



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. (10x1=10)

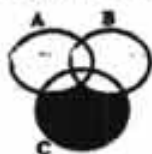
1. "Some students wants to learn Physics and some want to learn English." Which of the following quantified expression best represent the statement?

- a) ∃n∀x b) ∀x∃n c) ∃n ∨ ∃x d) ∃n ∧ ∃n

2. Traveling salesman problem is example for _____?

- a) Planar b) Undirected c) Euler d) Hamiltonian

3. The shaded area of figure is best described by:



- a) A - B - C b) C - A - B c) A ∪ B d) B ∩ A

4. If [x] = [x], then which of this following statement is true about x:

- a) Such value of x does not exist b) x is zero c) x is integer d) None of the mentioned

5. f(n) = -20n^5 + 987n^3 - 1000 is:

- a) O(n^3) b) O(n^5) c) O(n^6) d) Both a and b e) Both b and c f) None

6. The total number of edges in complete graph K5 will be?

- a) 5 b) 8 c) 10 d) 12

7. The relation R defined by R = {(1,1),(1,2),(1,3),(2,1),(3,3)} is reflexive.

- a) True b) False

8. The number of vertices of odd degree in an undirected graph is always _____.

9. If we have to ensure that at least four of the students have similar grade in a course (where total possible grades are 9), minimum number of students should be _____

10. If a compound Proposition statement is made up of eight propositions, then the number of distinct combinations in the truth table will be _____

Question#2:**(20 Marks)**

- a) Assume $P(x, y)$ is $(2x < (y + 2))$. Write both $\exists y \forall x P(x, y)$, $\forall x \exists y P(x, y)$ in expanded form and determine their truth value. where $[x, y \in \text{set of first four natural numbers}]$ (10)
- b) Evaluate following summations using $n=5$, $m=3$, $a=2$ and $b=-2$ (6)

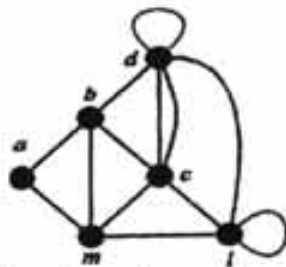
$$\sum_{j=1}^m \sum_{i=1}^n i + i^2 + 5bj - 4a$$

- c) Evaluate following summations by using formulas: (4)

$$\sum_{k=50}^{100} k^3? \text{ where } \sum_{k=1}^n k^3 = \left(\frac{n(n+1)}{2}\right)^2$$

Question#3:**(20 Marks)**

- a) Represent the following two graphs using Adjacency and Incidence matrix. Also determine that whether the given undirected graph has Hamiltonian circuit/Hamiltonian path, Euler circuit/Euler path. Also determine the chromatic number for the undirected graph. (14)



- b) Prove the following using mathematical induction. (6)

$$1^2 + 2^2 + 3^2 + 4^2 + 5^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}$$

Question#4:**(5+10+5=20)**

- a) What is the next term in the sequence: $\{5, 23, 113, 563, 2813, 14063, \dots\}$? Express the given sequence using recurrence relations. Also clearly write initial value(s).
- b) For $A = \{1, 2, 3\}$, $B = \{2, 4, 6\}$ and universal set being first ten natural numbers. Express Set A and B in form of bitstrings. Also compute $A \cup B$, $A - B$, \bar{A} and express the results using set-representation, bitstrings and Venn diagrams.
- c) In a programming language: variable names up to four-length are accepted. These variable names can start with a lowercase or uppercase English letter. However, for the remaining three letters, digits and seven-special characters are also allowed. Out of the total possible combinations: eight (8) single-length, sixteen (16) two-length, and forty (40) three-length variable names are reserved words. How many different variable names can be made in this language, excluding the reserved words?

Question#6:**(5 each)**

- a) Solve the following:
- Convert $(163.4)_8$ to decimal number system.
 - Let $A = 111010$ and $B = 101010$, perform $A-B$ using 1's complement.
- b) Reduce the expression $(x'y' + z)' + z + xy + wz$ to three literals using identities and theorems of Boolean Algebra.
- c) Draw the logic circuit diagram and truth table $F(A,B,C) = A'B + B'C$.
- d) Draw the circuit diagram of a 2-bit magnitude comparator that compares A_1A_0 and B_1B_0 . The circuit has only one output E, such that $E=1$, if the inputs are identical.

Question#7:**(20 Marks)**

- a) Draw the logic circuit diagram and truth table of 2×4 decoder with an enable input. Also show the construction of 3×8 decoder using two 2×4 decoders. (8)
- b) Implement $F(A,B,C) = \sum (1,4,5,7)$ using 4×1 multiplexer with variable A,B as a selection line. (6)
- c) Obtain the simplified expression in POS form for the following function using K-Map. (6)

$$F(A,B,C,D) = (A + B' + D).(A' + C + D).(C + D)$$

Question#8:**(20 Marks)**

- a) Explain instruction cycle and the CPU registers used in an instruction cycle. (10)
- b) Design a 3-bit synchronous counter using T flip flops with the following counting sequence. (10)
- $0 \rightarrow 1 \rightarrow 3 \rightarrow 5 \rightarrow 2 \rightarrow 4 \rightarrow \text{Repeat}$

PART – II (LOGIC DESIGN & COMPUTER ORGANIZATION)

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

Question # 5: Select the right answer cutting and overwriting is not allowed. (10x1=10)

- Which of the following codes is not a weighted code?
A) 2421 B) 84-2-1 C) gray D) Excess-3
- The smallest n-bit number written in signed 2's complement notation is:
A) -2^n B) -2^{n-1} C) $-2^n - 1$ D) $-2^{n-1} - 1$
- The complement of a Boolean function $F(A,B,C) = AB' + A'C$?
A) $(A+B).(A'+C)$ C) $(A'+B).(A+C)$
B) $A'+B'A+C$ D) $A'B+AC'$
- For an expression $XY' + XZ + YZ$, the consensus term is _____.
A) XY' B) XZ C) YZ D) $XY'Z$
- Which of the following is a standard SOP representation of $F(A,B,C)$?
A) $ABC + AB'C$ C) $AC + A'B'$
B) $A + B + C$ D) $A'B + AB'$
- A Boolean function $F(A,B) = A \oplus B$ can be written as _____.
A) $F = A'B + AB'$ B) $F = \prod(0,3)$ C) $F = \sum(1,2)$ D) All of the given
- Which of the following CPU register maintains the address of the next instruction to be executed?
A) Memory Address Register C) Next Address Register
B) Program Counter D) Next Instruction Register
- Which one of the following is not a combinational circuit?
A) Binary Adder B) Register C) Multiplexer D) Magnitude Comparator
- To decode the address for a ROM of size 256×8 , we need an address decoder of size:
A) 3×8 C) 16×256
B) 8×256 D) 256×8
- Which of the following inputs of a JK flip-flop will toggle the present state?
A) $J = 0, K = 0$ C) $J = 0, K = 1$
B) $J = 1, K = 0$ D) $J = 1, K = 1$