

2015

## 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) How can 1 : N relationship in E-R scheme be converted in relational mapping?
- ☒ ii) What do you mean by concurrency?
- ☒ iii) What is KAT function of hashed file?
- ☒ iv) What is Alternate key?
- ☒ v) What is cardinality ratio?
- ☒ vi) What is the difference between Cartesian product and Natural Join?
- ☒ vii) Why the cost of conversion of DBMS will increase?
- ☒ viii) Define: Free variable and bound variable in tuple relational calculus.
- ☒ ix) What is the role of Application Programmer in DBMS?
- ☒ x) What do you mean by Embedded SQL?
- ☒ xi) What is data model?

2. A university needs a database to hold current information on its students. An initial analysis of these requirements produced the following facts:

- i) Each of the faculties in the university is identified by a unique name and a faculty head is responsible for each faculty.
- ii) There are several major courses in the university. Some major courses are managed by one faculty member, whereas others are managed jointly by two or more faculty members.
- iii) Teaching is organized into courses and varying numbers of tutorials are organized for each course.

- 5
- iv) Each major course has a number of required courses.
  - v) Each course is supervised by one faculty member.
  - vi) Each major course has a unique name.
  - vii) A student has to pass the prerequisite courses to take certain courses.
  - viii) Each course is at a given level and has a credit-point value.
  - ix) Any number of students can be enrolled in each of the major courses.
  - x) Each student can be enrolled in only one major course and the university keeps a record of that student's name and address and an emergency contact number.
  - xi) Any number of students can be enrolled in a course and each student in a course can be enrolled in only one tutorial for that course.
  - xii) Each tutorial has one tutor assigned to it.
  - xiii) A tutor can tutor in more than one tutorial for one or more courses.
  - xiv) Each tutorial is given in an assigned class room at a given time on a given day.
  - xv) Each tutor not only supervises tutorials but also is in charge of some course.
- Identify the entities and relationships for this university and construct an E-R diagram. Mention the primary key of each entity set. 8 + 2

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

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

b) Describe the basic functions of a Database Management System.

5 + 5

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

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

5 + 5

6. 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 the following queries in the specified language given below: (any five)

2 x 5 = 10

- ✓ a) Who are the drivers who have delivered shipments for customers with annual revenue over Rs. 34 lakhs to cities with population over 45 lakhs? (SQL)
- ✓ b) List all cities that have received shipments from every customer. (SQL)
- ✓ c) Which city in the database has smallest population? (SQL)
- ✓ d) Find the average weight of a shipment sent to highest population city. (SQL)
- ✓ e) List the cities of population over 45 lakhs which have received a 2 ton shipment from customer 4501. (Relational Algebra)
- ✓ f) List all customers whose annual revenue more than 15 lakhs. (Domain or Tuple relational calculus).

- 7 a) Define Transitive Dependency and Loss-less join Dependency.
- ✓ b) Define: Boyce-Codd Normal Form (BCNF). How does it differ from 3NF?

5 + 5

8 Write short notes on any four:

4 X 2.5 = 10

- i) Non Procedural Language
- ✓ ii) Functional Dependency
- ✓ iii) Hierarchical Data Model
- ✓ iv) Hashed file
- ✓ v) Logical data independence



(MCA)

MCA/II/1st Sem/2015/302

2015

Operating Systems

Paper - 302

Full Marks - 70

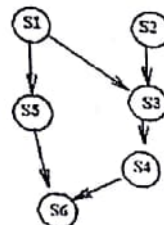
Time - 3 hours

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) Distinguish between the following:
- Multiprogramming and Multiprocessing.
  - Network system and Distributed system.
- (b) What is a real time system?
- (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.
- ✓ 2. (a) Distinguish between preemptive and nonpreemptive CPU scheduling. (2 + 2) + 2 + 2 + (2 + 4)
- (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 five 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            | 4          |
| P2      | 2            | 3          |
| P3      | 6            | 7          |
| P4      | 8            | 1          |
| P5      | 12           | 8          |
- (c) When does Round Robin scheduling behave like FCFS scheduling?
- (d) Explain the *exponential averaging* method for estimating the length of the next CPU burst.
- ✓ 3. (a) "Context switching among threads is less costlier than that among processes"-Justify. 2 + (2 × 3) + 2 + 4
- (b) Discuss the differences between user level threads and kernel level threads.
- (c) Describe the various multi-threading models.
- (d) Convert the following precedence graph into a program using Fork/Join construct.



- ✓ 4. (a) What is meant by critical section of a process? 3 + 4 + 3 + 4
- (b) What are the necessary conditions for achieving mutual exclusion?
- (c) Define the *Wait* and *Signal* operations on semaphore that do not involve busy waiting.

4. (d) Discuss the solution to the Reader-Writer problem using semaphore and write down the pseudo codes for the reader and writer processes. processes.  $2 + 3 + (2 + 2) + 5$

5. (a) What are the necessary conditions for a deadlock to occur?  
 (b) Does a cycle in the resource allocation graph always indicate a deadlock? Justify your answer.  
 (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				Max			
	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	1	2
P1	1	0	0	0	1	7	5	0
P2	1	3	5	4	2	3	5	6
P3	0	6	3	2	0	6	5	2
P4	0	0	1	4	0	6	5	6

If the available number of instances for resource types A, B, C and D are 1, 5, 2 and 0, respectively, then answer the following:

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

$$4 + 3 + (2 + 5)$$

6. (a) Briefly describe the hierarchy of memory organization.  
 (b) What do you mean by internal and external fragmentation? Give examples.  
 (c) Consider a pure paging system along with TLB for storing the most recent part of the page map table. If TLB hit ratio is 85%, main memory access time is 50 nanoseconds and TLB access time is 10 nanoseconds, what will be the overall average access time?  
 (d) What are the factors that affect page sizes in a pure paging system?  
 (e) What is sharing easier in segmentation than paging?

$$3 + 3 + 2 + 4 + 2$$

7. (a) Consider the following page reference string:

1 2 3 2 1 5 2 1 6 2 5 6 3 1 3 6 1 2 4 3

If the number of free frames in memory is 3 then find the number of page faults for the following page replacement strategies: i) FIFO, ii) Least Recently Used.

- (b) Discuss the *working set principle* for handling the thrashing problem. What is the disadvantage of working set model?  
 (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 matrix A in i) row wise and ii) column wise?

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

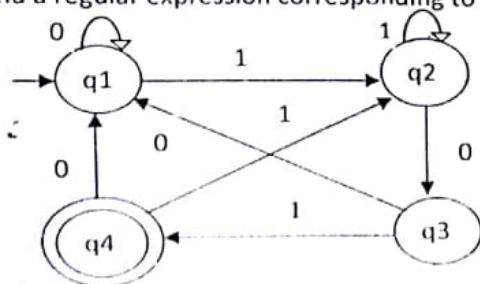
8. (a) Consider the following sequence of disc requests (track numbers): 45, 80, 64, 19, 120, 12, 62, 93. All the requests have come at the same time. The initial head position is on track 70. The range of tracks is from 0 to 199 and the disc head needs 1 ns to move between two consecutive tracks. Find out the total time to serve all the requests for the following disc scheduling algorithms: i) SSTF, ii) LOOK.  
 (b) Write short notes on the following (*any two*):  
 i. Process Control Block.  
 ii. Deadlock prevention.  
 iii. Multi-level page map table.  
 iv. Clock algorithm for page replacement.

$$(3 + 3) + (2 \times 4)$$

The figure in the right handed margin indicates marks. Candidates are required to give their answer in their own words as far as practicable.

Answer any five questions.

1. a) What do you understand about Finite Automaton? Write a short note over Finite Automaton with example.
  - b) Write some difference between DFA and NFA. Which one of that is better and why?
  - c) Write the definition of Mealy and Moore Machine. How can you differ from each other?
2. a) Design a Moore Machine and Mealy Machine for binary input sequence. Output 'A' if '101' is recognized otherwise output 'B'.
  - b) Design Moore and Mealy Machine to convert each occurrence of substring 100 by 101.
3. a) What do you understand about formal language? From the view of this language write different types of definition of a grammar with examples.
  - b) Discuss about Chomsky's Classification of language with proper example.
4. a) Let  $G = (\{S, A_1\}, \{0, 1, 2\}, P, S)$  where P consists of  $S \rightarrow 0SA_12$ ,  $S \rightarrow 012$ ,  $2A_1 \rightarrow A_12$ ,  $1A_1 \rightarrow 11$ . Show that  $L(G) = \{0^n 1^n 2^n \mid n \geq 1\}$ .
  - b) Describe Arden's theorem and prove it.
5. a) Give an regular expression for representing the set L of the strings in which every 0 is immediately followed by at least two 1's.
  - b) Prove that the regular expression  $R = \Lambda + 1^*(011)^*(1^*(011)^*)^*$  also describes the same set of strings.
6. a) Find a regular expression corresponding to the given figure:



F A

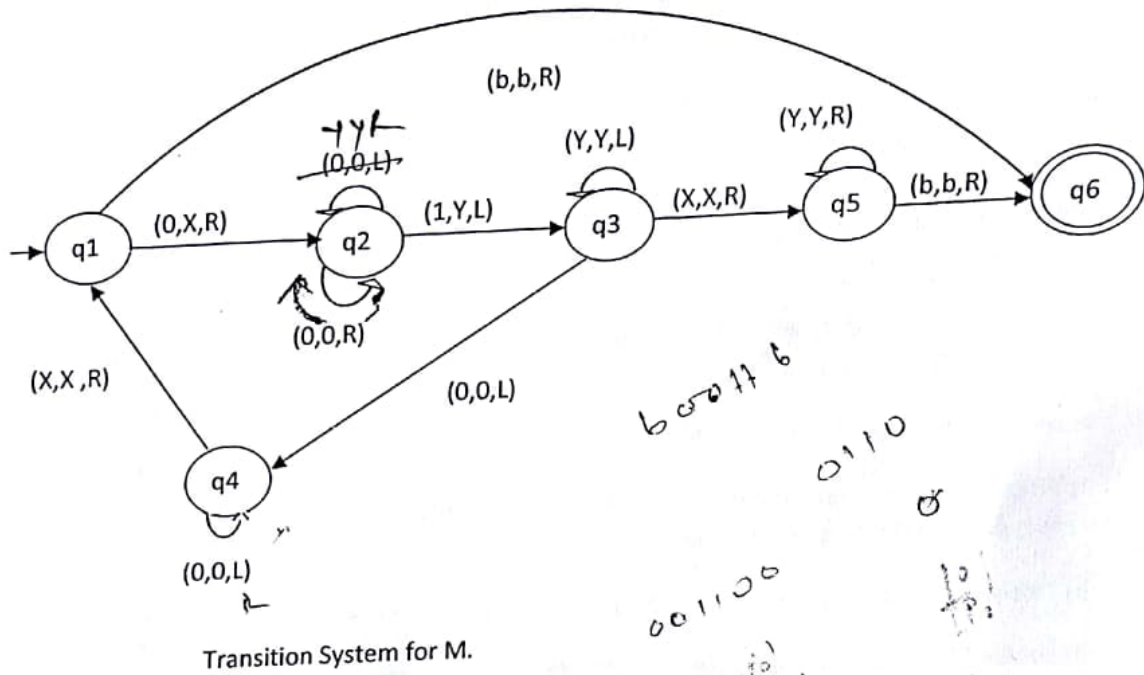


b) Construct a DFA with reduced states equivalent to the regular expressions  $10^+(0+11)0^*1$  and  $7+7=14$   
also write transition table of DFA.

7. a) Design a PDA to accept the following language.

$$L = \{WW^R \mid W \in (0,1)^*\}$$

b) 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.  
7+7=14



3(MCA)

MCA/II/1st Sem/2015/304

2015

Object Oriented Programming

Paper - MCA 304

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) Summarize the concepts of object oriented programming. [7 + (1 + 3) + 3 = 14]  
(b) Which operator in C++ is used to create memory dynamically? Write the characteristics of this operator.  
(c) What is reference variable in C++?

2. (a) Describe in details the two methods of overloading operators with the help of an example in each case.  
(b) Implement friend function and friend class with an example. Highlight the privileges enjoyed by friend function [7 + 7 = 14]

3. (a) Explain the default function arguments with an example.  
(b) Write a program in C++ to illustrate the effect of function overloading.  
(c) In which order the constructors and destructors are executed? Explain with examples. [4 + 6 + 4 = 14]

4. (a) Give four examples of objects from the hall in which you are writing the examination. Name the corresponding class or classes.  
(b) What is a class? How does it accomplish data hiding?  
(c) What is virtual base class. Give an example.  
(d) Explain the working of virtual function with the help of an example. [2 + 3 + 3 + 6 = 14]

5. (a) Write different data types in C++ with the help of diagram.  
(b) Write a program in C++ to overload "+" operator to add two complex number.

prog operator + (Complex)



- ✓(c) Write a program in C++ to concatenate and compare two given strings using operator overloading and dynamic constructor. [3 + 5 + 6 = 14]

6. (a) Define file stream.

✓(b) Describe the various classes available for the file operations.

(c) Write a program in C++ that will copy the content of one existing file into another. Modify your program so that you can run it using command line arguments.

✓(d) What are the advantages of saving data in binary form? [2 + 3 + 7 + 2 = 14]

7. ✓(a) How the end of a file is detected?

(b) Write a program in C++ to count the number of words in a given text file.

✓(c) Create two text files COUNTRY and CAPITAL. COUNTRY file contains name of at least five countries and CAPITAL file contains names of the corresponding capitals. Write a program in C++ to get the output in the following form:

The Capital of India is New Delhi  
and so for other.

[3 + 6 + 5 = 14]

[4 × 3½ = 14]

8. Discuss any four:

✓(a) Member functions

✓(b) Constructors

✓(c) Compile time polymorphism

✓(d) Multiple inheritance

(e) File pointers

(f) Template function and class.

3(MCA)

MCA/II/1st Sem/2015/305

2015

Design and Analysis of Algorithm

Paper - MCA 305

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) What is time complexity and how to find it?
- (b) Design a divide & conquer algorithm to find an item from an array of  $n$  elements and prove that its worst case time complexity is  $O(n \log n)$ .
- (c) Explain decision problem and optimization problem with an example.

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

2. (a) Define heap. Calculate the maximum and minimum number of elements in a heap of height  $h$ .
- (b) Show how to use heap sort algorithm to arrange in decreasing order the integers in the array  $\{4, 5, 2, 9, 8, 7, 1, 3\}$ .
- (c) What are the merits and demerits of implementing a priority queue using an ordered list?

$$[(1 + 3) + 7 + 3 = 14]$$

3. (a) Prove that the maximum number of comparisons performed by merge-sort algorithm to sort an array of  $n$  elements is  $O(n \log n)$ .
- (b) Write an array  $A$  for which the number of comparisons performed by quick-sort algorithm to sort  $A$  is maximum.
- (c) Show the execution of quick sort algorithm to arrange the integers in the array  $\{5, 7, 1, 6, 4, 8, 3, 2\}$ .

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

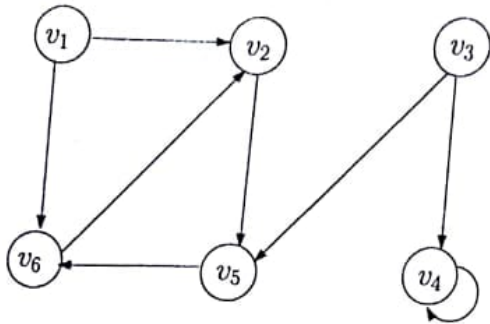
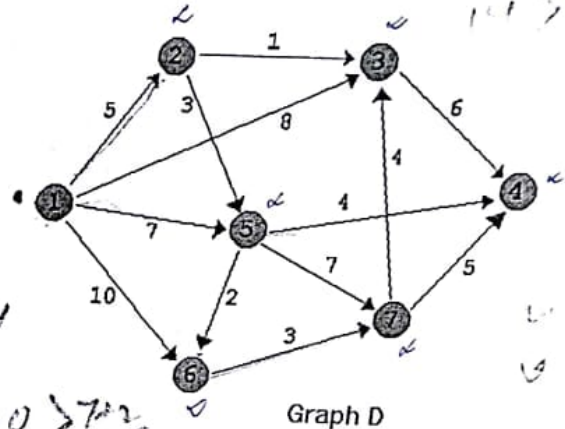


Figure 1:



Graph D

4. (a) The development of a DP algorithm can be broken into a sequence of four steps. Write these four steps.

(b) Give a parenthesized expression for the optimal order of multiplying the following five matrices:

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

$$[4 + 10 = 14]$$

5. (a) Consider a geometric environment having  $n$  axis-parallel rectangular obstacles where we want to navigate between any two points  $s$  and  $t$ . Show that the shortest path between  $s$  and  $t$  is a piecewise linear curve.

(b) Define minimum spanning tree of a weighted graph  $G(V, E, w)$ . How greedy method is used to compute a minimum spanning tree of a weighted graph  $G(V, E, w)$ ?

$$[6 + (2 + 6) = 14]$$

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

(b) Compute a depth-first forest for the graph in Figure 1.

$$[(6 + 2) + 6 = 14]$$

7. (a) How Dijkstra's shortest path algorithm is used to solve the single source shortest path problem (SSSPP)? Use this algorithm to solve the SSSPP for Graph D considering



the vertex marked 1 as the source.

✓(b) Write a note on topological sorting.

8. Write short notes (Any four):

- ✓(a) Different edges in depth first forest
- ✓(b) Strongly connected components of a graph.
- (c) Greedy method
- (d) Knapsack problem
- (e) Radix sort
- (f) The art gallery problem
- (g) Convex hull

$$[(5 + 5) + 4 = 14]$$

$$[4 \times 3\frac{1}{2} = 14]$$