

**I PRE BOARD EXAMINATION
COMPUTER SCIENCE**

**Paper 1
(THEORY)
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 questions from Section B,
two questions from Section C.*

*All working including rough work, should be done on the same sheet as the
rest of the answers.*

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

PART - I

Attempt all questions.

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

Question 1

- (i) The law which represents the Boolean equation $A + AB = A$ is : [1]
- (a) Associative Law
 - (b) Distributive Law
 - (c) Commutative Law
 - (d) Absorption Law
-

This paper consists of 12 printed pages.

(ii) **Assertion:** $A = 0$ $B = 1$ $C = 0$ and $D = 1$ and minterm is $A' \cdot B \cdot C' \cdot D$ [1]

Reason : The final sum term must be 0 so A and C are complemented.

Which one of the following options is correct?

- (a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.
- (b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.
- (c) Assertion is true and Reason is false.
- (d) Assertion is false and Reason is true.

(iii) The dual of the Boolean equation $(X \cdot Y) \cdot 1 = XY$ is : [1]

- (a) $X+Y+0$
- (b) $X \cdot Y + 0 = X \cdot Y$
- (c) $(X \cdot Y) + 1 = X \cdot Y$
- (d) $(X+Y) + 0 = X+Y$

(iv) The compliment of the Boolean expression $F(P, Q, R) = (P \cdot Q \cdot R)$ is : [1]

- (a) $P'Q'R'$
- (b) $P' + Q' + R'$
- (c) $P + (Q' + R')$
- (d) $(P + Q) + R'$

(v) Decoders are used for : [1]

- (a) Adding two bits
- (b) Converting Decimal to Binary
- (c) Converting Binary to Decimal
- (d) Data transmission

- (vi) **Assertion:** Boolean algebra and Binary number system are different from each other
Reason : There are some basic operations like AND, OR and NOT which are performed only in Boolean algebra. [1]
- (a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.
(c) Assertion is true and Reason is false.
(d) Assertion is false and Reason is true.
- (vii) State any one purpose of using the keyword super in Java programming. [1]
(viii) State any one purpose of using interfaces in Java programming. [1]
(ix) Define Canonical form of an expression with respect to its Cardinal form. [1]
(x) What is a linked list? [1]

Question 2

- (i) Convert the following into postfix form : [2]
 $(A - B) * (C / D) + E$
- (ii) Each element of an array Data[30][40] requires 4 bytes of storage. If the base address of Data[0][0] is 3000, determine the location of Data[10][10] when the array is stored as column major wise. [2]
- (iii) With reference to the code given below answer the questions that follow :
- ```
int Check(int m, int n)
{
if(n == 1)
return - m --;
else
return ++m + Check(m, -- n);
}
```

(a) What will the function Check() return when the values of both m and n are equal to 5? [2]

(b) What is the method Check() computing? [1]

(iv) The following function is a part of some class which computes and returns the value of a number 'p' raised to the power 'q' ( $p^q$ ). There are some places in the code marked by ?1?, ?2?, ?3? which must be replaced by an expression / a statement so that the function works correctly.

```
double power (double p , int q)
{
 double r = ?1? ;
 int c = (q < 0) ? -q : q ;
 if (q == 0)
 return 1 ;
 else
 {
 for (int i = ?1? ; i <= c ; ?2? , i++) ;
 return (q > 0) ? r : ?3? ;
 }
}
```

(a) What is the expression or statement at ?1? [1]

(b) What is the expression or statement at ?2? [1]

(c) What is the expression or statement at ?3? [1]



**PART - II [50 MARKS]**

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

**SECTION - A**

*Answer any two questions.*

**Question 3**

(i) A passenger is allotted a window seat in an aircraft, if he/she satisfies the criteria given below :

- The passenger is below 15 years and is accompanied by an adult.

OR

- The passenger is a lady and is not accompanied by an adult.

OR

- The passenger is not below 15 years, but is travelling for the first time.

The inputs are: -

**INPUTS:**

A : The passenger is below 15 years of age

C : The passenger is accompanied by an adult

L : The passenger is a lady

F : The passenger is travelling for the first time

(In all the above cases 1 indicates yes and 0 indicates no).

**OUTPUT:**

W - Denotes the passenger is allotted a window seat

(1 indicates yes and 0 indicates no).

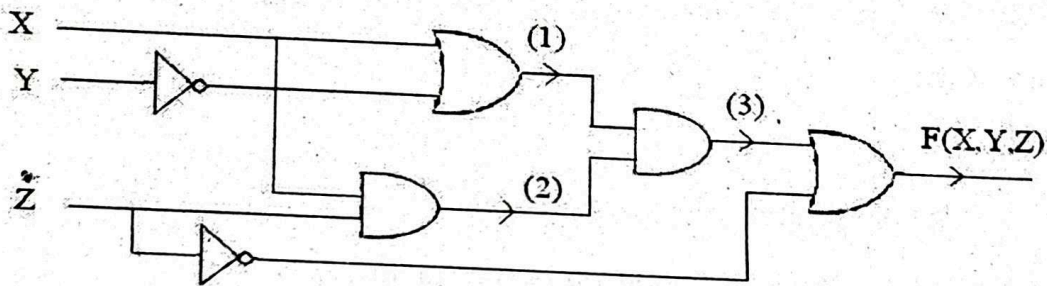
(i) Draw the truth table for the inputs and outputs given above and write the SOP expression for  $W(A, C, L, F)$ . [5]

(ii) Reduce the above expression  $W(A, C, L, F)$  by using 4-variable Karnaugh map, showing the various groups (i.e. octal, quads and pairs).

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

**Question 4**

- (i) (a) Reduce the Boolean function  $F(A, B, C, D) = \pi(0, 1, 2, 3, 5, 7, 8, 9, 10, 11)$  by using 4-variable Karnaugh map, showing the various groups (i.e. octal, quads and pairs). [4]
- (b) Draw the logic gate diagram for the reduced expression. Assume that the variables and their complements are available as inputs. [1]
- (ii) (a) From the logic circuit diagram given below, name the outputs (1), (2) and (3) and finally derive the Boolean expression (F) and simplify it. Identify the propositional connective which is equivalent to the simplified Boolean expression. [4]



- (b) If  $A = 1$  and  $B = 0$  then find the value of  $(A' + 1) \cdot B$ . [1]

**Question 5**

- (i) Draw the logic circuit to encode the following Hexadecimal number (1, 3, 5, 6, 9, A, C, E) to its binary equivalents. Also state the binary equivalents of the given numbers. [5]
- (ii) Verify if the following proposition is valid using the truth table : [3]  
 $A \Rightarrow (B \wedge C) = (A \Rightarrow B)$
- (iii) How is a 2 to 4 decoder related to 4:1 multiplexer? [2]



## SECTION - B

*Answer any two questions*

*Each program should be written in such a way that its clearly depicts the logic of the problem.*

This can be achieved by using mnemonic name and comments in the program.

(Flowcharts and Algorithms are **not** required)

**The programs must be written in Java.**

### Question 6

[10]

A Special number is a number in which the sum of the factorial of its digits is equal to the number. Example 145 ( $1! + 4! + 5! = 145$ ). Thus, 145 is a special number. Design a class Special to check if the given number is a Special number or not. Some of the members of the class are given below :

Class name : Special

Data members

n : integer to store the number

Member functions

Special() : default constructor void

read() : to accept the number

int factorial(int x) : return the factorial of a number using recursion technique

boolean isSpecial() : checks for the special number by invoking the function factorial() and returns true if Special, otherwise returns false.

void display() : to show the result with an appropriate message

Specify the class Sort giving details of the constructor, void readword(), void arrange() and void display().

Define the main function to create an object and call the functions accordingly to enable the task.

**Question 7**

[10]

Two matrices are said to be equal if they have the same dimension and their corresponding elements are equal.

For example the two matrices A and B given below are equal :

Matrix A

|   |   |   |
|---|---|---|
| 1 | 2 | 3 |
| 2 | 4 | 5 |
| 3 | 5 | 6 |

Matrix B

|   |   |   |
|---|---|---|
| 1 | 2 | 3 |
| 2 | 4 | 5 |
| 3 | 5 | 6 |

Design a class **EqMat** to check if two matrices are equal or not. Assume that the two matrices have the same dimension.

Some of the members of the class are given below:

- Class name : EqMat
- Data members/instance variables :
  - a[ ][ ] : to store integer elements
  - m : to store the number of rows
  - n : to store the number of columns
- Member functions/methods :
  - EqMat(int mm, int nn) : parameterised constructor to initialise the data members m = mm and n = nn
  - void readarray() : to enter elements in the array
  - int check(EqMat P, EqMat Q) : checks if the parameterized objects P and Q are equal and returns 1 if true, otherwise returns 0
  - void print() : displays the array elements

Define the class EqMat giving details of the constructor( ), void readarray( ), int check(EqMat, EqMat) and void print( ). Define the main( ) function to create objects and call the functions accordingly to enable the task.



**Question 8**

[10]

A class Encode has been defined to replace only the vowels in a word by the next corresponding vowel and form a new word.

i.e.  $A \rightarrow E, E \rightarrow I, I \rightarrow O, O \rightarrow U, U \rightarrow A$  and  
 $a \rightarrow e, e \rightarrow i, i \rightarrow o, o \rightarrow u,$  and  $u \rightarrow a$

Example :    Input     :    Institution  
              Output    :    Onstotatoun

Some of the members of the class are given below:

Class name         :    Encode

Data members/instance variables :

word                :    to store a word  
length              :    integer to store the length of the word  
new\_word           :    to store the encoded word

Methods / Member functions:

Encode()            :    default constructor to initialize data members with legal initial values  
void acceptWord() :    to accept a word  
void nextVowel() :    to replace only the vowels from the word stored in 'word' by the next corresponding vowel and to assign it to 'newword', with the remaining alphabets unchanged  
void display()     :    to display the original word along with the encrypted word

Specify the class Encode giving details of the constructor(), void acceptWord(), void nextVowel() and void display(). Define a main () function to create an object and call the functions accordingly to enable the task.

## SECTION - C

Answer only **two** questions.

Each program should be written in such a way that it clearly depicts the logic of the problem stepwise.

This can also be achieved by using comments in the program and mnemonic names or pseudocodes for algorithms. The program must be written in Java and the algorithms must be written in general/standard form, wherever required/ specified.

(Flowcharts are **not** required)

### Question 9

Register is an entity which can hold a maximum of 100 names. The register enables the user to add and remove names from the top most end only.

Define a class Register with the following details :

Class name : Register

Data members / instance variables:

stud[ ] : array to store the names of the students

cap : stores the maximum capacity of the array

top : to point the index of the top end

Member functions :

Register (int max) : constructor to initialize the data member  
cap = max, top = -1 and create the string array

void push(String n) : to add names in the register at the top location if possible, otherwise display the message  
"OVERFLOW"

String pop() : removes and returns the names from the top most location of the register if any, else returns "\$\$"

void display() : displays all the names in the register

(a) Specify the class Register giving details of the functions void push(String) and String pop(). Assume that the other functions have been defined. [4]

The main function and algorithm need NOT be written.

(b) Name the entity used in the above data structure arrangement. [1]



### Question 10

A super class Bank has been defined to store the details of the customer. Define a subclass Account that enables transactions for the customer with the bank. The details of both the classes are given below:

class Name : Bank

Data Members

name : stores the name of the customer

accno : stores the account number

p : stores the principal amount in decimals

Member functions

Bank(...) : parameterized constructor to assign values to the instance variables.

void display() : displays the details of the customer

Class name : Account

Data members

amt : stores the transaction amount in decimals

Member Functions

Account(...) : parameterized constructor to assign values to the instance variables of both classes.

void deposit() : accepts the amount and updates the principal as  
 $p = p + \text{amt}$

void withdraw() : accepts the amount and updates the principal as  
 $p = p - \text{amt}$

If the withdrawal amount is more than the principal amount, then display the message "Insufficient balance". If the principal amount after withdrawal is less than 500, then a penalty is imposed by using the formula  $p = p - (500p)/10$ .

void display() : displays the details of the customer.

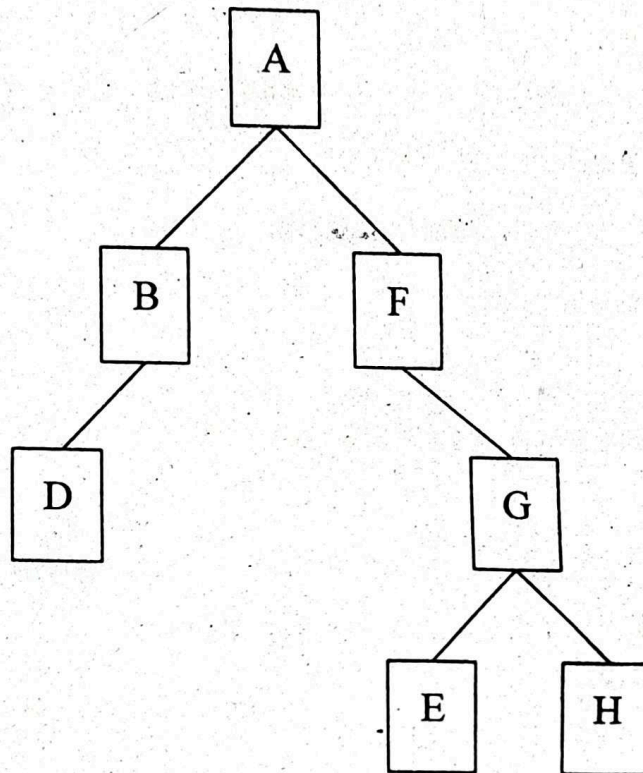
Assume that the super class Bank has been defined. Using the concept of inheritance, specify the class Account giving details of the constructor(...), void deposit ( ), void withdraw() and void display ( ).

The super class and main function need not be written.

[5]

**Question 11**

- (i) With the help of an example, briefly explain the constant factor in time complexity. [2]
- (ii) Answer the following questions from the diagram of a Binary Tree given below :



- (a) Name the external nodes of the right sub tree. [1]
- (b) State the size and depth of the tree. [1]
- (c) Write the post-order traversal of the above tree structure. [1]

#####