# Structural Analysis of Transport Network

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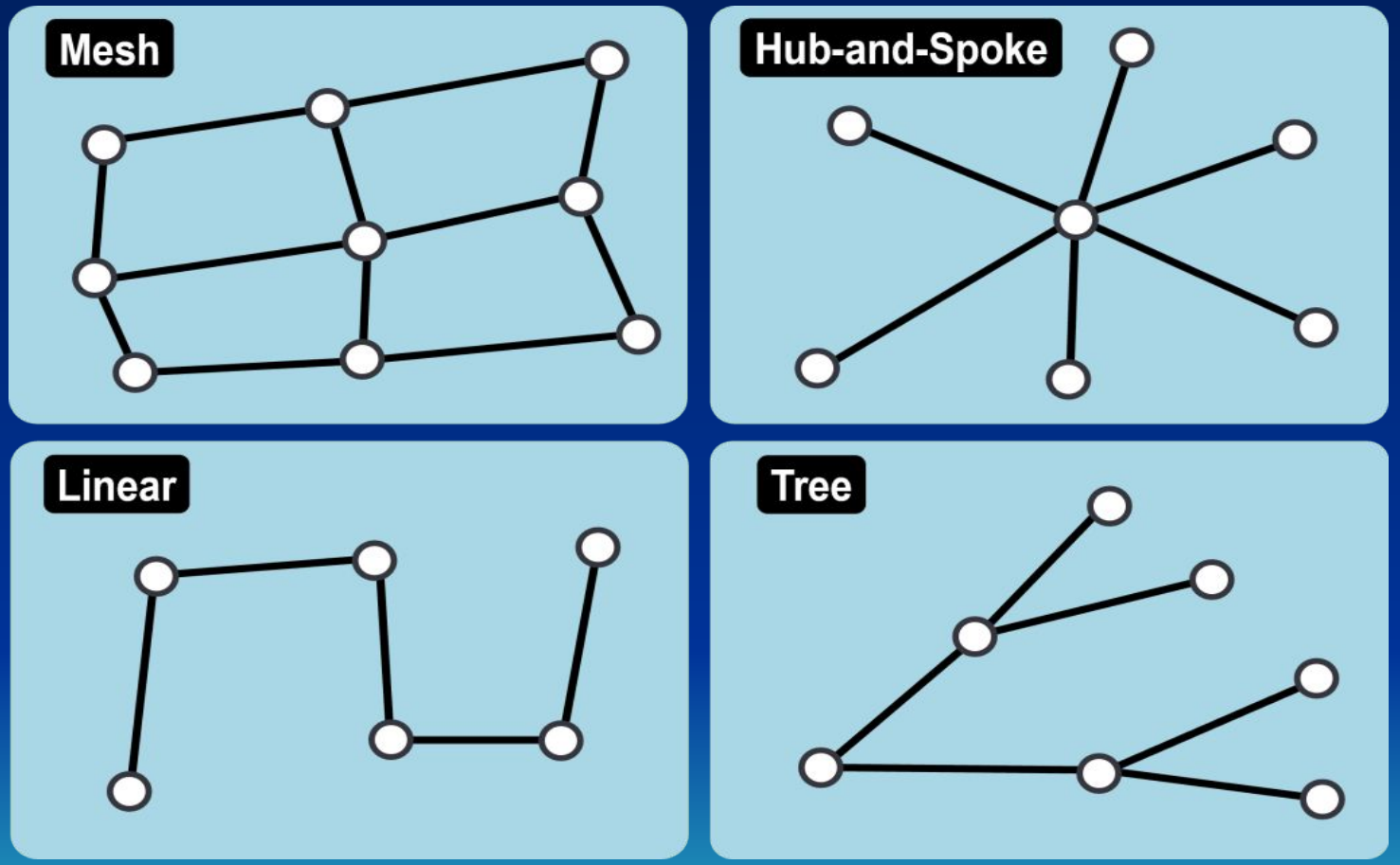
# What is meant by ‘Structural Analysis of Transport Network’ ?

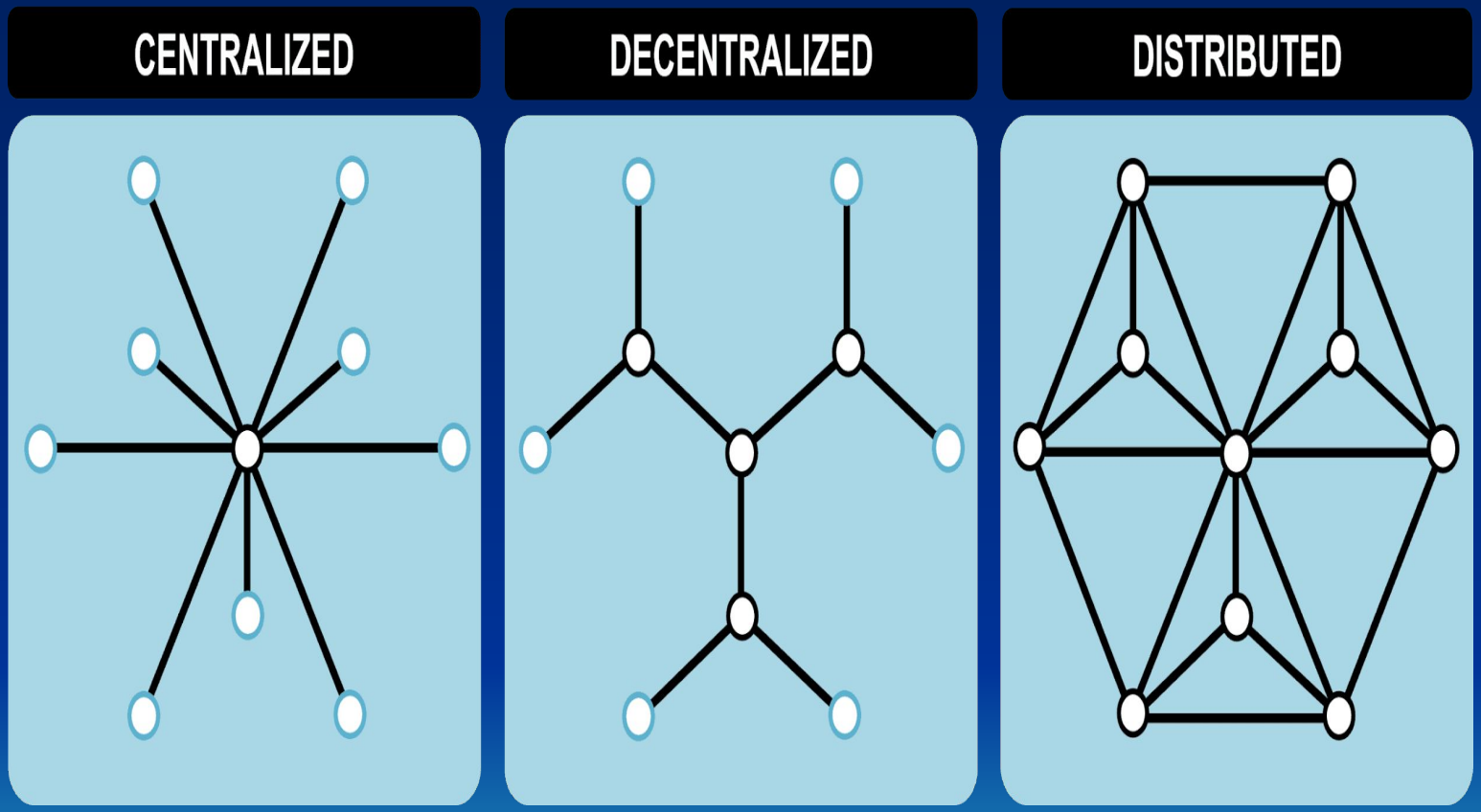
The term **network** refers to the framework of routes (Road, Rail, Sea, Air) within a system of locations, identified as nodes (mainly village , town or any settlement).

The structure of any region corresponds to networks of economic and social interactions through its geometrical shape.

# Network Types



# Network Structure



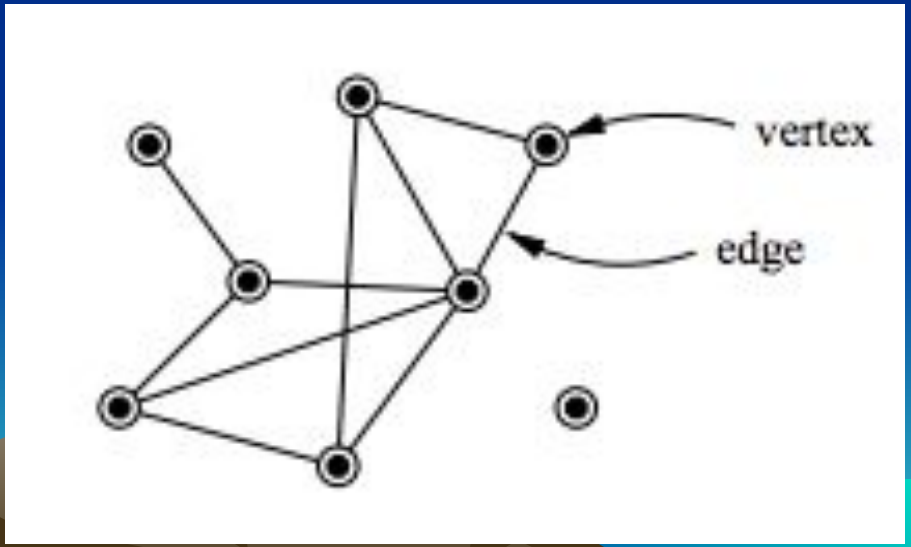
# Graph, Vertex and Edge in Transport Network

**Graph :** A graph G is a set of vertices (nodes) connected by edges (links)

**Vertex (v) (Node):** A node is a terminal point or an intersection point of a graph. It may be a village or town, a road intersection or a transport terminal (stations, terminuses, harbors and airports).

**Edge (e) (Link):** An edge e is a link between two nodes.

**Sub-Graph (p) :** A sub-graph is a subset of a graph where p is the number of sub-graphs.



# *Cyclomatic number in a Graph*

Cyclomatic number refers as the count of the number of edges, vertices and non-connected graph existing in the transport circuit in the graph. It is calculated as :

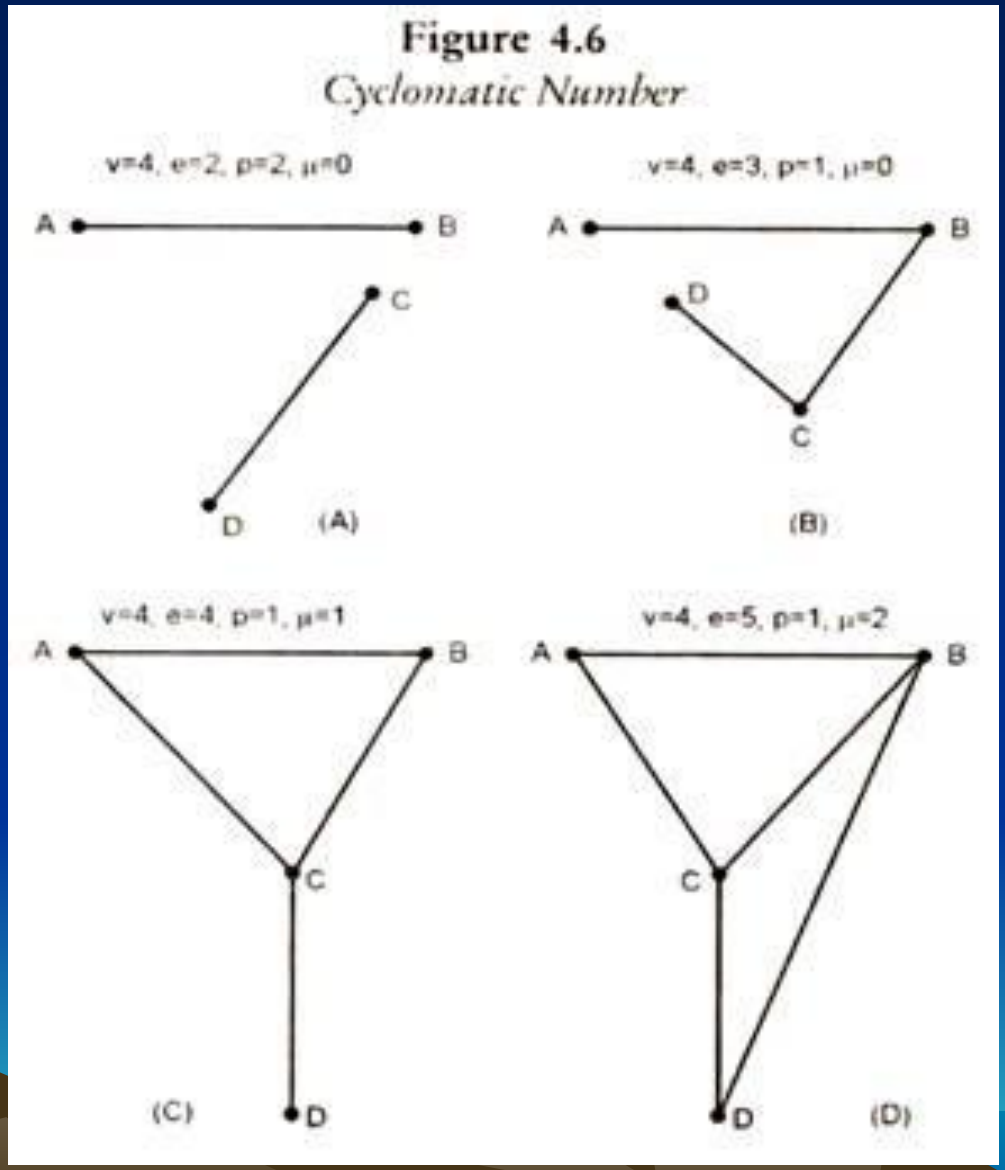
$$\mu = e - v + p$$

Where -

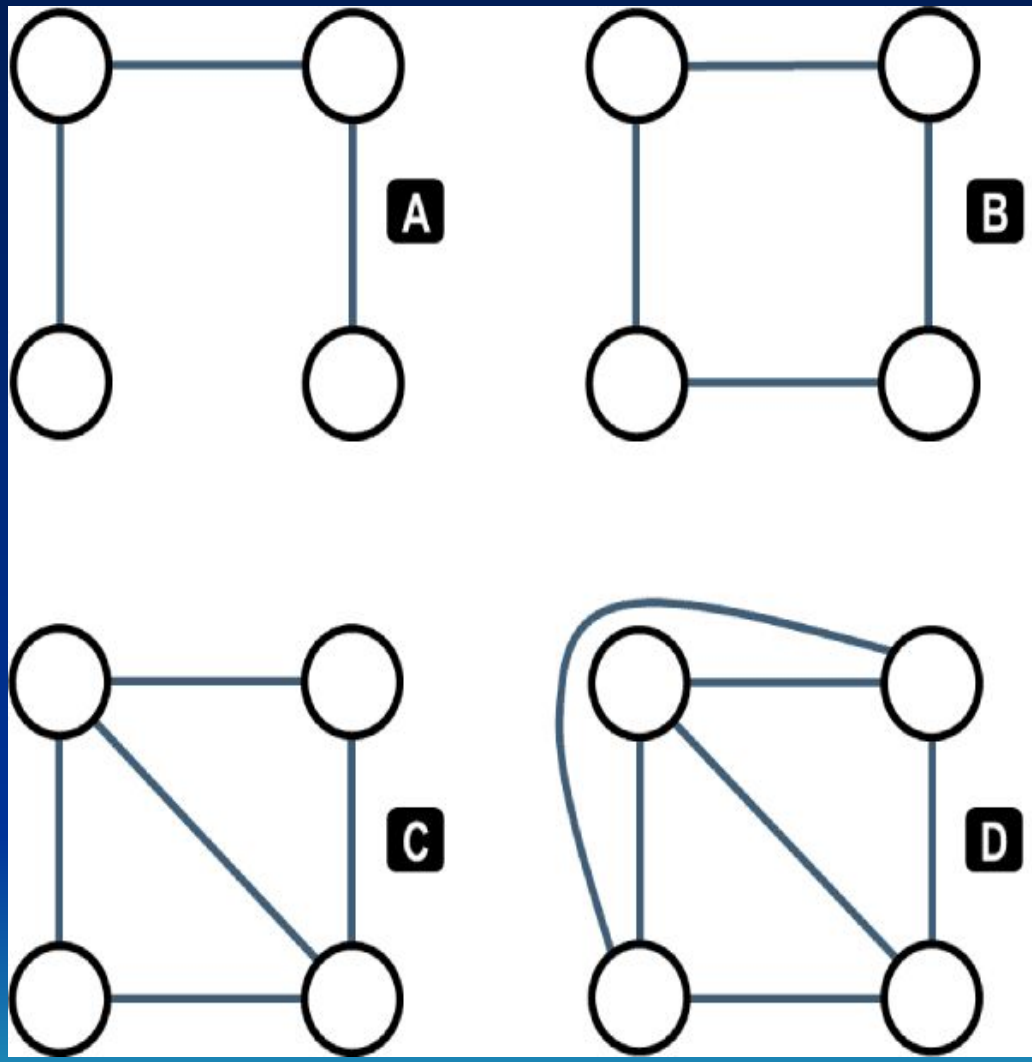
*e* = number of edges or routes

*v* = number of vertices or nodes

# Cyclomatic number in a Graph



# Alpha Index in a Graph



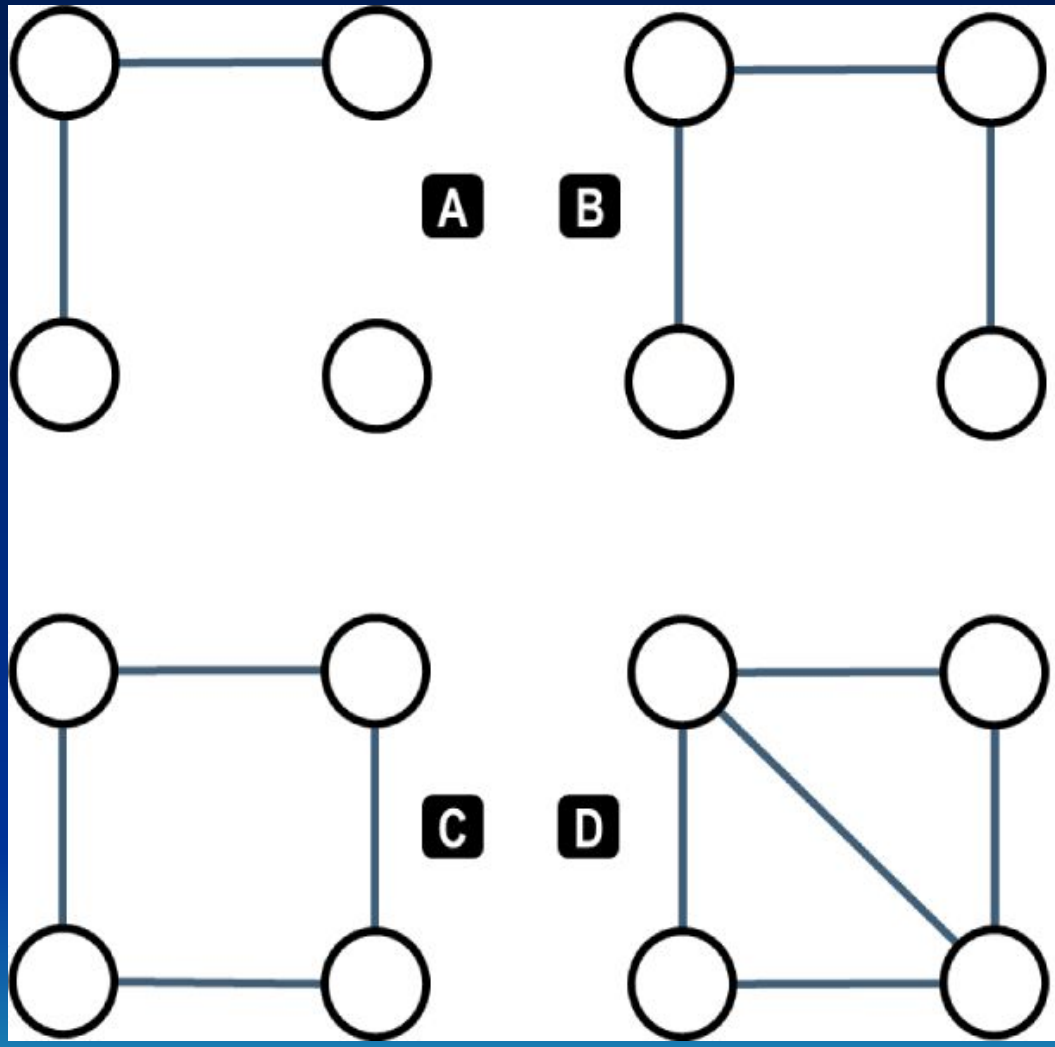

$$\alpha = \frac{u}{2v - 5}$$

| | $u\ (e\text{-}v\text{+}p)$ | $2v\text{-}5$ | Alpha |
|---|---|---|---|
| A | 0 | 3 | 0.0 |
| B | 1 | 3 | 0.33 |
| C | 2 | 3 | 0.66 |
| D | 3 | 3 | 1.0 |

# *Alpha Index in a Graph*

Alpha Index is one of the most useful indices that help to measure the connectivity of the network. It ranges from 0 to 1 and may be converted into percent if multiplied by hundred. Here, the common concept is that higher the obtained value of alpha index, the greater is the degree of connectivity as well as efficiency in a given network and vice versa.

# Beta Index in a Graph



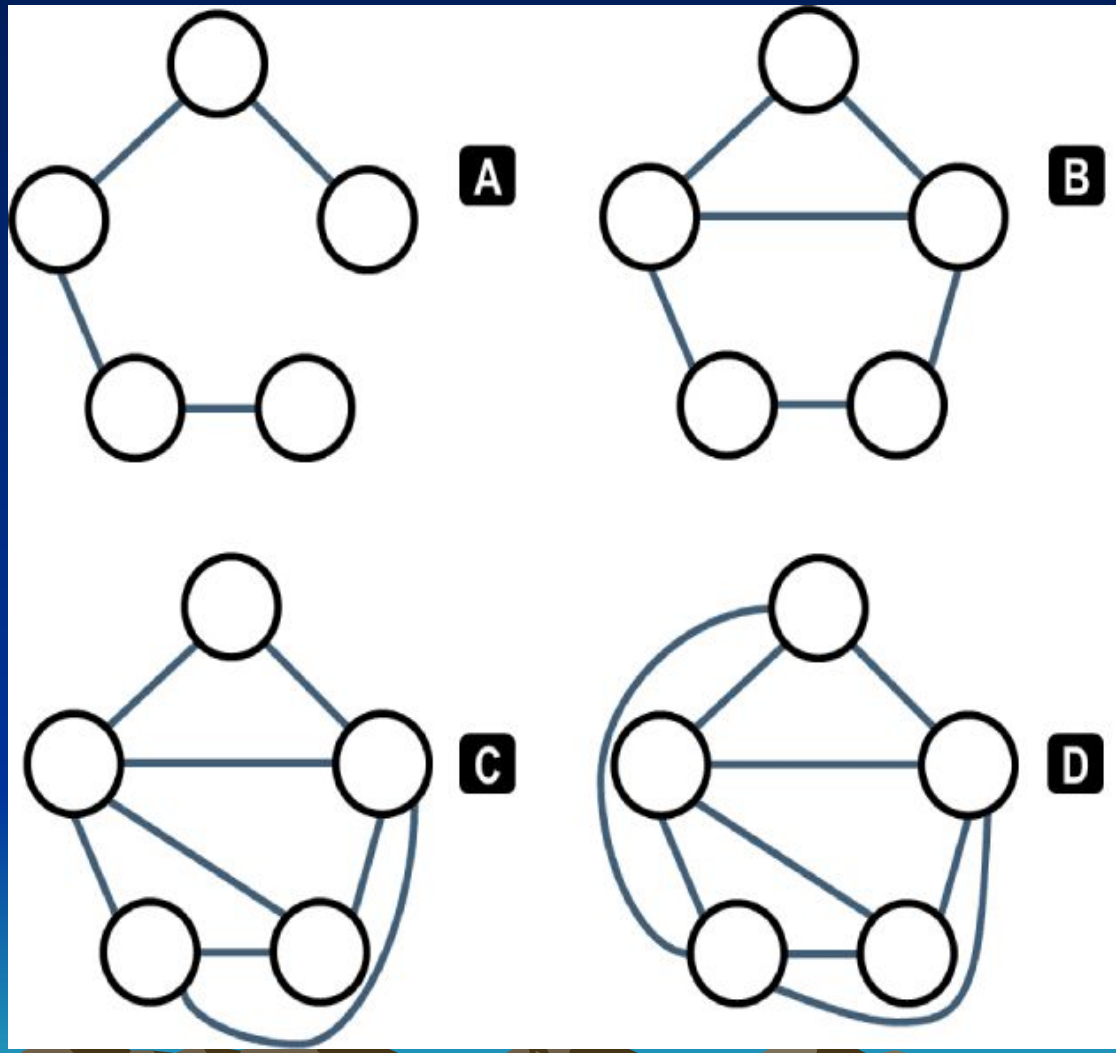

$$\beta = \frac{e}{v}$$

| | e | v | Beta |
|---|---|---|---|
| A | 2 | 4 | 0.5 |
| B | 3 | 4 | 0.75 |
| C | 4 | 4 | 1.0 |
| D | 5 | 4 | 1.25 |

# *Beta Index in a Graph*

This is an easy measure that is used to analyze transport network structure by exhibiting the ratio between edges and vertices. It commonly ranges from 0 to 1 and may be greater than 1 where network are very well connected or if an area is highly efficient in transport point of view. Therefore, low index value of beta indicates lesser connectivity as well as efficiency and vice versa.

# Gamma Index in a Graph




$$\gamma = \frac{e}{3(v-2)}$$

| | e | 3(v-2) | Gamma |
|---|---|---|---|
| A | 4 | 9 | 0.44 |
| B | 6 | 9 | 0.66 |
| C | 8 | 9 | 0.88 |
| D | 9 | 9 | 1.0 |

# *Gamma Index in a Graph*

It is another measure of connectivity that refers the relationship between the number of observed links and the number of possible links. The value of gamma lies between 0 and 1 where, 1 indicates a completely connected network and vice versa. Similarly values nearer to 1 show an area with higher level of efficiency.

# *Aggregate Transport Score*

Aggregate transportation score is obtained by adding up all the obtained values of cyclomatic number, alpha, beta and gamma index. Here, higher value indicates more connectivity or higher efficiency whereas medium and low values represent the moderate and poor connectivity or efficiency.

| Sl. No. | Places | Cyclomatic Number | Alpha Index | Beta Index | Gamma Index | Aggregate Transport Score (A.T.S.) |
|---|---|---|---|---|---|---|
| 1 | A | 0 | 0 | 0.89 | 0.39 | 1.28 |
| 2 | B | 0 | 0 | 0.92 | 0.37 | 1.29 |
| 3 | C | 0 | 0 | 0.89 | 0.39 | 1.28 |

THANK YOU