NPTEL

NPTEL ONLINE CERTIFICATION COURSE

Discrete Mathematics
Graph Theory – 2

Illustration of V - E + R = 2

By
Prof. S.R.S Iyengar
Department of Computer Science

So we learnt a new formula in the previous video V – E + R = 2, please note this is true only for planar graphs.
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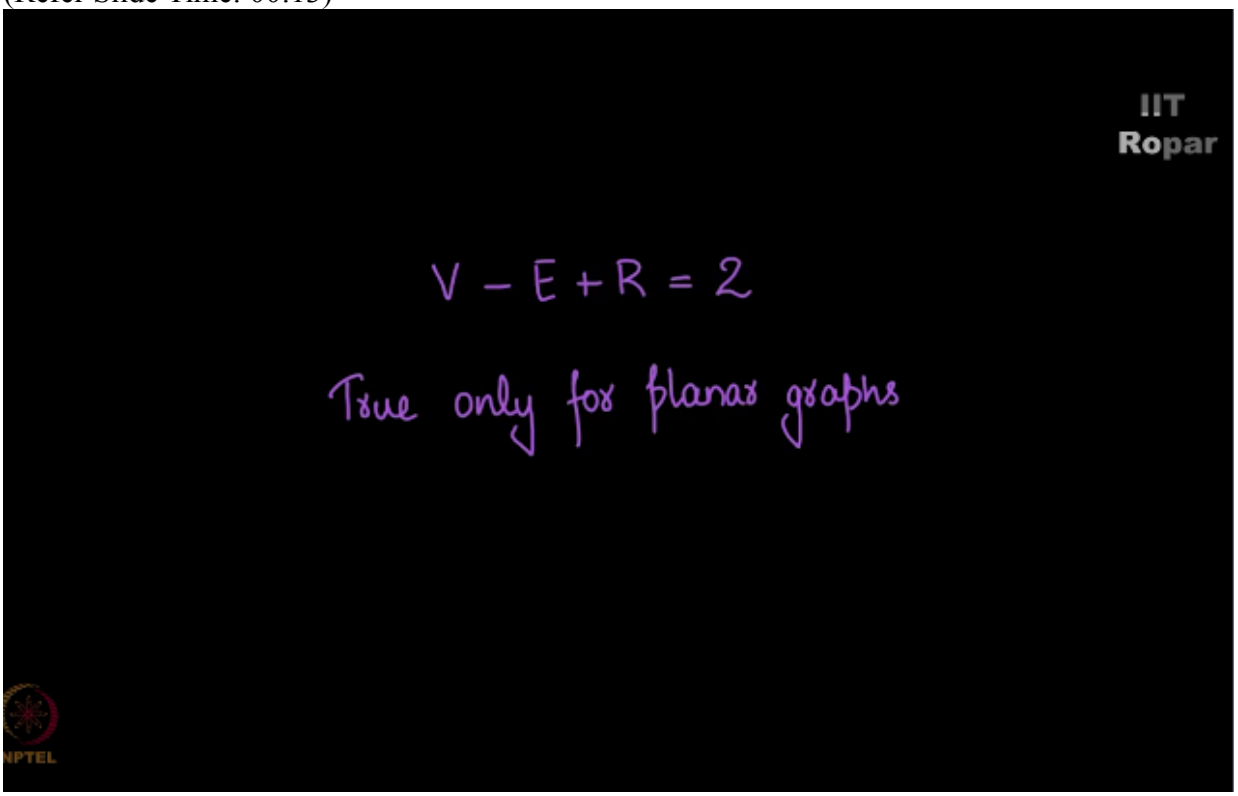

Let me consider this graph as we see it is planar, there are no intersection of edges or cross overs here,
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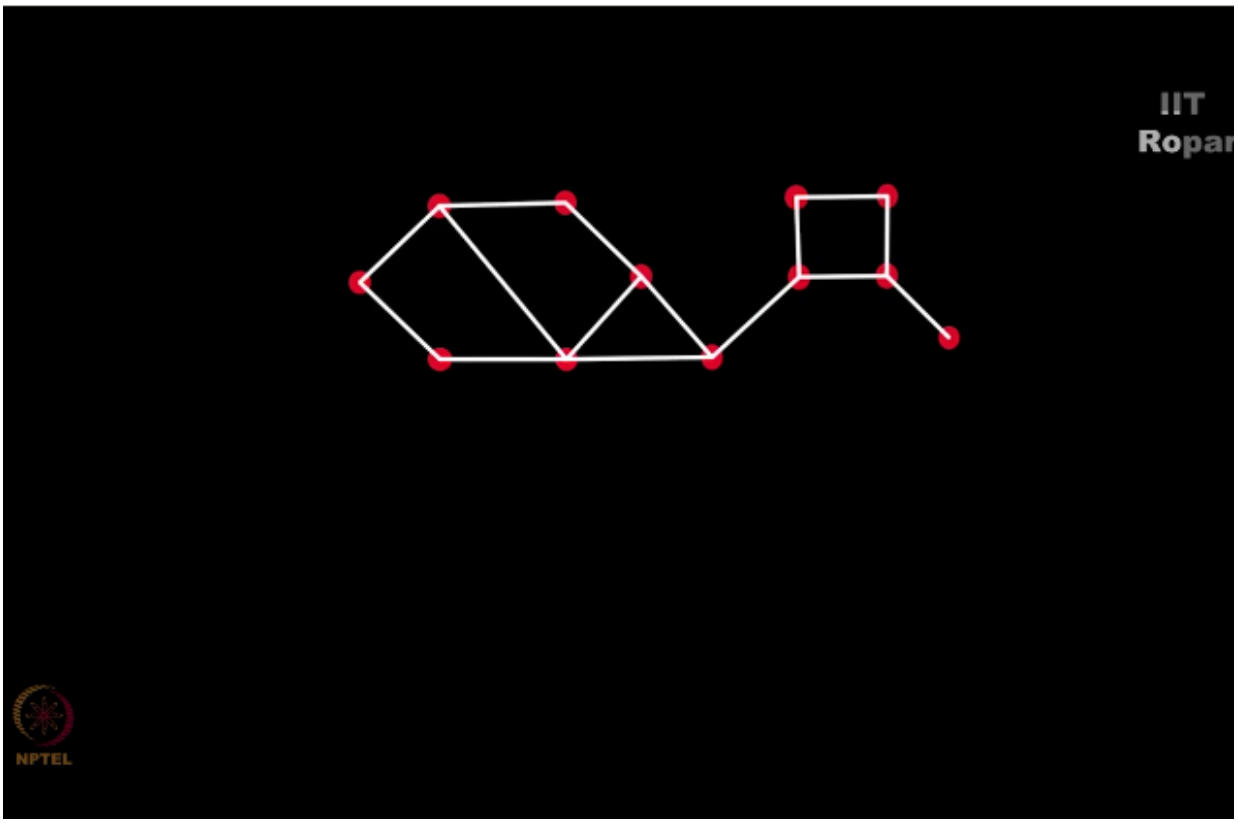

let me check if the formula is true, I'm just illustrating how to verify if this holds true or not.

Now the number of vertices here let us count, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,
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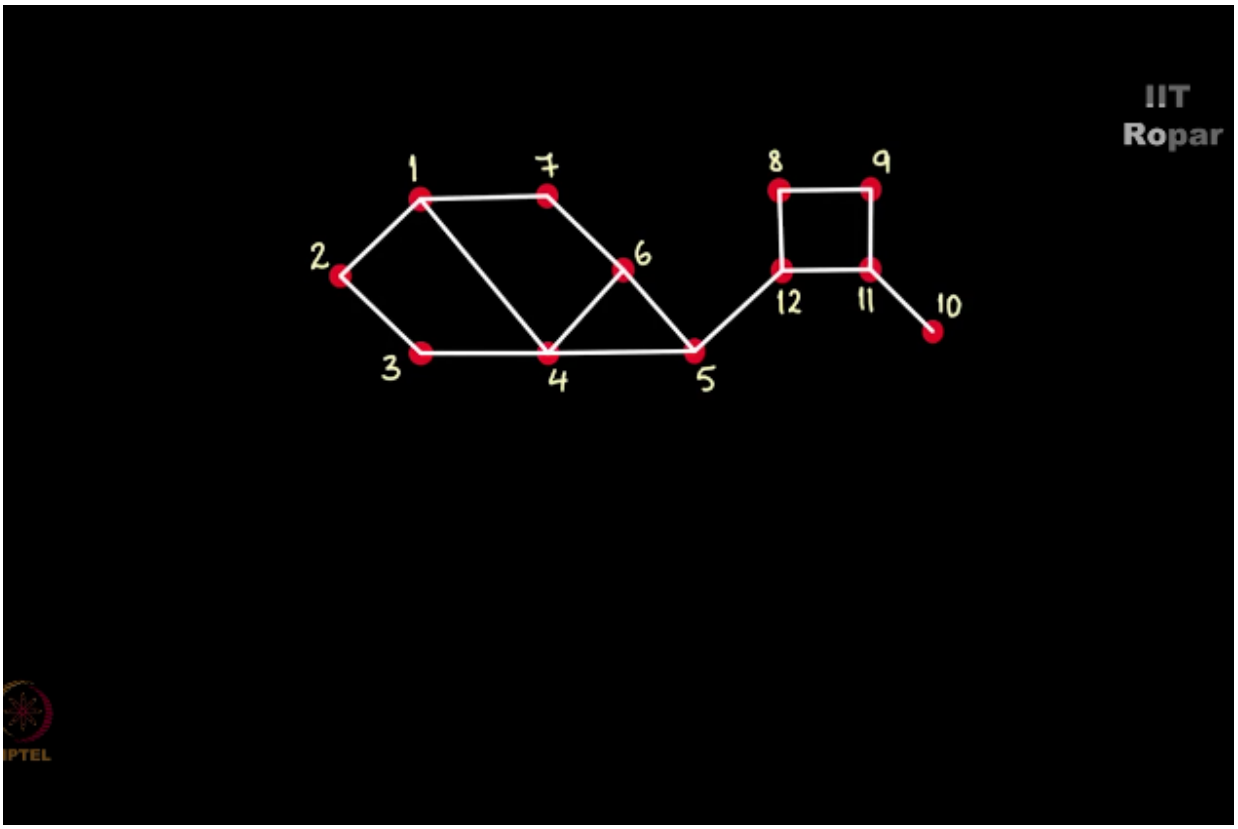

so the cardinality of vertices, the vertex set is 12,

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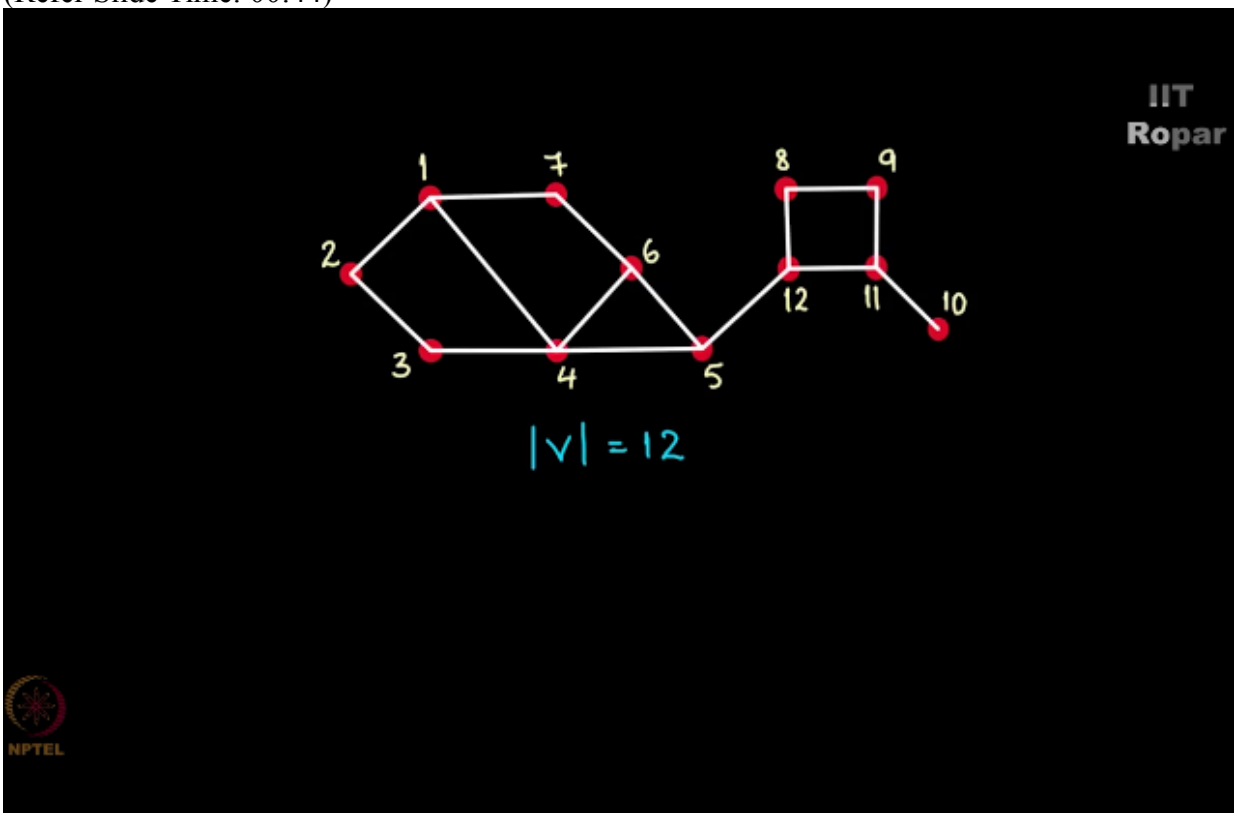

what are the number of edges here, let us see, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, so we have 15 edges,
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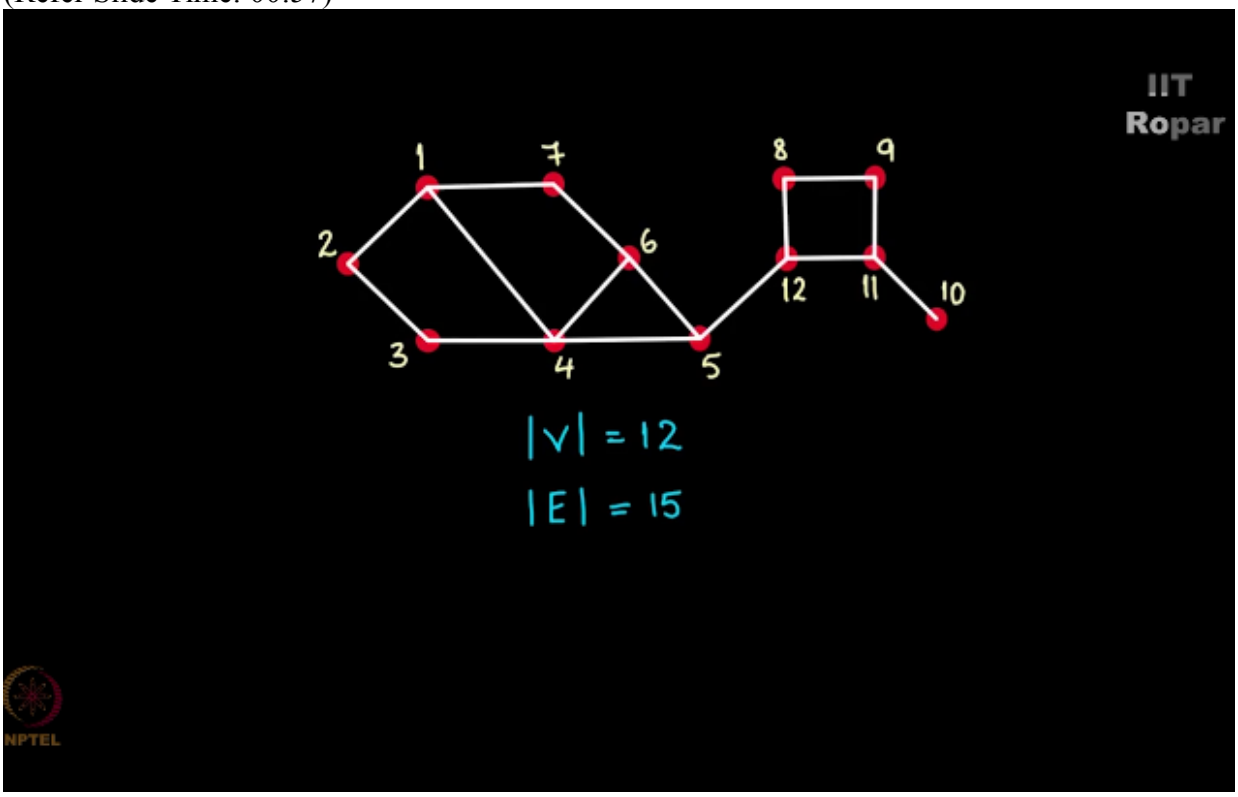

and the number of regions are 1, 2, 3, 4 and 5, the fifth one is the outer region, so we have 5 regions here, so R happens to be 5
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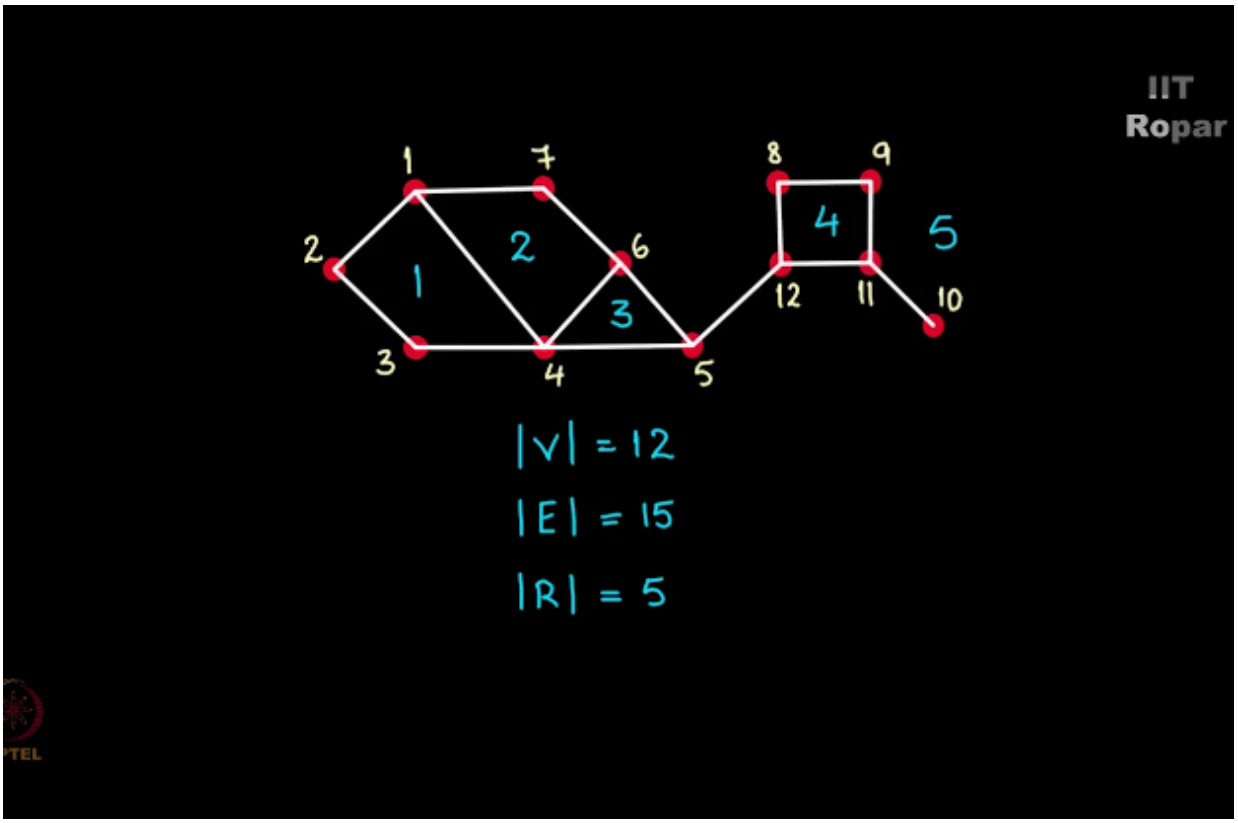

so 12 according to the formula, 12 – 15 + 5 what is it? -3 + 5 is 2,

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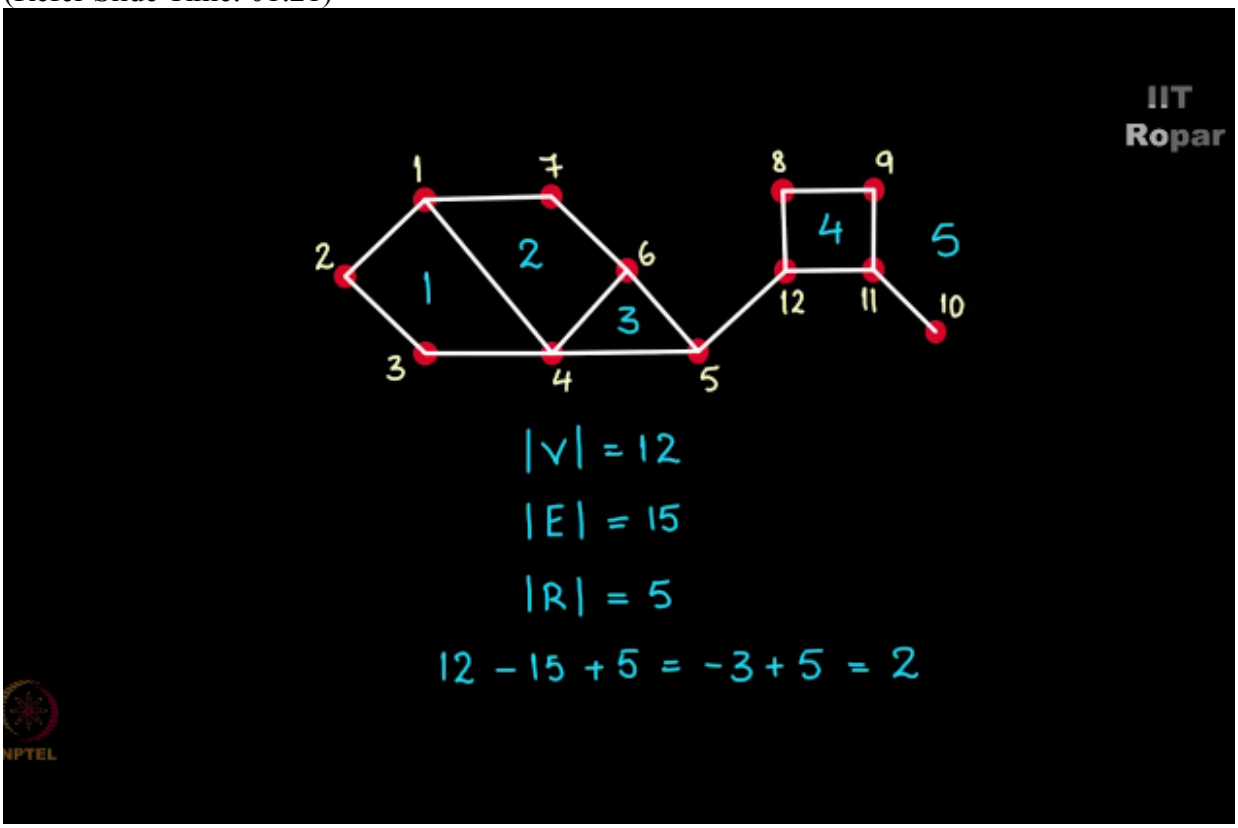

so yes, we have obtained 2 as the answer, and hence the formula holds true.

Let me consider this graph here where we have a C3 and a P2, what do I mean by P2, it's a path on 2 vertices and C3 as you all know as a cycle on 3 vertices.
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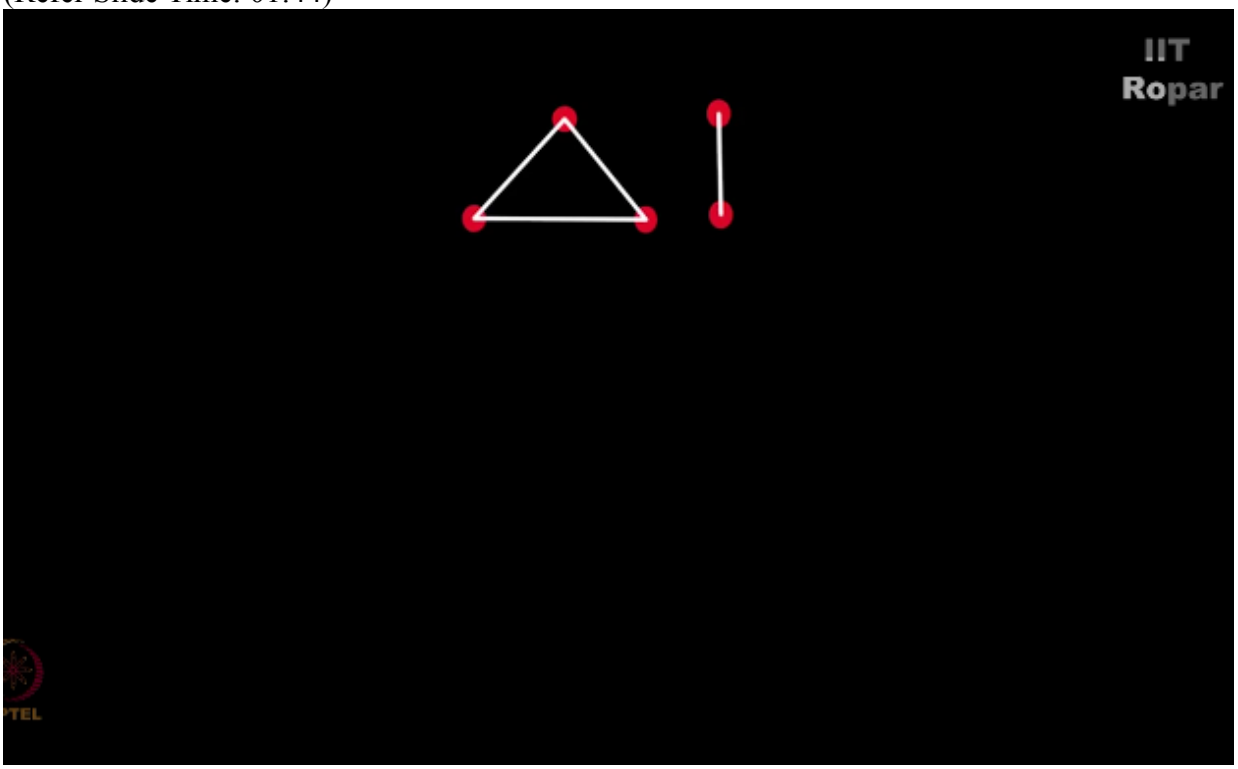

Now let me apply the formula here number of vertices are 5, number of edges are 4, and number of regions you see the region inside this triangle it is 1, the first region and the region outside this triangle is 2, so we have 2 regions here, 5 – 4 + 2, 5 – 4 is 1, and 1 + 2 happens to be 3, and hence V – E + R = 2 is false for this graph, did you observe that this graph was disconnected,
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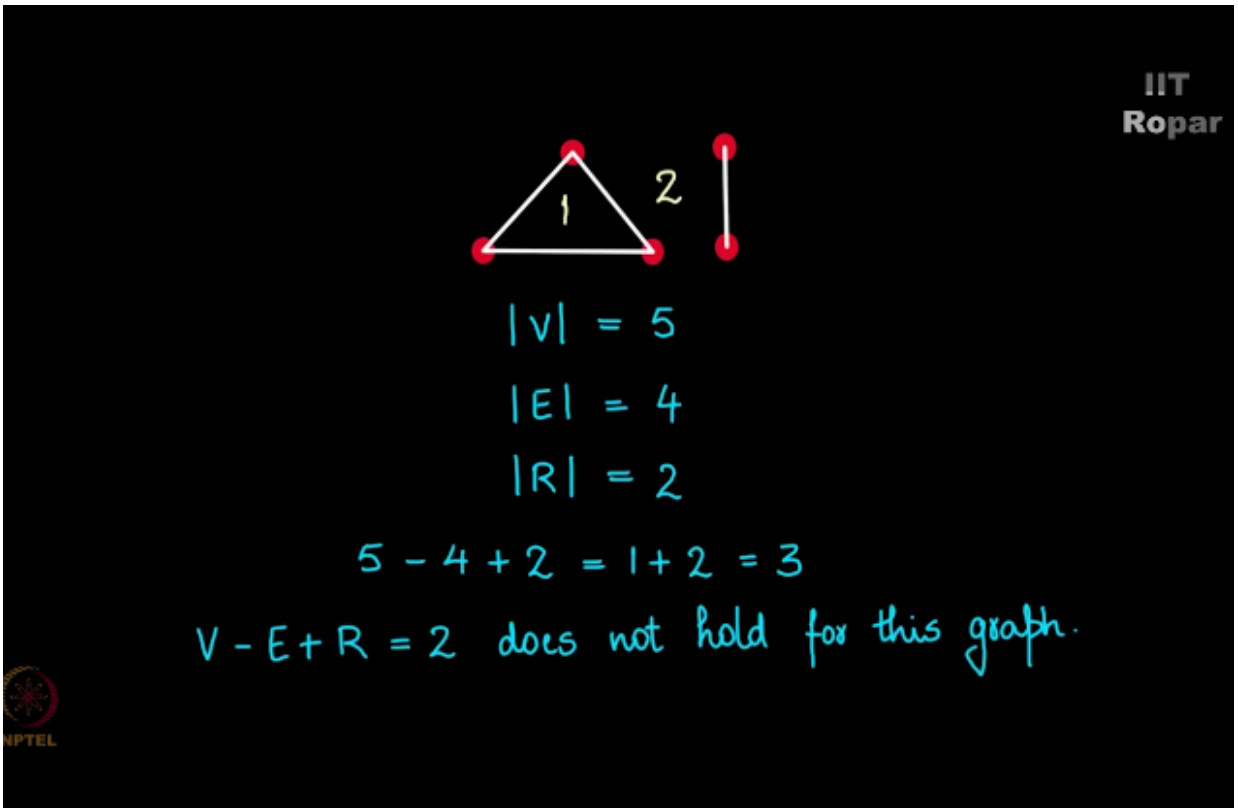

and hence we see that for disconnected graphs the formula doesn't hold true.

Here is a nice challenge for you people now that I said that this doesn't hold true for disconnected graphs, can you by yourself figure out the formula for disconnected graphs? There is a huge hint hidden here, the hint is consider the number of components in the graph,

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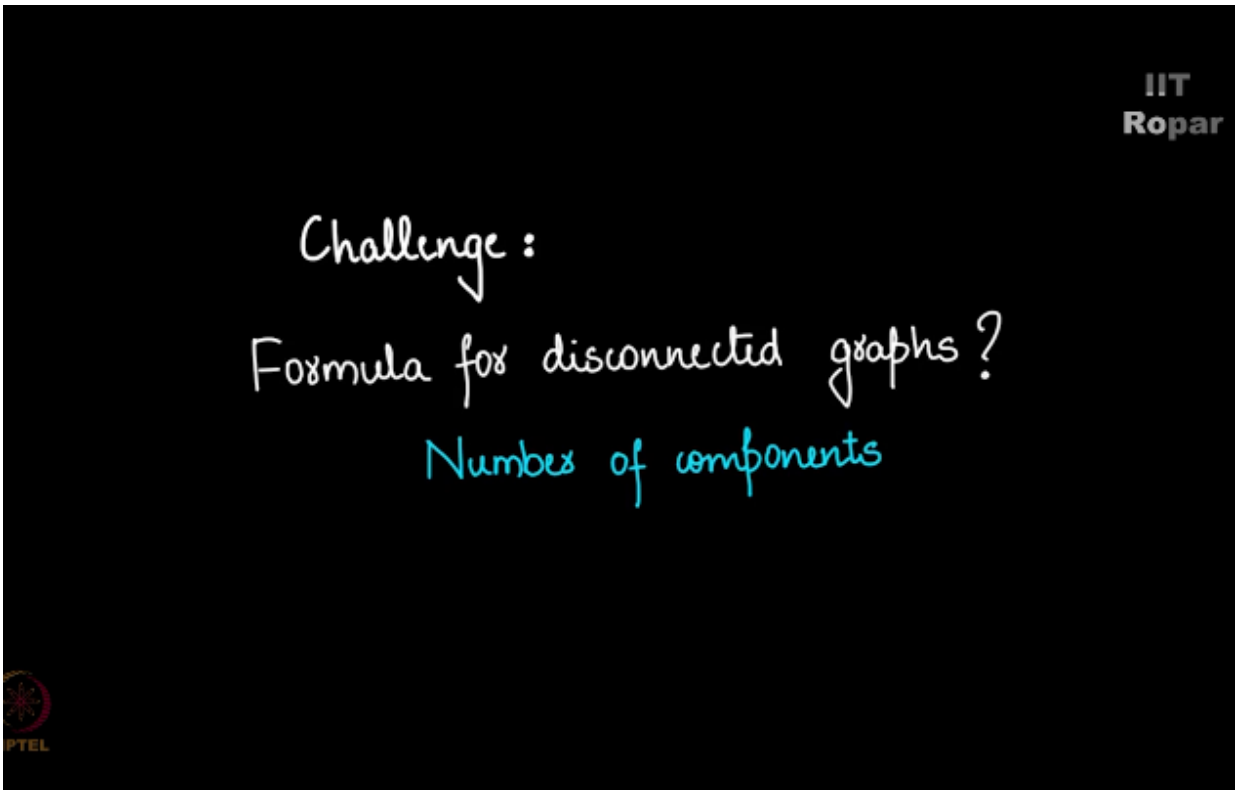

and you will be able to figure out the formula.

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