

**B.E. COMPUTER SCIENCE & ENGINEERING 3<sup>RD</sup> YEAR 2<sup>ND</sup> SEMESTER EXAM- 2018**

**COMPUTER NETWORKS**

Time: 3 hours

Answer question 1 and any four questions  
All questions carry equal marks

Full Marks: 100

1. Answer any ten
  - i. In Pure ALOHA, when a frame will reach its destination successfully?
  - ii. Why there is no need of CSMA/CD in today's Ethernet? Explain it.
  - iii. Explain why collision is an issue in a random access protocol, but not in controlled access or channelizing protocols?
  - iv. What is the difference between a unicast, multicast and broadcast address?
  - v. Explain hidden and exposed terminal problems.
  - vi. What is scatternet in Bluetooth?
  - vii. What is the purpose of NAV?
  - viii. What is the network address in a block of address?
  - ix. Explain why most of the addresses in class A are wasted and why a corporation does not want a class C addresses.
  - x. What are the two major functionalities of ICMP?
  - xi. What additional services are provided by SCTP?
  - xii. How does recursive resolution differ from iterative resolution?
  - xiii. Describe the functions of two FTP transmission connections.
  - xiv. In e-mail, what is MIME?.
  - xv. How are control and data characters distinguished in NVT?
  
2. a) Explain, why slotted ALOHA performs better than pure ALOHA with the help of throughput and maximum throughput calculations and schematic diagram. A network produces 200-bit frames on a shared channel of 200 kbps. Find the throughput if the system generates 500 frames/sec using i) Pure ALOHA ii) Slotted ALOHA. 6+4  
 b) Why the vulnerable time in ALOHA depends on the average time required to send out a frame and CSMA depends on the maximum propagation time? Explain the behavior of three persistence methods when a station finds a channel busy (use timing diagram and flow diagram). 4+6
  
3. a) How CDMA differs from FDMA and TDMA? Explain how a receiver can get the data sent by a specific sender in CDMA. Find the chips for a network with 4-stations using Walsh table for  $W_1 = [-1]$ . 3+3+4  
 b) What are the different fields of IEEE 802.3 MAC frame (give a schematic representation of the frame)? Explain their functionalities. Why Ethernet has imposed restrictions on both the minimum and maximum length of a frame? 6+4
  
4. a) Define subnetting and supernetting. How do the subnet mask and supernet mask differ from a default mask in classful addressing? How can NAT help in address depletion? Explain the address translation mechanism using NAT for outgoing packets and packets coming from the Internet? 2+2+2+4

[ Turn over

b) Assume that an ISP is granted a block of addresses starting from 190.100.0.0/16 for Jadavpur University. The ISP needs to distribute these addresses to four groups as follows:

- i. Faculty Council of Engineering and Technology has 128 units; each needs 256 addresses.
- ii. Faculty Council of Science has 64 units; each needs 128 addresses.
- iii. Faculty Council of Arts has 32 units; each needs 64 addresses.
- iv. Interdisciplinary Schools and Centers has 128 units; each needs 64 addresses.

Design the subblocks and find out how many addresses are still available.

10

5. a) Why physical to logical address mapping is required? Why RARP is obsolete? Explain how DHCP provides static and dynamic address allocation. 2+2+6
- b) Explain different error reporting messages of ICMP. Why IGMP message is encapsulated in an IP datagram? 8+2
6. a) Explain steps involved in Distance Vector Routing? Discuss the instability issue of distance vector routing. What strategies can be used to solve two-node loop instability problem? 4+3+3
- b) Compare the TCP header and UDP header (give schematic representations of the headers). Some fields are missing from UDP header, explain the reason for their absence. 6+4
7. a) Explain how TCP provides stream delivery service to the processes at the application layer. Why sliding window is used in TCP? Explain the main steps of error detection and correction in TCP. 5+2+3
- b) Describe the general architecture of e-mail system and main protocols used to implement it. 10

BCSE THIRD YEAR EXAMINATION 2018  
(2<sup>nd</sup> Semester)  
COMPILER DESIGN

Time : Three hours

Full Marks: 100

Group-1 (20 marks)	Answer Question No. 1 and any one from 2 and 3
	1. (a) Describe the role of lexical analysis in the design of a compiler. What are token, pattern and lexeme? Give example of each.
	(b) Define <i>regular grammar</i> . Write a regular expression for floating point numbers. <span style="float: right;">4+4</span>
	2. (a) Construct an NFA for the following regular expression using McNaughton-Yamada-Thompson algorithm. $(a \ b^* \ c) \mid (a \ b \ c^*)$ (b) Construct a DFA for the above NFA using subset construction. <span style="float: right;">6+6</span>
	3. Construct a DFA directly from a regular expression $(a \ b^* \ c) \ (a \mid b)^*$ <span style="float: right;">12</span>
Group-2 (40 marks)	Answer any two questions from this group.
	4. (a) Write a context free grammar for <i>if</i> and <i>else</i> statement in C. Is your grammar unambiguous? Justify your answer.
	(b) The following grammar generates all strings that start with one or more a, and end with a single b. This is an ambiguous context free grammar. $S \rightarrow A \ b \mid a \ A \ B$ $A \rightarrow a \mid A \ a$ $B \rightarrow b$ (i) Find a string s generated by the grammar that has two leftmost derivations. Show the derivations. (ii) Find an equivalent unambiguous context-free grammar. (iii) Compute the FIRST and FOLLOW sets for the unambiguous grammar and construct the parsing table. <span style="float: right;">6+(4+4+6)=20</span>
	5. Consider the grammar: $S \rightarrow a \ A \ B \ e$ $A \rightarrow A \ b \ c$ $A \rightarrow b$ $B \rightarrow d$ (a, b, c, d, e are terminals and S is the start symbol) (a) Show the parse trees of four strings (at least four characters long) which are generated from the above grammar. (b) Generate the LR(0) item set and SLR parsing table for the above grammar. (c) What is <i>shift-reduce</i> conflict? Explain with example. <span style="float: right;">4+(8+6)+2=20</span>
	6. Consider the grammar: $S \rightarrow B \ b \ b \mid a \ a \ b \mid b \ B \ a$ $B \rightarrow a$ (a, b are terminals and S is the start symbol) (a) Generate the LR(1) item set for the grammar. (b) Generate LALR parsing table. (c) What are the strings that can be generated from this grammar? Show the trace of parsing any one string. (d) What is a viable prefix? Give examples of 4 viable prefixes from the above grammar. <span style="float: right;">6+6+4+4=20</span>
	Group-3 (30 marks)
	Answer any two questions from this group.
	7. (a) Write a syntax-directed definition for generating three address code for an assignment statement S with the following productions. Use attribute 'code' for S and attribute 'addr' and 'code' for an expression E. $S \rightarrow id = E$ $E \rightarrow - E \mid E + E \mid E - E \mid id$

[ Turn over

(b) Describe the different ways of managing the scopes of variables in a symbol table.

8+7=15

8. (a) Generate three address code for the following block.

```
int a[10][10], sumofsq;
sumofsq=0;
for (i=0; i<10; i++)
    for (j=0; j<10; j++)
        sumofsq += a[i][j] * a[i][j];
```

(b) If the above code is written in a programming language which stores array variables in column-major order,, then what changes are needed in the three address code?

(c) What is the use of symbol table? How do you check the types of variables using a symbol table?

6+6+3=15

9. (a) Why does a compiler need *semantic analysis* phase?

(b) What do you mean by syntax-directed translation? What is an L-attributed grammar?

(c) What are the operations performed on a symbol table when it is implemented as a single hash table?

(d) Consider the following code block:

```
int sum (int k)
int a = k, j;
float area;
for (j = 0; j < a; j++) {
    float k = 3.14;
    double area;
    area += k * j * j;
}
return area;
```

With appropriate implementation show how the scope of the identifiers are maintained in the symbol table.

3+4+4+4=15

Group-4  
(10  
marks)

Answer any one question

10. (a) What is a basic block? Write an algorithm for identifying basic blocks.

(b) Optimize the following code and discuss each optimization technique that you have applied stating their advantages.

```
#include <stdio.h>
int main() {
    int j, n, array[20], k=1;
    for(j=0; j < 10; j++) {
        n=11;
        array[n+j] = j*5;
    }
    for(j=0; j < 10; j++)
        array[j+1] = array[j] + array[j+1];
    return 0;
}
```

11. (a) What are the uses of *register descriptor* and *address descriptor* in code generation.  
 (b) Explain the following code optimization techniques using examples:  
 (i) Constant propagation, (ii) Constant folding.  
 (c) How is the function *getreg* used for register allocation?

5+5=10

3+3+4=10

**BCSE 3<sup>rd</sup> Year 2<sup>nd</sup> Semester Examination, 2018****Database Management Systems****Full marks: 100****Time: 3 hours****Attempt any five questions**

- 1) a) In the context of relational model define relation. 4

- b) Consider the following relations:

ELECTIVE\_LIST (SCODE, SNAME)

STUDENT (ROLL, NAME)

OPTED (ROLL, SCODE)

ELECTIVE\_LIST contains list of elective subjects, STUDENT contains data for all students. A student may choose number of elective subjects and those information are stored in OPTED.

- i) Write down the relational algebra and relational calculus expressions to find out the subject codes which have been opted by none. 2+3

- ii) Write down the relational algebra expression to find out the subject codes opted by all students. 2

- iii) Write down the calculus expression to find out the name of the students who chose the subject named 'ABC'. 3

- c) What is the use of class-subclass relation in EER diagram? Explain the constraints on specialization in EER diagram? 6

- 2) a) In an organization, number of projects is going on. Each project has unique project id. For each project start date, end date is stored. Each project requires different skill sets. Each skill set has unique id, type (it denotes the type of skill set like operating system/language/tool etc.) and description (i.e. name of operating system/language/tool etc.). An employee has unique employee id. Name, phone, email-id of each employee is also to be stored. An employee possesses at least one skill set. An employee may act as coordinator of zero or more projects and a project must have exactly one coordinator. Number of employees may work in a project. An employee may take part in multiple projects. An employee gets involved in a project to play the role specific to one or more skill set. The system must be able to support query regarding skill set required for a project, skill set possessed by an employee, in which projects an employee is involved, who is coordinating which project, for which skill sets an employee is involved in a project.  
Draw the ER diagram for the described system. 10

[ Turn over

b) In a bank, a customer can own multiple accounts and for an account there may be multiple owners. Each customer has customer id (unique), name and date of birth. For each account, account no (unique), balance is to be stored. Furthermore, system must be able to say last date of access of an account by a particular owner. Draw the ER diagram, design the tables and write down the DDL statements to create the tables. Assume the type of the attributes according to your choice. 10

3) Consider the following tables:

SUBJECT (SCODE, SNAME)

STUDENT (ROLL, NAME)

QUESTION\_PAPER\_DETAILS (SCODE, QUESTION\_NO,  
ASSIGNED\_MARKS)

SCORE\_DETAILS (ROLL, SCODE, QUESTION\_NO, SCORE)

Assume, SUBJECT contains data for all subjects, STUDENT contains data for all students, QUESTION\_PAPER\_DETAILS contains details of the question paper (in which question what is the marks allotted) for each subject, SCORE\_DETAILS contains question number wise score of each student in each subject.

SCORE\_DETAILS will have an entry only if a student answers corresponding question in a subject.

a) Suggest the foreign keys for the tables. 4

b) Write down SQL statements for the following:

i) Find out the average score in each question for the subject named as 'ABC'

ii) Find total score of each student in each subject

iii) Find the subject codes for which the question paper contains maximum number of questions

iv) Find subject codes and corresponding question numbers which are not at all answered 4x4

4) a) To store the teaching assignments of each faculty member for various batches of students, consider the following data structure (primary key is faculty-id): Faculty-id, faculty-name and for each teaching assignment sub-code, sub-name, batch-id, batch-start-date, batch-coordinator

Further assume, the following FDs:

Faculty-id → faculty-name

sub-code → sub-name

batch-id → batch-start-date, batch-coordinator

i) Why shall we normalize the data structure? 4

ii) Normalize the data structure up to 3NF showing the steps. Indicate primary and foreign key wherever applicable. 8

b) Refer to the tables as in Question 3. Write down the trigger to ensure that score in SCORE\_DETAILS does not exceed corresponding ASSIGNED\_MARKS. 8

- 5) a) Compare contiguous and linked allocation of blocks in a file. 3  
b) Explain the steps for query optimization. 5  
c) What is the usefulness of B/B+ tree based indexing over binary search tree? 3  
d) A large file is ordered on key field and queried very frequently on key field.  
Explain your strategy. 3  
e) Two large relations R and S are to be joined. Joining attribute is primary key in R  
and foreign key in S. R has primary index and S has clustering index on join  
attribute. Explain your join strategy and specify number of disk block access. 4+2
- 6) a) What is a transaction? Describe the state diagram of a transaction? 6  
b) Explain, Why concurrency control is important? 6  
c) Describe timestamp based protocol for concurrency control that also can avoid  
cascading rollback. 8
- 7) a) A system follows log based recovery using redo and redo. Transactions are  
executed concurrently. It performs checkpoint.  
i) What is the utility of checkpoint?  
ii) What actions are taken at checkpoint?  
iii) How does the system prepare the transaction lists for redo and undo?  
3+3+6
- b) Discuss Security features of DBMS 4  
c) Define a conflict serializable schedule. 4
- 8) Write short notes on the following:  
a) Advantage of DBMS over file processing system  
b) Impact of foreign key on DML operation  
c) Lossless decomposition of schema  
d) Attributes of cursor in PL/SQL 4+5+5+6

**BACHELOR OF COMPUTER SCIENCE AND ENGINEERING**  
**Third Year, Second Semester Examination, 2018**

**Principles of Programming Languages**

**Full Marks-100**

**Time- Three Hours**

**Answer any five questions**

1. (a) Discuss about different kinds of data abstraction techniques.  
 (b) Describe Von Neumann bottleneck.  
 (c) How can a programming language be defined? 10+2+8
  
2. (a) How would you define efficiency of a programming language?  
 (b) Give an example of orthogonal language design.  
 (c) Discuss about Turing tarpit.  
 (d) State Flon's axiom. 10+4+3+3
  
3. (a) Write code snippets to compute factorial of a number following imperative, functional and logic programming paradigm.  
 (b) Write referentially transparent code to compute gcd of a number. Justify your answer.  
 (c) How can functions be treated as first class data values? Give an example. 10+6+4
  
4. (a) What is behavior parameterization? How is it implemented in Java?  
 (b) Which of these lambda expressions are valid Function<Long,Long> implementations?  
 Explain. (i)  $x \rightarrow x + 1$ ; (ii)  $(x) \rightarrow (y) \rightarrow (z) \rightarrow x + y + z + 1$ ;  
 (c) Would the following Java code compile? Give reasons w.r.t functional interfaces.
 

```
i. Runnable helloWorld = () -> System.out.println("hello world");
ii. The lambda expression being used as an ActionListener:
    JButton button = new JButton();
    String Name=getUserName(); //Assume the method is defined
    button.addActionListener(event->System.out.println("hello"+ name));
```

 (d) Find the String with the largest number of lowercase letters from a List<String> using Lambda expressions in Java.  
 (e) Given a text file, print the duplicate words using Lambda expressions in Java. 7+3+4+2+4

[ Turn over

5. (a)

<code>public class Trader</code>	<code>public class Transaction</code>
<code>private final String name;</code> <code>private final String city;</code>	<code>private final Trader trader;</code> <code>private final int year;</code> <code>private final int value;</code>
<code>public Trader(String n, String c);</code> <code>public String getName();</code> <code>public String getCity();</code>	<code>public Trader getTrader();</code> <code>public int getYear();</code> <code>public int getValue();</code>

Given the Trader and Transaction class (as shown), write code snippets using Java Streams API for the following queries:

- (i) Find out a list of all the unique cities where the traders work.
- (ii) Print the maximum and minimum of all transactions' values for the traders living in Cambridge.
- (iii) Group transactions by cities and then further categorize by whether they're expensive or not (multilevel groupings should be used).
- (b) Write implementation of the functions `max()`, `map()`, `filter()` and `count()` using only reduce and Lambda expressions. You can return a List instead of a Stream if you want.

10+10

6. (a) Use normal order reduction and applicative order reduction to reduce the following Lambda expressions.

- (i)  $(\lambda x. \lambda z. z) ((\lambda y. yy) (\lambda u. uu))$
- (ii)  $(\lambda x. x \ x \ x) (\lambda x. x \ x \ x)$
- (iii)  $((((\lambda f. (\lambda g. (\lambda x. ((fx)(g \ x)))))(\lambda m. (\lambda n. (n \ m))))(\lambda n. z))p)$
- (b) How would you find predecessor and successor of 2 in Lambda calculus?
- (c) How can the successor function be used to sum two natural numbers? Show the steps to find out the sum of 2 and 5.

(3+2+3)+8+4

7. (a) Write Prolog clauses to express the relationships: grandparent, cousin, sibling and mother. Given Parent (X, Y) means X is a parent of Y.

(b) Write a program in Prolog to sort a list of numbers according to insertion sort algorithm.

(c) Given the following Prolog clauses:

```
ancestor(X, Y) :- parent(X, Z), ancestor(Z, Y).
ancestor(X, X).
parent(amy, bob).
```

Place cut in such a way that (i) all solutions can be found; (ii) all solutions are pruned; (iii) one solution is found.

Show the search tree to be generated for the query `ancestor(X, bob)` for each of the cases. 6+5+9

8. (a) Describe multimethods with respect to object oriented programming.

(b) Compare between abstract methods and higher order functions.

(c) Describe currying in lambda calculus. How is it supported in Java through functional interfaces? Write relevant code snippets.

(d) Discuss width subtyping and depth subtyping and their relevance in object oriented programming.

4+4+7+5

B.C.S.E 3<sup>rd</sup> Year 2<sup>nd</sup> Semester Examination 2018

## DESIGN AND ANALYSIS OF ALGORITHMS

Time: Three hours

Full Marks: 100

Answer Question #1 and any four from the rest, all having the same value

1. Draw a line from each of the three functions in the centre to the best big  $\Omega$  value on the left and the best big  $O$  on the right:

$\Omega(1/n)$	$O(1/n)$
$\Omega(1)$	$O(1)$
$\Omega(\log \log n)$	$O(\log \log n)$
$\Omega(\log^2 n)$	$O(\log^2 n)$
$\Omega(n^{1/3})$	$O(n^{1/3})$
$\Omega(n/\log n)$	$O(n/\log n)$
$\Omega(n)$	$O(n)$
$\Omega(n^{1.00001})$	$O(n^{1.00001})$
$\Omega(n^2/\log^2 n)$	$O(n^2/\log^2 n)$
$\Omega(n^2/\log n)$	$O(n^2/\log n)$
$\Omega(n^2)$	$O(n^2)$
$\Omega(n^{3/2})$	$O(n^{3/2})$
$\Omega(2^n)$	$O(2^n)$
$1 / (\log n)$	
$7n^5 - 3n + 2$	
$3^n$	

2. Design a randomized algorithm and then give an analysis for identifying  $n/2$  repeated elements in an array which has another  $n/2$  distinct elements other than the repeated elements.
3. Design and analyze the KMP algorithm for string matching.
4. Prove that the following algorithm for the addition of natural numbers is correct:

```

add(y, z) {
    x = 0; c = 0; d = 1;
    while (y > 0) ∨ (z > 0) ∨ (c > 0) {
        a = y mod 2; b = z mod 2;
        if a ⊕ b ⊕ c then x = x + d;
        c = (a ∧ b) ∨ (b ∧ c) ∨ (c ∧ a); d = 2d; y = ⌊y/2⌋; z = ⌊z/2⌋;
    };
    return x;
}

```

[ Turn over

5. Design and analyze a dynamic programming solution for the matrix-chain multiplication problem.
6. How does a randomized input significantly improve the performance of quicksort? Give a detailed study.