = {1,3; a, c}, and C = {1,2; a, b}. What is the set $(A \cap B) X(C - (B - A))$? [4 marks]

Question Three (20 marks)

(a) Let R be the relation defined by xRy if x-y is even. Show that R is an equivalence relation. [4 marks]

(b) University students were asked whether they read Nation or Standard. It was found that, 55 read the nation, 80 read the standard and 38 read both. Find out how many read neither nation nor standard. [3 marks]

(c) Let $f(x) = x^2 + 4$ and $g(x) = x + 6$. Find $gof(x)$ and $fog(x)$ [3 marks]

(d) Represent the following sets using Venn diagrams. $B \cup (A \cap C)$, $A - (B - C)$ and $C - (A \cap B)$ [3 marks]

(e) What are the advantages of

- Lists over n-tuple [1.5 marks]
- Linked lists over lists [1.5 marks]

(f) Re-write the linked list below to include March, June, October and November in their proper place in the sequence. [4 marks]

Start = 1

Address	Day name	Pointer
1	January	2
2	February	3
3	April	4
4	May	5
5	July	6
6	August	7
7	September	8
8	December	0

Question Four: (20 marks)

(a) Show that the hypothesis: "I take the bus or I walk. If I walk I get tired. I do not get tired." Leads to the conclusion 'therefore I take the bus." [6 marks]

(b) The characters of the word MESOPOTAMIA are stored as a list L1 thus <M,E,S,O,P,O,T,A,M,I,A>. Find Tail (tail (L1) and Head (tail (L2)). [4 marks]

(c) Write out a truth table for the expression $\overline{(A \vee B)} \Rightarrow C$.(Hint: the table will have eight rows) [4 marks]

(d) Interpret this expression in practical terms if A = 'there is a bug in program X', B = 'computer Y is not functioning properly', and C = 'program X can run successfully on computer Y'. Can the direction of the implication be reversed? [2 marks]

(e) Briefly describe the application areas of trees. [4 marks]

Question Five: (20 marks)

a.) The following cities are accessible from the named motorways: Bath M4; Birmingham M6, M5; Winchester M3; Bristol M4, M5; Canterbury M2; Cardiff M4; Exeter M5; Leeds M1; London M1,M2,M3,M4; Manchester M6; and Sheffied M1. Suppose that set consists of the names of the cities and that the set M consists of the names of the motorways as given above. The relation A can be defined as follows:

A = {(x,y): (x,y) ∈ MxC and motorway x gives access to city y}

(i) How many elements are there in MxC? How many elements are there in A? [3 marks]

(ii) Tabulate the ordered pairs which are elements of the set D, defined thus: D ⊂ A, and (x,y) ∈ D if (x,y) ∈ A and x = 'M4' or y = 'London' [4 marks]

(iii) The cities Bath, Winchester, Canterbury and London are classified as not historic. Suppose we have the Boolean set H = {T,F}, where a value T corresponds to historic and a value F corresponds to non-historic. Draw a bipartite graph representation of the relation where

B = { (x,y): (x,y) ∈ CxH and city y has historic classification z} [4 marks]

(iv) How many elements does CxH have? [1.5 marks]

(v) How many elements does the composition of AoB have? [1.5 marks]

(vi) Suppose AoB = K: Write out the set of ordered triples V, defined by

V = { (x,y,z): (x,y,z) ∈ K and x = 'M4' and z = T} [2 marks]

(vii) Write out a set definition in terms of K, similar to the one in (vi), of the names of all historic cities [2 marks]

b.) Find the transitive closure of the relation R = { (1,1), (1,2), (2,2), (3,1), (3,3) on {1,2,3} [2 marks]

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