Department of Computer Science & Engineering,
Motilal Nehru National Institute of Technology, Allahabad.
Mid Semester Examination
September-2017
MCA-III Semester

Subject: Analysis of Algorithms | **Paper code: CA-3304**
Duration: 90 Minutes | **Max. Marks: 20**

Note: **Attempt all questions. Make assumptions wherever necessary and quote it.**

Q1. Solve the following using Master Theorems: ***[1×2=2 Marks]***

(a) $T(n) = 16T\left(\frac{n}{4}\right) + n!$

(b) $T(n) = 3T\left(\frac{n}{3}\right) + \frac{n}{2}$

Q2. Find upper bound for $n^4 + 100n^2 + 50$ ***[1 Marks]***

Q3. Find the complexity of the below function: ***[2 Marks]***

```
function(int n){
 for (int i=0; i<n; i++)
    for(int j=i; j<i*i; j++)
       if(j%i==0){
       for(int k=0; k<j; k++)
          print("*")
   }
}
```

Q4. Write down the Quick sort and Merge sort pseudocode and give the complexity analysis with help of some example. ***[4 Marks]***

Q5. Prove that the complexity of heap sort is $O(nlogn)$. ***[4 Marks]***

Q6. Show that selection (using RANDOMIZED-SELECT algorithm) in expected linear time is $O(n)$. ***[3 Marks]***

Q7. Consider the array A={26, 17, 41, 14, 21, 30, 47, 10, 16, 19, 21, 28, 38, 7, 12, 14, 20, 35, 39, 3}. Create RED-BLACK tree with one more attributes its size of node. Retrieve 17^{th} smallest element in the RED-BLACK tree. ***[4 Marks]***

Department of Computer Science & Engineering,
Motilal Nehru National Institute of Technology, Allahabad.
End Semester Examination
November-2017
MCA-III Semester

Subject: Analysis of Algorithms
Duration: 3 Hours

Paper code: CA-3304
Max. Marks: 60

Note: **Attempt all questions. Write all used formula in questions. Make assumptions wherever necessary and quote it.**

Q1. What is an optimal Huffman code for the following set of frequencies? Solve with description of Huffman algorithm. ***[5 Marks]***

Character	Frequency
A	5
B	9
C	12
D	13
E	16
F	45

Q2. What are greedy approaches? How it is different from backtracking and dynamic programming? Give the complete solution (step by step) for 8- Queen problem using back-tracking with pseudocode and explanation of each step. ***[8 Marks]***

Q3. Explain the optimal sub-structure and overlapping sub-problem with help of Fibonacci series and give the complete solution of Fibonacci series using dynamic programming with complexity analysis. ***[6 Marks]***

Q4. Find the length of longest increasing subsequence of given sequence {11, 21, 9, 32, 20, 49, 40, 59} such that all element of the subsequence are sorted in increasing order. ***[6 Marks]***

Q5. Consider the rod of length and piece of all prices smaller than 7, find the most profitable way of cutting of rod. ***[6 Marks]***

Length	1	2	3	4	5	6	7
Prices in $	2	6	9	11	18	19	21

Q6. Find the optimal way to multiply the following matrices to perform the fewest multiplications. ***[6 Marks]***

Matrix	A_1	A_2	A_3	A_4
Dimension	5×11	11×4	4×15	15×23

Q7. Consider the array A={26, 17, 41, 14, 21, 30, 47, 10, 16, 19, 21, 28, 38, 7, 12, 14, 20, 35, 39, 3}. Create RED-BLACK tree with one more attributes its size of node. Retrieve 17^{th} smallest element in the RED-BLACK tree. ***[6 Marks]***

P.T.O.

Q8. Show the comparisons the naive string matcher makes for the pattern P = 0001 in the text T = 000010001010001. ***[3 Marks]***

Q9. Working modulo q = 11, how many spurious hits does the Rabin-Karp matcher encounter in the text T = 3141592653589793 when looking for the pattern P = 26? ***[3 Marks]***

Q10. Construct the string-matching automaton for the pattern P = aabab and illustrate its operation on the text string T = aaababaabaababaab. ***[3 Marks]***

Q11. Write short note on: [2×4=8 Marks]

a. Floyd Warshall algorithm.
b. Optimal binary search tree.
c. Naive string matching algorithm.
d. Polynomial and non-polynomial time verification.

Motilal Nehru National Institute of Technology Allahabad
Department of Computer Science and Engineering
MCA-IV Sem, End-Sem Exam, May 2018
Database Management Systems (CA 3403)

Time 3 hrs **M.M. 60**

All questions are compulsory. Assume any missing data and mention it at the top of answer.

Q1 a) Consider relation R = (A, B, C, D, E, F) and the set of functional dependencies: 5*3=15
   a) AB → C
   b) BC → A
   c) BC → D
   d) D → E
   e) CF → B
   List the Candidate Keys of R.

   b) Do the above functional dependencies imply AB → E? If yes, for each step be sure to indicate which axioms and other functional dependencies you are using.

   c) Is relation R in BCNF? If yes, say why. If not, then decompose R into two or more relations that are all in BCNF. Your decomposition must be lossless, but does not need to preserve dependencies.

Q2 a) In general, is it possible to have a deadlock when the regular two-phase-locking (i.e., non-strict) protocol is obeyed? If yes, give an example. If not, explain briefly. What happens with strict two-phase locking and rigorous two-phase locking? 5+(5+5)

   b) For each of the following schedules:
   Sa = r1(A);w1(B);r2(B);w2(C);r3(C);w3(A);
   Sb = r1(A);r2(A);r1(B);r2(B);r3(A);r4(B);w1(A);w2(B);
   Here, ri denotes read operation by a transaction i and wi denotes write operation by a transaction i. For example, r1 denotes read operation by transaction T1. Similarly, w1 denotes write operation by transaction T1. Answer the following questions:
      i. What are the precedence graphs for the schedules?
      ii. Is the schedule conflict-serializable? If so, what are all the equivalent serial schedules?

Q3 Design an ER-model of a flight reservation system. The model should include: 10
   a) A plane (with a unique ID) is assigned to each flight. The assignment can be different each day. A flight that flies on Monday and Wednesday can be using different planes on each day.
   b) Planes have a bunch of seats, usually identified by a seat number.
   c) A particular flight number can only be used once a day.
   d) A particular fight number can have different Source/ Destination on different date. For example, flight number "UA111" can be assigned to "Los Angeles to Oakland" on Monday and then changed to "San Francisco to Boston" on Tuesday.
   e) A passenger reserves a seat for a particular flight.
   f) Some passengers are frequent flyers, and therefore have account numbers and accumulated miles.
   g) Flights are assigned to a gate which is located in one terminal.
   h) A gate can handle multiple flights each day and different flights on various days.
   i) There are terminals (usually identified by letters) which contain the gates (usually identified by numbers).

Q4 Consider a disk with a sector size of 512 bytes, 2000 tracks per surface, 50 sectors per track, five double-sided platters, and average seek time of 10 msec. 5*2=10
   a) What is the capacity of a track in bytes?
   b) What is the capacity of each surface?
   c) What is the capacity of the disk?
   d) How many cylinders does the disk have?
   e) If the disk platters rotate at 5400 rpm (revolutions per minute), what is the maximum rotational delay?

Q5 Draw the resulting B+Tree in each step. Assume that each page can hold (at most) 4 index entries (or, equivalently, 5 pointers to its children).The leaf nodes have same structure as non-leaf nodes. 10

a) Bulk load the B+Tree with values 10, 23, 29, 30, 34, 40, 46, 49, 54, 59, 70, 75
b) Insert 80
c) Remove 70
d) Go back to the original bulk loaded B+Tree (step a) and Remove 70
e) Delete 59
f) Delete 54
g) How many I/O to find 80?
h) How many I/O to find out 79 is not in index?
i) How many I/O to find 40?
j) How many I/O to find 10?

Motilal Nehru National Institute of Technology
Department of Computer Science & Engineering
Mid Term Examination 2017-18

Subject- Operating System (CA 1502), MCA- 3th Sem.

Duration- 1:30 h **Max. Marks:20**

Attempt all questions. Assume if something missing.

1. Our discussion of process states and the corresponding event queues maintained by the operating system suggests that a process can only be in one event queue at a time. **(2+2)**
   a) Is it possible that you would want to allow a process to wait on more than one event at the same time? Provide an example.
   b) In that case, how would you modify the queuing structure to support this new feature?

2. Consider the seven processes with arrival time and burst time as per scenario given below. Consider the Highest Response Ratio Next (HRN) scheduling algorithm. Compute the average waiting time, average turn around time and throughput of the algorithm. **(2+2+1)**

Processes	Arrival Time	Burst Time	Priority
P0	0	6	3
P1	1	3	2
P2	2	7	5
P3	3	4	1 (highest)
P4	5	3	4
P5	6	5	7 (Lowest)
P6	8	6	6

3. In the discussion of user level threads (ULTs) versus kernel level threads (KLTs), it was pointed out that a disadvantage of ULTs is that when a ULT executes a system call, not only is that thread blocked, but also all of the threads within the process are blocked. Why is that so? **(2)**

4. What is the difference between interrupt and a trap? Discuss atleast three example of interrupt. Also, discuss the general categories of information in process control block (PCB). **(1+2+2)**

5. Many current language specifications, such as for C and C++, are inadequate for multithreaded programs. This can have an impact on compilers and the correctness of code, as this problem illustrates. Consider the following declarations and function definition:

Motilal Nehru National Institute of Technology Allahabad
Department of Computer Science & Engineering
End Semester (Odd) Examination 2017-18

Subject- Operating Systems (CA 3301), MCA- III Semester

Duration- 3:00 hours **Max. Marks: 60**

All questions are compulsory. Assume if something missing.

1. List five services provided by an operating system. Explain how each provides convenience to the users. Explain also in which cases it would be impossible for user-level programs to provide these services. **(6)**

2. Consider the following definition of semaphores given as in Figure 2 (i) : **(6)**

```
void semWait(s)
{
      if (s.count > 0) {
        s.count--;
       }
else {
    place this process in s.queue;
       block;
    }
}
void semSignal (s)
{
  if (there is at least one process
          blocked on semaphore s) {
   remove a process P from s.queue;
   place process P on ready list;
  }
else
s.count++;
}
```

Figure 2 (i)

```
struct semaphore {
          int count;
          queueType queue;
};
void semWait (semaphore s)
{
     s.count--;
   if (s.count < 0) {
   /* place this process in s.queue */;
   /* block this process */;
    }
}
void semSignal (semaphore s)
{
    s.count++;
    if (s.count <= 0) {
/* remove a process P from s.queue */;
/* place process P on ready list */;
    }
        }
```

Figure 2 (ii)

Compare this set of definitions with definition as given in Figure 2 (ii). Note one difference: With the preceding definition, a semaphore can never take on a negative value. Is there any difference in the effect of the two sets of definitions when used in programs? That is, could you substitute one set for the other without altering the meaning of the program?

3. **(a)** List four characteristic of suspended process? What is the meaning of the term busy waiting? Can busy waiting be avoided altogether? Explain your answer. **(3)**
(b) Draw a neat labeled process state transition diagram with two suspended states. Explain the role of each transition in this state transition diagram. **(3)**

4. An operating system uses the Banker's algorithm for deadlock avoidance when managing the allocation of three resource types X, Y, and Z to three processes P0, P1, and P2. The table given below presents the current system state. Here, the Allocation matrix shows the current number of resources of each type allocated to each process and the Max matrix shows the maximum number of resources of each type required by each process during its execution. **(6)**

P.T.O

Process	Allocation			Max		
	X	Y	Z	X	Y	Z
P0	0	0	1	8	4	3
P1	3	2	0	6	2	0
P2	2	1	1	3	3	3

There are 3 units of type X, 2 units of type Y and 2 units of type Z still available. The system is currently in a safe state. Consider the following independent requests for additional resources in the current state:

REQ1: P0 requests 0 units of X, 0 units of Y and 2 units of Z

REQ2: P1 requests 2 units of X, 0 units of Y and 0 units of Z

Identify **REQ1** or **REQ2** is satisfied or not satisfied. Give proper explanation.

5. A process has been allocated 3 page frames. Assume that none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string): **4, 1, 2, 1, 1, 3, 7, 4, 5, 6, 3, 1,7, 4, 6, 3, 3,2 ,1**
If **OPTIMAL** and **Least Recently Used (LRU)** page replacement policy is used, how many page faults occur for the above reference string? **(3+3=6)**

6. **The Dinning –Philosophers Problem:** Consider five philosophers who spend their lives thinking and eating. The philosophers share a circular table surrounded by five chairs, each belonging to one philosopher. In the center of the table is a bowl of rice, and the table is laid with five single chopsticks. When a philosopher thinks, she does not interact with her colleagues. From time to time, a philosopher gets hungry and tries to pick up the two chopsticks that are closest to her (the chopsticks that are between her and her left and right neighbors). A philosopher may pick up only one chopstick at a time. Obviously, she cannot pick up a chopstick that is already in the hand of a neighbor. When a hungry philosopher has both her chopsticks at the same time, she eats without releasing her chopsticks. When she is finished eating, she puts down both of her chopsticks and starts thinking again. **(5+5=10)**
   a. Write a deadlock free solution to the above problem using monitor.
   b. It is noted that a deadlock-free solution does not necessarily eliminate the possibility of starvation. Write a solution, if possible, that is free from starvation.

7. **(a)** Consider a paging hardware with a TLB. Assume that the entire page table and all the pages are in the physical memory. It takes 10 milliseconds to search the TLB and 80 milliseconds to access the physical memory. If the TLB hit ratio is 0.6, find the effective memory access time (in ms). **(5)**

(b) Consider six memory partitions of size **200 KB, 400 KB, 600 KB, 500 KB, 300 KB**, and **250 KB**, where KB refers to kilobyte. These partitions need to be allotted to four processes of sizes **357 KB, 210 KB, 468 KB** and **491 KB** in that order. If the best fit algorithm is used, find out partitions that are NOT allotted to any process? **(5)**

8. Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is: **86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130**
Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms? **(10)**
   a. SSTF
   b. SCAN
   c. LOOK
   d. C-SCAN

Motilal Nehru National Institute of Technology Allahabad
Department of Computer Science and Engineering
Mid-Sem Examination 2017-18
M.C.A 3rd semester, Course Name: Soft Computing(CA3303)

Time: 1.5 hours MM:20 marks

Note: i) All questions are compulsory
ii) For numericals, precision should be upto 3 decimal places.

Q1:)Write the answers of the following: [1+1+1 marks]
a) Explain Fuzzy systems with example.
b) How fuzzy logic is different from probability ?
c) Write out the properties of fuzzy set and crisp sets. Also list their diffference.

Q2:) Write the answers of the following: [1+ 2 + 2 marks]
a) Classify this question paper alongwith answer as soft/hard computing with proper reasoning and cases you considered.
b) Explain how an unsupervised neural network can be used for character recognition.
c) Explain fuzzy inference process with an example.

Q3:) Explain why law of contradiction and law of exclusive middle are violated in fuzzy set theory. [2 marks]

Q4:) The task is to recognize English Alphabetical character(F, E, X, Y, I, T) in an image-processing system. For given two fuzzy sets A and B to represent the identification of characters I and F as

A = {(F, 0.4), (E, 0.3), (X, 0.1), (Y, 0.1), (I, 0.9), (T, 0.8)}
B = {(F, 0.99), (E, 0.8), (X, 0.1), (Y, 0.2), (I, 0.5), (T, 0.5)}

a) Find the following i) AUB; ii) (A-B) iii) (AUA^c) [3 marks]
b) Verify De Morgan's Law: $(AUB)^c = (A^c \cap B^c)$ [2 marks]

Q5:) For given neural network in given Fig 1, initial input, weight and bias values are given in Fig 2. Also Learning rate = 0.9

Using back propogation algorithm:

a) Find the outputs at 4, 5 and 6 node. [3 marks]
b) Calculate the error on these nodes. [2 marks]

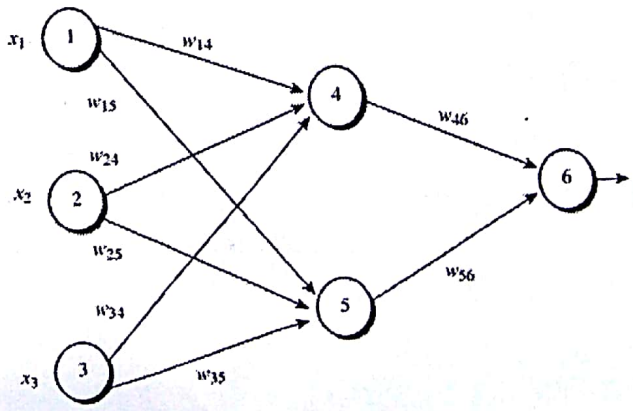

Fig: 1

Initial input, weight, and bias values.

x_1	x_2	x_3	w_{14}	w_{15}	w_{24}	w_{25}	w_{34}	w_{35}	w_{46}	w_{56}	θ_4	θ_5	θ_6
1	0	1	0.2	−0.3	0.4	0.1	−0.5	0.2	−0.3	−0.2	−0.4	0.2	0.1

Fig 2: