Q1) You have a problem called (Independent Set) as follows:

"Given a graph $G=(V,E)$, we say a set of nodes $S \subseteq V$ is independent if no two nodes in $S$ are joined by an edge. The independent set problem is, given $G$, find an independent set that is as large as possible". For example, the maximum size of an independent set in the below graph is four, achieved by the 4 nodes independent set {1, 4, 5, 6}. Write an algorithm to find Independent Set using Simulated Annealing technique.

![Graph Example]

Q2) Find the association rules from the following transaction sample:

<table>
<thead>
<tr>
<th>ID</th>
<th>Transaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A B D</td>
</tr>
<tr>
<td>2</td>
<td>A B C D</td>
</tr>
<tr>
<td>3</td>
<td>B C</td>
</tr>
<tr>
<td>4</td>
<td>A B C D</td>
</tr>
<tr>
<td>5</td>
<td>C D</td>
</tr>
<tr>
<td>6</td>
<td>A B C D</td>
</tr>
<tr>
<td>7</td>
<td>B C</td>
</tr>
</tbody>
</table>

Hint: Minimum support = 2

Q3) Write the general pseudo code of Bees Colony Algorithm (BCA), then trace it to illustrate how BCA can solve 4-colors mapping.
Q4) A) Write a “specific to general” learning algorithm. Then trace the following facts using above algorithm.

- Positive (large, blue, cube)
- Positive (small, blue, ball)
- Positive (small, blue, cube)
- Positive (large, blue, ball)

B) Write a predicate planning rules for the block world problem as in the below figure.

![Start State](image1)

B   C
A
Start State

![Goal State](image2)

C
B
A
Goal State

Q5) Suggest an approach to design hybrid search technique depend on Variable Neighborhood Search & Scatter Search, give a simple example for hybrid technique.

Q6) Write a pseudo code of the following meta-heuristic algorithms (only 3) with features of each one:

1- GRASP.
2- VNS.
3- Scatter Search.
4- Tabu Search.
5- Iterated Local Search.