

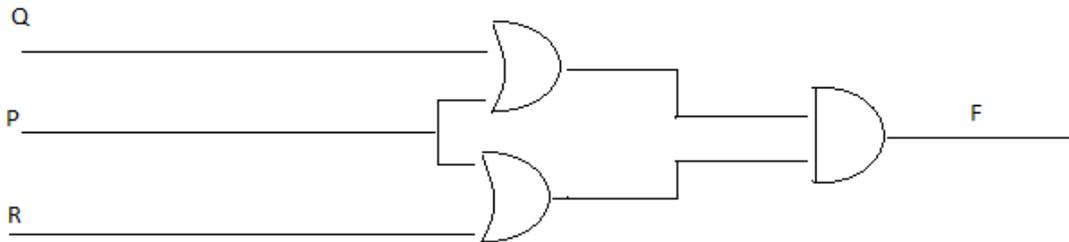
**Computer Science
Paper 1
Theory
Year 2014
Part I**

Answer all questions.

While answering questions to this part, indicate briefly your working and reasoning, wherever required.

Question 1.

- a) From the logic circuit given below, find the output 'F' and simplify it. Also, state the law represented by the logic diagram.



- b) Write the truth table for a two input conjunction and disjunction in a proposition.
c) Find the complement of $XY'Z + XY + YZ'$
d) Convert the following expression into its canonical POS form: $F(A,B) = (A+B).A'$
e) Minimise the following expression using a Karnaugh map:
 $F(A,B,C) = A'BC' + A'BC + ABC' + ABC$

[2 X 5 =

10]

Question 2.

- a) State two advantages of using the concept of inheritance in Java.
b) An array AR[-4...6,-2....12], stores elements in Row Majorwise, with address AR[2][3] AS 4142. If each element requires 2 bytes of storage, find the Base address.
c) State the sequence of traversing binary tree in :
i) Preorder
ii) Postorder
d) Convert the following infix expression into its postfix form:
 $(A/B + C) * (D/(E-F))$
e) State the difference between the functions `intnextInt()` and `Boolean hasNextInt()`.

[2 x 5
=10]

Question 3.

- a) The following functions are part of some class:
- ```
void fun1(char s[], int x)
{
 System.out.println(s);
 char temp;
 if(x < s.length/2)
 {
 temp = s[x];
 s[x] = s[s.length-x-1];
 s[s.length-x-1] = temp;
 }
}
```

```

 fun1(s,x+1);
 }
}
void fun2(String n)
{
char c[]=new char[n.length()];
for(int i=0;i<c.length;i++)
c[i]=n.charAt(i);
 fun1(c,0);
}

```

- i) What will be the output of fun1() when the value of s[]={‘J’,‘U’,‘N’,‘E’} AND X = 1  
[ 2 ]
- ii) What will be the output of fun2() when the value of n= “SCROLL”?  
[ 2 ]
- iii) State in one line what does the function fun1() do apart from recursion.  
[ 1 ]
- b) The following is a function of some class which sorts an integer array a[] in ascending order using selection sort technique. There are some places in the code marked by ?1?, ?2?, ?3?, ?4?, ?5? which may be replaced by a statement/ expression so that the function works properly:

```

voidselectsort(int []a)
{
inti,j,t,min,minpos;
for(i=0;i<?1?;i++)
{
min=a[i];
minpos=i;
for(j=?2?;j<a.length;j++)
{
if(min>a[j])
{
?3?=j;
min=?4?;
}
}
t=a[minpos];
a[minpos]=a[i];
a[i]=?5?;
}
for(int k=0;k<a.length;k++)
System.out.println(a[k]);
}

```

- i) What is the expression or statement at ?1?  
[ 1 ]
- ii) What is the expression or statement at ?2?  
[ 1 ]
- iii) What is the expression or statement at ?3?  
[ 1 ]
- iv) What is the expression or statement at ?4?  
[ 1 ]
- v) What is the expression or statement at ?5?  
[ 1 ]

## Part II

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

**Section A**  
**Answer any three questions**

**Question 4.**

- a) Given the Boolean function  $F(A,B,C,D) = \sum(0,1,2,3,5,6,7,10,13,14,15)$
- Reduce the above expression by using 4 variable Karnaugh map, showing the various groups (i.e. octals, quads and pairs).  
[ 4 ]
  - Draw the logic gate diagram for the reduced expression. Assume that the variables and their complements are available as inputs.  
[ 1 ]
- b) Given the Boolean function  $P(A,B,C,D) = \pi(0,1,2,3,5,6,7,10,13,14,15)$
- Reduce the above expression by using 4-variable Karnaugh map, showing the various groups (i.e. octals, quads and pairs).
  - Draw the logic gate diagram for the reduced expression. Assume that the variables and their complements are available as inputs.

**Question 5.**

A school intends to select students for the Inter - school athletic meet, as per the criteria given below:

- The candidate is from the Senior school and has participated in an inter school athletic meet earlier.  
OR
- The candidate is not from the Senior School, but the height is between 5 ft. and 6ft. And weight is between 50 kg and 60 kg.  
OR
- The candidate is from the senior school and has height between 5ft. And 6ft., but the weight is not between 50 and 60 kg.

The inputs are :

INPUTS

|   |                                                  |
|---|--------------------------------------------------|
| S | Student is from the senior school                |
| W | Weight is between 50 kg and 60 kg                |
| H | Height is between 5 ft. And 6 ft.                |
| A | Taken part in Inter school athletic meet earlier |

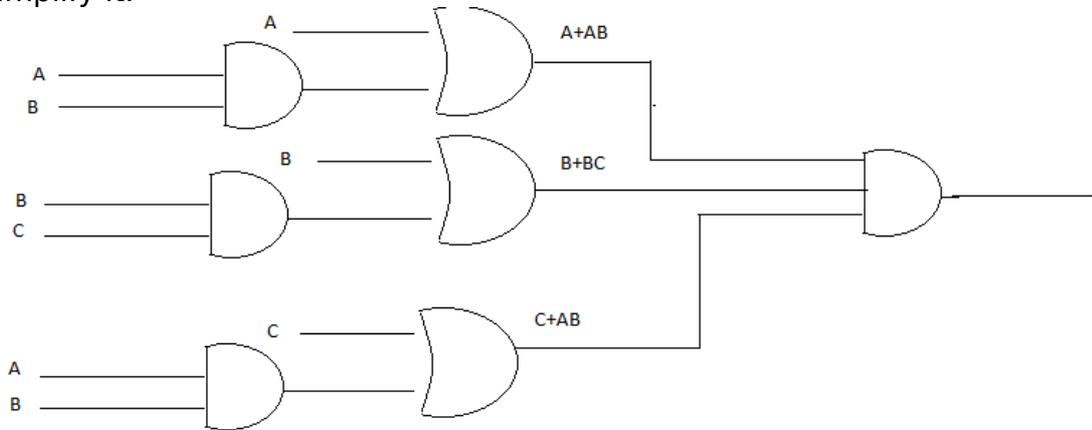
(In all the above cases 1 indicates Yes and 0 indicates No.)

OUTPUT:X Denotes the selection criteria [ 1 indicates selected and 0 indicates rejected in all cases.]

- Draw the truth table for the inputs and outputs given above and write the SOP expression for  $X(S,W,H,A)$ .  
[ 5 ]
- Reduce  $X(S,W,H,A)$  using Karnaugh map. Draw the logic gate diagram for the reduced SOP expression for  $X(S,W,H,A)$  using AND and OR gate. You may use gates with two or more inputs. Assume that the variable and their complements are available as inputs. [ 5 ]

**Question 6.**

- a) With the help of a logic diagram and a truth table explain a Decimal to Binary encoder. [ 4 ]
- b) Derive a Boolean expression for the logic diagram given below and simplify it.



[ 3 ]

- c) Reduce the following expression using Boolean laws:  
 $F(A,B,C,D) = (A'+C)(A'+C')(A'+B+C'D)$   
 [ 3 ]

### Question 7.

- a) Differentiate between XNOR and XOR gates. Draw the truth table and logic diagrams of three input XNOR gates. [ 4 ]
- b) Differentiate between proposition and wff. [ 2 ]
- c) Define half adder. Construct the truth table and logic diagram of a half adder. [ 4 ]

### Section B

Answer any 2 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.

### Question 8.

A class Mixer has been defined to merge two sorted integer arrays in ascending order. Some of the members of the class are given below:

Class Name : Mixer

#### Data members

intarr[] : to store the elements of an array  
 int n : to store the size of the array

#### Member functions

Mixer(intnn) : Constructor to assign n = nn  
 void accept() : to accept the elements of the array in ascending

Mixer mix(Mixer A) : order without any duplicates.  
 elements with the : to merge the current object array

parameterized array elements and return the resultant object.

void display() : to display the elements of the array.

Specify the class Mixer, giving details of the constructor(int), void accept(), Mixer mix(Mixer) and void display(). Define the main() function to create an object and call the function accordingly to enable the task.  
[ 10 ]

**Question 9.**

A class SeriesSum is designed to calculate the sum of the following series:-  
Sum =  $x^2/1! + x^4/3! + x^6/5! + \dots + x^n/(n-1)!$

Some of the members of the class are given below:

Class name : SeriesSum

**Data members**

x : to store an integer number  
n : to store number of terms  
sum : double variable to store the sum of the series

**Member functions**

SeriesSum(intxx,intnn) : constructor to assign x=xx, n=nn  
doublefindfact(int m) : to return the factorial of m using recursive technique  
void calculate() : to calculate the sum of the series by invoking the recursive functions repeatedly  
void display() : to display the sum of the series

- a) Specify the class SeriesSum, giving details of the constructor(int,int), double findfact(int), double findpower(int,int), void calculate() and void display(). Define the main() function to create an object and call the functions accordingly to enable the task. [ 8 ]
- b) State the two differences between iteration and recursion. [ 2 ]

**Question 10.**

A sequence of Fibonacci strings is generated as follows:

S0 = "a", S1 = "b", Sn = S(n-1)+S(n-2) where '+' denotes concatenation. Thus the sequence is: a,b,ba,bab,babba,babbabab,..... n terms.

Design a class FiboString to generate Fibonacci strings. Some of the members of the class are given below:

Class name : FiboString  
Data members  
x : to store the first string  
y : to store the second string  
z : to store the concatenation of the previous two strings

|                    |   |                                    |
|--------------------|---|------------------------------------|
| n                  | : | to store the number of terms       |
| Member methods     |   |                                    |
| FiboString()       | : | constructor to assign x="a", y="b" |
| and                |   | z="ba"                             |
| void accept()      | : | to accept the number of            |
| terms 'n'          |   |                                    |
| void generate()    | : | to generate and print the          |
| Fibonacci strings. |   |                                    |

The sum of ('+' i.e. concatenation) first two strings is the third string. Eg. "a" is first string, "b" is second string then the third will be "ba", and fourth will be "bab" and so on.

Specify the class FiboString, giving details of the constructor(), void accept() and void generate(). Define the main() function to create an object and call the functions accordingly to enable the task.

[ 10 ]

### Section C

#### Answer any 2 questions.

Each program/algorithm should be written in such a way that it clearly depicts the logic of the problem step wise. This can also be achieved by using comment in the program and mnemonic names or pseudo codes for algorithms.

(Flowcharts are not required)

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

**The algorithm must be written in general standard form wherever required/specified.**

#### Question 11.

A super class Stock has been defined to store the details of the stock of a retail store. Define a subclass Purchase to store the details of the items purchased with the new rate and updates the stock. Some of the members of the classes are given below:

|               |   |                                       |
|---------------|---|---------------------------------------|
| Class name    | : | Stock                                 |
| Data members: |   |                                       |
| item          | : | to store the name of the item         |
| qty           | : | to store the quantity of an item in   |
| stock         |   |                                       |
| rate          | : | to store the unit price of an item    |
| amt           | : | to store the net value of the item in |
| stock         |   |                                       |

Member functions:

|               |   |                              |
|---------------|---|------------------------------|
| Stock(.....)  | : | parameterized constructor to |
| assign values |   | to the data members          |

|                  |   |                                         |
|------------------|---|-----------------------------------------|
| void display()   | : | to display the stock details            |
| Class name       | : | Purchase                                |
| Data members     |   |                                         |
| pqty             | : | to store the purchased quantity         |
| prate            | : | to store the unit price of the          |
| purchased item   |   |                                         |
| Member functions |   |                                         |
| Purchase(.....)  | : | parameterized constructor to            |
| assign values    |   | to the data members of both             |
|                  |   | classes                                 |
| void update()    | : | to update stock by adding               |
| the previous     |   | quantity by the purchased quantity      |
|                  |   | and replace the rate of item if there   |
|                  |   | is a difference in the purchase rate    |
|                  |   | of the item if there is a difference in |
|                  |   | the purchase rate. Also update the      |
|                  |   | current stock value as:                 |
|                  |   | (quantity * unit price)                 |
| void display()   | : | to display the stock details            |
| before and       |   | update                                  |

Specify the class Stock, giving details of the constructor() and void display(). Using concept of inheritance, specify the class Purchase, giving details of the constructor(), void update() and void display(). The main function and algorithm need not be written.

[ 10 ]

### Question 12.

A stack is a linear data structure which enables the user to add and remove integers from one end only, using the concept of LIFO (Last In First Out). An array containing the marks of 50 students in ascending order is to be pushed into the stack.

Define a class Array\_to\_Stack with the following details:

|                       |   |                                                  |
|-----------------------|---|--------------------------------------------------|
| Class name            | : | Array_to_Stack                                   |
| Data members          |   |                                                  |
| m[]                   | : | to store marks                                   |
| st[]                  | : | to store the stack elements                      |
| cap                   | : | maximum capacity of the array and stack          |
| top                   | : | to point the index of the topmost element of the |
| stack                 |   |                                                  |
| Member functions      |   |                                                  |
| Array_to_Stack(int n) | : | parametrized constructor to initialize           |
| cap=n and top=-1      |   |                                                  |

void input\_marks() : to input the marks from user and store it in the array m[] in ascending order and simultaneously push the marks into the stack st[] by invoking the function pushmarks()  
 int popmarks() : to return marks from the stack if possible, otherwise, return -999  
 void display() : to display the stack elements

Specify the class Array\_to\_Stack, giving the details of the constructor(int), void input\_marks(), void pushmarks(int), int popmarks() and void display().

The main function and the algorithm need not be written.  
 [ 10 ]

**Question 13**

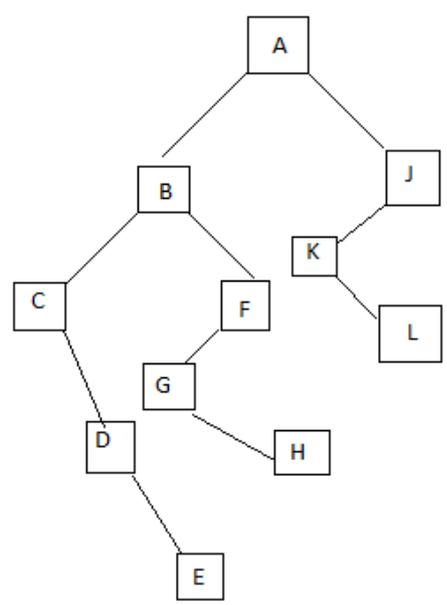
a) A linked list is formed from the objects of a class:  
 class Node  
 {  
     int number;  
     Node nextNode;  
 }

Write an algorithm OR method to add a node at the end of an existing linked list. The method declaration is as follows:

void addnode(Node start, int num)  
 [ 4 ]

b) Define the terms complexity and Big 'O' notation.  
 [ 2 ]

c) Answer the following from the diagram of the Binary Tree given below:



- i) Root of the tree.
- ii) Left subtree
- iii) Inorder traversal of the tree
- iv) Size of the tree

[ 4 ]