

**NPTEL**

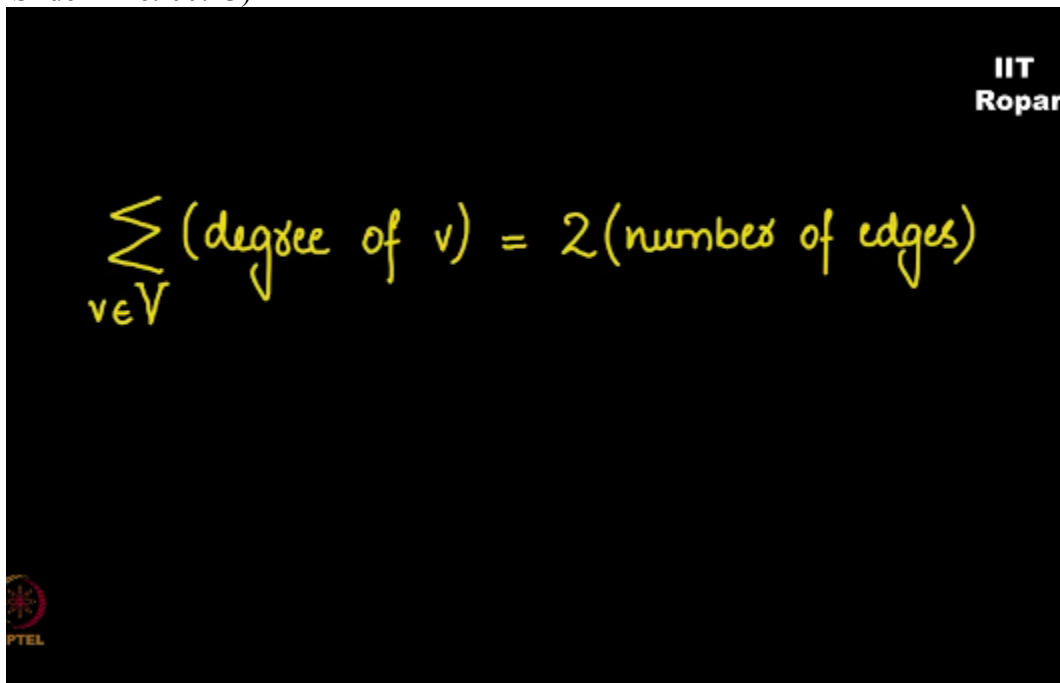
**NPTEL ONLINE CERTIFICATION COURSE**

**Discrete Mathematics  
Graph Theory - 1**

**Relation between number of edges and degrees – Proof**

**By  
Prof. S.R.S Iyengar  
Department of Computer Science  
IIT Ropar**

So summation of degree of all the vertices where  $V$  belongs to the vertex set is 2 times the number of edges,  
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The slide features a black background with a white equation written in a cursive font. The equation is  $\sum_{v \in V} (\text{degree of } v) = 2(\text{number of edges})$ . In the top right corner, the text "IIT Ropar" is written in white. In the bottom left corner, there is a small circular logo with a red and white design, and the word "NPTEL" is written in white below it.

$$\sum_{v \in V} (\text{degree of } v) = 2(\text{number of edges})$$

isn't this obvious as I have been telling and as you are seeing. If you take the sum of the degrees of individual nodes you will be counting an edge twice, correct? Let me give you an example, assume there are two counters and every single person goes to both the counters  
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let the first counter be soup counter where soup is being served  
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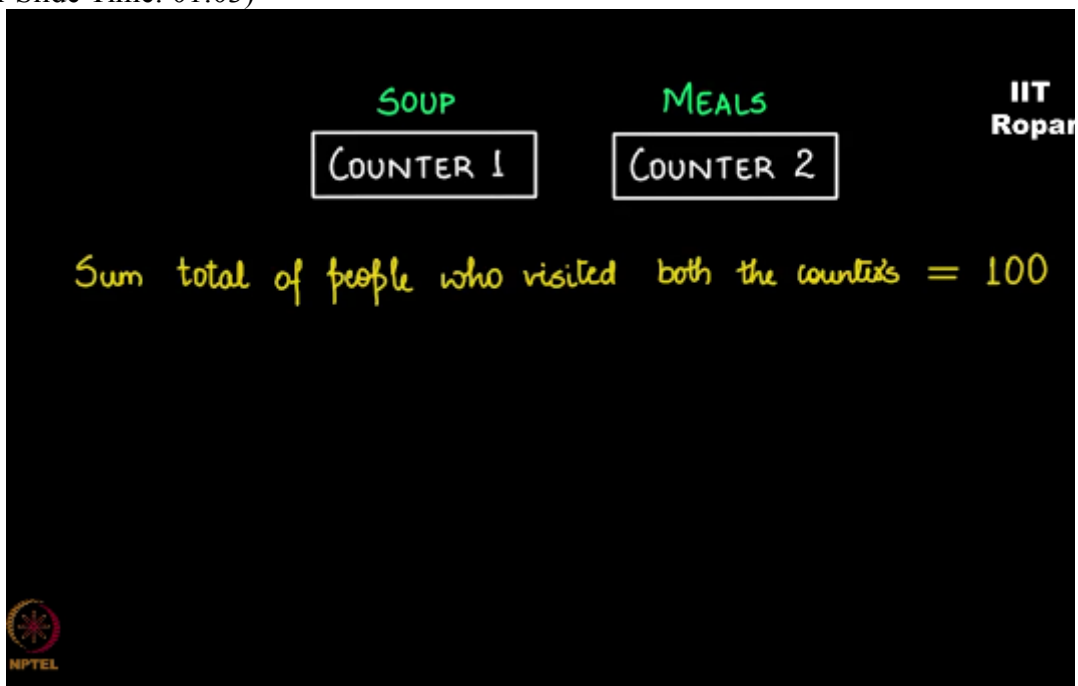


and the second counter is the main meals  
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so that every single person goes to both the counters, and they are keeping a head count of people in both the counters, and if someone tells you the sum total of people who visited both the counters put together is 100

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you know very well that the number of people is actually 50,

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SOUP                      MEALS  
COUNTER 1              COUNTER 2

Sum total of people who visited both the counters = 100  
Number of people = 50




why? You know for sure that you are counting by, over counting by 2 folds here, because a person who comes to soup shop also comes to the meals place, right.  
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SOUP                      MEALS  
COUNTER 1              COUNTER 2

Sum total of people who visited both the counters = 100  
Number of people = 50

A person who comes to Soup counter, also  
comes to Meals counter.



Similarly, every edge contributes to a degree in two different vertices, right,  
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Every edge contributes a degree in two  
different vertices.



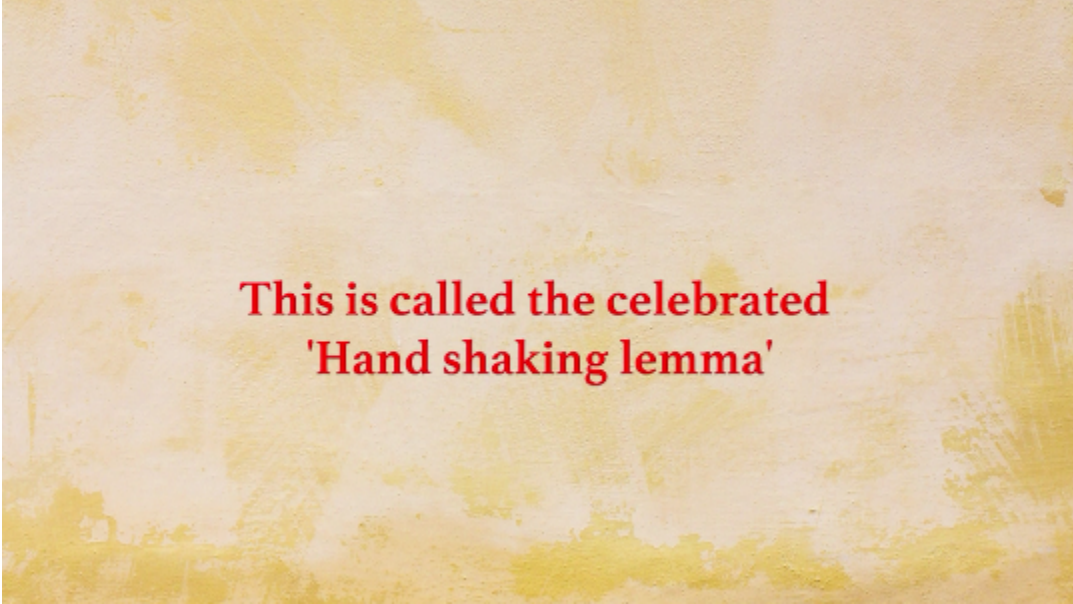
which means the sum total degree should actually be counting the total number of edges twice  
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Every edge contributes a degree in two  
different vertices.

$$\sum_{v \in V} (\text{degree of } v) = 2(\text{number of edges})$$



and hence sum of degrees of all possible vertices  $V$  is 2 times the number of edges.  
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**This is called the celebrated  
'Hand shaking lemma'**

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