2014

COMPUTER APPLICATION

Paper: Database Management Systems (MCA – 301)

Full Marks: 70

Time: 3 hours

Answer question No. 1 and any *Five* questions from the rest.

The figures in the right hand margin indicate full marks.

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

1. Answer any ten questions:

   2 X10 = 20

   i) What are the functions done by DBA in DBMS?

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

   iii) What do you mean by total participation?

   iv) Differentiate between schema and instances.

   v) What is Foreign key?

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

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

   viii) What is relational schema?

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

   x) What is the difference between JOIN and OUTER JOIN operator?

2. Persons in the org   are identified by a PERSON-ID and have a SURNAME, FIRST-NAME and DATE-OF-BIRTH.

   The persons are responsible for orde   which are identified by an ORDER-NO and have an ORDER-DATE, DESCRIPTION   d ORDERED-PRICE. Each   rder is from one customer. Only one person is responsible for a given order . .   ponsible for many orders.

   The organization manufactures .   .   f jobs.   person responsible for an order makes formal requests to se   s to c   y out th   jobs.   e re   ests are identified by a REQUEST-NO. They nominate St   f-C   and   END-D   E fo   ch request.

A number of jobs can be created by a section in response to a request. Each job is identified by a JOB-NO and has a COST. All jobs for one request go to the same section, which is identified by SECTION-ID and has one MANAGER.

Each job uses a QTY-USED of one or more materials. Materials are identified by MAT-ID and have a MAT-DESCRIPTION.

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) 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

5. a) Describe how DBMS controls data redundancy and data consistency.
   b) Compare the similarity and dissimilarity between Network data model and Hierarchical data model.

                                                                              5 + 5

6. 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.
                                                                              p
                                                                              5 + 5

7. The following relations keep track of airline flight information:
    FLIGHT (*flno*, from, to, distance, departs, arrives, aid)
    AIRCRAFT (*aid*, aname, cruising-range)
    CERTIFIED (*eid, aid*)
    EMPLOYEES (*eid*, ename, salary)
    Note that every pilot is certified for some aircraft.
    Write the following queries in the specified language given below:
                                                                              4 X 2.5 = 10

i) For each pilot who is certified for more than three aircrafts, find the pilot's eid and the maximum cruising range of the aircraft that he or she is certified for.(SQL)

ii) Find the names of aircrafts those can be used on route from X to Y. (Tuple or domain Relational Calculus)

iii) Write the names of all pilots who traverse on maximum distance route(SQL)

iv) Find the flights that can be piloted by every pilot whose salary is more than Rs. 10,000. (Relational Algebra)

8. Write short notes on any four: 4 X 2.5 = 10

i) Limitations of file-based system

ii) Sophisticated Users

iii) Full functional dependency

iv) Physical data model.

v) Embedded SQL.

MCA

2014

Operating Systems

Paper - 302

Full Marks - 70

Time - 3 hours

Answer any five questions.

The figures in the margin indicate full marks.

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

Illustrate the answer whenever necessary

1. (a) "Operating system is a resource manager" - Justify.

    (b) Distinguish between *kernel mode* and *user mode* of an operating system.

    (c) Briefly discuss different generations of operating systems.

    (d) Draw the state transition diagram of a process with proper labelling of the states and transitions.

    $$3 + 2 + 5 + 4$$

2. (a) Distinguish between short term and long term process scheduling.

    (b) What are the advantages of multilevel feedback queue scheduling over multilevel queue scheduling?

    (c) When does *shortest remaining time first scheduling* behave like shortest job first scheduling?

    (d) Using the following information, draw the Gantt charts and find out the average waiting time and average turnaround time of the five processes for the following cases: i) non-preemptive priority scheduling, and ii) preemptive priority scheduling.

Process	Arrival time	Burst time	Priority
P1	0	100	3
P2	0	10	1
P3	0	300	2
P4	0	60	5
P5	80	150	4

    $$2 + 2 + 2 + (4 + 4)$$

3. (a) What are the advantages of using multiple threads instead of multiple processes?

    (b) What are the similarities and dissimilarities between threads and processes?

(c) Distinguish between user level and kernel level threads.

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

S_1

S_2

S_3 . S_4

S_5

. S_6
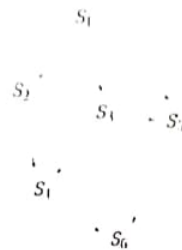
$$2 + 3 + 3 + (3 + 3)$$

4. (a) What are the conditions for solving the critical section problem? Comment with justification whether the "strict alteration" algorithm for two-process critical section problem satisfies all these criteria.

(b) Write a semaphore definition that does not suffer from busy waiting problem.

(c) Discuss a solution to the *Dining Philosopher* problem using semaphores. Give two solutions to make your approach deadlock-free

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

5. (a) Distinguish between deadlock prevention and deadlock avoidance

(b) Discuss how the circular wait condition is negated for deadlock prevention.

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

If the available number of instances for resource type D is 1 and for other resource types is 0, then answer the following:

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

ii. 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.

iii. If a request from process P2 arrives for (0,0,0,1), can the request be granted immediately? Explain your answer

$$2 + 3 + (2 + 5 + 2)$$

2

6. (a) Distinguish between absolute and relocatable address binding.

   (b) Distinguish between internal and external fragmentation. What kinds of fragmentation are noticed in pure paging and segmentation?

   (c) Suppose a system generates 32 bit virtual addresses and page size is 128 KB. If each entry in the page map table takes 4 KB, then what will be the maximum size of the page map table?

   (d) Discuss the hybrid paging-segmentation scheme with address translation diagram.

$$2 + (2 + 2) + 3 + 5$$

7. (a) Distinguish between local and global page replacement.

   (b) What is Belady's anomaly?

   (c) What is thrashing? What is locality of reference? Discuss how working set model handles thrashing by utilizing the concept of locality of reference?

   (d) Compute the number of page faults to initialize an $n \times 2n$ integer array in row major and column major when page size is $\frac{n}{2}$ bytes. Assume FIFO page replacement and a single free frame.

$$2 + 2 + (1 + 1 + 4) + (2 + 2)$$

8. (a) Consider the following sequence of disc requests (track numbers):

   95, 180, 34, 119, 11, 123, 62, 64

   All the requests have come at the same time. The initial head position is on track 50. The range of tracks is from 0 to 199 and the disc head needs 1 ns to move between two consecutive tracks. Find out the average waiting time of the requests for the following disc scheduling algorithms.

   i. SSTF

   ii. C-LOOK

   (b) Write short notes on the following (any two):

   i. Process Control Block.

   ii. Bounded buffer problem using semaphore.

   iii. Multiprogramming using swapping.

   iv. Inverted page map table.

$$98, 183, 37, 122, 14, 124, 65, 62 \qquad (3 + 3) + (2 \times 4)$$

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3

9(MCA)

2014

COMOPUTER APPLICATION

Paper: System Software (MCA-303)

Full Marks: 70

Time: 3 Hours

The figure in the right-handed margin indicate marks.
Candidates are required to give their answer in their own words as far as practicable.
Answer any seven questions.

1. Prove that DFA and NFA are equivalent.
2. a) A Mealy machine described by the transition table given in the table below. Construct a Moore machine which is equivalent to the Mealy machine.   10

Present state	Next state			
	a = 0		a = 1	
	state	output	state	output
→q_1	q_1	1	q_2	0
q_2	q_4	1	q_4	1
q_3	q_2	1	q_3	1
q_4	q_3	0	q_1	1

b) Construct a Mealy machine which is equivalent to the Moore machine given in the table

Present state	Next state		Output
	a = 0	a = 1	
→q_0	q_1	q_2	1
q_1	q_3	q_2	0
q_2	q_2	q_1	1
q_3	q_0	q_3	1

3. a) Let G= ({S, A1}, {0, 1, 2}, P,S)   5+5=10
   Where p consists of S→0SA₁2, S→012, 2A₁→A₁2, 1A₁→11.
   Show that L (G) = {$0^n1^n2^n$ | n≥1}.

   b) Let G= ({S, A₁, A₂}, {a, b}, P, S)
   Where P consists of S→aA₁A₂a, A1→baA₁A₂b, A₂→A₁ab, aA₁→baa, bA₂b→abab.
   Test whether W=baabbabaaabbaba is in L. (G).   6+4=10

4. a) Write Arden's theorem and prove it.

b) Construct a regular expression corresponding to the state diagram given in figure.

F.A.
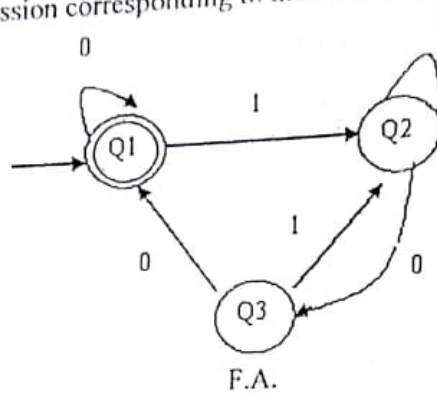
5+5=10

5. Construct an FA equivalent to the regular Expression
   $(0+1)^*(00+11)(0+1)^*$ 10

6. Design a PDA for the language
   $L= \{WCW^R \mid W\in (a, b)^*\}$

7. a) Check ambiguous for the description "a+b*c"
      Consider the grammar $G= (N, T, P, S)$
      $N= \{E, I\}$; $P= \{F \to I\}$.
      $T= \{a, b, c, +, *, (,)\}$
      $E \to E+E, E \to E*E, F \to (E)$
      $I \to a \mid b \mid c$.

   b) Show that the grammar
      $S \to a \mid abSb \mid aAb$
      $A \to bS \mid aAAb$
      is ambiguas.   5+5=10

8. a) Draw the derivation tree for 'bbabbbbab' using grammar,
      $S \to SAS, S \to b, A \to ba, A \to b$

   b) Convert the following CFG into CNF
      $S \to bA \mid aB,$
      $A \to aAA \mid aS \mid a,$
      $B \to aBB \mid bS \mid b$ 5+5=10

9. Design the turing machin over $\{1, b\}$ each can compute concation function over $\Sigma \{1\}$.
   If a pair of words $\{W_1, W_2\}$ is the input, the output has to be W_1W_2.   10

10. Write short notes on.
    i)   Mealy and Moore Machine.
    ii)   Chomskey Classification of Language with example.
    iii) Identities for regular expresion
    iv)   Pumping Lemma.   4* 2.5=10

2014
COMPUTER APPLICATION .
MCA 305
(Design & Analysis of Algorithm)
Full Marks: 70   Time: Three Hours
Answer any *five* questions.

1 (a) Define a *simple polygon* and the *convex hull*. Let $CH(P)$ denote the convex hull of a set P of points in a plane. Suppose you know a method, say *Algo*, to check whether a point is on the left or right side of a given line. Use this method *Algo* to design an algorithm for computing $CH(P)$ and analyse the time complexity of your proposed algorithm.

(b) Design a recursive algorithm to compute $CH(P)$. Analyze the time complexity of this algorithm.

$$[(2 + 2 + 4) + (4 + 2) = 14]$$

2. (a) Find the 13th smallest element from the following array A where you are not allowed to sort whole array.
$A = \{8, 33, 17, 51, 57, 49, 35, 11, 25, 37, 14, 3, 2, 13, 52, 12, 6, 29, 32, 54, 5, 16, 22, 23, 7\}$.

(b) Write a sorting algorithm that does not require comparisons.

$$[8 + 6 = 14]$$

3. (a) Compute the minimum number of guards for an *art gallery* in *star shape polygon*. Is this number is optimum?

(b) Find an optimal solution to the *fractional Knapsack problem* with following data: Total number of items =3, Knapsack size = 20, Profit components = (25, 24, 15) and Weight components = (18, 15, 10).

(c) Define the *storage problem on a single tape*. Solve this problem for m tapes.

$$[(3 + 1) + 4 + (2 + 4) = 14]$$

4. (a) What are the main differences between *divide and conquer* and *dynamic programming* techniques?

(b) Define the *matrix chain multiplication* problem (MCMP).

(c) Write the first two steps to solve MCMP by dynamic programming technique.

$$[2 + 2 + (5 + 5) = 14]$$

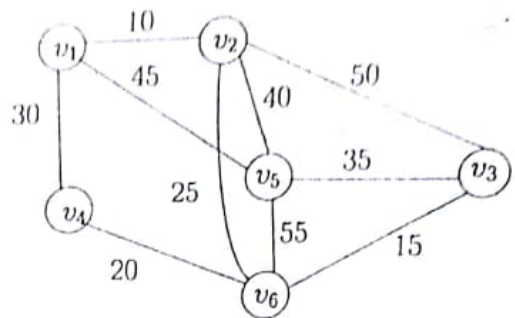5. (a) Define *Minimum Spanning Tree* (MST) of a weighted graph $G(V, E, w)$.

Figure 1:

(b) Design *Kruskal's* algorithm to find a MST of a weighted graph $G(V, E, w)$ and use this algorithm to find a MST of the graph in Figure 1.

$$[3 + (6 + 5) = 14]$$

6. (a) Explain *shortest path* (SP) problem for a directed weighted graph $G(V, E, w)$

(b) "It is not possible to compute shortest paths for a directed weighted graph $G(V, E, w)$ having negative cycle." Justify this statement.

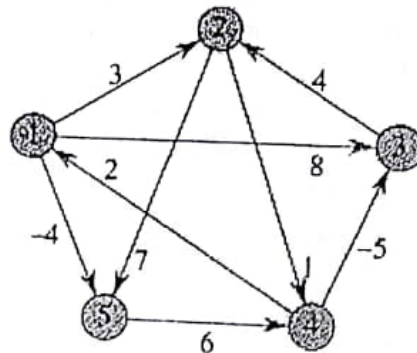(c) Compute all SPs from the vertex marked 1 in Figure 2.

$$[5 + 3 + 6 = 14]$$

Figure 2:

7. Write short notes (Any *four*).

(i) *Approximation* Algorithm

(ii) *Star shape* polygon

iii) Decision Problem

iv) Optimization ,,

v) Priority Queue

vi) Heap Sort

$$[3.5 \times 4 = 14]$$

(a) Abstraction
(b) Polymorphism
(c) Inheritance
(d) Encapsulation

(v) Which of the following is an abstract data type?

(a) int
(b) double
(c) class
(d) string

(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 typecasting? Explain with examples
(c) What is const qualifier? Explain with an example
(d) What is dynamic memory management in C++? How it is done in C? hus

$$[4 + (1 + 2) + (1 + 2) + (3 + 1) - 14]$$

4. (a) What is constructor?
(b) Write a program in C++ to pass arguments to the constructor of a base class from the constructor of the derived class.
(c) What is a friend function? What are the merits and demerits of using friend functions?
(d) "In some cases, operator function must be a friend function to overload an operator." Justify

$$[2 + 3 + 6 + 3 = 14]$$

5. (a) What are the different forms of inheritance? Give an example for each such form.
(b) How compile time polymorphism is implemented in C++?
(c) Write a program in C++ to show the implementation of runtime polymorphism.

$$[6 + 3 + 5 = 14]$$

6. (a) State the various parameters used to open a file in C++. What are the file pointers and their manipulations?
(b) Write a program in C++ to count and display the number of lines not starting with alphabet 'A' present in a text file "STORY.TXT". For Example, if the file "STORY.TXT" contains the following lines:

The rose is red.
A girl is playing there.
There is a playground.
An aeroplane is in the sky.
Numbers are not allowed in the password.

2

(c) Write a program in C++ to count the number of lines, blank spaces and characters in a given file. $[(3 + 2) + 4 + 5 = 14]$

7. (a) What is the specialty of template function? Give Examples

(b) Design a template class to multiply (scalar) two vectors in a 3 dimensional space

(c) What is an exception?

(d) How is an exception handled in $C++$? $[3 + 6 + 2 + 3 = 14]$

$[4 \times 3.5 = 14]$

8. Discuss any four:

(i) Member functions

(ii) Data types in C++

(iii) logic, syntax and run time error.

(iv) Hybrid inheritance

(v) Detecting end-of file

(vi) Formatted console I/O operations

2014
Computer Applications
Paper – Operations Research (MCA – 306)

Full Marks: 70

Time: 3 Hours

The figures in the margin indicate full marks
Symbols have their usual meanings
Answer Question No. 1 and any FIVE from the rest

$1 \times 10 = 10$

1 Fill in the blanks:

a) If a constraint of a dual problem is of equality type, the corresponding primal _____.

b) The minimum number of non-basic cells in a 5×4 transportation problem is _____.

c) In dual simplex method a linear programming problem is said to reach at its optimality if _____.

d) A transportation problem can be converted into a maximization type problem by _____.

e) The total float of a non-critical activity in CPM can be calculated as _____.

f) A point in a convex set is said to be an extreme point if _____.

g) In MODI method the optimality of a transportation problem arises when _____.

h) A game is said to be fair if _____.

i) Floyd's algorithm is more general than Dijkstra's algorithm because _____.

j) An activity is said to be critical if _____.

2 a) A farm manufactures two products A and B on which the profits earned per unit are Rs 3/ and Rs. 4/-, respectively. Each product is processed on two machines M1 and M2. Product A requires 1 minute of processing time on M1 and 2 minutes on M2; while B requires 1 minute of processing time on each machine. Machine M1 is available for not more than 7 hours 30 minutes; while machine M2 is available for 10 hours in any working day. Find the number of units of products A and B to be manufactured to get maximum profit by formulating a linear programming problem.

4+6+2

b) Define convex set.

3. a) Find the optimal solution and optimal cost of the following transportation problem:

	A	B	C	D	
I	3	2	4	1	20
II	2	4	5	3	15
III	3	5	2		25
IV	4	3	1	4	40
	30	20	25	25	

b) Find the minimum cost for the following assignment problem:

	J1	J2	J3	J4
M1	9	10	8	7
M2	6	9	3	8
M3	9	7	6	0

7+5

(iii) *Decision* problem

(iv) *Optimization* problem

(v) *Priority queue.*

(vi) *Heap* sort