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University of Sargodha

B.S. 2nd Term Examination 2017

Subject: Information Technology **Paper: Discrete Structures (CMP-2111)**

Time Allowed: 2.30 Hours **Maximum Marks: 80**

Note: Objective part is compulsory. Attempt any Three questions from subjective part.

Objective Part (Compulsory)

Q. No.1. Write short answers of the following in 2-3 lines on your answer sheet. (2*16)

i. Find the conjunction of the propositions p and q where p is the proposition "Today is Friday" and q is the proposition "It is raining today".
ii. What are the negations of the statements" All goats are mammals".
iii. Define contradiction.
iv. What is Cartesian product of A = {a, b, c} and B = {1, 2}.
v. Define Commutative Law with the help of example.
vi. Define this function $f(x) = (x+1)/(x^2+2)$ onto or one-to-one. Domain consist of all integers.
vii. Differentiate between mathematical induction and strong induction?
viii. How many permutations of the letters ASSESSINATION contain the string SES?
ix. How many comparisons are needed for a binary search in a set of 64 elements?
x. Let P (x) be the statement ""x spends more than 5 hours every work day in class.", where the domain consists of all students. Express each of these quantification in English
   a. $\forall x \sim P(x)$ b. $\exists x\, P(x)$
xi. Different between projection and join operator?
xii. What is pigeonhole principle?
xiii. How many bit strings of length eight either start with a 0 bit or end with the two bits 11?
xiv. Define reflexive closure and symmetric closure.
xv. Difference between tree and graph.
xvi. What is a recurrence relation?

Subjective Part (16*3=48)

Q.2 Prove that following are logically equivalent by developing a series of logically equivalences.

(ii) $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$

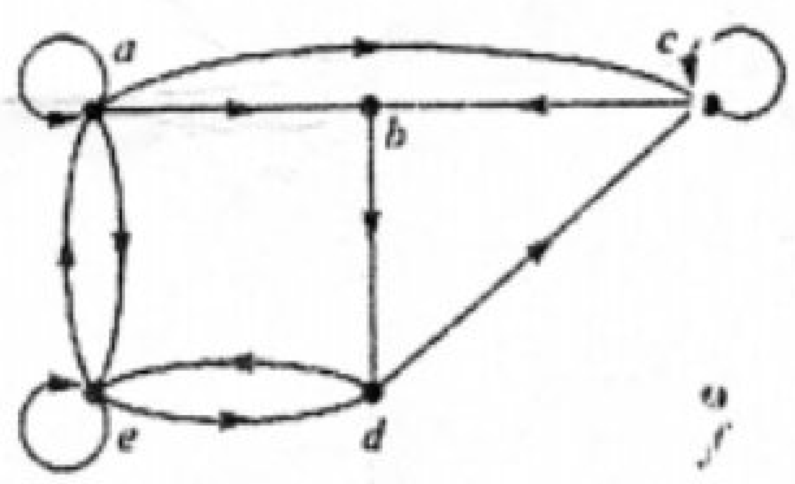
(iii) $\neg p \leftrightarrow q \Leftrightarrow p \leftrightarrow \neg q$

Q.3 Use the divide and conquer algorithm to put 6, 1, 2, 5, -7, 23, 11, 12, 4, 3 into decreasing order.

Q.4 Mention whether the following problems are permutation or combination problem

i. In how many ways can 6 tosses of coin yield 2 heads and 4 tails?
ii. How many lines can you draw using 3 non collinear (not in a single line) points A, B and C on a plane?
iii. How many triangles can you make using 6 non collinear points on a plane?
iv. In a certain country, the car number plate is formed by 4 digits from the digits 1, 2, 3, 4, 5, 6, 7, 8 and 9 followed by 3 letters from the alphabet. How many number plates can be formed if neither the digits nor the letters are repeated?

Q.5 Find the in-degree and out-degree of given graph. Also find whether the given graph has Hamiltonian or Euler tour? Show visually. Also represent the graph into Adjacency matric.



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Q.6 Determine whether each of these functions is a bijection from R to R.

(a) i) $f(x) = -5x/2 + 4$, **ii)** $f(x) = -3x^2 + 7$ **iii)** $f(x) = (x + 1)/(x^3 + 2)$, **iv)** $f(x) = x^5 + 1$

(b) Write down base and recursive case for sum of array elements. Also solve for array of length 5 via tree convention.

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DS IT 2017

Short Questions

ii - What are the negations of the statements
" All goats are mammals."

$\neg$(All goats are mammals)

→ All goats are not mammals.

i - Find the conjunction of the propositions
P & q where p is proposition
P = Today is friday.
Q = It is raining today

$P \wedge Q$ = Today is friday & it is raining today

iii - Define contradiction
A compound proposition that is always false is called contradiction

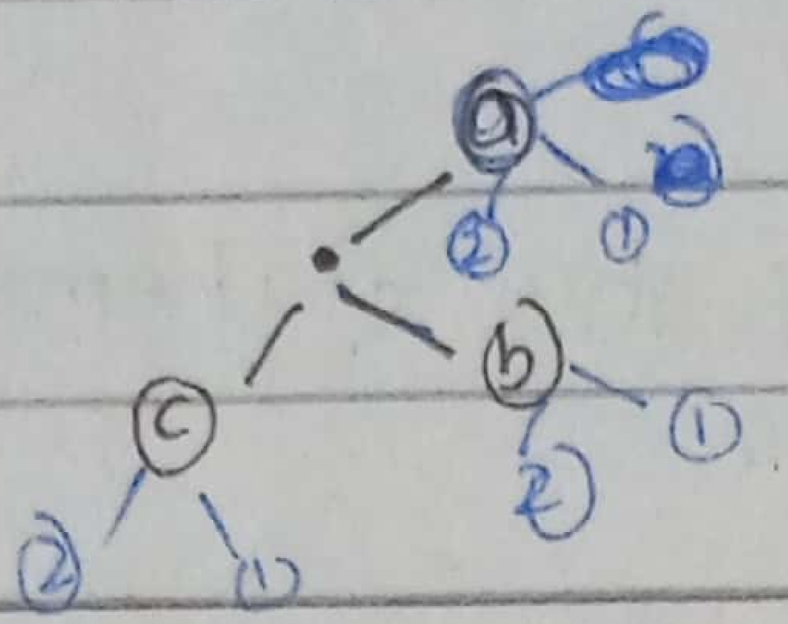
$P \wedge \sim P$ is always false

iv) What is cartesian product of A = {a, b, c}
& B = 1, 2}.

$A \times B = \{a, b, c\}\{1, 2\}$

~~$= \{(a,1), (a,2), (b,1), (b,2), (c,$~~

$= \{(a,1), (a,2), (b,1), (b,2), (c,1)(c,2)\}$



v- Define commutative law with the help of e.g.

The Law that says ~~th~~ you can swap no's around & still get the same answer when you add or multiply.

Example:-

$6+3 = 3+6$

$2 \times 4 = 4 \times 2$

$p \vee q = q \vee p$

$p \wedge q = q \wedge p$

vi- Define this function $f(x) = (x+1)/(x^2+2)$ onto or one-to-one. Domain consists of all integers.

$f(0) = \frac{0+1}{0+2} = 1/2$

$f(1) = \frac{1+1}{1+2} = 2/3$, $f(-1) = \frac{-1+1}{-1+2} = 0$

$f(2) = \frac{2+1}{4+2} = \frac{\cancel{3}}{2\cancel{6}} = \frac{1}{2}$, $f(-2) = \frac{-2+1}{-4+2} = \frac{-1}{6}$

As $f(0) = \frac{1}{2}$ & $f(2) = \frac{1}{2}$.

So, the function is not one-to-one & onto function

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vii- Diff. b/w mathematical induction & strong induction?

Mathematical Induction	Strong Induction
• It is a mathematical proof techchique.	• It is a type of proof closely related to simple induction.
• It is essentially used to prove that a property P(n) holds for every real no:s. n	• As in simple induction, we leave a statement P(n) about the whole no:s n & we want to prove that P(n) is true for every value of n
• **Example:** n=0,1,2,3....n if p(k) is true then p(k+1)	• **Example:** if p(i) is true for all; < or = k then p(k+1)

is true. | is true, where $p(k)$ is some statement depending on the +ve integer k. They are not identical but equivalent.

viii- How many permutations of the letters ASSESSINATION contain the string SES?

Letters are 2A's, 4S's, 2I's, 2N's, 1 T & 1 O's

Total no. of ways these letters can be arranged $= n(S) = \frac{13!}{2!4!2!2!}$

If for S, come consectively in the word then we consider these 4S's as 1 group.

x- Let $P(x)$ be the statement " x "spends more than 5 hours every work day in class," where the domain consists of all students. Express each of these quantification in English.

a) $\forall x \sim P(x)$ b) $\exists x\, P(x)$

$\forall x\, P(x > 5)$ $\forall x\, (P(x) > 5)$

There is at least no x such that $p(x)$

for same x $P(x)$

xi- Diff. b/w projection & join operator?

Projection Operator:-

It (π) is a unary operator in relational algebra that performs a projection operation. It displays columns of a relation or table based on the specified attributes.

Join Operator:-

An SQL join clause corresponding to a join operation in relational algebra combines columns from one or more tables in a relational database. It creates a set that can be saved as a table or use as it is. A join is a means for combining columns from one or more tables by using values common to each.

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xii- What is pigeonhole principle.

★ In Mathematics,

It states that if n items are put into m containers, with $n > m$, then at least 1 container must contain more than 1 item.

★ in Discrete Mathematics,

It states that if we must put N+1 or more pigeons into N pigeon Holes, then some pigeonholes must contain 2 or more pigeons.

Example:

If kn+1 (where k is a +ve integer) pigeons are distributed among n holes than some holes contains at least k+1 pigeons.

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xiii- How many bit strings of length 8 either start with a 0 bit or end with the 2 bits 11?

0 _ _ _ _ _ 1 1

$5! = 5 \times 4 \times 3 \times 2 \times 1$

$= 120$

xiv- Define reflexive closure & symmetric closure.

Reflexive Closure:-

of a binary relation R on a set X is the smallest refrexive relation on X that contains R.

Example:-

if x is a set of distinct no: & xRy means "x<y" then the reflexive closure "x is less or = y"

Symmetric Closure:-

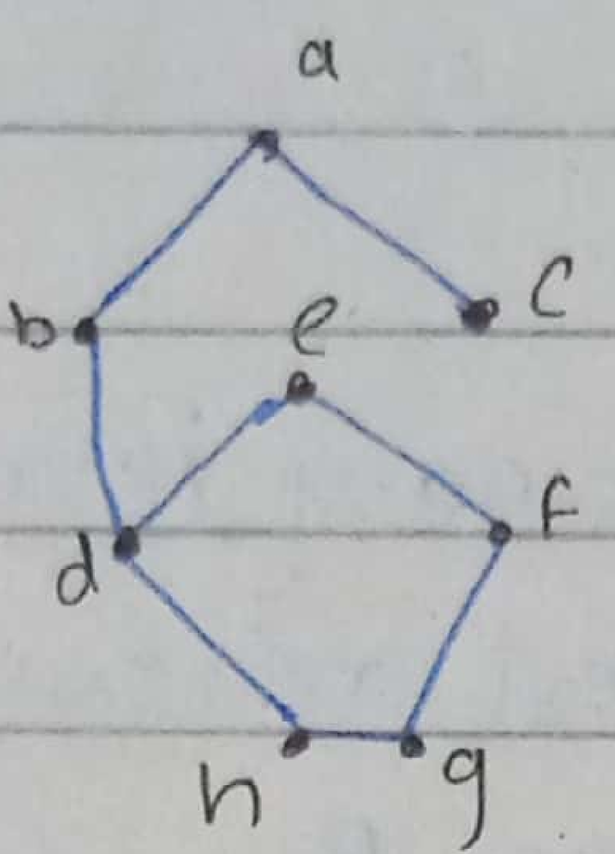
The Symmetric Closure S of a relation R on a set X is given by.

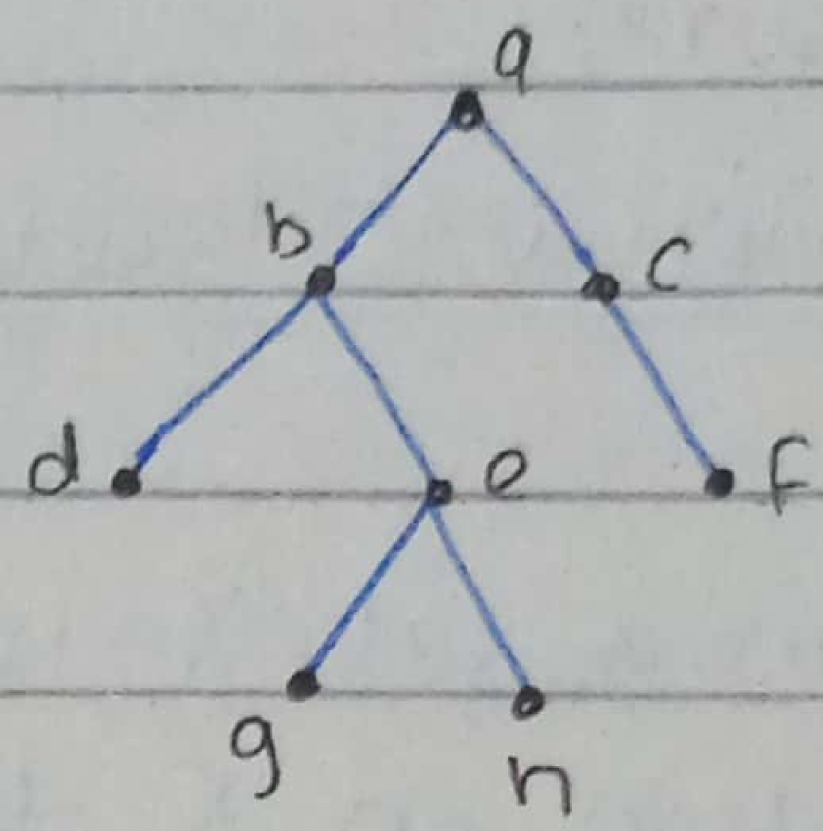
In other words, the symmetric closure of R is union of R with its converse relation R^T.

xv- Diff. b/w tree & graph

Graph	Tree
It is a group of vertices & edges where an edge connects a pair of	It is considered as ~~minimumally~~ minimully connected graph which must be connected &

vertices. | & free from loops.





Graph & tree are the non-linear data structure which is used to solve various complex problems.

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xvi- What is a reccurrence relation?

Its the sequence $\{a_n\}$ is an equation that expresses a_n in terms of one or more of perivious terms of the sequence.

A sequence is called a solution of a occurrence relation if its terms satisfy the occurrence relation.

Example:-

$\{1, 2, 3, 5, 8, 13, 21\}$

Long Questions:

Q.2 Prove that following are logically equivalent by developing a series of logically equivalences

i- $(p \lor q) \land (\sim p \lor r) \rightarrow (q \lor r)$ is a tautology

$\sim p$	p	q	r	$p \lor q$	$\sim p \lor r$	$(p \lor q) \land (\sim p \lor r)$	$q \lor r$	$\rightarrow$
F	T	T	T	T	T	T	T	T
F	T	T	F	T	F	F	T	T
F	T	F	T	T	T	T	T	T
F	T	F	F	T	F	F	F	T
T	F	T	T	T	T	T	T	T
T	F	T	F	T	T	T	T	T
T	F	F	T	F	T	F	T	T
T	F	F	F	F	T	F	F	T

Yes, this is tautology

ii- $(p \to q) \to (r \to s)$ & $(p \to r) \to (q \to s)$

p	q	r	s	$p \to q$	$r \to s$	$(p \to q) \to (r \to s)$	$p \to r$	$(q \to s)$	$(p \to r) \to (q \to s)$
T	T	T	T	T	T	T	T	T	T
T	T	T	F	T	F	F	T	F	F
T	T	F	T	T	T	T	F	T	T
T	T	F	F	T	T	T	F	F	T
T	F	T	T	F	T	T	T	T	T
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