1. A graph has two self-loops and no parallel edges. Total degree of all the vertices in this graph is 16. Hence, the number of edges in this graph including the self-loops will be:
   i. 6
   ii. 7
   **iii. 8**
   iv. 9

2. In a network model
   i. **All paths and trails are walks**
   ii. Paths are walks but trails are not
   iii. Trails are walks but paths are not
   iv. Paths and trails are not walks

3. In the Königsberg Bridge problem, one needs to cross all the 7 bridges exactly once starting from any of the four landmasses and coming back to the same landmass. For this problem:
   i. Everyone can do as stated in the problem
   **ii. Nobody can fulfill the given condition**
   iii. Some people can do while others cannot
   iv. The problem itself has no meaning

4. The Chinese postman problem relates to:
   i. **Finding an Closed Walk covering all edges**
   ii. Finding a Hamiltonian Circuit
   iii. Finding a circuit covering all edges exactly once
   **iv. Finding a closed trail Covering all edges exactly once**

5. How many vertices are there in a complete graph with 120 edges?
   i. 10
   ii. 12
   iii. 15
   **iv. 16**
6. Three graphs G1{e1, e2, e3}, G2{e3, e4, e5}, and G3{e1, e2, e4, e5} are shown below. Graph G3 is obtained by an operation on graphs G1 and G2. This operation is:

i. Union
ii. Joining
iii. **Ring sum**
iv. Fusion

7. A Tree is
   i. A connected graph
   ii. A graph without any circuit
   iii. A graph without components
   iv. A **connected graph with n vertices and n-1 edges**

8. Which is not a spanning tree in the graph given below

   i. \{e2, e3, e4, e6\}
   ii. \{e1, e2, e3, e4\}
   iii. \{e1, e3, e4, e6\}
   iv. \{e2, e3, e4, e5\}
9. Consider a graph with 5 vertices and 7 edges with a spanning tree \{e_2, e_3, e_4, e_6\} as shown below. Find out which option represents the Fundamental Circuits of this graph with respect to the spanning tree mentioned.

\[ \begin{align*}
\text{i.} & \quad \{e_1, e_2, e_3\}, \{e_3, e_4, e_5\}, \text{ and } \{e_3, e_4, e_6, e_7\} \\
\text{ii.} & \quad \{e_1, e_2, e_3\}, \{e_3, e_4, e_6, e_7\}, \text{ and } \{e_5, e_6, e_7\} \\
\text{iii.} & \quad \{e_1, e_2, e_3\}, \{e_3, e_4, e_5\}, \text{ and } \{e_5, e_6, e_7\} \\
\text{iv.} & \quad \{e_1, e_2, e_3\}, \{e_1, e_2, e_4, e_5\}, \text{ and } \{e_5, e_6, e_7\}
\end{align*} \]

10. A graph has 15 vertices and 22 edges without any parallel edges or self-loops. How many fundamental circuits and fundamental cutsets does the graph contain with respect to any spanning tree of the graph?

\[ \begin{align*}
\text{i.} & \quad 7 \text{ fundamental circuits and } 15 \text{ fundamental cutsets} \\
\text{ii.} & \quad 15 \text{ fundamental circuits and } 7 \text{ fundamental cutsets} \\
\text{iii.} & \quad \textbf{8 fundamental circuits and 14 fundamental cutsets} \\
\text{iv.} & \quad 14 \text{ fundamental circuits and } 8 \text{ fundamental cutsets}
\end{align*} \]

11. Which of the following statements is not true for Kruskal’s Algorithm for finding Minimal Spanning Tree:

\[ \begin{align*}
\text{i.} & \quad \text{The algorithm is edge-based} \\
\text{ii.} & \quad \text{The algorithm sorts the edges first} \\
\text{iii.} & \quad \textbf{The algorithm is node based} \\
\text{iv.} & \quad \text{The algorithm need to check making of circuits}
\end{align*} \]

12. A network is of 6 cities, namely: C1, C2, C3, C4, C5, and C6. Eight possible connections between the cities are considered for road building as detailed below:

<table>
<thead>
<tr>
<th>Connections</th>
<th>Distances</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1C2</td>
<td>10 km</td>
</tr>
<tr>
<td>C1C3</td>
<td>12 km</td>
</tr>
<tr>
<td>C1C5</td>
<td>8 km</td>
</tr>
<tr>
<td>C1C6</td>
<td>11 km</td>
</tr>
<tr>
<td>C2C3</td>
<td>9 km</td>
</tr>
<tr>
<td>C2C4</td>
<td>12 km</td>
</tr>
<tr>
<td>C2C5</td>
<td>10 km</td>
</tr>
<tr>
<td>C3C4</td>
<td>6 km</td>
</tr>
<tr>
<td>C3C5</td>
<td>5 km</td>
</tr>
<tr>
<td>C4C5</td>
<td>8 km</td>
</tr>
<tr>
<td>C4C6</td>
<td>6 km</td>
</tr>
<tr>
<td>C5C6</td>
<td>4 km</td>
</tr>
</tbody>
</table>
What will be the total distance of minimum road connections amongst the cities by using Prim’s algorithm?

i. 29
ii. 31
iii. **32**
iv. 33

13. Six cities C1 to C6 could be connected by 12 possible road connections. The corresponding graph and the possible road connection distances are given below:

What will be the total distance of minimum road connections amongst the cities by using Kruskal’s algorithm?

i. 27
**ii. 28**
iii. 29
iv. 30

14. Which graph-theoretic operation will help one to find out all the cutsets of a graph given the fundamental cutsets of the graph for a given spanning tree?

i. Union
ii. Intersection
**iii. Ring sum**
iv. Fusion

15. What will be the maximum vertex connectivity of a graph with 14 vertices and 48 edges?

i. 2
ii. 3
iii. 4
**iv. 6**
Explanations

5. Let, there are \( n \) vertices. Then for a complete graph, there will be \( nC_2 \) number of edges.
   i.e. \( nC_2 = 120 \). We can find that \( n = 16 \)

12. Let start from C1 then nearest city will be C5. Now, taking C1 and C5 as one subgraph, nearest node will be C6. Followed by C3, C4 and C2. Total distance will be \( 8 + 4 + 5 + 6 + 9 = 32 \).

13. After sorting all the edges, we will find C1C2 will be the shortest edge followed by C2C3, then C3C4, C5C6 and C4C6. Total distance of the minimal spanning tree will be \( 4 + 5 + 6 + 6 + 7 = 28 \).

15. We know that vertex connectivity (\( VC \)) \( \leq \) Int(\( 2e/n \)) where \( e \): no of edges and \( n \):no of nodes. Therefore, maximum \( VC = 2*48/14 \). Now, taking integer value only, we get \( VC = 6 \).