Chettinad College of Engineering & Technology
Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai.

Department of Computer Science and Engineering

CS8451 Design and Analysis of Algorithms – (6th semester, 2017 Regulation)

MCQ Bank

Unit III – Dynamic Programming and Greedy Technique

1. Which of the following is/are property/properties of a dynamic programming problem?

a) Optimal substructure

b) Overlapping subproblems

c) Greedy approach

d) Both optimal substructure and overlapping subproblems

Answer: d

Explanation: A problem that can be solved using dynamic programming possesses overlapping subproblems as well as optimal substructure properties.

2. If an optimal solution can be created for a problem by constructing optimal solutions for its subproblems, the problem possesses ____________ property.

a) Overlapping subproblems

b) Optimal substructure

c) Memoization

d) Greedy

Answer: b

Explanation: Optimal substructure is the property in which an optimal solution is found for the problem by constructing optimal solutions for the subproblems.

3. If a problem can be broken into subproblems which are reused several times, the problem possesses ____________ property.

a) Overlapping subproblems

b) Optimal substructure

c) Memoization

d) Greedy

Answer: a

Explanation: Overlapping subproblems is the property in which value of a subproblem is used several times.

4. If a problem can be solved by combining optimal solutions to non-overlapping problems, the strategy is called ______________

a) Dynamic programming

b) Greedy

c) Divide and conquer

d) Recursion

Answer: c

Explanation: In divide and conquer, the problem is divided into smaller non-overlapping subproblems and an optimal solution for each of the subproblems is found. The optimal solutions are then combined to get a global optimal solution. For example, mergesort uses divide and conquer strategy.

5. When dynamic programming is applied to a problem, it takes far less time as compared to other methods that don’t take advantage of overlapping subproblems.

a) True

b) False

Answer: a

Explanation: Dynamic programming calculates the value of a subproblem only once, while other methods that don’t take advantage of the overlapping subproblems property may calculate the value of the same sub problem several times. So, dynamic programming saves the time of recalculation and takes far less time as compared to other methods that don’t take advantage of the overlapping sub problems property.

6. A greedy algorithm can be used to solve all the dynamic programming problems.

a) True

b) False

Answer: b

Explanation: A greedy algorithm gives optimal solution for all subproblems, but when these locally optimal solutions are combined it may NOT result into a globally optimal solution. Hence, a greedy algorithm CANNOT be used to solve all the dynamic programming problems.

7. In dynamic programming, the technique of storing the previously calculated values is called ___________

a) Saving value property

b) Storing value property

c) Memoization

d) Mapping

Answer: c

Explanation: Memoization is the technique in which previously calculated values are stored, so that, these values can be used to solve other subproblems.

8. When a top-down approach of dynamic programming is applied to a problem, it usually _____________

a) Decreases both, the time complexity and the space complexity

b) Decreases the time complexity and increases the space complexity

c) Increases the time complexity and decreases the space complexity

d) Increases both, the time complexity and the space complexity

Answer: b

Explanation: The top-down approach uses the memoization technique which stores the previously calculated values. Due to this, the time complexity is decreased but the space complexity is increased.

9. Which of the following problems is NOT solved using dynamic programming?

a) 0/1 knapsack problem

b) Matrix chain multiplication problem

c) Edit distance problem

d) Fractional knapsack problem

Answer: d

Explanation: The fractional knapsack problem is solved using a greedy algorithm.

10. Which of the following problems should be solved using dynamic programming?

a) Merge sort

b) Binary search

c) Longest common subsequence

d) Quicksort

Answer: c

Explanation: The longest common subsequence problem has both, optimal substructure and overlapping sub problems. Hence, dynamic programming should be used the solve this problem

11. The following sequence is a fibonacci sequence:

0, 1, 1, 2, 3, 5, 8, 13, 21,…..

Which technique can be used to get the nth fibonacci term?

a) Recursion

b) Dynamic programming

c) A single for loop

d) Recursion, Dynamic Programming, For loops

Answer: d

Explanation: Each of the above mentioned methods can be used to find the nth fibonacci term.

12. Consider the recursive implementation to find the nth fibonacci number:

```
int fibo(int n)
   if n <= 1
        return n
   return __________
```

Which line would make the implementation complete?

a) fibo(n) + fibo(n)

b) fibo(n) + fibo(n – 1)

c) fibo(n – 1) + fibo(n + 1)

d) fibo(n – 1) + fibo(n – 2)

Answer: d

Explanation: Consider the first five terms of the fibonacci sequence: 0,1,1,2,3. The 6th term can be found by adding the two previous terms, i.e. fibo(6) = fibo(5) + fibo(4) = 3 + 2 = 5. Therefore,the nth term of a fibonacci sequence would be given by:

fibo(n) = fibo(n-1) + fibo(n-2).

13. What is the time complexity of the recursive implementation used to find the nth fibonacci term?

a) O(1)

b) O(n2)

c) O(n!)

d) Exponential

Answer: d

Explanation: The recurrence relation is given by fibo(n) = fibo(n – 1) + fibo(n – 2). So, the time complexity is given by: T(n) = T(n – 1) + T(n – 2)

14. You are given infinite coins of denominations v1, v2, v3,…..,vn and a sum S. The coin change problem is to find the minimum number of coins required to get the sum S. This problem can be solved using ____________

a) Greedy algorithm

b) Dynamic programming

c) Divide and conquer

d) Backtracking

Answer: b

Explanation: The coin change problem has overlapping subproblems(same subproblems are solved multiple times) and optimal substructure(the solution to the problem can be found by finding optimal solutions for subproblems). So, dynamic programming can be used to solve the coin change problem.

15. Suppose you have coins of denominations 1, 3 and 4. You use a greedy algorithm, in which you choose the largest denomination coin which is not greater than the remaining sum. For which of the following sums, will the algorithm NOT produce an optimal answer?

a) 20

b) 12

c) 6

d) 5

Answer: c

Explanation: Using the greedy algorithm, three coins {4,1,1} will be selected to make a sum of 6. But, the optimal answer is two coins {3,3}.

16. Suppose you have coins of denominations 1,3 and 4. You use a greedy algorithm, in which you choose the largest denomination coin which is not greater than the remaining sum. For which of the following sums, will the algorithm produce an optimal answer?

a) 14

b) 10

c) 6

d) 100

Answer: d

Explanation: Using the greedy algorithm, three coins {4,1,1} will be selected to make a sum of 6. But, the optimal answer is two coins {3,3}. Similarly, four coins {4,4,1,1} will be selected to make a sum of 10. But, the optimal answer is three coins {4,3,3}. Also, five coins {4,4,4,1,1} will be selected to make a sum of 14. But, the optimal answer is four coins {4,4,3,3}. For a sum of 100, twenty-five coins {all 4's} will be selected and the optimal answer is also twenty-five coins {all 4's}.

17. You are given infinite coins of denominations 1, 3, 4. What is the total number of ways in which a sum of 7 can be achieved using these coins if the order of the coins is not important?

a) 4

b) 3

c) 5

d) 6

Answer: c

Explanation: A sum of 7 can be achieved in the following ways:

{1,1,1,1,1,1,1}, {1,1,1,1,3}, {1,3,3}, {1,1,1,4}, {3,4}.

Therefore, the sum can be achieved in 5 ways.

18. You are given infinite coins of denominations 1, 3, 4. What is the minimum number of coins required to achieve a sum of 7?

a) 1

b) 2

c) 3

d) 4

Answer: b

Explanation: A sum of 7 can be achieved by using a minimum of two coins {3,4}.

19. You are given infinite coins of denominations 5, 7, 9. Which of the following sum CANNOT be achieved using these coins?

a) 50

b) 21

c) 13

d) 23

Answer: c

Explanation: One way to achieve a sum of 50 is to use ten coins of 5. A sum of 21 can be achieved by using three coins of 7. One way to achieve a sum of 23 is to use two coins of 7 and one coin of 9. A sum of 13 cannot be achieved.

20. You are given infinite coins of denominations 3, 5, 7. Which of the following sum CANNOT be achieved using these coins?

a) 15

b) 16

c) 17

d) 4

Answer: d

Explanation: Sums can be achieved as follows:

15 = {5,5,5}

16 = {3,3,5,5}

17 = {3,7,7}

we can’t achieve for sum=4 because our available denominations are 3,5,7 and sum of any two denominations is greater than 4.

21. Floyd Warshall’s Algorithm is used for solving ____________

a) All pair shortest path problems

b) Single Source shortest path problems

c) Network flow problems

d) Sorting problems

Answer: a

Explanation: Floyd Warshall’s Algorithm is used for solving all pair shortest path problems. It means the algorithm is used for finding the shortest paths between all pairs of vertices in a graph.

22. Floyd Warshall’s Algorithm can be applied on __________

a) Undirected and unweighted graphs

b) Undirected graphs

c) Directed graphs

d) Acyclic graphs

Answer: c

Explanation: Floyd Warshall Algorithm can be applied in directed graphs. From a given directed graph, an adjacency matrix is framed and then all pair shortest path is computed by the Floyd Warshall Algorithm.

23. What is the running time of the Floyd Warshall Algorithm?

a) Big-oh(V)

b) Theta(V2)

c) Big-Oh(VE)

d) Theta(V3)

Answer: d

Explanation: The running time of the Floyd Warshall algorithm is determined by the triply nested for loops. Since each execution of the for loop takes O(1) time, the algorithm runs in time Theta(V3).

24. What approach is being followed in Floyd Warshall Algorithm?

a) Greedy technique

b) Dynamic Programming

c) Linear Programming

d) Backtracking

Answer: b

Explanation: Floyd Warshall Algorithm follows dynamic programming approach because the all pair shortest paths are computed in bottom up manner.

25. Floyd Warshall Algorithm can be used for finding ______________

a) Single source shortest path

b) Topological sort

c) Minimum spanning tree

d) Transitive closure

Answer: d

Explanation: One of the ways to compute the transitive closure of a graph in Theta(N3) time is to assign a weight of 1 to each edge of E and then run the Floyd Warshall Algorithm.

26. What procedure is being followed in Floyd Warshall Algorithm?

a) Top down

b) Bottom up

c) Big bang

d) Sandwich

Answer: b

Explanation: Bottom up procedure is being used to compute the values of the matrix elements dij(k). The input is an n x n matrix. The procedure returns the matrix D(n) of the shortest path weights.

27. Floyd- Warshall algorithm was proposed by _____________

a) Robert Floyd and Stephen Warshall

b) Stephen Floyd and Robert Warshall

c) Bernad Floyd and Robert Warshall

d) Robert Floyd and Bernad Warshall

Answer: a

Explanation: Floyd- Warshall Algorithm was proposed by Robert Floyd in the year 1962. The same algorithm was proposed by Stephen Warshall during the same year for finding the transitive closure of the graph.

28. Who proposed the modern formulation of Floyd-Warshall Algorithm as three nested loops?

a) Robert Floyd

b) Stephen Warshall

c) Bernard Roy

d) Peter Ingerman

Answer: d

Explanation: The modern formulation of Floyd-Warshall Algorithm as three nested for-loops was proposed by Peter Ingerman in the year 1962.

29. What happens when the value of k is 0 in the Floyd Warshall Algorithm?

a) 1 intermediate vertex

b) 0 intermediate vertex

c) N intermediate vertices

d) N-1 intermediate vertices

Answer: b

Explanation: When k=0, a path from vertex i to vertex j has no intermediate vertices at all. Such a path has at most one edge and hence dij(0) = wij.

30. Using logical operator’s instead arithmetic operators saves time and space.

a) True

b) False

Answer: a

Explanation: In computers, logical operations on single bit values execute faster than arithmetic operations on integer words of data.

31. The time taken to compute the transitive closure of a graph is Theta(n2).

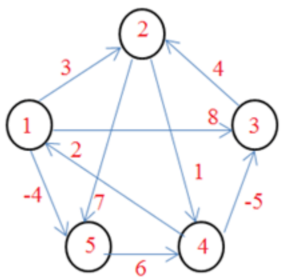
a) True

b) False

Answer: b

Explanation: The time taken to compute the transitive closure of a graph is Theta(n3). Transitive closure can be computed by assigning weight of 1 to each edge and by running Floyd Warshall Algorithm.

32. In the given graph, what is the minimum cost to travel from vertex 1 to vertex 3?



a) 3

b) 2

c) 10

d) -3

Answer: d

Explanation: The minimum cost required to travel from node 1 to node 5 is -3.

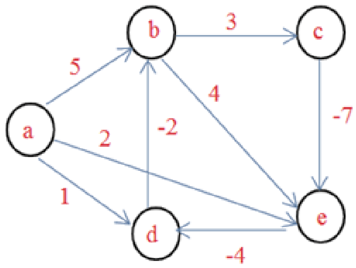
1-5, cost is -4

5-4, cost is 6

4-3, cost is -5

Hence total cost is -4 + 6 + -5 = -3.

33. In the given graph, how many intermediate vertices are required to travel from node a to node e at a minimum cost?



a) 2

b) 0

c) 1

d) 3

Answer: c

Explanation: The minimum cost to travel from node a to node e is 1 by passing via nodes b and c.

a-b, cost 5

b-c, cost 3

c-e, cost -7

Hence the total cost is 1.

34. What is the formula to compute the transitive closure of a graph?

a) tij(k) = tij(k-1) AND (tik(k-1) OR tkj(k-1))

b) tij(k) = tij(k-1) OR (tik(k-1) AND tkj(k-1))

c) tij(k) = tij(k-1) AND (tik(k-1) AND tkj(k-1))

d) tij(k) = tij(k-1) OR (tik(k-1) OR tkj(k-1))

Answer: b

Explanation: Transitive closure of a graph can be computed by using Floyd Warshall algorithm. This method involves substitution of logical operations (logical OR and logical AND) for arithmetic operations min and + in Floyd Warshall Algorithm.

Floyd Warshall Algorithm: dij(k)=min(dij(k-1), dik(k-1) + dkj(k-1))

Transitive closure: tij(k)= tij(k-1) OR (tik(k-1) AND tkj(k-1)).

35. Which of the following is true?

a) Prim's algorithm initialises with a vertex

b) Prim's algorithm initialises with a edge

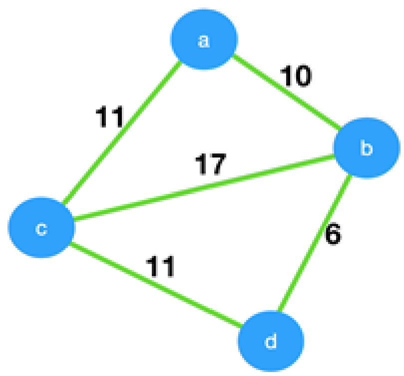
c) Prim's algorithm initialises with a vertex which has smallest edge

d) Prim's algorithm initialises with a forest

Answer: a

Explanation: Steps in Prim's algorithm: (I) Select any vertex of given graph and add it to MST (II) Add the edge of minimum weight from a vertex not in MST to the vertex in MST; (III) It MST is complete the stop, otherwise go to step (II).

Consider the given graph.



36. What is the weight of the minimum spanning tree using the Prim's algorithm,starting from vertex a?

a) 23

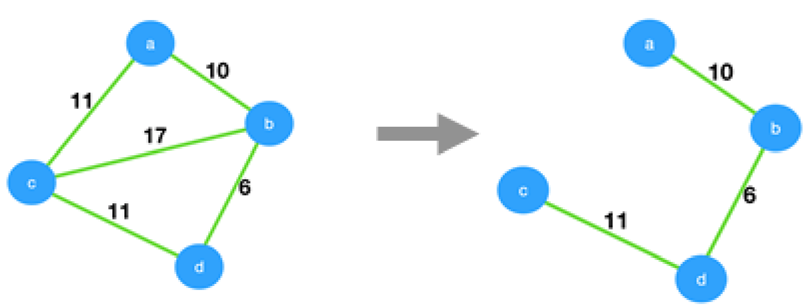
b) 28

c) 27

d) 11

Answer: c

Explanation: In Prim's algorithm, we select a vertex and add it to the MST. Then we add the minimum edge from the vertex in MST to vertex not in MST. From, figure shown below weight of MST = 27.



37. Worst case is the worst case time complexity of Prim's algorithm if adjacency matrix is used?

a) O(log V)

b) O(V2)

c) O(E2)

d) O(V log E)

Answer: b

Explanation: Use of adjacency matrix provides the simple implementation of the Prim's algorithm. In Prim's algorithm, we need to search for the edge with a minimum for that vertex. So, worst case time complexity will be O(V2), where V is the number of vertices.

38. Prim's algorithm is a ______

a) Divide and conquer algorithm

b) Greedy algorithm

c) Dynamic Programming

d) Approximation algorithm

Answer: b

Explanation: Prim's algorithm uses a greedy algorithm approach to find the MST of the connected weighted graph. In greedy method, we attempt to find an optimal solution in stages.

39. Prim's algorithm resembles Dijkstra's algorithm.

a) True

b) False

Answer: a

Explanation: In Prim's algorithm, the MST is constructed starting from a single vertex and adding in new edges to the MST that link the partial tree to a new vertex outside of the MST. And Dijkstra's algorithm also rely on the similar approach of finding the next closest vertex. So, Prim's algorithm resembles Dijkstra's algorithm.

40. Kruskal's algorithm is best suited for the sparse graphs than the prim's algorithm.

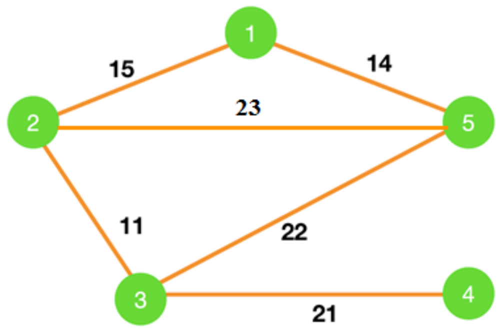
a) True

b) False

Answer: a

Explanation: Prim's algorithm and Kruskal's algorithm perform equally in case of the sparse graphs. But Kruskal's algorithm is simpler and easy to work with. So, it is best suited for sparse graphs.

Consider the graph shown below.



41. Which of the following edges form the MST of the given graph using Prim algorithm, starting from vertex 4.

a) (4-3)(5-3)(2-3)(1-2)

b) (4-3)(3-5)(5-1)(1-2)

c) (4-3)(3-5)(5-2)(1-5)

d) (4-3)(3-2)(2-1)(1-5)

Answer: d

Explanation: The MST for the given graph using Prim's algorithm starting from vertex 4 is,

So, the MST contains edges (4-3)(3-2)(2-1)(1-5).

42. Prim's algorithm is also known as __________

a) Dijkstra–Scholten algorithm

b) Borůvka's algorithm

c) Floyd–Warshall algorithm

d) DJP Algorithm

Answer: d

Explanation: The Prim's algorithm was developed by Vojtěch Jarník and it was latter discovered by the duo Prim and Dijkstra. Therefore, Prim's algorithm is also known as DJP Algorithm.

43. Prim's algorithm can be efficiently implemented using _____ for graphs with greater density.

a) d-ary heap

b) linear search

c) fibonacci heap

d) binary search

Answer: a

Explanation: In Prim's algorithm, we add the minimum weight edge for the chosen vertex which requires searching on the array of weights. This searching can be efficiently implemented using binary heap for dense graphs. And for graphs with greater density, Prim's algorithm can be made to run in linear time using d-ary heap(generalization of binary heap).

44. Which of the following is false about Prim's algorithm?

a) It is a greedy algorithm

b) It constructs MST by selecting edges in increasing order of their weights

c) It never accepts cycles in the MST

d) It can be implemented using the Fibonacci heap

Answer: b

Explanation: Prim's algorithm can be implemented using Fibonacci heap and it never accepts cycles. And Prim's algorithm follows greedy approach. Prim's algorithms span from one vertex to another.

45. Kruskal's algorithm is used to ______

a) Find minimum spanning tree

b) Find single source shortest path

c) Find all pair shortest path algorithm

d) Traverse the graph

Answer: a

Explanation: The Kruskal's algorithm is used to find the minimum spanning tree of the connected graph. It construct the MST by finding the edge having the least possible weight that connects two trees in the forest.

46. Kruskal's algorithm is a ______

a) divide and conquer algorithm

b) dynamic programming algorithm

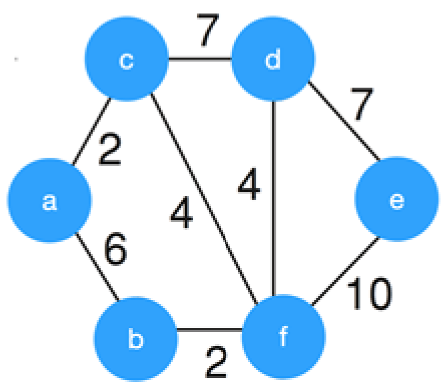
c) greedy algorithm

d) approximation algorithm

Answer: c

Explanation: Kruskal's algorithm uses a greedy algorithm approach to find the MST of the connected weighted graph. In the greedy method, we attempt to find an optimal solution in stages.

Consider the given graph.



47. What is the weight of the minimum spanning tree using the Kruskal's algorithm?

a) 24

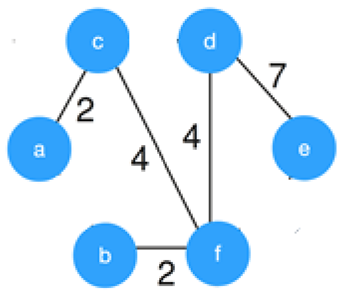
b) 23

c) 15

d) 19

Answer: d

Explanation: Kruskal's algorithm constructs the minimum spanning tree by constructing by adding the edges to spanning tree one-one by one. The MST for the given graph is,



So, the weight of the MST is 19.

48. What is the time complexity of Kruskal's algorithm?

a) O(log V)

b) O(E log V)

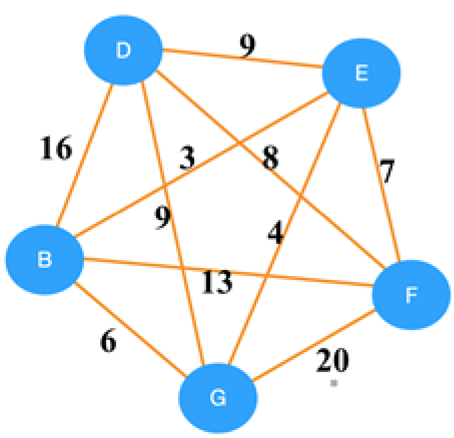
c) O(E2)

d) O(V log E)

Answer: b

Explanation: Kruskal's algorithm involves sorting of the edges, which takes O(E logE) time, where E is a number of edges in graph and V is the number of vertices. After sorting, all edges are iterated and union-find algorithm is applied. union-find algorithm requires O(logV) time. So, overall Kruskal's algorithm requires O(E log V) time.

49. Consider the following graph. Using Kruskal's algorithm, which edge will be selected first?



a) GF

b) DE

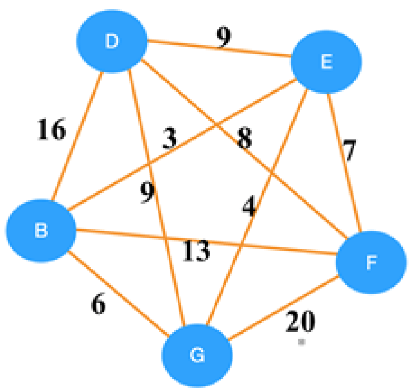
c) BE

d) BG

Answer: c

Explanation: In Krsuskal's algorithm the edges are selected and added to the spanning tree in increasing order of their weights. Therefore, the first edge selected will be the minimal one. So, correct option is BE.

50. Which of the following edges form minimum spanning tree on the graph using kruskals algorithm?



a) (B-E)(G-E)(E-F)(D-F)

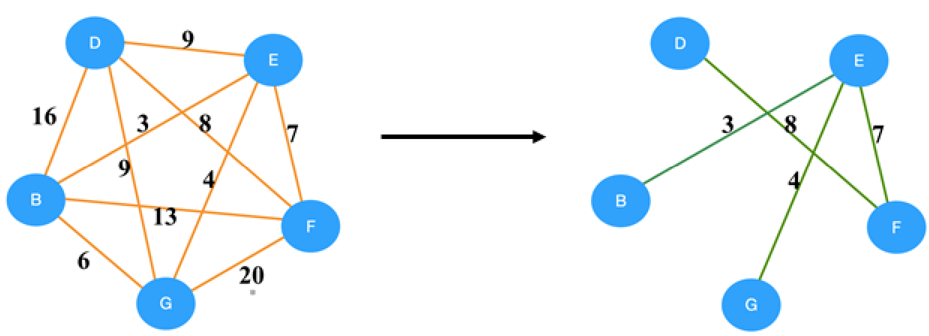
b) (B-E)(G-E)(E-F)(B-G)(D-F)

c) (B-E)(G-E)(E-F)(D-E)

d) (B-E)(G-E)(E-F)(D-F)(D-G)

Answer: a

Explanation: Using Krushkal's algorithm on the given graph, the generated minimum spanning tree is shown below.



So, the edges in the MST are, (B-E)(G-E)(E-F)(D-F).