

- N. B.: (1) **All** questions are **compulsory**.
(2) Make **suitable assumptions** wherever necessary and **state the assumptions** made.
(3) Answers to the **same question** must be **written together**.
(4) Numbers to the **right** indicate **marks**.
(5) Draw **neat labeled diagrams** wherever **necessary**.
(6) Use of **Non-programmable** calculators is **allowed**.

1. **Attempt any three of the following:** 15
a. Explain the different types of programming language.
b. Explain the different steps in the program development cycle.
c. Draw the flowchart and pseudo code of program that doubles a number.
d. Describe the structure of a C program.
e. What are the various data types in C? Explain them.
f. What is a statement in C? Explain the different classes of statement in C.
2. **Attempt any three of the following:** 15
a. Write a program in C to swap two numbers without using third variable.
b. Describe the five arithmetic operators in C.
c. Explain the conditional operator in C.
d. Explain the getchar and putchar functions used in C programming language.
e. Write a short note on scanf function.
f. Explain the gets and puts functions used in C programming language.
3. **Attempt any three of the following:** 15
a. Explain if-else statement with an example.
b. Write a program in C to find the sum of squares of digits of a number.
c. What is the difference between while and do-while loop in C?
d. Explain the function with an example.
e. Write a program in C to find the factorial of a number using recursion.
f. Explain call by value and call by reference.
4. **Attempt any three of the following:** 15
a. What is meant by the storage class of a variable?
b. Write a short note on Global variable.
c. Write a program in C to calculate successive Fibonacci numbers.
d. What are preprocessor directives in C? Explain #include and #define in C.
e. Write a program in C to arrange the 'n' numbers stored in the array in ascending order.
f. What is a two dimensional array? How can they be declared and initialized in C?
5. **Attempt any three of the following:** 15
a. Explain the term pointers with an example.
b. Write a C program to perform addition of two pointer variable.
c. Write a short note on pointer arithmetic.
d. Differentiate between structure and union.
e. What is an array within the structure and array of structure?
f. Explain nested structure in C with an example.

(2½ Hours)

[Total Marks: 75]

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1. Attempt any three of the following: 15
- a. Convert the following.
 (i) $(1051.36)_{10} = (?)_8$
 (ii) $(F9A.D5)_{16} = (?)_{10}$
- b. What is Hamming code? A seven bit even parity hamming code is received as 1110101. What is the correct code?
- c. Certain number system has base 7. What is the hexadecimal equivalent of the minimum and maximum number that is expressed using the base 7 and four bits?
- d. Solve the following.
 (i) $(111000.01)_2 - (100111.00)_2$
 (ii) $(1010101)_2 \div (11)_2$
- e. Perform the following.
 (i) $(727)_8 + (234)_8$
 (ii) $(2C48)_{16} - (9AA)_{16}$ using 1C method
- f. Solve the following.
 (i) Convert the following number to BCD and add them $(11)_{10} + (9)_{10}$
 (ii) Convert the following number to XS-3 and subtract them $(53)_{10} - (28)_{10}$
2. Attempt any three of the following: 15
- a. Reduce the following using Boolean laws and theorems.
 (i) $W\bar{X}(W + Y) + WY(\bar{W} + \bar{X})$
 (ii) $XY + \bar{X}\bar{Y}Z + (\bar{X}\bar{Y} + Z)$
- b. Write short notes on input-bubbled AND gate and input bubbled OR gate.
- c. Prove the following:
 (i) $\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC = AB + AC + BC$
 (ii) $(A + \bar{A}B)(C + \bar{D}) = \bar{A}\bar{B} + \bar{C}D$
- d. Simplify using K-map and realize it using minimum number of gates.
 $F(A,B,C,D,E) = \sum m(0,2,5,7,13,15,18,20,21,23,28,29,31)$
- e. Simplify using K-map and realize it using minimum number of gates.
 $F(A,B,C,D) = \prod M(4,6,8,9,10,12,13,14) + d(0,2,5)$
- f. Minimize expression using Quine Mc Cluskey method.
 $f(W,X,Y,Z) = \sum m(2,6,8,9,10,11,14,15)$
3. Attempt any three of the following: 15
- a. The input to a combinational logic circuit is a 4-bit binary number. Design the logic circuit with minimum hardware for the following
 (i) Output Y1 = 1 if the input binary number is 5 or less than 5.
 (ii) Output Y2 = 0 if the input binary number is 9 or more than 9.
- b. Convert 4 bit gray to 4 bit binary. Draw the truth table, necessary k-maps and logic circuit.

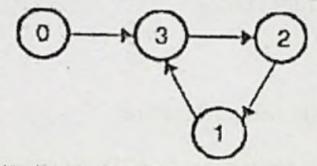
- c. Draw circuit and explain working of XS-3 adder.
- d. Design the Full Subtractor using K-map. Draw the circuit diagram for the same.
- e. How Booths algorithm speeds up the multiplication process? Explain with an example.
- f. Design single bit magnitude comparator. Draw truth table, K-map and circuit diagram for the same.

4. Attempt any three of the following:

- a. Implement full adder circuit using 8:1 MUX.
- b. Cascade Demultiplexer. Build 1:8 demux using 1:4 demux chips.
- c. $Y = A + B + \bar{C}$. Realize using a multiplexer.
- d. Draw logic circuit diagram of D flip flop and describe with a truth table the working of it.
- e. How SR flip-flop can be used to work as T flip-flop? Explain.
- f. How flip-flop is used in eliminating keyboard debouncing? Explain.

5. Attempt any three of the following:

- a. Design modulo 6 ripple counter.
- b. Design 4 bit binary up/down counter with control input of up/down.
- c. Implement synchronous counter using JK FF for state diagram shown in figure.



- d. Write a short note on buffer register.
- e. Explain working of SIPO register.
- f. Write a short note on Johnson counter.

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1. **Attempt any three of the following:** 15
 a. What is Operating System? Explain the role of operating system as extended machine.
 b. Write a short note on Fifth Generation of Operating System.
 c. Explain multithreaded and multi-core chips.
 d. Using suitable diagram explain the structure of disk drive.
 e. Write a short note on Process Model.
 f. Explain the dining philosopher's problem.
2. **Attempt any three of the following:** 15
 a. Explain the concept of running multiple programs without memory abstraction.
 b. How swapping helps to hold large programs in RAM? Explain Using suitable diagram.
 c. Explain Clock page replacement algorithm using suitable example.
 d. List and explain any five operations performed on Files.
 e. Explain the Unix V 7 File system.
 f. List and explain any five operations performed on Directories.
3. **Attempt any three of the following:** 15
 a. What are block devices and character devices? Explain.
 b. Write a short note on Memory Mapped IO.
 c. Explain Direct Memory Access using suitable diagram.
 d. Explain preemptable and non-preemptable resources.
 e. List Coffman's four conditions that must hold for a resource to be in deadlock.
 f. Explain the process of Deadlock Detection with One Resource of Each Type.
4. **Attempt any three of the following:** 15
 A. Write a note on Type-1 and Type-2 Hypervisor.
 B. Explain any five advantages of virtualization.
 C. List and explain five essential characteristics of Cloud.
 D. Write a note on Virtual Machine Migration.
 E. What is Master-Slave Multiprocessors Operating System?
 F. List the different Multicomputer Interconnection Technologies. Explain any two.
5. **Attempt any three of the following:** 15
 a. Explain the kernel structure of Linux.
 b. List and explain any five file-system related system calls in Linux.
 c. Using suitable diagram explain the architecture of Android Operating System.
 d. Explain the programming layers in modern windows operating System.
 e. Explain the booting process of windows OS.
 f. Write a note on windows power management.

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1. **Attempt any three of the following:** 15
- a. Define Universal Existential Statement and Existential Universal Statement. Give examples of each.
- b. Define Cartesian product. Let \mathbb{R} denote the set of all real numbers. Describe $\mathbb{R} \times \mathbb{R}$.
- c. Find the number of integers between 1 and 250 that are divisible by 2 or 3 or 5 or 7.
- d. Prove that $(A \cup B) \cap (A \cap B)' = (A - B) \cup (B - A)$
- e. Write the negation of each of the following statements as simply as possible:
- If she works, she will earn money.
 - He swims if and only if the water is warm.
 - If it snows, then they do not drive the car.
 - John is 6 feet tall and he weighs at least 120 Kg.
 - The train was late or Amol's watch was slow.
- f. Define the following:
- Argument, Premises
 - Syllogism
 - Explain Modus Ponens and Modus Tollens with examples.
2. **Attempt any three of the following:** 15
- a. Let
- $Q(n)$ be " n is a factor of 8,"
 $R(n)$ be " n is a factor of 4,"
 $S(n)$ be " $n < 5$ and $n \neq 3$,"
- and suppose the domain of n is \mathbb{Z}^+ , the set of positive integers. Use the \Rightarrow and \Leftrightarrow symbols to indicate true relationships among $Q(n)$, $R(n)$, and $S(n)$.
- b. Define **necessary and sufficient conditions** and **only if** as applied to universal conditional statements. Rewrite the following statements as formal and informal quantified conditional statements. Do not use the word necessary or sufficient.
- Squareness is a sufficient condition for rectangularity.
 - Being at least 35 years old is a necessary condition for being President of the United States.
- c. A college cafeteria line has four stations: salads, main courses, desserts, and beverages. The salad station offers a choice of green salad or fruit salad; the main course station offers spaghetti or fish; the dessert station offers pie or cake; and the beverage station offers milk, soda, or coffee. Three students, Uta, Tim, and Yuen, go through the line and make the following choices:
- Uta: green salad, spaghetti, pie, milk
 Tim: fruit salad, fish, pie, cake, milk, coffee
 Yuen: spaghetti, fish, pie, soda

Write each of following statements informally and find its truth value.

- i. \exists an item I such that \forall students S, S chose I .
- ii. \exists a student S such that \forall items I, S chose I .
- iii. \exists a student S such that \forall stations Z, \exists an item I in Z such that S chose I .
- iv. \forall students S and \forall stations Z, \exists an item I in Z such that S chose I .
- d. Define a prime number and composite number. Give symbolic definitions of the same. Disprove the following by giving two counter examples:
 - i. For all real numbers a and b , if $a < b$ then $a^2 < b^2$.
 - ii. For all integers n , if n is odd then $(n-1)/2$ is odd.
 - iii. For all integers m and n , if $2m+n$ is odd then m and n are both odd.
- e. Define divisibility. Hence prove that for all integers a, b , and c , if $a \mid b$ and $a \mid c$ then $a \mid (b+c)$ and $a \mid (b-c)$.
- f. Use the quotient-remainder theorem with $d=3$ to prove that the product of any three consecutive integers is divisible by 3. Use the mod notation to rewrite the result

3. Attempt any three of the following:

- a. i. Write the following as a single summation:

$$3 \sum_{k=1}^n (2k-3) + \sum_{k=1}^n (4-5k)$$
- ii. Write the following as a single product:

$$\left(\prod_{k=1}^n \frac{k}{k+1} \right) \cdot \left(\prod_{k=1}^n \frac{k+1}{k+2} \right)$$
- iii. Find $1(1!) + 2(2!) + 3(3!) + \dots + m(m!); m=2$
- iv. Find

$$\left(\frac{1}{1+1} \right) \left(\frac{2}{2+1} \right) \left(\frac{3}{3+1} \right) \dots \left(\frac{k}{k+1} \right); k=3$$
- v. Prove that for all nonnegative integers n and r with $r+1 \leq n$,

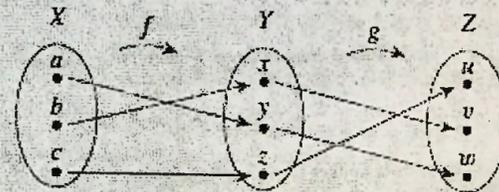
$$\binom{n}{r+1} = \frac{n-r}{r+1} \binom{n}{r}$$
- b. Prove that $7^{2n} + (2^{3n-3})(3^{n-1})$ is divisible by 25 $\forall n \in \mathbb{N}$
- c. Determine the sequence whose recurrence relation is $a_n = 4a_{n-1} + 5a_{n-2}$ with $a_1 = 2$ and $a_2 = 6$
- d. i. Define $G: J_5 \times J_5 \rightarrow J_5 \times J_5$ as follows: For all $(a, b) \in J_5 \times J_5$,

$$G(a, b) = ((2a+1) \bmod 5, (3b-2) \bmod 5)$$
 Find: $G(4, 4), G(2, 1), G(3, 2), G(1, 5)$
- ii. Let F and G be functions from the set of all real numbers to itself. Define the product functions $F \cdot G: \mathbb{R} \rightarrow \mathbb{R}$ and $G \cdot F: \mathbb{R} \rightarrow \mathbb{R}$ as follows: For all $x \in \mathbb{R}$,

$$(F \cdot G)(x) = F(x) \cdot G(x)$$

$$(G \cdot F)(x) = G(x) \cdot F(x)$$
 Does $F \cdot G = G \cdot F$? Explain.

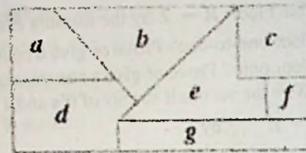
- e. i. Define Floor: $\mathbb{R} \rightarrow \mathbb{Z}$ by the formula $Floor(x) = [x]$, for all real numbers x .
 - Is Floor one-to-one? Prove or give a counterexample.
 - Is Floor onto? Prove or give a counterexample.
- ii. Let S be the set of all strings of 0's and 1's, and define $l: S \rightarrow \mathbb{Z}^{nonneg}$ by
 $l(s) =$ the length of s , for all strings s in S .
 - Is l one-to-one? Prove or give a counterexample.
 - Is l onto? Prove or give a counterexample.
- f. Let $X = \{a, c, b\}, Y = \{x, y, z\}$, and $Z = \{u, v, w\}$. Define $f: X \rightarrow Y$ and $g: Y \rightarrow Z$ by the arrow diagrams below.



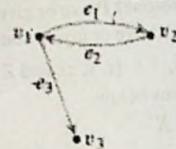
Find: $g \circ f, (g \circ f)^{-1}, f^{-1} \circ g^{-1}, f^{-1} \circ g^{-1}$
 How $(g \circ f)^{-1}$ and $f^{-1} \circ g^{-1}$ are related?

4. Attempt any three of the following:

- a. Draw the directed graph for the following relations:
 - i. A relation R on $A = \{0, 1, 2, 3\}$ by $R = \{(0, 0), (1, 2), (2, 2)\}$.
 - ii. Let $A = \{2, 3, 4, 5, 6, 7, 8\}$ and define a relation R on A as follows:
 For all $x, y \in A, x R y \Leftrightarrow x \mid y$.
- b. Determine whether the following relations are reflexive, symmetric, transitive or none of these. Justify your answer.
 - i. R is the "greater than or equal to" relation on the set of real numbers:
 For all $x, y \in \mathbb{R}, x R y \Leftrightarrow x \geq y$.
 - ii. D is the relation defined on \mathbb{R} as follows:
 For all $x, y \in \mathbb{R}, x D y \Leftrightarrow xy \geq 0$.
- c. Let \mathbb{R} be the set of all real numbers and define a relation R on $\mathbb{R} \times \mathbb{R}$ as follows: For all (a, b) and (c, d) in $\mathbb{R} \times \mathbb{R}, (a, b) R (c, d) \Leftrightarrow$ either $a < c$ or both $a = c$ and $b \leq d$. Is R a partial order relation? Prove or give a counterexample.
- d. Imagine that the diagram shown below is a map with countries labeled $a-g$. Is it possible to color the map with only three colors so that no two adjacent countries have the same color? To answer this question, draw and analyze a graph in which each country is represented by a vertex and two vertices are connected by an edge if, and only if, the countries share a common border.



e. i. Find the adjacency matrix of the following graph:



ii. Find directed graphs that have the following adjacency matrix:

$$\begin{bmatrix} 1 & 0 & 1 & 2 \\ 0 & 0 & 1 & 0 \\ 0 & 2 & 1 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix}$$

f. For the following either draw the graph as per the specifications or explain why no such graph exists:

- i. Graph, circuit-free, nine vertices, six edges
- ii. Tree, six vertices, total degree 14
- iii. Tree, five vertices, total degree 8
- iv. Graph, connected, six vertices, five edges, has a nontrivial circuit
- v. Graph, two vertices, one edge, not a tree

5. Attempt *any three* of the following:

- a. There are four bus lines between A and B and three bus lines between B and C. In how many ways can a man travel
 - i. by bus from A to C by way of B?
 - ii. round-trip by bus from A to C by way of B?
 - iii. round-trip by bus from A to C by way of B if he does not want to use a bus line more than once?
- b.
 - i. How many ways can the letters of the word ALGORITHM be arranged in a row?
 - ii. How many ways can the letters of the word ALGORITHM be arranged in a row if A and L must remain together (in order) as a unit?
 - iii. How many ways can three of the letters of the word ALGORITHM be selected and written in a row?
 - iv. How many ways can six of the letters of the word ALGORITHM be selected and written in a row if the first letter must be A?
 - v. How many ways can the letters of the word ALGORITHM be arranged in a row if the letters GOR must remain together (in order) as a unit?

15

- c.
 - i. If 4 cards are selected from a standard 52-card deck, must at least 2 be of the same suit? Why?
 - ii. If 5 cards are selected from a standard 52-card deck, must at least 2 be of the same suit? Why?
 - iii. A small town has only 500 residents. Must there be 2 residents who have the same birthday? Why?
 - iv. Given any set of four integers, must there be two that have the same remainder when divided by 3? Why?
 - v. Given any set of three integers, must there be two that have the same remainder when divided by 3? Why?
- d.
 - i. How many distinguishable ways can the letters of the word HULLABALOO be arranged in order?
 - ii. How many distinguishable orderings of the letters of HULLABALOO begin with U and end with L?
 - iii. How many distinguishable orderings of the letters of HULLABALOO contain the two letters HU next to each other in order?
- e. A bakery produces six different kinds of pastry, one of which is eclairs. Assume there are at least 20 pastries of each kind.
 - i. How many different selections of twenty pastries are there?
 - ii. How many different selections of twenty pastries are there if at least three must be eclairs?
 - iii. How many different selections of twenty pastries contain at most two eclairs?
- f. A drug-screening test is used in a large population of people of whom 4% actually use drugs. Suppose that the false positive rate is 3% and the false negative rate is 2%. Thus a person who uses drugs tests positive for them 98% of the time, and a person who does not use drugs tests negative for them 97% of the time.
 - i. What is the probability that a randomly chosen person who tests positive for drugs actually uses drugs?
 - ii. What is the probability that a randomly chosen person who tests negative for drugs does not use drugs?

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1. Attempt any three of the following: 15
 a. Discuss the seven Cs of effective communication.
 b. What is conferencing? Explain different types of conferencing.
 c. Explain the stages in developing relationships through interpersonal communication.
 d. Discuss Dysfluency and Tempo/Pacing, the sub-categories of paralanguage.
 e. What is the role of proxemics in non-verbal communication? Explain.
 f. Distinguish between the attributes of high-context and low-context cultures.
2. Attempt any three of the following: 15
 a. Explain the five main stages of writing business messages.
 b. Discuss the different strategies for writing the body of a business letter.
 c. What are different types of audience? Discuss the factors required for audience analysis.
 d. State and explain the steps in writing a routine business report.
 e. List and explain the ten resume mistakes that must be avoided.
 f. Explain the different barriers that create listening barriers.
3. Attempt any three of the following: 15
 a. What are the purposes of a conference? Explain the different points to be considered for effectively conducting a conference.
 b. Enumerate the different steps involved in a Group Discussion. Discuss the critical success factors in a group discussion.
 c. What is team briefing? How can it be made effective?
 d. What is marketing communication? How does it work?
 e. State and explain the activities involved in branding a project.
 f. What is financial communication? What are its constituents? Explain.
4. Attempt any three of the following: 15
 a. What is corporate citizenship and social responsibility? How does CSR fit with PR?
 b. How can advertisements be planned for better results?
 c. What are different approaches to effective negotiation? Explain the six steps of negotiations.
 d. Explain the different ethical perspectives in communication.
 e. Explain the rules of grammar that would be helpful in business communication.
 f. Explain the functions performed by comma.
5. Attempt any three of the following: 15
 a. What is mind-map? How is it useful in presentations? Explain. What should be included in the conclusion of a presentation?
 b. How can presentations be made more effective?
 c. Discuss the success factors in business presentation.
 d. What are the different type of graphics used in presentations? Explain.
 e. Why use of font, colour and layout is important in the impress stage of presentation?
 f. Explain concept map with an example.