



# UNIVERSITY OF THE PUNJAB

M.Sc. I.T. (First Year) Supply 2020 / Annual – 2021

Paper: I-NI / I-NII (Discrete Mathematics + Logic Design & Computer Organization)

Roll No. ....

Time: 3 Hrs. Marks: 100

## USE SEPARATE ANSWER SHEET FOR EACH PART

NOTE: Question No. 1 is Compulsory. Attempt any TWO questions from remaining Questions.

### PART – I (DISCRETE MATHEMATICS)

Question # 1: Select the right answer cutting and overwriting is not allowed. (2x5=10)

- 1) What is the cardinality of the set of odd positive integers less than 10?
  - a) 10
  - b) 5
  - c) 3
  - d) 20
- 2) The converse of conditional statement  $p \rightarrow q$  is \_\_\_\_\_?
  - a)  $q \rightarrow p$
  - b)  $\neg q \rightarrow \neg p$
  - c)  $\neg p \rightarrow \neg q$
  - d) None of these
- 3) What is the Cartesian product of  $A = \{1, 2\}$  and  $B = \{a, b\}$ ?
  - a)  $\{(1, a), (1, b), (2, a), (2, b)\}$
  - b)  $\{(1, 1), (2, 2), (a, a), (b, b)\}$
  - c)  $\{(1, a), (2, a), (1, b), (2, b)\}$
  - d)  $\{(1, 1), (a, a), (2, a), (1, b)\}$
- 4) Big-O estimate of function  $f(n)=16n^3+3n^2$  is:
  - a)  $O(n^2)$
  - b)  $O(3n^2)$
  - c)  $O(n^3)$
  - d)  $O(19n^5)$
- 5) A complete graph (undirected) with 4 vertices has \_\_\_\_\_ edges?
  - a) 4
  - b) 5
  - c) 6
  - d) 7

Question # 2

[10 + 10]

- a) Give a big-O estimate for  $f(n) = (n^2 + 4n \log n)^*(n + 1)$
- b) Prove by mathematical induction that  $4^n - 1$  is divisible by 3, for integers  $n \geq 1$ .

Question # 3

[10+10]

- a) Prove by truth tables that  $\neg(A \leftrightarrow B) \Leftrightarrow (\neg A \vee \neg B) \wedge (A \vee B)$
- b) Given the adjacency matrix:

$$A = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

Draw its corresponding graph.

Question # 4

[10 + 10]

- a) Draw  $W_6, C_6, K_6$ .
- b) Give a proof by contradiction that if  $x$  is a rational number and  $y$  an irrational number, then  $x+y$  is irrational.

## PART – II (LOGIC DESIGN & COMPUTER ORGANIZATION)

**NOTE: Question No. 5 is Compulsory. Attempt any TWO questions from remaining Questions.**

**Question # 5:** Fill in the blanks with appropriate answer. (5x2=10)

1. Decoder is a \_\_\_\_\_ circuit.
2. ~~The simplified expression of half adder carry is \_\_\_\_\_.~~
3. ~~Table that lists inputs for required change of states is called \_\_\_\_\_.~~
4. DR register is named as \_\_\_\_\_.
5. To implement 4-bit counter using D flip flop \_\_\_\_\_ numbers of flip flop required.

**Question # 6:** (10+10)

- a) Design code converter circuit that accepts input as Excess-3 code and generates output in 7421 Code.
- b) Simplify the function in SOP using Boolean Algebra.  
 $F(A,B,C) = A'B'C + A'BC + A'BC' + ABC$

**Question # 7:** (10+10)

- a) Design a 3-bit majority circuit.
- b) Design Full Adder Circuit using Half Adder and some extra gates.

**Question # 8:** (10+10)

- a) The content of PC in the basic Computer is ABC. The content of Memory at address ABC is 2DEF. ~~The content of memory at address DEF is 0EFC. The content of memory at address ECA is ABCD.~~  
Write down the name of the instruction that will be executed next? Give the contents of registers PC, IR, DR, AC at the end of the execution of this instruction.
- b) Design 8 X 3 Encoder Circuit.