

N.B.:1) Question no.1 is compulsory.

2) Attempt any three questions from Q.2 to Q.6.

3) Use of statistical tables permitted.

4) Figures to the right indicate full marks.

Maximum

Marks

Q1. a) Evaluate  $\int_C |z| dz$ , where C is the left half of unit circle  $|z| = 1$  from  $z = -i$  to  $z = i$ . [5]

b) If  $A = \begin{bmatrix} 1 & 0 \\ 2 & 4 \end{bmatrix}$ , then find the eigen values of  $4A^{-1} + 3A + 2I$ . [5]

c) If the tangent of the angle made by the line of regression of y on x is 0.6 and  $\sigma_y = 2\sigma_x$ , find the correlation coefficient between x and y. [5]

d) Construct the dual of the following L.P.P. [5]

Minimise  $z = x_2 + 3x_3$ Subject to  $2x_1 + x_2 \leq 3$  $x_1 + 2x_2 + 6x_3 \geq 5$  $-x_1 + x_2 + 2x_3 = 2$  $x_1, x_2, x_3 \geq 0$ 

Q2. a) Evaluate  $\int_C \frac{e^{2z}}{(z+1)^4} dz$ , where c is the circle  $|z - 1| = 3$ . [6]

b) Show that the matrix  $A = \begin{bmatrix} 7 & 4 & -1 \\ 4 & 7 & -1 \\ -4 & -4 & 4 \end{bmatrix}$  is derogatory. [6]

c) For a normal variate with mean 2.5 and standard deviation 3.5, find the probability that (i)  $2 \leq X \leq 4.5$ , (ii)  $-1.5 \leq X \leq 5.3$ . [8]

Q3. a) The daily consumption of electric power is a random variable X with probability [6]

$$\text{distribution function } f(x) = \begin{cases} kxe^{-\frac{x}{3}}, & x > 0 \\ 0, & x \leq 0 \end{cases}$$

Find the value of k, the expectation of k and the probability that on a given day the electric consumption is more than expected value.

b) Solve the following L.P.P. by simplex method [6]

Maximise  $z = 4x_1 + 10x_2$ Subject to  $2x_1 + x_2 \leq 10$  $2x_1 + 5x_2 \leq 20$  $2x_1 + 3x_2 \leq 18$  $x_1, x_2 \geq 0$ 

c) Expand  $f(z) = \frac{2}{(z-1)(z-2)}$  in the regions (i)  $|z| < 1$  (ii)  $1 < |z| < 2$  (iii)  $|z| > 2$ . [8]

Q4. a) The incidence of an occupational disease in an industry is such that the workers have 20% chance of suffering from it. What is the probability that out of 6 workers chosen at random 4 or more will be suffering from the disease? [6]

b) Calculate the coefficient of correlation between X and Y from the following data. [6]

X	3	5	4	6	2
Y	3	4	5	2	6

c) Show that the matrix  $A = \begin{bmatrix} -9 & 4 & 4 \\ -8 & 3 & 4 \\ -16 & 8 & 7 \end{bmatrix}$  is diagonalizable. Find the transforming [8]

matrix M and the diagonal form D.



Q5.a) Can it be concluded that the average life-span of an Indian is more than 70 years, if a random sample of 100 Indians has an average life span of 71.8 years with standard deviation 8.9 years? [6]

b) Evaluate  $\int_0^{2\pi} \frac{d\theta}{3+2\cos\theta}$ , using Cauchy's residue theorem. [8]

c) Using the Kuhn – Tucker conditions, solve the following N.L.P.P. [6]

$$\begin{aligned} \text{Maximise } z &= x_1^2 + x_2^2 \\ \text{Subject to } x_1 + x_2 - 4 &\leq 0 \\ 2x_1 + x_2 - 5 &\leq 0 \\ x_1, x_2 &\geq 0 \end{aligned}$$

Q6.a) A die was thrown 132 times and the following frequencies were observed. [6]

No obtained	1	2	3	4	5	6	Total
Frequency	15	20	25	15	29	28	132

Test the hypothesis that the die is unbiased.

b) Two independent samples of sizes 8 and 7 gave the following results. [6]

Sample 1	19	17	15	21	16	18	16	14
Sample 2	15	14	15	19	15	18	16	

Is the difference between sample means significant? [8]

b) Using Penalty (Big-M) method solve the following L.P.P.

$$\begin{aligned} \text{Maximise } z &= 3x_1 - x_2 \\ \text{Subject to } 2x_1 + x_2 &\leq 2 \\ x_1 + 3x_2 &\geq 3 \\ x_2 &\leq 4 \\ x_1, x_2 &\geq 0 \end{aligned}$$

ALL THE BEST!



N.B

- (1) Question no. 1 is compulsory.
- (2) Attempt any 3 from the remaining questions.
- (3) Assume suitable data if necessary.
- (4) Figures to right indicate full marks.

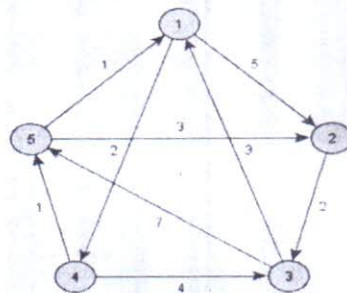
- Q.1** a. Consider the instance of knapsack problem where  $n=6$ ,  $M=15$ , 08  
Profits are  $(P_1, P_2, P_3, P_4, P_5, P_6) = (1, 2, 4, 4, 7, 2)$  and weights are  
 $(W_1, W_2, W_3, W_4, W_5, W_6) = (10, 5, 4, 2, 7, 3)$ . Find Max Profit using Fractional Knapsack.
- b. Compute worst case complexity of following program segment 02  
 $\text{sum} = 0;$   
 $\text{for}( i = 0; i < n; i++ )$   
 $\quad \text{for}( j = 0; j < i; j++ )$   
 $\quad \quad \text{sum}++;$
- c. Write Quicksort algorithm using Divide and Conquer approach. Derive its complexity 10  
for all the three cases.
- Q.2** a. Explain Divide and Conquer approach. Write a recursive algorithm to determine the 20  
max and min from given elements and explain.  
Derive the time complexity of this algorithm and compare it with a simple brute force  
algorithm for finding max and min.  
For the following list of elements trace the recursive algorithm for finding max and min  
and determine how many comparisons have been made.  
22, 12, -5, -8, 15, 60, 17, 31, 47
- Q.3** a. What is optimal binary search tree? Let  $n = 3$  and  $\{a_1, a_2, a_3\} = \{\text{do}, \text{if}, \text{while}\}$ . Let  $p(1:3)$  12  
 $= \{0.5, 0.1, 0.05\}$  and  $q(0:3) = \{0.15, 0.1, 0.05, 0.05\}$ . Compute and construct OBST for  
above value using Dynamic Programming.
- b. Solve 8 puzzle problem by Branch and Bound. Draw State space tree. 08
- |   |   |   |
|---|---|---|
| 1 | 2 | 3 |
| 5 | 6 |   |
| 7 | 8 | 4 |

Initial state

1	2	3
5	8	6
7	4	

Final State
- Q.4** Write and Explain the algorithm to compute all pair source shortest path using 20  
dynamic programming and prove that it is optimal.  
For the following graph determine the all pairs source shortest path

TURN OVER



- Q.5 a. Write an algorithm to determine the sum of subsets for a given Sum and a Set of numbers. Draw the tree representation to solve the subset sum problem given the numbers set as {3,5,6,7,2} with sum = 15. Derive all the subsets. Comment on the complexity of the algorithm. 15
- Q.5 b. An algorithm takes 0.5ms for input size 100. How long will it take for an input size 500. If the running time is following 05  
 1) Linear 2) Quadratic 3) Cubic 4)  $\sqrt{n}$  5)  $n \log_2 n$
- Q.6 A Explain the idea behind backtracking? Write an algorithm for N-queen problem. Draw state space tree for 4-queen problem. 12
- b What is LCS? Find LCS for string S = "ABAZDC" and T = "BACBAD" 08

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Time: 3 hours

Marks: 80

- N.B. : (1) Question Number 1 is compulsory  
 (2) Solve any three Questions from the remaining.  
 (3) Make suitable assumptions if needed

1. (a) Construct an E-R diagram for a Library Management System. Convert the E-R Diagram to Tables. 10
  - (b) Explain Authorization in SQL. 5
  - (c) List four significant differences between file processing system and database management system 5
  2. (a) Explain Types of Integrity Constraints with example. 10
  - (b) Write SQL queries for the given database 10
- Employee(eid, emp-name, street, city)  
 Works(eid, cid, salary)  
 Company(cid, comp-name, city)  
 Manager (eid, manager-name)
- (i) Find the names of all the employees having 'S' as first letter in their Names
  - (ii) Display the annual salary of all the employees.
  - (iii) Find the name, street and city of all employees who work for "Accenture" and earn more than 30,000.
  - (iv) Give total number of employees
3. (a) What is an attribute? Explain different types of attributes with examples. 10
  - (b) What is Normalization? Explain 1NF, 2NF, 3NF and BCNF. 10



4. (a) Explain following terms with examples 10
- (i) Weak Entity Set
  - (ii) Data Independence
  - (iii) Extended ER features
  - (iv) Total and Partial participation
- (b) Explain any five Relational Algebra Operators in detail. 10
- 5 (a) What is Transaction? Discuss the ACID properties of Transaction. 10
- (b) Describe the Overall architecture of DBMS with suitable Diagram. 10
- 6 (a) Explain log based recovery. 10
- (b) Write a note on 10
- 1) Armstrong axioms
  - 2) Thomas write rule

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may 2018.

S.E. SEM IV (CMPH) (CISGS) Rev. 2012  
Theoretical Comp. Science

Q. P. Code: 37715

Duration : 3 hours

Total marks : 80

- N.B.: (1) Question No. 1 is Compulsory  
(2) Attempt any three questions out of remaining five questions  
(3) Assume suitable data wherever required but justify that  
(4) Assumptions should be clearly stated.

- 1 a Differentiate between DFA and NFA. [5]  
b Show that  $L = \{0^n 1^n \mid n > 0\}$  is not regular using pumping lemma. [5]  
c Define FA. List down the applications of FA. [5]  
d Explain Recursively Enumerable Language. [5]
- 2 a Construct the NFA with  $\epsilon$ -moves for the regular expression [10]  
a) for the language which ends in either 01 or 101 over  $\Sigma = \{0, 1\}$   
b) for the R.E  $(a^* b^* + (ab)^*)$  over  $\Sigma = \{a, b\}$   
b Construct the DFA that accepts the language represented by  $0^* 1^* 2^*$ . [10]
- 3 a Convert the given grammar into Griebach Normal Form [10]  
 $S \rightarrow ABA \mid AB \mid BA \mid AA \mid A \mid B$   
 $A \rightarrow aA \mid a$   
 $B \rightarrow bB \mid b$   
b Design Mealy Machine for the language represented as  $(0+1)^*(00+11)$  [10]
- 4 a State and prove pumping lemma for context free languages. [10]  
b Write Short note on [10]  
i) Post Correspondence problem  
ii) Chomsky Hierarchy
- 5 a Design PDA that accepts the language  $L = \{a^n b^m a^n \mid m, n \geq 1\}$  [10]  
b Design turing machine to accept languages over  $\Sigma = \{0, 1\}$  where  $L = \{0^n 1^n \mid n \geq 0\}$  [10]
- 6 a Draw a parse tree for the string aabbba for the CFG given by G where [10]  
 $P = \{S \rightarrow aAS \mid a$   
 $A \rightarrow SbA \mid SS \mid ba$   
Perform both leftmost and rightmost derivation.  
b Briefly Explain the types of Turing Machine. [10]

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