

MARTHOMA RESIDENTIAL SCHOOL  
Second Model Examination - Jan 2019

Class-XII

Computer Science

Time: 3 hrs  
Marks: 70

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**

- (a) State the duality principle and find the dual of  $(a+b').c.1=a.c+b'.c.$  [1]  
(b) Verify if the following proposition is valid using truth table [1]  
 $(a \Rightarrow b) \wedge (a \Rightarrow c) = a \Rightarrow (b \wedge c)$   
(c) Find the complement of following expression  $F = p' + pq'$  [1]  
(d) If  $A=0, B=1, C=0, D=1$  find its (i) minterm (ii) maxterm [1]  
(e) State 2 absorption laws. Verify anyone of them using truth table [1]

**Question 2**

- (a) What are the different types of errors in Java. What do you mean by fall through? [2]  
(b) What is a linked list? What is the purpose of *implements* keyword? [2]  
(c) Convert the following *infix notation* to *postfix* form: [2]  
 $P + (Q / R - S * T) / A$   
(d) What do you mean by wrapper class? Define copy constructor.

- (e) Each element of an array  $arr[-15 \dots 10, 15 \dots 40]$  requires one byte of storage. If the array is stored Row Major Order with the beginning location 1500, determine the location of  $arr[5, 20]$ .

**Question 3**

- (a) The following functions `show()` and `calling()` are a part of some class. Assume that the parameter greater than 1 when the function is invoked. It returns the value 1 when true otherwise it return  
Answer the following questions with dry run / working.

```
void calling( int i)
{
int f = 2;
int c=show(n,f);
}
int show (int n , int f)
{
if (n==f)
return 1;
if(n%f == 0 || n ==1)
```

```

return 0;
else
return show( n,f+1 );
}

```

- i) What will the function show( ) returns when the value of n is 11 ?
- ii) What will the function show( ) returns when the value of n is 27 ?
- iii) State in one line that what the function show(...) do apart from recursion?

**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**

*Answer any two questions.*

**Question 4**

(a) Given the Boolean function  $F(A, B, C, D) = \sum(0, 2, 5, 7, 8, 10, 11, 13, 14, 15)$

(i) Reduce the above expression by using 4-variable Karnaugh map, showing the various groups (octal, quads and pairs).

(ii) Draw the logic gate diagram for the reduced expression. Assume that the variables and complements are available as inputs.

(b) Given the Boolean function  $F(P, Q, R, S) = \prod(0, 1, 2, 3, 5, 7, 9, 13)$

(i) Reduce the above expression by using 4-variable Karnaugh map, showing the various groups (octal, quads and pairs).

(ii) Draw the logic gate diagram for the reduced expression. Assume that the variables and complements are available as inputs.

**Question 5**

A government institution intends to award a medal to a person who qualifies any one of the following criteria:

The person should have been an Indian citizen and had lost his/her life in a war but has not completed 25 years of service.

OR

The person must be an Indian citizen and has served the nation for a continuous period of 25 years or more but has not lost his/her life in a war.

OR

The person is not an Indian citizen but has taken active part in activities for the upliftment of the nation.

The inputs are:

**INPUTS**

I: The person is/was an Indian citizen

S: Has a continuous service of more than 25 years

L: Lost his/her life in a war

U: Taken part in activities for upliftment of the nation

Output M Denotes eligible for medal [ 1 indicates YES and 0 indicates NO in all cases] a) Draw the truth table for the inputs and outputs given above and write the POS expression for  $M(I, S, L, U)$

- (b) (i) Differentiate between XOR and XNOR gate. State any two applications of multiplexer. [3]  
(ii) Draw the logic gate diagram for 3 input function  $F(x,y,z)$  using NOR gates only.. [2]  
 $F(x,y,z) = \sum(0,1,3,4,7)$

#### Question 6

- (a) Derive a POS expression for SUM and CARRY in half adder and draw its logic circuit. [2]  
(b) Draw the truth table and logic gate diagram of a 3 x 8 decoder. [3]  
(c) What are maxterms? Convert the following cardinal expression into its canonical form and reduce it using boolean laws  $F(a,b,c,d) = \prod(0,2,8,10)$  [5]

### SECTION – B

*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 Algorithms are **not** required.)

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

#### Question 7

A class called **EvenSeries** has been defined to find the smallest value of integer,  $n$ , such that,  
 $2 + 4/2! + 8/3! + 16/4! + \dots + 2^n / n! \geq S$ , where  $2.0 < S < 7.0$ . Some of the members of the class **EvenSeries** are given below:

Class name : **EvenSeries**

Data members:

$n$  : long integer type to store number of terms.

$S$  : float variable where  $2.0 < S < 7.0$ .

$k$  : float variable to store the value of series evaluated.

Member functions: **EvenSeries()** : constructor to initialize data members to 0.

**void accept()** : to accept value of data member  $S$ .

**long fact(long x)** : to compute and return factorial of  $x$ .

**void disp()** : calculates and displays the least value of  $n$ .

Specify the class **EvenSeries** giving details of the constructor and functions **void accept()**, **long fact(long x)** and **void disp()**. **The main function need not be written.**

#### Question 8

Class **Convert** has been defined to express digits of an integer in words. The details of the class are below:

Class name : **Convert**

Data members

$n$  : integer whose digits are to be expressed in words.

Member functions

**Convert()** : constructor to assign 0 to  $n$ .

**void inpnumber()** : to accept the value of  $n$ .

**void extractdigit(int)** : to extract the digits of  $n$  using **recursive technique**.

**void num\_to\_words(int)** : to display the digits of an integer in words.

Specify the class **Convert** giving details of the constructor and function **void inpnumber()**, **void extractdigit(int)** and **void num\_to\_words(int)**. **The main function need not be written.**

### Question 9

The co-ordinates of a point P on a two-dimensional plane can be represented by P(x,y) with x as the x co-ordinate and y as the y co-ordinate. The co-ordinates of midpoint of two points P1(x1,y1) and P2(x2,y2) can be calculated as P(x,y) where:  $x=(x1+x2)/2$ ,  $y=(y1+y2)/2$

Design a class **Point** with the following details:

Class name : Point

Data members

x : stores the x co-ordinate

y : stores the y co-ordinate

Member functions:

Point( ) : constructor to initialize x=0 and y=0

void readPoint( ) : accepts the co-ordinates x and y of a point

Point midpoint(Point A, Point B): calculates and returns the midpoint of the two points A and B.

void displaypoint( ) : displays the co-ordinates of a point

Specify the class Point giving details of the constructor( ), member functions void readPoint( ), Point midpoint(Point, Point) and void displaypoint( ) along with the main function to create an object and call the functions accordingly to calculate the midpoint between any two given points. [10]

### SECTION – C

*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 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 10

A super class **Fact** is defined to calculate the factorial of a number. Define a sub class **Series** to find the sum of the series  $S = 1 + 1/2! + 1/3! + 1/4! + \dots + 1/n!$

The details of the members of both the classes are given below:

[5]

Class name : Fact

Data member/instance variable:

n : to store an integer number

Member functions/methods:

Fact (int nn) :parameterized constructor to initialize the data member n = nn

int factorial (int a) :returns the factorial of a number (factorial of n =  $1 \times 2 \times 3 \times \dots \times n$ )

void display( ) : displays the data members

Class name: Series

Data member/instance variable:

sum : to store the sum of the series

Member functions/methods:

Series(...) :parameterized constructor to initialize the data members of both the classes

void sum\_series() : calculates the sum of the given series

void display() : displays the data members of both the classes

Assume that the super class **Fact** has been defined. Using the concept of inheritance, specify the class **Series** giving the details of the constructor(...),void sum\_series ( ) and void display ( ). **The super class, main function and algorithm need NOT be written.**

[5]

### Question 11

A Queue is a linear data structure in which the operations are performed based on FIFO (First In First Out) principle. Define a class Cqueue with the following details:

Class name : Cqueue

Data member/instance variable:

ele[ ] : array to hold the integer elements

cap : stores the maximum capacity of the array

front : to point the index of the front

rear : to point the index of the rear.

Member functions/methods:

Cqueue(int max) : constructor to initialize the data member cap = max, front = rear = 0 and create the integer array

void insert(int v) : to add integers from the rear index if possible else display the message "FULL"

int delete() : to remove and return elements from front, if any, else returns -999

void display() : to display elements of queue

Specify the class Cqueue giving the details of **void insert(int)** and **int delete()**. Assume that the other functions have been defined. The main function need not be written.

[5]

### Question 12

(a) A linked list is formed from the objects of the class **Node**. The class structure of the Node is given below:

```
class Node
{
    int num;
    Node link;
}
```

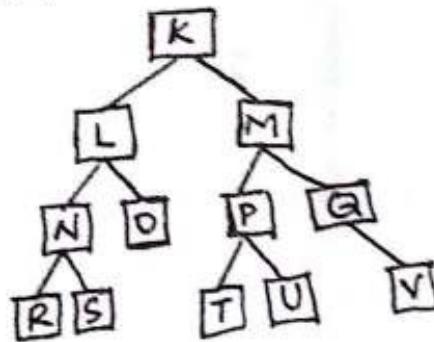
Write an *Algorithm* OR a *Method* to check whether the given number in an existing linked list is **prime** or not.

The method declaration is as follows:

**void checkprime( Node first)**

[2]

(b) Answer the following questions from the diagram of a Binary Tree given below:



(a) Write the in order traversal of the tree.

(b) State the terminal nodes of the tree and the level of node P

(c) Draw right subtree of node M

[3]

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