2016

Computer Application

(Design and Analysis of Algorithms)

Paper : 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) Define the *convex hull* of a set of points.

   b) Write down the *Graham's scan* algorithm to find the convex hull of a given point set. Analyze the algorithm to find its worst-case time complexity.

   c) What do you mean by the term *output sensitive algorithm?* 3+(6+2)+3=14

2. a) Design *quick sort* algorithm to sort an array having *n* elements so that the corresponding algorithm requires $O(n \log n)$ time in *worst case*.

   b) Write a sorting algorithm that does not require comparisons. 8+6=14

   b) Write an algorithm to solve the *single source shortest path problem* for a directed acyclic graph. (5+5)+4=14

7. Write short notes (any four): $3\frac{1}{2} \times 4 = 14$

   i) *Approximation algorithm*

   ii) *Time complexity of merge sorting*

   iii) *Deterministic algorithm*

   iv) *Optimization problem* versus *decision problem*

   v) *Cook's Theorem*

   vi) *Heap sorting*

   vii) Various *Shortest path problems*

(handwritten annotations:)

sorting { Quick, Merge, heap, Bucket sort/Radix.

graph { BFS, DFS, topological sort

Scanned by CamScanner

3. a) Define *art gallery* problem.

   b) Let $l_1, l_2, l_3, ..., l_n$ be lengths of n programs to be stored in a *tap*. Show that the *mean retrival time* becomes minimum when the programs are arranged so that

   $$l_1 \le l_2 \le l_3 \le .... \le l_n.$$

   c) Define the *storage problem on a single tape*.

   d) The development of a *Dynamic Programming* algorithm can be broken into a sequence of four steps. Write these four steps.

   . 3+4+3+4=14

4. a) Design *breath-first search* algorithm for a graph $G=(V,E)$ and compute its time complexity.

   b) How *depth-first search* is used to compute the maximum number of connected components of a graph. (6+2)+6=14

5. a) Define the following terms used for finding *Minimum Spanning Tree* (MST) of a weighted graph $G(V, E, w)$:

   (i) Cut (ii) Crosses (iii) Respect (iv) Light Edge

10MCA [2]

   b) Write *Prim's* algorithm to compute Minimum Spanning Tree (MST) of a weighted graph $G(V, E, w)$ and use this algorithm to find the MST of the graph in Figure 1.
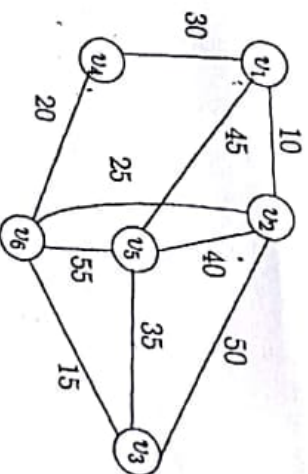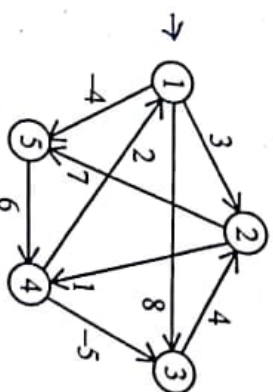
   3+(4+7)=14

Figure 1

6. a) How *Bellman-Ford shortest path algorithm* is used to solve the single source shortest path problem (SSSPP)? Use this algorithm to solve the SSSPP for the graph in Figure-2 considering the vertex marked 1 as the source.

Figure 2

10MCA [3] [Turn over]

Scanned by CamScanner

2016

Operating Systems

Paper : 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.

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

1. Answer the following questions in brief (any **five**):

         2×5=10

a) What is meant by context switching of processes?

b) What do you mean by busy waiting?

c) When does round robin scheduling behave like FCFS scheduling?

d) Distinguish between deadlock prevention and deadlock avoidance.

e) What is meant by a safe sequence?

f) What is meant by locality of reference?

g) Why is sharing easier in segmentation than that in paging?

Dijkstra

7/MCA   [Turn over]

---

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

         5×3

a) Multilevel feedback queue scheduling.

b) Dining Philosopher problem using semaphore.

c) Multithreading models.

d) Multiprogramming by swapping.

e) Inverted Page Map Table.

Dijkstra

7/MCA   [6]

2. a) Why is an operating system called as virtual machine?

b) Differentiate between the following:

   i) Multiprogramming and multiprocessing.

   ii) Network OS and distributed OS.

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

3+(2+2)+(2+6)

0 . c) Write the corresponding code for the following precedence graph using *fork/join* construct.

2+(4×2)+5

3. a) Distinguish between preemptive and non-preemptive scheduling.

b) Using the following information, draw the Gantt charts and find out the average waiting time and turn around time of the four processes if the CPU scheduling is (i) Shortest Remaining Time First, (ii) Round Robin with time slice 3.

Process	Arrival time	Burst time
P1	0	6
P2	3	4
P3	4	1
P4	7	5
P5	10	3
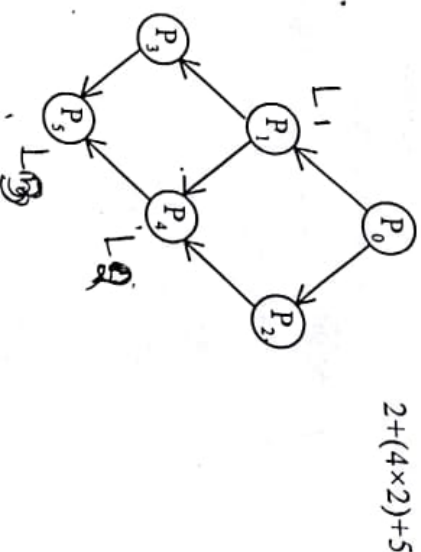
4. a) What are the necessary conditions for solving the critical section problem? Show that Peterson's two-process solution to the critical section problem satisfies all these conditions.

b) Suppose the instruction i of process P_1 is to be executed only after the execution of instruction j of process P_2. How can you ensure this using semaphores?

c) Discuss the solution to the bounded buffer problem using semaphore and write down the pseudo codes for the producer and consumer processes.

(3+4)+2+(3+3)

5.

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

b) What is the complexity of banker's algorithm for determining safe/unsafe state when there are n processes and m resource types?

c) Consider the following system with 5 processes, P0 through P4 and four resource types, A, B, C, and D. At time T0, the following snapshot of the system was taken:

Process	Max A B C D	Allocation A B C D
P0	6 0 1 2	4 0 0 1
P1	1 7 5 0	1 1 0 0
P2	2 3 5 6	1 2 5 4
P3	1 6 5 3	0 6 3 3
P4	1 6 5 6	0 2 1 2

If the available number of instances for resource types A, B, C and D are 3, 2, 1 and 1, respectively, then answer the following:

i) How many instances of each resource type are there?

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

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

4+2+(2+2+5)

6. a) Explain the following terms:

i) Absolute address translation

ii) Relocatable address translation.

b) What is compaction? What are the disadvantages of compaction?

c) Discuss the pure paging addressing scheme when multilevel Page Map Table is used.

d) If CPU generates 32 bit virtual address and page size is 8 kB, then what is the maximum number of rows in the page map table?

(2+2)+(1+2)+5+3

7. a) What are the disadvantages of having smaller page size?

b) Discuss the advantages and disadvantages of pure paging and pure segmentation.

c) Discuss the address translation process of hybrid paging-segmentation scheme with suitable figure.

3+4+8

8. Write short notes on the following: (any three): 5×3

   a) Multilevel feedback queue scheduling.
   b) Dining Philosopher problem using semaphore.
   c) Multithreading models.
   d) Multiprogramming by swapping.
   e) Inverted Page Map Table.

Dijkstra

6(MCA) MCA/Part-II/1st Sem./MCA-301/16

2016

Database Management System

Paper : 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 Q.No.1 and any five questions from the rest.

1. Answer any ten questions: 2×10=20

   i) "The complexity of the DBMS will be increased" – Why? Give reasons.

   ii) Define derived attribute with an example.

   iii) What are the major components of DBMS?

   iv) Mark the difference between naive users and sophisticated users.

   v) Find the differences between tuple relational calculus and domain relational calculus.

   vi) Write two characteristics of fourth generation language.

vii) What is metadata?

viii) What do you mean by reorganization of a file?

ix) What do you mean by determinant of a functional dependency?

x) What do you mean by Lossless-join dependency?

xi) What is referential integrity constraint?

xii) What are the uses of SUM () and COUNT () in SQL?

2. The Prescriptions-R-X chain of pharmacies has offered to give you a free life-time supply of medicines if you design its database. Given the rising cost of health care, you agree. Here is the information that you gather.

a) Patients are identified by SSN, and their names, addresses, and also ages.

b) Doctors are identified by an SSN, for each doctor, the name, speciality and years of experience must be recorded.

c) Each pharmaceutical company is identified by name and has a phone number.

d) For each drug, the trade name and formula must be recorded. Each drug is sold by a given

pharmaceutical company and the trade name identifies a drug uniquely from among the products of that company. If a pharmaceutical company is deleted, you need not keep track of its products any longer.

e) Each pharmacy has a name, address, and phone number.

f) Every patient has a primary physician. Every doctor has at least one patient.

g) Each pharmacy sells several drugs and has a price for each. A drug could be sold at several pharmacies, and the price could vary from one pharmacy to another.

h) Doctors prescribe drugs for patients. A doctor could prescribe one or more drugs for several patients, and a patient could obtain prescriptions from several doctors. Each prescription has a date and a quantity associated with it. You can assume that if a doctor prescribes the same drug for the same patient more than once, only the last such prescription needs to be stored.

i) Pharmaceutical companies have long-term contracts with pharmacies. A pharmaceutical

[2]

[3]

[Turn over]

company can contract with several pharmaceutical companies. For each contract, you have to store a start date, and end date, and the text of the contract.

j) Pharmacies appoint a supervisor for each contract. There must always be a supervisor for each contract.

Draw the E-R diagram for the above database and identify primary key of every Entity Set.

8+2=10

3. Consider the E-R diagram drawn from the question no. 2 and modify the E-R diagram suitably if necessary, then convert the E-R diagram into a relational database step by step. 10

4. a) What is data independence? Explain the terms of logical and physical data independence with suitable example.

b) Describe how DBMS controls data redundancy and data consistency. 5+5=10

5. Consider the relational schema having the following relations with their keys underlined:
CUSTOMER(cust-id, cust-name, annual-revenue, cust-type)

SHIPMENT (shipment-no, cust-id, weight, truck-no, destination, ship-date)

TRUCK (truck-no, driver-name)

CITY(city-name, population)

Write down the SQL expressions for the following queries:

a) Who are the drivers and who have delivered shipments for customers with annual revenue over Rs. 15 lakhs to cities with population over 35 lakhs?

b) List all cities that have received shipments from every customer.

c) List the name and annual revenue of customers whose shipments have been delivered by truck driver 'Amiya'.

d) Which city in the database has smallest population?

e) Find the average weight of a shipment sent to highest population city. 2×5=10

6. Consider the, relational schema described in question no. 5. Give an expression in the specified language for the queries given below: (any four)

a) List all the truck numbers who carry one ton

of weight in every shipment. (Domain Relational calculus)

b) List all customers whose annual revenue more than 15 lakhs. (Tuple relational calculus)

c) List the cities of population over 45 lakhs which have received a 2 ton shipment from customer 4501. (Relational Algebra)

d) List the customer names who have never sent shipment to the city 'BOMBAY'. (Relational Algebra)

e) Find the driver name who takes the maximum weight of shipment sent to the city 'DELHI'. (Relational Algebra) 2.5×4=10

7. a) What is the necessity of Normalization?

b) Define: Functional Dependency with example.

c) A relation in 3NF may not be in BCNF - Justify it. 2+4+4

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

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

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

a) Inverted file

b) Multi-valued Dependency

c) Conceptual View

d) Object base data model

e) Embedded SQL

2016

Object Oriented Programming
Paper : 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 Q.No.1, **2** and any **four** from the rest.

1. State whether the following statements are **TRUE** or **FALSE**:   [1×8=8]

a) The meaning of all the C++ operators (such as *, + etc.) is fixed and cannot be changed. T

b) Data member cannot be initialized inside class specifier. F

c) Member function defined inside a class specifier becomes inline function by default. T

d) It is not possible to access the attributes of a class with no member functions (methods). F

e) There are certain restrictions and limitations in overloading operators. Operator functions T

[*Turn over*]

must either be member functions (non-static) or friend functions. The overloading operator must have at least one operand that is of user-defined type.

f) Adding a derived class to a base class requires fundamental changes to the base class. F

g) Exceptions can be caught and re-thrown.

h) It is possible to make a catch statement to catch all types of exceptions using ellipses as its argument. T

2. Fill up the blanks or select the correct answers: 1×6=6

i) What does your class can hold?

(a) data

(b) functions

(c) both (a) & (b)

(d) none of the mentioned

ii) What are mandatory parts in function declaration?

(a) return type, function name

(b) return type, function name, parameters

(c) both (a) & (b)

(d) none of the mentioned

iii) What is the index number of the last element of an array with 9 elements?

(a) 9

(b) 8

(c) 0

(d) Programmer-defined

iv) What is the syntax of inheritance of class?

(a) class name

(b) class name : access specifier

(c) class name : access specifier class name

(d) none of the mentioned.

v) Which operator is having the highest precedence?

(a) postfix

(b) unary

(c) shift

(d) equality

vi) Cout is a/an _____.

(a) operator

(b) function

(c) object

(d) macro

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

b) What is the difference between declaration and definition?

c) What is const qualifier? Explain with an example.

d) What are the differences between new operator in C++ and malloc function in C?

4+3+3+4=14

4. a) What is encapsulation?

b) What is the purpose of iostream.h header file?

c) What is an inline function? State its advantages and disadvantages.

d) Write a program to swap two integer values by using call by reference.

e) Write a program to illustrate the concept of parameterized constructor.

2+2+4+3+3=14

5. a) What is the use of static variable?

b) Differentiate between macros and functions?

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

9/MCA   [4]

d) Explain the use of this pointer.

e) What are some advantages/disadvantages of using friend functions?   [2+3+2+2+5=14]

6. a) What is the difference between Static binding and Run time binding? Explain with a suitable C++ code.

b) Construct a class TIME having three data members for hours, minutes, seconds and some member functions. One constructor should initialize these data members to 0 and another should initialize those to fixed values. Write a member function to display time in the format 12:28:35 and another member function to add two TIME objects and hence develop a program in C++ to add two given TIME objects.

8+6=14

×7. a) Write statements using seekg() to achieve the following:

i) To move the pointer by 15 positions backward from current position.

ii) To go to the beginning after an operation is over.

iii) To go to byte number 50 in the file.

9/MCA   [5]   [Turn over]

b) Write a C++ program to merge two existing files into a third file. Use command line arguments to modify your program.

c) How generic programming is implemented in C++?

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

8. Discuss any four:
   i) Data types
   ii) Role of Destructor
   iii) Multilevel inheritance
   iv) Exception handling
   v) File opening modes
   vi) Formatted I/O operations

$3.5 \times 4 = 14$

2016
Theory of Computing
Paper : 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) Let $G=(\{G,C\}, \{a,b\}, P,S)$ where P consists of $S \to aCa$, $C \to aCa\mid b$. Find L(G).
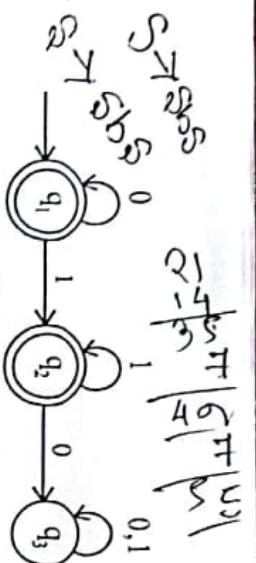
   b) If G is $S \to aS\mid bs\mid a\mid b$, find L(G). $7+7=14$

2. a) Consider the transition system given in figures prove that the strings recognized are $(a+a(b+aa)*b)*(b+aa)*a$

   b) Describe in English the aspect by FA whose transition diagram is given in figure.

(handwritten) Repeated
$S \to SbS$

$S \to SbS$ 0 $2-4$ ... *(handwritten Devanagari/notes)*

$7+7=14$

3. a) Construct a DFA for regular expression
r = ba+(a+bb)a*b.

b) Construct a transition graph for regular
expression R=(0(011)*)⁺;

    $7+7=14$

4. a) Consider G whose productions are
S→aAS | a, A→SbA|SS|ba. Show that
S→aabbaa and construct a derivation tree
whose yield is aabbaa.

b) If G is the grammar S→SbS|a. Show that G
is ambiguous.

    $7+7=14$

5. a) Consider a grammar G=({S,A,B}, {a,b}, P,S)
where S is the start symbol and P is given by
S→bA|aB, A→ bAA|aS|a, B→aBB|bS|b.
Convert it an equivalent Chomsky normal
form.

b) Convert the following grammar into CNF.
S→aXX, X→aS|bS|a.

    $7+7=14$
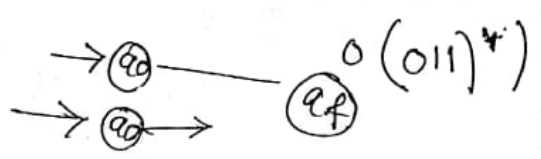
6. Design a PDA for the language L={aⁿbⁿ|n>0}.

    14

7. For the grammar G=({S, A, B}, {a, b}, P, S) where
P consists of S→aAB, S→bBA, A→bS, A→a,
B→as, B→b, W=abbbab is in L (G). Construct a
deterministic PDA accepting L (G) and a leftmost
derivation of abbbab.

    14

8/MCA   [2]

8/MCA   [3]

Scanned by CamScanner