9. Write short notes on (any **four**):     2.5×4=10

a) Hashed file

b) Functional Dependency.

c) Database Designer

d) Network data model.

e) Physical data independence

———————

6/MCA     [ 6 ]

---

## 2017

## Computer Application

Paper : Database Management Systems

(MCA-301)

Full Marks : 70     Time : 3 Hours

*The figures in the right-hand margin indicate marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

Answer **Question No. 1** and any **five** qustions from the rest.

1. Answer any **ten** questions:     2×10=20

i) How can M : N relationship in E-R scheme be converted in relational mapping?

ii) Why the cost of conversion of DBMS will be increased?

iii) Distinguish between Candidate key and Alternate key.

iv) What is KAT function?

v) What is an inverted file?

vi) Define: 2NF.

6/MCA     [Turn over]

(vii) What are the symbols used representing a multi-valued and a derived attribute?

(viii) What do you mean by total participation?

(ix) Differentiate between schema and instances.

(x) What is the function of DDL?

(xi) What is the difference between JOIN and OUTER JOIN operator?

2. Persons (identified by PERSON-ID) work on machines (identified by MACHINE-NO) to produce garments.

Various GARMENT-KINDs can be produced. Each GARMENT-KIND has a description (GARMENT-DESCRIPTION) and is made up of a variety of materials (identified by MAT-KIND). A record of the QTY-NEEDED of each MAT-KIND for each GARMENT-KIND is stored.

The production of each garment is recorded as a job identified by JOB-NO. Each JOB-NO has a START-TIME and an END-TIME and is performed by a person on one machine. A number of garments of the same kind can be produced on one job.

Other information of interest is:

i) The NAME and DATE-OF-BIRTH of each person

ii) The DATE-PURCHASED of each machine

iii) The DESCRIPTION of each MAT-KIND

iv) The TIME-SPENT by a person on a job

v) The NUMBER-OF-GARMENTS produced on one job

Where required, make suitable assumptions and carefully specify those assumptions. If you need, other attributes in any entity set, add them and mention. Draw the E-R diagram for this database and indicate the primary key of each entity set.

10

3. Consider the E-R diagram that can be drawn in problem 2, modify the E-R diagram suitably and design a relational database corresponding to E-R diagram step by step.

10

4. a) Describe the three level architecture of DBMS.

b) Describe how DBMS controls data consistency and improves data integrity.

5+5=10

5. Consider the relational schema having the following relations with their keys underlined:

BOOK (Book-id, title, publisher-name)

BOOK-AUTHOR (Book-id, Author-name)

PUBLISHERS (Pub-Name, Aut-Address, APhone)

BOOK-COPIES (Book-id, Branch-id, no-of-copies)

BOOK-LOANS (Book-id, Branch-id, Card-No., Date-out)

LIBRARY-BRANCH (Branch-id, Branch-name, address)

BORROWER (Card-No., Bor-Name, BAddress, Bphone)

Write down the SQL expressions for the following queries:

a) Write the title of the book that has the maximum number of copies in the branch name "MOTIJIL".

b) Retrieve the name of the borrowers who do not take any book from any branch.

c) For each book that is loaned out from the "NAIHATI" branch and whose date-out is today, retrieve the book title, the borrower's name and the borrower's address.

d) For each library branch, retrieve the branch name and the total number of books loaned out from that branch. 2.5×4=10

6. Consider the relational schema describe in question no. Give an expression in the specified language for the queries given below:

a) Retrieve the name of the publisher's who have more than 100 no-of-copies of books at "SHIMURALI" branch. (Relational Algebra)

b) How many copies of the book titled "The Gitanjali" are owned by the "DUM DUM" branch. (Tuple relational calculus)

c) How many copies of the book titled "The Paradise Lost" are owned by each library branch. (Relational Algebra)

d) Retrieve the name and address of the publisher of the book titled "The Agnibina". (Domain relational calculus) 2.5×4=10

7. a) Define: Multi-valued dependency and Loss-less join dependency.

b) Define: Boyce-Codd Normal Form (BCNF). How does it differ from 3NF? 5+5=10

8. a) What are the different characteristics of sequential file? Mention them.

b) Compare the advantages and disadvantages of Indexed file over Indexed sequential file. 5+5=10

## 2017

## Computer Application

### Paper : Operating Systems

### (MCA-302)

Full Marks : 70      Time : 3 Hours

*The figures in the right-hand margin indicate marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

**Illustrate the answer wherever necessary.**

Answer any *five* questions.

1. a) Why operating system is called a resource manager?

   b) Why operating System is called virtual machine?

   c) What do you mean by context switching?

   d) What are the various states of a process? Show them by means of the state diagram and explain the different state transitions.

   3+3+2+(2+4)

---

7. a) What is second chance FIFO page replacement algorithm? Discuss why it is expected to perform better than FIFO?

   b) What is thrashing? Discuss the working set principle for handling the thrashing problem.

   c) Consider a two dimensional array A[100][100], each element taking 2 bytes. Suppose page size is 50 bytes. Page replacement strategy is FIFO and the number of available frames is 1. How many page faults will occur to initialize the lower triangle of matrix A in i) row wise and ii) column wise?

   (3+2)+(2+3)+(2+2)

8. a) Differentiate between SCAN and LOOK algorithms for disc scheduling.

   b) Write short notes on the following (any **three**):

   i) Process Control Block

   ii) Multi-level feedback queue scheduling

   iii) Peterson's algorithm for critical section problem

   iv) Inverted page map table

   v) Hybrid paging-segmentation scheme

   2+(3×4)

2. a) Define CPU utilization and CPU throughput.

b) Using the following information, draw the Gantt charts and find out the average waiting time, average response time and average turnaround time of the four processes for the following CPU scheduling algorithms:

i) Shortest Remaining Time First and

ii) Round Robin with time slice 3.

| Process | Arrival time | Burst time |
|---------|--------------|------------|
| P1 | 0 | 8 |
| P2 | 3 | 4 |
| P3 | 4 | 9 |
| P4 | 8 | 2 |

c) Explain the exponential averaging method for estimating the length of the next CPU burst.

2+(2×4)+4

3. a) "Context switching among threads is less costlier than that among processes"– Justify.

b) Convert the following precedence graph into a program using Fork/Join construct.

c) How does race condition affect consistency in process execution? Discuss with an example.



d) What are the necessary conditions of the critical section problem?

3+5+3+3

4. a) Define the *Wait* and *Signal* operations on semaphore that do not involve busy waiting.

b) Discuss with example how semaphore is used to achieve mutual exclusion in a multiprogramming environment.

c) Discuss the solution to the Reader-Writer problem using semaphore and write down the pseudo codes for the reader and writer processes.

(2+2)+4+6

5. a) What are the necessary conditions for a deadlock to occur?

b) Differentiate between deadlock prevention and deadlock avoidance.

c) Consider the following system with 5 processes, P0 through P4 and four resource types, R0, R1, R2 and R3. At time T0, the following snapshot of the system was taken:

Allocation

|  | R0 | R1 | R2 | R3 |
|---|---|---|---|---|
| P0 | 2 | 0 | 1 | 2 |
| P1 | 0 | 1 | 2 | 1 |
| P2 | 4 | 0 | 0 | 3 |
| P3 | 1 | 2 | 1 | 0 |
| P4 | 1 | 0 | 3 | 0 |

Max

|  | R0 | R1 | R2 | R3 |
|---|---|---|---|---|
| P0 | 3 | 2 | 1 | 4 |
| P1 | 0 | 2 | 5 | 3 |
| P2 | 5 | 1 | 0 | 5 |
| P3 | 1 | 4 | 3 | 0 |
| P4 | 3 | 0 | 3 | 3 |

If total number of instances for resource types R0, R1, R2 and R3 are 8, 5, 9 and 8, respectively, then answer the following:

i) How many instances of each resource type are currently available?

ii) What is the content of the matrix *Need*, which stores the number of resources still needed by each process?

iii) Determine whether the system is in *safe state* or not using *banker's algorithm*. If it is in safe state, then give a safe sequence of the processes.

4+2+(1+2+5)

7/MCA                    [ 4 ]

6. a) Differentiate between the following:

i) Contiguous memory allocation vs. non-contiguous memory allocation.

ii) Absolute address binding vs. relocatable address binding.

b) Discuss the pure paging scheme when part of the page map table is stored in TLB. Use proper diagram for explanation.

c) Consider the following segment map table:-

| Segment | Base | Length |
|---|---|---|
| 0 | 219 | 600 |
| 1 | 2300 | 14 |
| 2 | 90 | 100 |
| 3 | 1327 | 580 |
| 4 | 1952 | 96 |

Find the real address of the following virtual addresses given as (segment number, displacement) pair:

i) (0, 430)

ii) (1, 12)

iii) (3, 400)

iv) (4, 110)

(2+2)+6+4

7/MCA                    [ 5 ]                    [Turn over]

## 2017

## Computer Application

Paper : Theory of Computing

(MCA-303)

Full Marks : 70          Time : 3 Hours

*The figures in the right-hand margin indicate marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

Answer any **five** questions.

1. a) Prove that DFA and NFA are equivalent.    14

    b) Construct a Moore Machine equivalent to the Mealy Machine 'M' given in table:

| Present State | Next State | | | |
|---|---|---|---|---|
| | A=0 | | A=1 | |
| | Next State | Output | Next State | Output |
| →$q_1$ | $q_1$ | 1 | $q_2$ | 0 |
| $q_2$ | $q_2$ | 1 | $q_4$ | 1 |
| $q_3$ | $q_3$ | 1 | $q_3$ | 1 |
| $q_4$ | $q_4$ | 0 | $q_1$ | 1 |

b) Design Mealy machine for the following table and also find the output for the storing 'abbabaaa': 7+7

| Q \ E | a | b | O/P |
|---|---|---|---|
| $q_0$ | $q_3$ | $q_2$ | 0 |
| $q_1$ | $q_1$ | $q_0$ | 0 |
| $q_2$ | $q_2$ | $q_3$ | 1 |
| $q_3$ | $q_3$ | $q_1$ | 0 |

3. a) Let $G=(\{S, A_1\}, \{0, 1, 2\}, P, S)$, where P consider of $S \to 0SA_1 2$, $S \to 012$, $2A_1 \to A_1 2$, $1A_1 \to 11$. Show that $L(G) = \{0^n 1^n 2^n \mid n \geq 1\}$.

b) Find the language generated by grammar $G=(\{S, A\}, \{0, 1\}, P, S)$, where P consists of $S \to 0S1 \mid 0A1$, $A \to 1A1 \mid 1$.

c) Find the language generated by the grammar $G=(\{S, A, B\}, \{0, 1\}, P, S)$, where P consists of $S \to 0S1 \mid 0A \mid 0 \mid 1B \mid 1$, $A \to 0A \mid 0 \mid 1B \mid 1$. 8+3+3
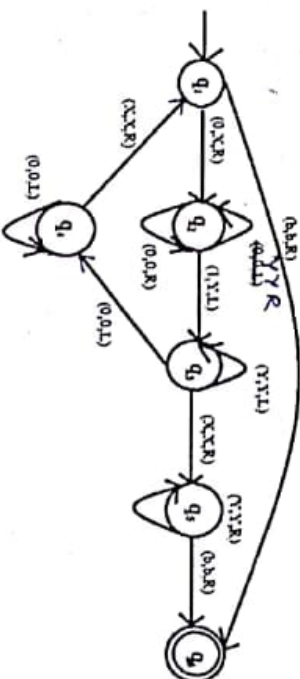
4. a) Given an regular expression for representing the set 1 of the string in which every 0 is immediately followed by at least two 1's. [2]

b) Prove that the regular expression $R = A + 1^*(011)^*(1^*(011))^*$ also describe the same set of strings. 7+7

5. Design a PDA to accept the following language. $L = \{ww^R \mid W \in (0, 1)^*\}$. 14

6. M is a Turing machine represented by the transition system in given figure. Obtain the computation sequence of M for processing the input string 0011. 14

7. Describe Arden's theorem and prove it. 14

[3]

**2017**

**Computer Application**

**Paper : Object oriented Programming**

**(MCA-304)**

Full Marks : 70     Time : 3 Hours

*The figures in the right-hand margin indicate marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

Answer Question No. **1** and any **four** from the rest.

1. State whether the following statements are **TRUE** or **FALSE**:     1×14=14

a) C++ can be said to be as C language with classes.

b) It is possible to initialize any data member inside a class.

c) Member function defined inside a class specifier does not become inline function by default.

d) We say a function in C++ overloaded when it is applied to an object that is too big.

e) You can only create an array of objects if the class has a default constructor.

(b) Explain the difference between **get()** and **getline()**.

c) How a C++ file can be opened?

d) Write a C++ program to write and read object using **read()** and **write()** function.     4+2+2+6=14

6. a) State the various parameters used to open a file in C++.

b) State the various classes available for the file operations.

c) Write a C++ program to compute the scalar multiplication of two vectors using operator overloading and template class.

d) How exception is handled in C++?     4+2+5+3=14

7. Discuss any four:     3.5×4=14

i) Data types in C++

ii) Dynamic memory allocation in C++

iii) Virtual function

iv) Logic, syntax and run time error

v) Generic programming

vi) Formatted console I/O operations

f) We can have virtual destructors but not virtual constructors.

g) C++ never provides a default constructor.

h) A base class is never used to create objects.

i) A stream cannot be connected to more than one file at time.

j) While opening the file using constructor, we must pass the desired filename as a parameter to the constructor.

k) We have a class called Animal Type. Its constructors will be named Animal Type.

l) Binary files store floating point values more accurately and compactly than the text files.

m) We can not place two or more catch blocks together to catch and handle multiple types of exceptions thrown by a try block.

n) Exceptions can be caught and re-thrown.

2. a) What are the unique advantages of an object-oriented programming paradigm?

b) What do you understand by expression #include<iostream> in a C++ program? Is it mandatory to write return 0 as last line in all C++ programs?

c) In C++, a variable can be declared anywhere in the scope. What is the significance of this feature?

d) How does an inline function differ from a preprocessor macro?

c) How does **swap()** work? Can it swap values of variables of different types?

$$4+(2+1)+2+2+(2+1)=14$$

3. a) What is constructor?

b) What is a friend function? What are the merits and demerits of using friend functions?

c) Write a program in C++ where two classes have a common friend function.

d) "In some cases, operator function must be a friend function to overload an operator." – Justify.

$$2+4+5+3=14$$

4. a) How polymorphism is achieved at compile time and run time?

b) Write a program in C++ to concatenate two strings using dynamic constructor and operator overloading.

c) How run time polymorphism is implemented in C++?

$$(3+3)+6+2=14$$

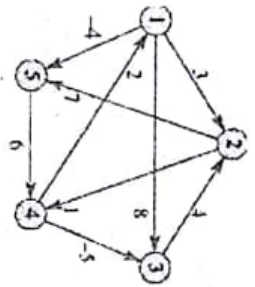5. a) What are the different forms of inheritance? Give an example for each form.

Scanned by CamScanner

# 2017

## Computer Application

Paper : Design and Analysis of Algorithms

(MCA-305)

Full Marks : 70                                Time : 3 Hours

*The figures in the right-hand margin indicate marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

Answer any **five** questions.

1. a)  Write an algorithm to find the $k$-th smallest element from a data set S of size $n$, $k \leq n$. Use this algorithm to sort the elements of S in $O(n\log n)$ time.

   b)  Write merge sort algorithm to sort the data set S size $n$.                           (6+4)+4=14

2. a)  Find the 13th smallest element from the following array A where you are not allowed to sort whole array.

   $A=\{8, 33, 17, 51, 57, 49, 35, 11, 25, 37, 14, 3,$
   $2, 13, 52, 12, 6, 29, 32, 54, 5, 16, 22, 23, 7\}.$

---

7. a)  What is graph coloring problem? Write the decision version of this problem.



**Figure 2**

   b)  Define the convex hull of a set S of planar points.

   c)  Write an algorithm to find the convex hull of S and analyze this algorithm to find its worst-case time complexity.

   $(2+2)+3+(5+2)=14$

8. Write short notes (any **four**):          3.5×4=14

   i)    Deterministic algorithm

   ii)   Art gallery problem

   iii)  Connected components of a graph

   iv)   Single tape problem

   v)    Decision problem versus Optimization problem

   vi)   Heap sort

   _____

Scanned by CamScanner

b) Find an optimal solution to the fractional **Knapsack** problem with following information.

Total number of items=3, Knapsack size=20, Profit components=(25, 24, 15) and Weight components=(18, 15, 10).     9+5=14

3. a) Use dynamic-programming (**DP**) to characterize the structure of an optimal solution of the *matrix-chain parenthesization* problem (**MCPP**).

b) Consider the following five matrices with orders:

$M_1 : 2×3$, $M_2 : 3×4$, $M_3 : 4×5$, $M_4 : 5×6$, $M_5 : 6×7$

i) Find the minimum number of scalar multiplications needed to multiply the above five matrices.

ii) Give a parenthesized expression for the order in which this optimal number of multiplications is achieved.     4+10=14

4. a) Design depth-first search (DFS) algorithm for a graph $G=(V, E)$ and compute its time complexity.     [ 2 ]

10/MCA

b) How DFS is used to design topological sort algorithm?     (6+2)+6=14

5. a) Define minimum spanning tree (MST) of a weighted graph $G(V, E, w)$.

b) Write Kruskal algorithm to compute a MST of a weighted graph $G(V, E, w)$ and use this algorithm to find a MST of the graph in Figure 1.     2+(5+7)=14
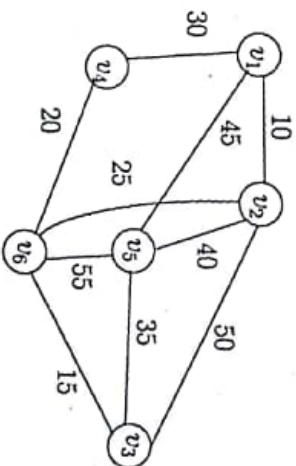


**Figure 1**

6. a) Explain the shortest path problem.

b) Design an algorithm to solve the single source shortest path problem and use this algorithm to solve this problem for the graph in Figure 2 with the vertex marked 1 as the source vertex.     3+(5+6)=14

10/MCA     [ 3 ]     [Turn over]