JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/ IT/ PCC- CS 404 / 2021-22
2022

DESIGN AND ANALYSIS OF ALGORITHMS

Full Marks: 70 Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer *all* questions 5x2=10

1. Find the time complexity for summation of N numbers. 2
2. How many elements are in a heap? 2
3. What is the time complexity of Binary Search? 2
4. Why do we study algorithms? 2
5. What are the various types of asymptotic notations used for complexity of an algorithm? 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions 4x15 = 60

6. i) Explain the relationship between Turing Machine and RAM models. Write an algorithm for the polynomial $f(x) = 2^k$, $0 \leq k \leq n$ for some x. 8
   ii) Define Big O notation. Derive Big O value for the cubic function $f(n) = 2n^3 + n^2 + 2n$ 7
7. i) Construct max-heap using the following list L = <3, 5, 4, 7, 6, 8, 9> 7
   ii) Consider the following sorted list L of 14 elements. Suppose key= 69. Search the following using Binary Searching Technique: 8

12	18	22	31	34	40	46	59	67	69	72	82	84	98

8. i) Explain the importance of asymptotic analysis for running time of an algorithm. Define Direct and indirect Recursion. 8
   ii) Find the solution for the recurrence using iteration method: $T(n) = 3\,T(n/4) + n, \forall\, n \geq 0$ 7
9. i) What is Growth order? Solve the following recurrence using master theorem: $T(n) = 5\,T(n/4) + n^2$ 7
   ii) Write a divide-and-conquer version of Binary search algorithm which starts with dividing the input elements into approximately two halves. Find space complexity required by algorithm. 8
10. i) What are the basic characteristics of Dynamic programming? Suppose , we are given three matrices B= 3 x 10, C= 10 x 5, D= 5 x 5 then find the optimal cost multiplication and order of multiplications are either ((BC)D) or as (B(CD)) to have 3 x 5 matrix after multiplication 7
    ii) Write the best case , worst case and average case time complexities of quicksort. 8
11. i) Fibonacci series is defined as follows: f (0) = 0, f (1) = 1, f(n) = f(n-1) + f(n-2). Find both iterative and recursive algorithms to compute Fibonacci(n) for a number n in Fibonacci series. Analyze the running time for each algorithm. 8
    ii) How many balancing operations are necessary in a Height Balanced Tree for a single insertion? Explain 7
12. i) Write the working principle of Prim's Algorithm. Show that for each minimum spanning tree T of G = (V, E) , there is a way to sort the edges of G in Kruskal's algorithm so that the algorithm returns T. 7
    ii) Explain how the Knapsack problem can be solved using Branch and Bound Algorithms? Analyze the time complexity for the same. 8

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JGEC/B.TECH/ CSE/IT/ MC-401/ 2021-22
2022
ENVIRONMENTAL SCIENCES

Full Marks: 70 Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer *all* questions 5x2=10

1. What are resources? 2
2. What are the objectives of environmental management? 2
3. What are pathogens.? Mention different types of pathogens. 2
4. Define noise threshold limit value. 2
5. What do you mean by 'Criteria Air Pollutant'? 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions 4x15=60

6. i) What are the main objectives of environmental science? 3
   ii) What is exponential growth of population? For exponential growth prove that, $N_t = N_0 e^{-Rt}$ where the symbol has their usual meaning. 2+3
   iii) Show that half life time of population $t_{1/d} = 70 / R_1$ (%). Prove that in the case of similar growth and decay rates, the half-life time and doubling time become equal? 2+3
   iv) The increase in population from 1 million to 10 million took 200 years. For exponential growth at constant rate, find out the growth rate. 2

7. i) What is Eutrophication? In what way does 'eutrophication' occur? What are the harmful effects of eutrophication? How can you prevent eutrophication? 1+2+3+3
   ii) Prove that, the relation $BOD_t = C_0(1- e^{-kt})$ where the terms indicate their usual meaning. 3
   iii) Write down the differences between BOD and COD methods. 3

8. i) What do you mean by hardness of water? What are the effects of hardness? How can you remove the hardness? 1+3+3
   ii) What are various processes involved in surface water treatment to make it potable? 3
   iii) A BOD test is run using 50 ml of waste water mixed with 100 ml of pure water. The initial DO of the mixture is 6.0 mg/l and after 5 days it becomes 2.0mg/l. After a long time, the DO remains fixed at 1.0 mg/l. a) What is BOD5 of waste water b) What is the ultimate BOD(BODu). c) What is remaining BOD after 5 days? d) What is the reaction rate measured at 200C? e) What would be the reaction rate if measured at 350C? 1 x 5

9. i) Write the differences between photochemical smog and London smog? What is acid rain? What are the harmful effects of acid rain? 2+1+2
   ii) What do you mean by particulate matter? Explain its role on air pollution. 1+4
   iii) What are greenhouse effect and global warming? Write down the different measures to control global warming. 3+2

10. i) Define the term 'noise'. Classify different types of noise. How much is a 100 dB sound louder than a 80 dB sound? 1+1.5+2.5
    ii) What is noise pollution? Discuss the adverse effects of noise on human health. 1+4
    iii) Explain on the various causes of flood and landslides. 2+3

11. Write short notes on any three of the following: i) Catalytic converter, ii) Ozone layer Depletion, iii) Arsenic pollution and its effect, iv) Population growth, v) Primary and Secondary pollutants. 3 x 5

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JGEC/B.TECH/IT/CSE/ BSC-401/2021-22
2022
BIOLOGY

Full Marks: 70 Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer *all* questions 5x2=10

1. Define Biomolecules with examples. 2
2. What do you mean by monomer of proteins, Give examples. 2
3. What biomolecules acts as genetic materials in living organisms. 2
4. Which biomolecule is regarded as main source of energy in our body. 2
5. Define Enzyme with examples. 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions 4x15=60

6. Describe different structural aspects of Protein with diagram. 15
7. Describe the Monohybrid Cross on sweet pea plants performed by Mendel along with law of segregation. 15
8. Classify enzyme on the basis of chemical reaction with examples. 15
9. Classify carbohydrate with examples. 15
10. Classify the living organism on the basis of mode of nutrition, cellularity, ultrastructure with examples. 15
11. How does DNA acts as the Genetic material in most of the organism-explain? 15

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JGEC/B.TECH/ IT/ PCC-CS401/ 2021-22

2022

DISCRETE MATHEMATICS

Full Marks: 70 Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer *all* questions 5x2=10

1. Define Subset of a finite Set. 2
2. Find the truth table of $\neg p \wedge q$. 2
3. Let $A = \begin{bmatrix} 1 & 2 \\ 4 & -3 \end{bmatrix}$ Find A^2 2
4. Suppose A and B are events with P(A) = 0.6, P (B)= 0.3, and P (A ∩ B) =0.2. Find the probability that "A does not occur". 2
5. Define a complete graph with suitable examples. 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions 4x15 = 60

6. i) Write the Principle of Mathematical Induction. Prove the proposition P that the sum of the first n positive integers is $\frac{1}{2} n(n+1)$ 3+4=7

   ii) If A and B are disjoint finite sets, then find A U B is finite and n (A U B) = n(A) + n(B). 3+5=8

   Consider the following data for 120 mathematics students at a College concerning the languages French, German and Russian:
   65 study French, 45 study German, 42 study Russian, 20 study French and German, 25 study French and Russian, 15 study German and Russian, 8 study all three languages. Find the number of students who study at least one of the three languages.

7. i) Define Equivalence Relations on a nonempty set S. Given A = {1,2,3,4}, Consider the following relation in A: R= {(1,1), (2,2), (2,3), (3,2), (4,2), (4,4)}. Is R (a)reflexive, (b)symmetric, (c)transitive or (d)antisymmetric? Find $R^2 = R \circ R$. 8

   ii) Show that the propositions $\neg (p \wedge q)$ and $\neg p \vee \neg q$ are logically equivalent 7

8. i) Define CNF and DNF with suitable examples in Propositional Calculus. 7

   ii) If p: Madhu goes to Cinema and q: Ram goes to Cinema be two propositions, then construct symbolic form of the following statements: 8
   a) Both Madhu and Ram goes to Cinema. b) At least one of Madhu and Ram goes to Cinema.
   c) Madhu does not goes to Cinema but Ram goes to Cinema. d) Either Madhu or Ram goes to Cinema.

9. i) Find the transpose of each matrix: $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$, $B = \begin{bmatrix} 2 \\ -4 \\ 6 \end{bmatrix}$ Show that $(AB)^T = B^T A^T$ 8

   ii) Find the inverse of $A = \begin{bmatrix} 1 & -2 & 2 \\ 2 & -3 & 6 \\ 1 & 1 & 7 \end{bmatrix}$ 7

10. i) A bag contains six white marbles and five red marbles. Find the number of ways four marbles can be drawn from the bag if a) they can be any colour b) two must be white and two red. What is Pigeonhole Principle ? 8

    ii)What is the probability of exactly k success in a Binomial Experiment B (n, p). An unbiased coin is tossed 6 times, call heads a success. Find the probability that a) exactly two heads occur. B) of getting at least ~~four~~ heads. c) of getting no heads. 7

11. i) Prove that if A and B are independent events, then A^c and B^c are independent events

ii) A linear array EMPLOYEE has n elements. Suppose NAME appears randomly in the array, and there is a linear search to find the location K of NAME, that is, to find K such that EMPLOYEE[K] = NAME, let f(n) denote the number of comparisons in the linear search. a) Find the expected value of f(n). b) Find the maximum value (worst case) of f(n). 8

12. i) What do you mean by degree of a vertex in a graph G? Prove that the sum of the degrees of the vertices of a graph G is equal to twice the number of edges in G. 2+5=7

ii) With a suitable graph define Adjacency Matrix. Draw the graph G corresponding to the following 8

matrix: $\begin{bmatrix} 1 & 3 & 0 & 0 \\ 3 & 0 & 1 & 1 \\ 0 & 1 & 2 & 2 \\ 0 & 1 & 2 & 0 \end{bmatrix}$

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
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COE/B.TECH./CSE/IT/PCC-CS 403
2022
FORMAL LANGUAGE & AUTOMATA THEORY

Full Marks: 70 Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions 5x2=10

1. Define the relationship between the following formal languages with their corresponding automata with the help of Venn diagram: Regular languages, Context Free Languages, Context Sensitive Languages.
2. Define Nondeterministic Finite Automata (NFA) with a suitable example.
3. State the Pumping Lemma for Regular Languages and state also the application of this lemma.
4. Define Chomsky Normal Form (CNF) with example.
5. Define Push-down Automata.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***four*** questions 4x15=60

6. i) Prove that the following language is context-free language but not regular language. 5

   ii) Prove that the family of regular languages is closed under intersection.
   iii) Write regular expressions for the following languages on {0, 1}: 5
   a) all strings ending with 01}
   b) all strings containing an even number of 0's} 5

7. i) Prove that.
   ii) Design a NFA to accept the following language: 5+5+5=10

   iii) Construct a regular expression for the following language

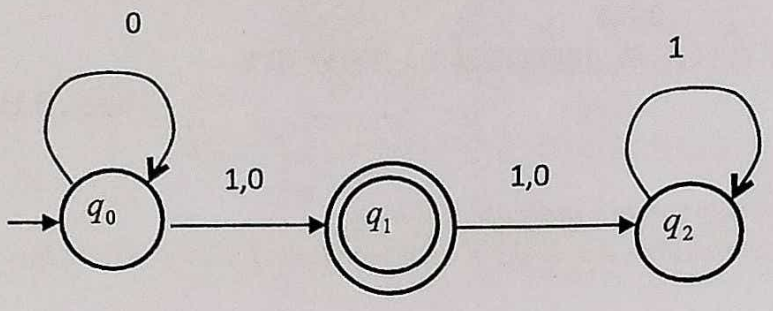
8. i) Show that the language is context free. 5
   ii) Prove that every regular language is also a context free language, but vice-versa is not true. 5
   iii) Define formal grammar and formal language with examples. 5

9. i) Prove that the family of context-free language is closed under union, concatenation, and star-closure. 3x2=6
   ii) Construct a NPDA for the following language.

   iii) Is it possible to construct a regular expression for the following language? Justify your answer. 5

4

10. i) Convert the following NFA into an equivalent DFA. 5



ii) Construct the finite automata corresponding to the regular expression is 5

iii) Prove that the following given language is not regular language using pumping lemma: 5

11. Write short notes on any three of the following topics: 3x5=1

i. CNF and GNF

ii. Turing Machine

iii. Hierarchical structure of all different kind of Automata & their corresponding languages

iv. Regular Expression

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
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JGEC/B.TECH/ IT/ PCC-CS-402/ 2021-22
2022
COMPUTER ARCHITECTURE

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.
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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer *all* questions 5x2=10

1. What do you mean by compaction technique? 2
2. What do you mean by pipeline technique? 2
3. Write the formula for "Busy time space span"? 2
4. Write down the solution for structural hazard? – split cache 2
5. What do you mean by logical address? 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions 4x15 = 60

6. i) Compare vector processor and array processor? 10
   ii) Write down the properties of a vector processor? 5
7. i) Describe demand paging with the help of a suitable diagram? 10
   ii) Compare RISC and CISC? 5
8. i) Describe direct mapped cache with the help of suitable diagram? 10
   ii) Describe pipeline data hazards? 5
9. i) Write down steps to find greedy cycle. Given collision vector = [10110001]? 10
   ii) What is speedup, throughput and efficiency of a pipeline architecture? 5
10. i) Describe paged memory management with the help of a suitable diagram? 10
    ii) Explain strip mining in vector processing? 5
11. i) Given no of frames = 3 and page trace [7, 24, 7 ,15, 24 24, 8 ,1, 1, 8, 9, 24, 8, 1]. Find hit-ratio and miss-ratio for FIFO, LRU and Optimal page replacement algorithms. 15
