****

**KIIT Deemed to be University**

**Online Mid Semester Examination(Autumn Semester-2021)**

**Subject Name & Code:** Design & Analysis of Algorithms (CS-2012)

**Applicable to Courses:** CSE, IT, CSCE,CSSE & ECS

**Full Marks=20** **Time:1 Hour**

**SECTION-A(Answer All Questions. All questions carry 2 Marks)**

**Time:20 Minutes (5×2=10 Marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Question No** | **Question Type (MCQ/SAT)** | **Question** | **Answer Key**  **(if MCQ)** | **CO Mapping** |
| **Q.No: 1(a)** | **MCQ** | Consider the following code fragment.  int a[] = {2, 1, 3, 4, 5, 6, 7, 8, 9, 0}  int fun(int b[], int n)  {  if (n==1)  return b[n-1];  else return b[n] + fun(b, n-1) + fun(b, n-1);  }  What is the result of the function call fun(a, 3) and What's the asymptotic running time of this function in terms of n respectively.   1. 18, Θ(n) 2. 18, Θ(2n) 3. 19, Θ(n) 4. 19, Θ(2n) 5. NONE | B | CO1 |
|  | **MCQ** | Consider the following code fragment.  int a[] = {2, 1, 3, 4, 5, 6, 7, 8, 9, 0}  int fun(int b[], int n)  {  if (n==1)  return b[n-1];  else return b[n] + 2\*fun(b, n-1);  }  What is the result of the function call fun(a, 3) and What's the asymptotic running time of this function in terms of n respectively.   1. 18, Θ(n) 2. 18, Θ(2n) 3. 19, Θ(n) 4. 19, Θ(2n) 5. NONE | A | CO1 |
|  | **MCQ** | Consider the following code fragment.  int a[] = {2, 1, 4, 3, 5, 6, 7, 8, 9, 0}  int fun(int b[], int n)  {  if (n==1)  return b[n-1];  else return b[n] + fun(b, n-1) + fun(b, n-1);  }  What is the result of the function call fun(a, 3) and What's the asymptotic running time of this function in terms of n respectively.   1. 18, Θ(n) 2. 18, Θ(2n) 3. 19, Θ(n) 4. 19, Θ(2n) 5. NONE | D | CO1 |
|  | **MCQ** | Consider the following code fragment.  int a[] = {2, 1, 4, 3, 5, 6, 7, 8, 9, 0}  int fun(int b[], int n)  {  if (n==1)  return b[n-1];  else return b[n] + 2\*fun(b, n-1);  }  What is the result of the function call fun(a, 3) and What's the asymptotic running time of this function in terms of n respectively.   1. 18, Θ(n) 2. 18, Θ(2n) 3. 19, Θ(n) 4. 19, Θ(2n) 5. NONE | D | CO1 |
| **Q.No: 1(b)** | **MCQ** | f(n) = 2^(2^n), g(n) =2^(n^2), h(n)=n^(n^2)  Which of the following correctly represents the asymptotic relationships between the functions? (^ represents to the power)   1. f(n)=O(g(n)) 2. f(n)=Θ(g(n)) 3. h(n)=O(g(n)) 4. g(n)=f(n)) 5. NONE | B | CO1 |
|  | **MCQ** | f(n) = 2^(2^n), g(n) =2^(n^2), h(n)=n^(n^2)  Which of the following correctly represents the asymptotic relationships between the functions? (^ represents to the power)   1. f(n)=(g(n)) 2. f(n)=Θ(g(n)) 3. h(n)=O(g(n)) 4. g(n)=f(n)) 5. NONE | A | CO1 |
|  | **MCQ** | f(n) = 2^(2^n), g(n) =2^(n^2), h(n)=n^(n^2)  Which of the following correctly represents the asymptotic relationships between the functions? (^ represents to the power)   1. f(n)=O(g(n)) 2. f(n)=O(h(n)) 3. g(n)=O(h(n)) 4. g(n)=f(n)) 5. NONE | C | CO1 |
|  | **MCQ** | f(n) = 2^(2^n), g(n) =2^(n^2), h(n)=n^(n^2)  Which of the following correctly represents the asymptotic relationships between the functions? (^ represents to the power)   1. f(n)=O(g(n)) 2. f(n)=Θ(h(n)) 3. h(n)=O(g(n)) 4. h(n)=g(n)) 5. NONE | D | CO1 |
| **Q.No: 1(c)** | **MCQ** | If all the elements in an input array are same, for example {4,4,4,4,4,4}, Which of the following sorting algorithm has the lowest time complexity?   1. Insertion Sort 2. Quick Sort 3. Merge Sort 4. Both Quick & Merge Sort 5. NONE | A | CO2 |
|  | **MCQ** | If all the elements in an input array are same, for example {4,4,4,4,4,4}, Which of the following sorting algorithm has the highest time complexity?   1. Insertion Sort 2. Quick Sort 3. Merge Sort 4. Both Quick & Merge Sort 5. NONE | B | CO2 |
|  | **MCQ** | In an array of n integers first n/2 elements are sorted in ascending order, rest sorted in descending order. What is the minimum time required to sort the data in ascending order?   1. O(log n) 2. O(nlog n) 3. O(n) 4. O(n2) 5. NONE | C | CO2 |
|  | **MCQ** | What is the minimum time required to merge two max-heaps, each having n elements, into one max heap?   1. O(1) 2. O(log n) 3. O(nlog n) 4. O(n) 5. NONE | D | CO2 |
| **Q.No: 1(d)** | **MCQ** | What will be the content of the array if 15 is inserted to an max-heap A={20, 10, 8, 6, 7, 5, 3, 3, 2}.   1. {20, 15, 8, 6, 10, 5, 3, 3, 2, 7} 2. {20, 15, 10, 5, 8, 6, 7, 3, 2, 3} 3. {20, 10, 15, 5, 8, 6, 7, 3, 2, 3} 4. {20, 15, 6, 8, 10, 5, 3, 3, 2, 7}   NONE | A | CO3 |
|  | **MCQ** | What will be the content of the array if 15 is inserted to an max-heap A={20, 8, 10, 5, 3, 6, 7, 3, 2}.   1. {20, 15, 8, 6, 10, 5, 3, 3, 2, 7} 2. {20, 15, 10, 5, 8, 6, 7, 3, 2, 3} 3. {20, 10, 15, 5, 8, 6, 7, 3, 2, 3} 4. {20, 15, 6, 8, 10, 5, 3, 3, 2, 7} 5. NONE | B |  |
|  | **MCQ** | What will be the content of the array if 2 is inserted to an min-heap A={2, 3, 3, 5, 7, 6, 8, 10, 20}.   1. {1, 2, 3, 5, 3, 6, 8, 10, 7, 20} 2. {1, 2, 3, 3, 6, 5, 7, 10, 20, 8} 3. {1, 2, 3, 5, 3, 6, 8, 10, 20, 7} 4. {1, 2, 3, 6, 3, 5, 7, 10, 20, 8} 5. NONE | C | CO3 |
|  | **MCQ** | What will be the content of the array if 2 is inserted to an min-heap A={2, 3, 3, 5, 7, 6, 8, 10, 20}.   1. {1, 2, 3, 5, 3, 6, 8, 10, 7, 20} 2. {1, 2, 3, 3, 6, 5, 7, 10, 20, 8} 3. {1, 2, 3, 5, 3, 6, 8, 10, 20, 7} 4. {1, 2, 3, 6, 3, 5, 7, 10, 20, 8} 5. NONE | D | CO3 |
| **Q.No: 1(e)** | **MCQ** | Given items as {value, weight} pairs {{30,10},{40,20},{20,5}}. The capacity of knapsack=35. Find the maximum value output assuming items to be divisible and nondivisible respectively.   1. 70, 80 2. 80, 90 3. 90, 80 4. 90, 90 5. NONE | D | CO3 |
|  | **MCQ** | Given items as {value, weight} pairs {{30,10},{40,20},{60,15}}. The capacity of knapsack=30. Find the maximum value output assuming items to be divisible and nondivisible respectively.   1. 100, 100 2. 90, 100 3. 100, 90 4. 90, 90 5. NONE | C | CO3 |
|  | **MCQ** | Given items as {value, weight} pairs {{30,10},{40,20},{60,15}}. The capacity of knapsack=35. Find the maximum value output assuming items to be divisible and nondivisible respectively.   1. 110, 100 2. 100, 110 3. 100, 90 4. 90, 90 5. NONE | A | CO3 |
|  | **MCQ** | Given items as {value, weight} pairs {{30,10},{40,20},{60,15}}. The capacity of knapsack=40. Find the maximum value output assuming items to be divisible and nondivisible respectively.   1. 110, 100 2. 120, 100 3. 100, 120 4. 120, 90 5. NONE | B | CO3 |

**SECTION-B(Answer Any One Question. Each Question carries 10 Marks)**

**Time: 30 Minutes** **(1×10=10 Marks)**

|  |  |  |
| --- | --- | --- |
| **Question No** | **Question**  **SET B(1)** | **CO Mapping** |
| **Q.No:2** | 1. Write down the PARTITION(A, p, r) procedure with last element as pivot, where p and r are lower & upper bound of array A. If the input array is A={2, 5, 7, 9, 6, 3, 1, 8, 4}, what is the result sequence of numbers in A after making a call to PARTITION(A, 1, 9). Also show the intermediate steps of PARTITION(A, 1, 9) procedure. 2. The Best case, worst case & average case time complexities are depend upon the pivot index (let it be q). Write the general recurrence for the time complexity T(n) for recursive QUICK-SORT(A, p, r) algorithm in terms of n and q. If A contains distinct elements and sorted in decreased order what will be recurrence equation and its time complexity? | CO3 |
| **Q.No:3** | ❹❴s❚❯②➐❱s❛❑❳✛❴❨❳①❘✐➂❑❴❥❤❨◗❙❫❇❖✶❱❨❴❨❳①❳✛❭✴❫❬❴④➬✈❦✴➟➮q❹➱í÷❬➬✈❦♥➟➮❮ ➨ qÝÐ✗➎❣➟✰❦✴◗r➝❇❖✕❫❇❴❨❳✡❱❨❛❑❳✦ø✸❫✧❫❬❴❹❭✴➂❑❖❑❘①❱❨◗r❫❇❖✸q⑦❩➮②⑥❛❑❳✐❴❥❳➀➎✡◗❙❤④❚  ❘✐❫❬❖❑❤❥❱s❚❬❖➑❱❯❩➻❚❬❖❑P✶❝❑❴❨❫③Ó❷◗rP❑❳➄❚➸❱s◗❙➝❇❛➑❱⑧❚❬❤❥➣❷➃➄❝✕❱s❫❲❱s◗r❘✦t❼❫❇➂❑❖✕Pù❫❇❖✶◗❙❱❨❤✼❤❨❫❇✉❙➂✕❱s◗❙❫❇❖❪❩⑤ú❾❳①❴❨◗↕❭❒➣➇➣❇❫❇➂✕❴⑧t❼❫❇➂❑❖✕Pùt➑➣➏❱s❛✕❳  ➃❧❚❬❤❥❱❨❳✐❴❃➃➄❳①❱s❛✕❫✧P❪❿   1. Draw the recurrence tree for T(n) = 4T(n/2) + cn, where c is a constant, and provide a tight asymptotic tight bound on its solution, verify the bound by master theorem. 2. Solve the recurrence T(n) = T(n-1) + 2n using master method by changing variable first to transfer the recurrence to an appropriate form. | CO1 |
| **Q.No:4** | 1. Write the MERGE-SORT(A, p, r) procedure where at each step it divides the array/sub-array into two parts such that second part contains elements twice of first part instead of dividing at middle. 2. For array A={10, 45, 15, 40, 10, 20, 40, 25, 35}, MERGE-SORT(A, 9) is applied to sort the array in ascending order. Show in diagram how this procedure is applied to this array. | CO3 |
| **Q.No:5** | 1. Write an algorithm MAX-HEAP-CHANGE(A n, i, key) that rebuilds the n-element max-heap if the value at index i is changed to the value as key. 2. Apply this algorithm to the max-heap A={20, 15, 18, 10, 8, 12, 9, 6, 4, 8, 10} if at index 5 the value is changed to 25 and then at index 2 of modified heap the value is changed to 3. Assume root is at index 1. Show the process & result in max-heap diagram. | CO3 |
| **Q.No:6** | **Set B(2)**  Q1.  Prof. HariBol holds shares on some commodities in his Demat Account as given in the Table below. Write an algorithm for Prof. HariBol to decide number of shares to be sold from different commodities to make maximum profits subject to generate fixed amount of money. Find the number of shares to be sold by Prof. HariBol for each commodity to maximize the profits subject to generate a liquid cash of Rs**800**/-. Fraction of a share can be sold.  Table: Prof. HariBol holdings of shares (Assume N=Your Roll Number)   |  |  |  |  | | --- | --- | --- | --- | | Commodity Name | Unit Selling Price in Rs (S) | Profits per Share in Rs (P) | No. of Shares | | Gold | 90 | 9 | 5 | | Silver | 40 | 5 | 8 | | Crude Oil | 80 | 20 | N MOD 5 | | Sugar | 55 | 5 | 4 | | Wheat | 30 | 3 | 5 | | Rubber | 30 | 5 | 3 | | Mentho Oil | 45 | 15 | 6 | | Natural Gas | 21 | 3 | 2 | | Cotton | 10 | 2 | 20 |   Q2.  Prof. BolHari holds shares on some commodities in his Demat Account as given in the Table below. Find the number of shares to be sold by Prof. BolHari for each commodity to maximize the profits subject to generate a liquid cash of Rs**700**/-. Fraction of a share can be sold. Write an algorithm for Prof. BolHari to decide number of shares to be sold from different commodities to make maximum profits subject to generate fixed amount of money.  Table: Prof. BolHari holdings of shares (Assume N=Your Roll Number)   |  |  |  |  | | --- | --- | --- | --- | | Commodity Name | Unit Selling Price in Rs (S) | Profits per Share in Rs (P) | No. of Shares | | Gold | 80 | 8 | 5 | | Corn | 40 | 5 | N MOD 5 | | Crude Oil | 80 | 20 | 3 | | Soyabeans | 55 | 5 | 4 | | Wheat | 30 | 3 | 4 | | Rubber | 30 | 5 | 6 | | Mentho Oil | 45 | 15 | 5 | | Natural Gas | 21 | 3 | 2 | | Copper | 10 | 2 | 15 | |  |

**Controller of Examinations**