

83 COMPUTER SCIENCE

2011

SECOND PAPER

Full Marks : 200

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer any eight questions

1. (a) Give the finite-state automation and the regular grammar for the following : $4 \times 2 = 8$
 - (i) $(11^*) * (110 \vee 01)$
 - (ii) All strings over $\{0, 1\}$ which do not contain the string 010
- (b) Show that SQL is relationally complete by showing that it includes analogues of the five algebraic primitives. 7
- (c) An AM signal in which the carrier is modulated by 70% contains 1500 W at the carrier frequency. Determine the power content of the upper and lower sidebands. 10
2. (a) Write the different issues considered while designing the different layers of ISO/OSI model of computer communication. 10

(b) Convert the data in the invoice in Table 1 below to third normal form. Show each stage : 10

ABC Company
St. Hilapara,

Order Number : Customer Number :
Date : Billing Address :
Delivery Date : Ship to Address : Same
Discount :

Product Number	Description	Quantity ordered	Unit price	Extension
Total				

Table 1

(c) Show that the language generated by the following grammar is a regular language : 5

$$S \rightarrow aSa / a$$

3. (a) A binary tree T is stored in memory as shown in Table 2. Draw the diagram of T : 10

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
INFO	20	30	40	50	60	70	80	90			35	45	55	95
LEFT	0	1	0	0	2	0	0	7			0	3	11	0
RIGHT	0	13	0	0	6	8	0	14			12	4	0	0

Table 2

(b) If S be a regular set, i.e., recognised by a finite-state automation, show that S^R , i.e., S -reversed is a regular set. 5

- (c) A pulse train is transmitted along a transmission line which is 200 meters long. The pulse train consists of pulses with a duration of 30 nsec each and separated by 45 nsec. How many pulses can be on the line at a given time? Assume the speed of $e-m$ waves to be same as in free space. 10
4. (a) How does DNS work in Internet? Illustrate the complete procedure of mapping a domain name to an IP address. 9
- (b) Suppose the conceptual schema is restructured in such a way that relations A and B are replaced by their natural join C . To what extent can the view mechanism conceal this restructuring from existing users? Justify your logic. 10
- (c) Declare a function f satisfying the specification. Use additional function as needed.

For $x \geq 0$, $f(x)$ is largest integer $n \geq 0$
such that $n^2 \leq x$

What will happen when the function do
for negative values of x ? 3+3=6

5. (a) Consider the following class definition :

```
Class LinkedList
{ Public : AddToList (LinkedList *X)//
           add X to list here
  Private : LinkedList * PreviousListItem,
           * NextListItem;;
```

Develop an algorithm for AddToList that inserts the argument after the current location in the list, as in

```
LinkedList A[12];
  int i, j;
  .....
  .....
// insert A[j] after A[i]
A[i]. AddToList (& A[j])
```

10

(b) Write the different types of anomalies found in relational database. What is the basic purpose of 4 NF? 4+3=7

(c) A 9.6 Kb/s NRZ data stream is to be transmitted over a 2.4 kHz bandwidth channel. What modulation system would you choose if an error rate of 10^{-4} is to be achieved with a minimum S/N ratio? Justify your arguments. 8

6. (a) Consider the weighted adjacency matrix below :

0	12	20	0	7
15	0	10	18	0
22	10	0	11	0
0	18	11	0	13
8	0	0	12	0

(i) Draw the graph.

(ii) Draw the adjacency list for the graph. $3\frac{1}{2} \times 2 = 7$

(b) Explain the following with respect to their advantages and disadvantages : $3 \times 3 = 9$

(i) Message switching versus Packet switching

(ii) Connection-oriented versus Connection-less protocol

(iii) TDMA versus FDMA

(c) Describe the effect of the procedure call Swap (i, A[i]) under each of the following parameter passing : $3 \times 3 = 9$

(i) Call-by-value

(ii) Call-by-reference

(iii) Call-by-value-result

7. (a) You need to manipulate an array A , whose elements are pointers to objects of either class D or class E . Each object has two numbers : id , an identifying integer, and $print$, a function that prints the name of the class of the object belongs to.

(i) Derive D and E as subtypes of base class B , and declare the array elements to be pointers to B .

(ii) Modify your solution to Q. No. (i) to simulate variant records by adding a tag to each object; the value of the tag specifies the class of the object.

$$7\frac{1}{2} \times 2 = 15$$

(b) A relation **TIMETABLE** is defined with the following attributes :

- D : Day of the week (1-5)
- P : Period within day (1-8)
- C : Classroom number
- T : Teacher name
- S : Student name
- L : Lesson identifier

A tuple $\langle d, p, c, t, s, l \rangle$ is an element of this relation if at time $\langle d, p \rangle$ student s is taught lesson l by the teacher t in classroom c . You may assume that lessons have an identifier that is unique among all lessons taught in the week. Reduce the **TIMETABLE** to a more desirable structure.

10

8. (a) What is a socket? Write the difference between active and passive socket. $2+4=6$

(b) Explain the concept of recursive and iterative resolution of DNS. How does FTP differ from other application layer protocol? Explain. $3+3=6$

(c) Develop an algorithm of an array implementation of a FIFO buffer based on the following invariants : 13

(i) The buffer is empty when $Test = 0$

(ii) The buffer is full when $Test = size$

(iii) The first-in element is in $buff[front]$

(iv) The last-in element is in $buff[rear]$

(v) The elements wrap around the right end of the array

9. (a) Describe the distinctive features of—

(i) unicasting;

(ii) broadcasting;

(iii) multicasting;

with reference to transmitting a message over a network. Mention their relative advantages and disadvantages. $(3 \times 3) + 6 = 15$

(b) 500 users employ FDMA to transmit 1000-bit packets of data. The channel BW is 100 MHz and QPSK is used at each of the 500 carrier frequencies employed.

(i) What is the maximum BW allocated to each user?

(ii) What is the packet rate?

(iii) How long does it take to transmit one packet from each user? 10

10. (a) (i) Generally, "connect" function is used by the client program to establish a connection to a remote machine (server). Write the syntax of "connect".

(ii) After receiving system call, accept() completes the process of establishing connection between the server and the client. The accept() system call is used for stream sockets-server like TCP server.

With the above information, write the syntax of accept() system call.

6×2=12

- (b) Explain the impact of the following in a relational database system : 13
- (i) The rule of guaranteed access
 - (ii) The systematic treatment of null values
 - (iii) Insert and update rule
 - (iv) Integrity rule
11. (a) Explain the following with respect to Andrew file system : 2×5=10
- (i) Location-independent file sharing
 - (ii) Scalability
 - (iii) Distinguishing client machines (work station) and dedicated server machines
 - (iv) Homogeneity
 - (v) Directory protection
- (b) Illustrate, citing suitable example(s), the HTTP as a request-reply protocol. 7
- (c) Develop an algorithm to find the k -th occurrence of x , from left-to-right, $k \geq 0$ in a subarray $A[1 \dots n]$. 8
12. (a) State and explain the essential differences between the Hierarchical and Network approaches used in the database design. 10

(10)

- (b) A bandpass signal has a carrier frequency f_0 and extends from $f_0 - 5$ kHz to $f_0 + 5$ kHz. The signal is sampled at a rate $f_s = 25$ kHz. As the center frequency f_0 varies from $f_0 = 5$ kHz to $f_0 = 50$ kHz, find the ranges of f_0 for which the sampling rate is adequate. 10
- (c) How is TCP different from UDP? Write three standard applications of UDP. 3+2=5
