

PREBOARD EXAMINATION PAPER

COMPUTER SCIENCE PAPER I

(THEORY)

Maximum Marks: 70

Time Allowed: Three hours

*(Candidates are allowed additional 15 minutes for only reading the paper.
They must NOT start writing during this time.)*

*Answer all questions in Part I (compulsory) and six questions from Part-II, choosing two questions from Section-A, two from Section-B and two from Section-C.
All working, including rough work, should be done on the same sheet as the rest of the answer.*

The intended marks for questions or parts of questions are given in brackets [].

PART - I (20 MARKS)

Answer all questions.

While answering questions in this Part, indicate briefly your working and reasoning, wherever required.

Question 1

(10×1)

(i) The expression for distributive law is:

[1]

- (a) $A(B + C) = A \cdot B + (A + C)$
- (b) $A(B + C) = A \cdot B + A \cdot C$
- (c) $A(B + C) = (A + B) \cdot (A + C)$
- (d) $A(B + C) = (A + B) + (A \cdot C)$

(ii) **Assertion (A):** The dual relation for the boolean relation $A + AB(C + A'D)$ is obtained as $A \cdot (A + B) + \{C \cdot (A' + D)\}$

[1]

Reason (R): According to the principle of Duality, the dual relations of the boolean postulates or theorems are equally true.

Based on the above discussion, choose an appropriate statement from the options given below:

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is a correct explanation of Assertion (A).
- (b) Both Assertion (A) and Reason (R) are true and Reason (R) is not a correct explanation of Assertion (A).
- (c) Assertion (A) is true and Reason (R) is false.
- (d) Assertion (A) is false and Reason (R) is true.

(iii) The expression for the sum of full adder is:

[1]

- (a) $A'B'C + A'BC' + AB'C' + ABC$
- (b) $A'BC + A'BC' + AB'C' + ABC$
- (c) $AB'C + A'BC' + AB'C' + ABC$
- (d) $A'B'C + A'BC' + A'B'C' + ABC$

$a \oplus b \oplus c$			
a	b	c	Sum
0	0	0	0
0	0	1	1 A'B'C
0	1	0	1 A'BC'
0	1	1	0 A'BC
1	0	0	1 ABC'
1	0	1	0
1	1	0	0
1	1	1	1 ABC

[1]

(iv) The converse of the expression $(\sim P \Rightarrow Q)$ is:

- (a) $Q \Rightarrow P$
- (b) $Q \Rightarrow \sim P$
- (c) $\sim Q \Rightarrow \sim P$
- (d) $\sim Q \Rightarrow P$

(v) Super keyword in Java is used to:

- (a) Refer immediate parent class instance variables.
- (b) Invoke immediate parent class methods.
- (c) Invoke immediate parent class constructor
- (d) All of the above.

[1]

22

(vi) Assertion(A) : In overriding, the methods having the same names are defined in different class.
Reason(R) : Method Overriding is an example of run time polymorphism.

Based on the above discussion, choose an appropriate statement from the options given below.

- (a) Both Assertion (A) and Reason(R) are true and Reason(R) is the correct explanation of Assertion (A)
- (b) Both Assertion (A) and Reason(R) are true and Reason(R) is not the correct explanation of Assertion (A)
- (c) Assertion (A) is true and Reason(R) is false
- (d) Assertion (A) is false and Reason(R) is true

[1]

(vii) Given $F(X,Y,Z) = (X'+Y')(Y+Z)$

Write the function in canonical product of sum(POS) form.

[1]

(viii) Draw the truth table and logic circuit for a 2-input XNOR gate.

[1]

(ix) Find the complement of the following expression

$$X'+XY'$$

[1]

(x) Given : x = it is raining .
 y = Sky is not clear

if $x \rightarrow y$ then write its :-

- (a) Converse
- (b) Contrapositive

[1]

Question 2

(10 marks)

(i) In what way a static data is different than instance variable of a class ?

[2]

(ii) Convert the following infix expression into its postfix form:

$$A/(B+C)+D*(E-F)$$

[2]

(iii) With reference to the code given below, answer the questions that follow along with dry run/ working .

boolean check (int number)

$n = 28$

{
if(number<1) *if not false sum=0 for*

{
return false ;
}

int sum=0;
for(int i=1;i<=number/2;i++)

{
if(number % i==0)
{
sum+=i
}

}
return sum==number;
}

(a) What will the function check() return when the value of number=28 ?

[2]

(b) What is the function check() performing ?

[1]

(iv) The following function is a part of a class which accepts two numbers and computes the result as the input values . There are some places in the code marked as ?1?, ?2?, ?3? which should be replaced by a statement /expression so that the function executes properly .

class Check

```
{  
int get(int a,int b) ? 2  
{  
if (b==1)  
return(a--);
```

else

return(++a + get(a,--b));

3 + get(2, 1)

2, 7, 4
3 + get(2, 4)
3
4
5
2
1

What will be the result of the above task when the variables are assigned with the following values?

(i) (7, 2)

(ii) (5, 2)

(iii) (2, 5)

[3]

15

11

22

PART - II (50 MARKS)

Answer six questions in this part, choosing two questions from Section A, two from Section B and two from Section C.

Section A (20 marks)

Answer any two questions.

(10 marks)

Question 3

(i) Given the Boolean function $F(A, B, C, D) = \Sigma(4, 6, 7, 10, 11, 12, 14, 15)$

(a) Reduce the above expression by using 4-variable Karnaugh's-Map, showing the various groups. (i.e. octets, quads and pairs).

(b) Draw the logic gate diagram of the reduced expression. Assume that the variables and their complements are available as inputs. [5]

(ii) Given the Boolean function: $F(P, Q, R, S) = \pi(0, 5, 7, 8, 10, 12, 13, 14, 15)$

(a) Reduce the above expression by using 4-variable Karnaugh's-Map, showing the various groups. (i.e. octets, quads and pairs).

(b) Draw the logic gate diagram of the reduced expression. Assume that the variables and their complements are variables as inputs. [5]

(10 marks)

Question 4

(i) The Principal of a school intends to select students for admission to class XI based on the following criteria:

(a) Student is of the same school and has passed the class X Board Examination with more than 60% marks.

Or

(b) Student is of the same school and has passed the class X Board Examination with less than 60% marks but has taken active part in co-curricular activities.

Or

(c) Student is not from the same school and has passed the class X Board Examination with more than 60% marks but has participated in sports at the National level.

The inputs are:

Inputs

S : Students of the same school.

P : Has passed the class X Board Examination with more than 60% marks.

C : Has taken active part in co-curricular activities.

T : Has participated in sports at the National level.

Output:

X - denotes admission status [1 indicates granted and 0 indicates refused in all these cases.]

Draw the truth table for the inputs and outputs given above and write the SOP expression. [5]

(ii) Reduce $X(S, P, C, T)$ using Karnaugh's Map.

Draw the logic gate diagram for the reduced SOP expression for $X(S, P, C, T)$ using AND and OR gates. You may use gates with two or more inputs. Assume that the variables and their complements are available as inputs. [5]

Question 5

(10)

- (i) Verify algebraically if, $X'Y'Z' + X'YZ' + X'YZ + XY'Z' + XY'Z = X' + Y'$ [3]
- (ii) Represent the Boolean expression $X + YZ'$ with the help of NOR gates only. [2]
- (iii) Define the terms Contingency, Contradiction and Tautology [3]
- (iv) Consider the following truth table where A and B are two Inputs and X is the Output [2]

(a) Write expression and draw the logic gate for the given truth table.

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

$z' y' z' + z' y z' + x y z'$
 $x' z' (y' + y) + x y z'$
 $x' z' 1 + x y z'$

$z' (x + x y')$
 $z' x'$

(b) Write the POS of X (A,B).

$z' x'$
 $=$

SECTION-B [20 marks]

Answer any two questions

Each program should be written in such a way that it clearly depicts the logic of the problem. This can be achieved by using mnemonic names and comments in the program.

(Flowcharts and algorithm are not required)

The program must be written in java

Question-6

(10 marks)

Input a sentence from the user and count the number of times, the word "an" and "and" are present in the sentence. Design a class Frequency using the description given below.

Class Name

Frequency

Data members /Instance Variables

text
countand
countan
len

:- stores the sentence
 :- to store the frequency of the "and"
 :- to store the frequency of the "an"
 :- stores the length of the string

Member methods/functions

Frequency ()
 void accept(String n)

 void checkandfreq()
 void checkanfreq()
 void display()

: constructor to initialise the instant variables
 : to assign n to text, where value of the parameter n should be in lowercase.
 : to count the frequency of "and"
 : to count the frequency of "an"
 : to display the number of "and" and "an" with appropriate messages.

Specify the class Frequency giving details of the constructor(), void accept(String), void checkandfreq(), void checkanfreq() and void display(). Also define the main function to create an object and call methods accordingly to enable the task.

[10]

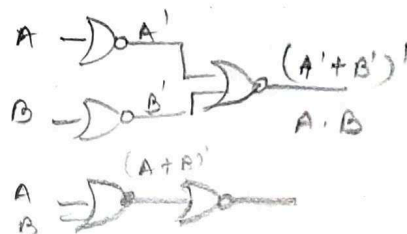
Question-7

(10 marks)

A class Decioct has been defined to convert a decimal number into its equivalent octol number. Some of the members of the class are given below.

Class name

: Decioct



members/Insta
 oct
 member functi
 DeciOct

Data members/Instance variables

n : stores the decimal number
oct : stores the octal number

Member functions/methods

DeciOct() : constructor to initialise data members n and oct with 0
void getnum(int nn) : assigns nn to n
void deci_oct() : calculates the octal equivalent of n and stores in oct using the recursive technique
void show() : displays the decimal number n, calls the function deci_oct() and displays its octal equivalent.

- (i) Specify the class **DeciOct**, giving details of the constructor(), void **getnum(int)**, void **deci_oct()** and void **show()**. Also define a **main()** function to create an object and call the functions accordingly to enable the task. [8]
(ii) State any two disadvantages of using recursion. [2]

Question 8

(10 marks)

You are given a sequence of N integers, which are called as pseudo arithmetic sequences (sequences that are in arithmetic progression).

Sequence of N integers : 2,5,6,8,9,12

We observe that $2 + 12 = 5 + 9 = 6 + 8 = 14$.

The sum of above sequence can be calculated as $14 \times 3 = 42$

For sequence containing odd number of elements, the rule is to double the middle element.

For example, 2, 5, 7, 9, 12 = $2 + 12 = 5 + 9 = 7 + 7 = 14$

$14 \times 3 = 42$ [middle element is 7]

A class **Pseudoarithmetic** determines whether a given sequence is a pseudo arithmetic sequence.

Class name : **Pseudoarithmetic**

Data members/Instance variables

n : to store the size of the sequence
a[] : integer array to store the sequence of the numbers
ansflag : stores the status
sum : stores the sum of the two numbers

Member functions/methods

Pseudoarithmetic() : default constructor
void accept(int nn) : to assign nn to n and create an integer array. Fill in the elements of the array.
boolean check() : returns true if the sequence is a pseudo arithmetic sequence, otherwise returns false

Specify the class **Pseudoarithmetic**, giving details of the constructor(), void **accept(int)** and **Boolean check()**. Also define a **main()** function to create an object and call the member functions accordingly to enable the task. [10]

Section C (10 marks)

Answer any two questions.

Each program should be written in such a way that it clearly depicts the logic of the problem stepwise. This can be achieved by using comments in the program and mnemonic names or pseudo codes for algorithms. The programs must be written in Java and the algorithms must be written in general/standard form, wherever required/specified.

(Flowcharts are not required.)

Question 9

A library issues books on a rental basis at a 2% charge on the cost price of the book per day . As per the rules of the library , a book can be retained for 7 days without any fine . if the book is returned after 7 days , a fine will also be charged for the extra days as per the chart given below :

Number of extra days	Fine per day
1 to 5	Rs. 2.00
6 to 10	Rs. 3.00
Above 10 days	Rs. 5.00

Design a class **Library** and another class **Compute** to perform the task .

Details of both the classes are given below

Class name : **Library**

Data members /Instance variables

name : name of the book
author : author of the book
P : price of the book in decimals

Member functions/Methods

Library(..) : Parameterised constructor to assign values to data members .

void show() display the book details

Class name : **Compute**

Data members /Instance variables

d : number of days taken in returning the book
f : to store the fine

Member functions/Methods

Compute(....) : Parameterised constructor to assign values to data members of both the classes.

void fine() : calculates the fine for extra number of days

void display() : displays the book details along with the number of days , fine and total amount to be paid .

Total amount is calculated as : $(2\% \text{ of price of book } * \text{ total no. of days }) + \text{fine}$

Specify the class **Library** giving details of the constructor() and void show() . Using the concept of

Inheritance , Specify the class **compute** giving details of the of the constructor (), void fine() and the void display() function. You need not write the main() function .

[5]

Question 10

Queue is an entity which can hold a maximum of 1000 integers. The queue enables the user to add integers from the rear and remove integers from the front . Define a class **Queue** with the following details :

Class Name : **Queue**

Data Members /Instance variables

Que[] : array to hold the integer elements

size : stores the size of the array

front : to point the index of the front

rear : to point the index of the rear

Member functions/methods

Queue (int nn) : constructor to initialise the data members size=nn, front =-1 rear=-1

void addelm(int p) : to add integer from the rear if possible else display the message "Overflow"

void delelm() : returns elements from front if present, otherwise displays the message "Underflow" and return -999

void display() : displays the array elements .

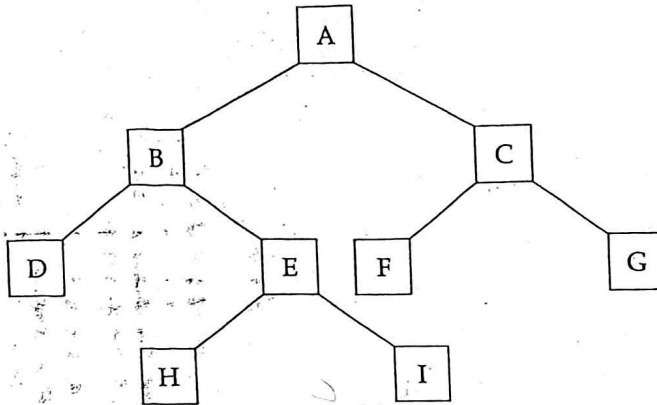
As per the
part 7

Specify the class `Queue` giving details of ONLY the functions `void addelm(int)` and `int delelm()`. Assume that the other functions have been defined. The `main()` function and algorithm need NOT be written. [5]

Question 11

(5 marks)

Answer the following from the diagram of a binary tree given below:



- (a) Root of the tree
- (b) External nodes of the tree
- (c) Inorder traversal of the tree
- (d) Left subtree
- (e) Height of the tree

[5]