A)

In the execution of Bellman-Ford Algorithm, can you randomise the order that you relax the edges at each iteration? Explain your answer.

Yes, this solution is known as the randomized Bellman-Ford algorithm and in this version of Bellman-Ford, the relaxation of the edges is randomized at each iteration. This works on the concept of that if the vertex a is already at the correct distance from the source node, and given the fact that the edge ab actually belongs to the shortest path from the source node to the node b, then relaxing the edge of ab will give the correct distance as well to node b. Doing this form edges where each iteration takes O(n) of time then the solution takes around O(mn) of times in the worst-case scenario. This is an efficient solution because the search space is divided into two directed graphs lets say A and B since the ordering of the vertices of the graph is created randomly.

B)

In the matrix multiplication method for all-pairs shortest path, explain why to compute L (8) , you only need to compute L (4) (i.e. there is no need to compute L (5) , L (6) , and L (7) .

Using information from A, if there is a direct path between node 8 and node 8 in a graph and the cycle doesn't exist within the graph and hence there is literally no need for calculating L5, L6, L7 to calculate the L8 using L4. This is because if the vertex 8 is already at the correct distance from the source node, and given the fact that the edge ab actually belongs to the shortest path from the source node to the node 4, then relaxing the edge of 8 and 4 will give the correct distance as well to node 4.

C)

In the execution of the Floyd-Warshall Algorithm, what does it signify when the diagonal of the matrix contains a negative number instead of a zero?

If there are negative weights in the graph and the adjacency matrix that is used for representing the graph it is always a complex thing to handle. The weights will not represent the distance between the nodes of a graph always. Although the Floyd - Warshall algorithm can deal with the negative weights and if some negative cycle is found then nothing will happen rather than calculating the cost of traversal. So if the negative values are present in the adjacency matrix then it may represent a number of possibilities e.g. the cost of traversal, the presence of a negative weight cycle, etc.