NPTEL

NPTEL ONLINE CERTIFICATION COURSE

Discrete Mathematics
Graph Theory – 3 &
Generating Functions

Words and the polynomial - Explained

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If you saw some pattern there of linking these two problems, good,
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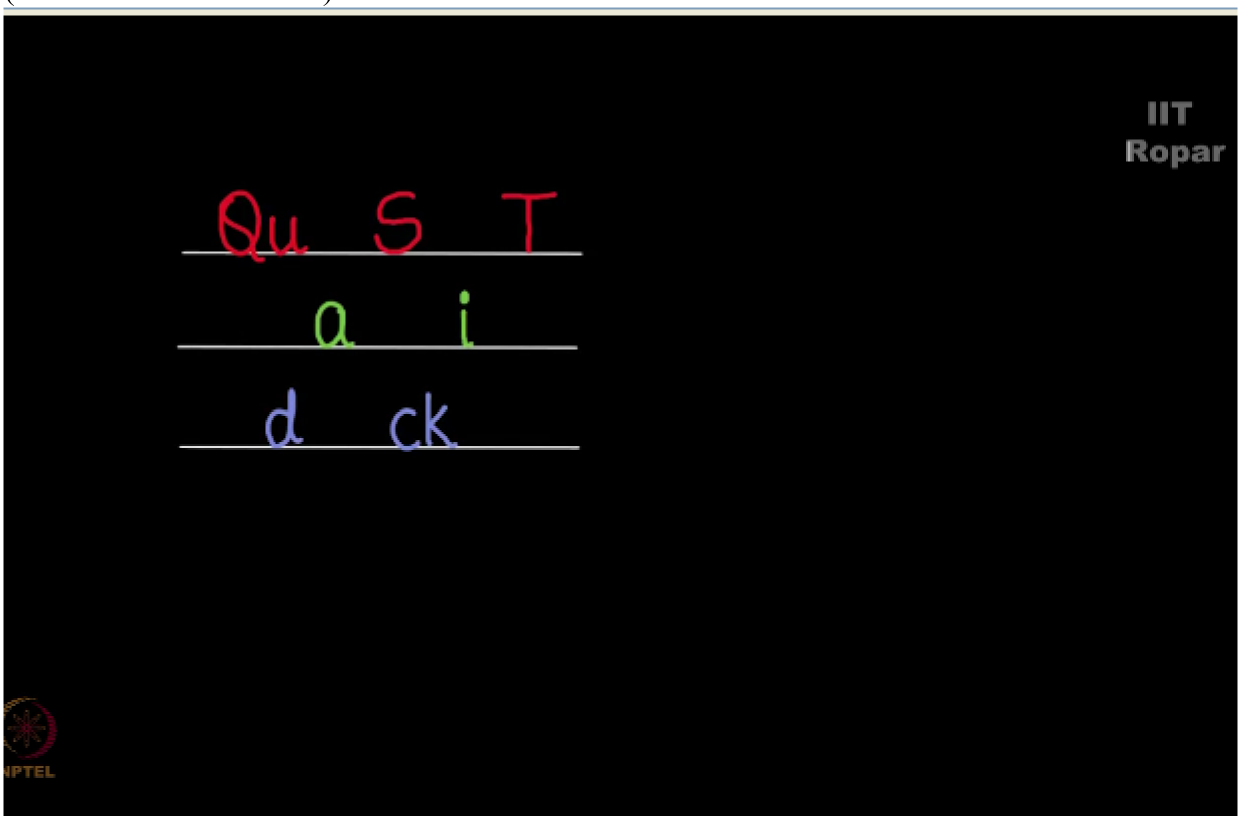

if you didn't still good enough that you tried, so let me now try to help you in understanding the connection.

Look at this, how do we create a word out of these 3 lines, I pick a QU, and A, and D, or I might pick S and I and D here, right, so let me just write down X into X + X + X which denotes the first line, you will soon understand what I am doing,
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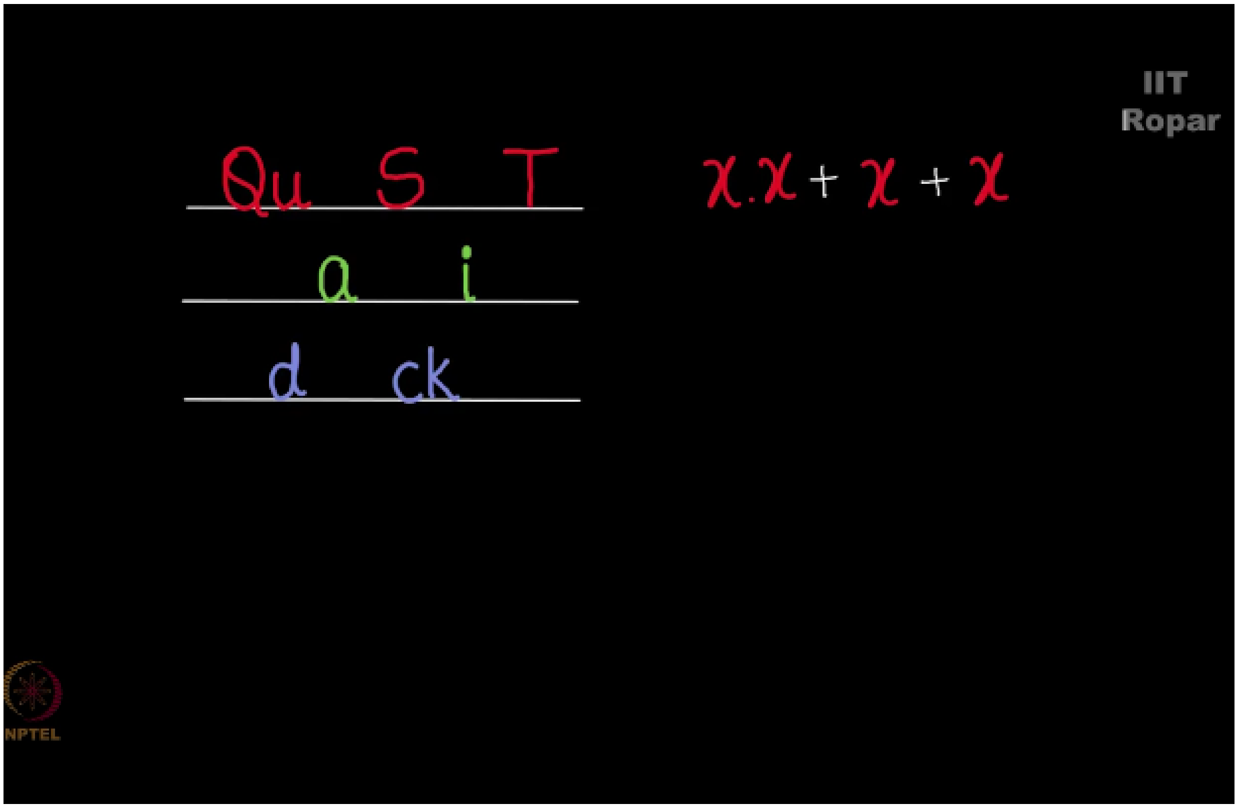

and then the second line is all letter here A, another letter I here, so it's X and X, times the last line will be D and a CK which is X + X into X, so now when I expand this I get 4X cube + 6 into X to the 4 + 2 into X to 5, now look at X cube,

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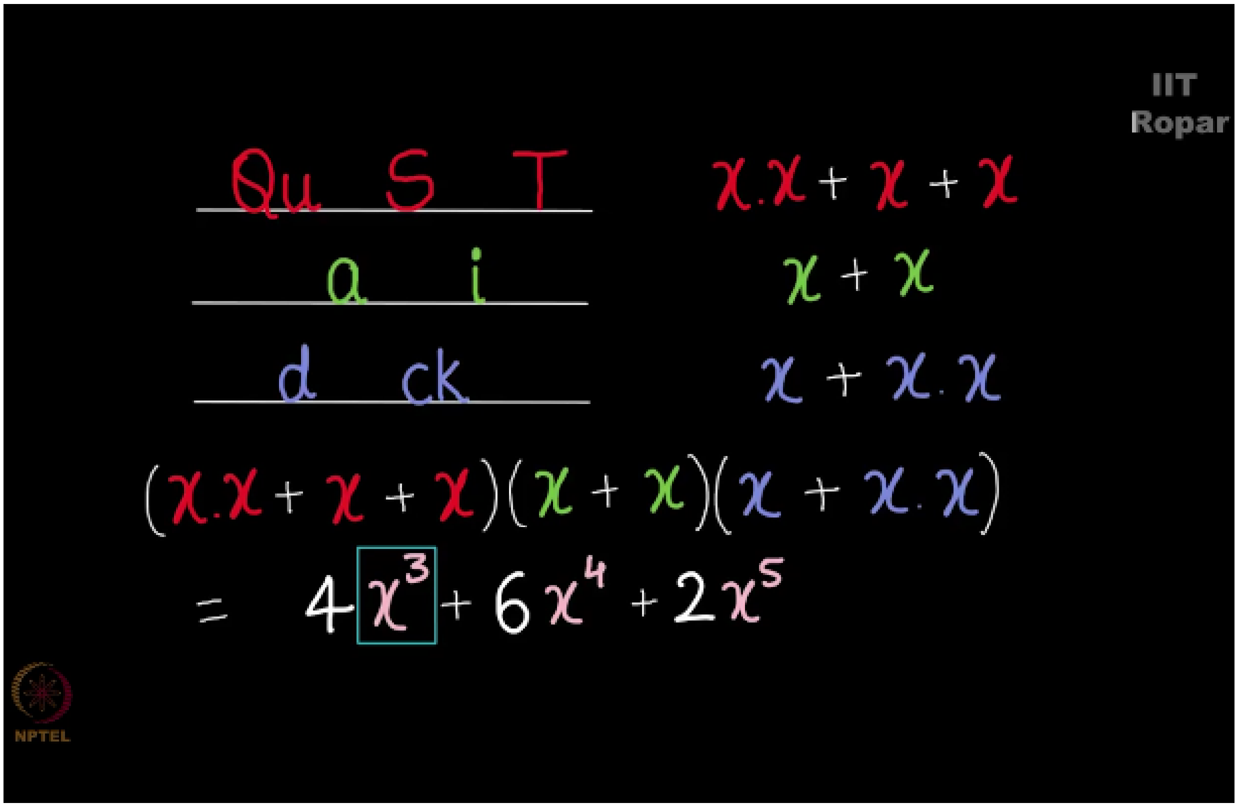

how do you get X cube by multiplying this polynomial, by picking 1X from the first house, another X from the second house, another X from the third house, right, there is no other way to get a X cube here, if you end up picking X and X in the first house, rather X square you cannot get a X cube, you will be forced to pick one element in the second house and one element in the third house that is one polynomials get multiplied and you get X cube, or I'm trying to ask here is how do you get an X cube in the expansion of this polynomial, you are forced to take an X from individual houses, now doesn't that correlate with you picking S and A, and D or T and I and D, think about it, correct.

So if you observe with a keen eye you will observe that we will see that the way you get X cube by this polynomial multiplication and the total number of ways in which you can do it is precisely the same as the number of ways in which you can form a 3 lettered word here, right, that is how you made a sad, sid, tad and tid here, there is a corresponding way of making an X cube from this polynomial, similarly you look at the coefficient of X to the 4 it happens to be 6, you look at the total number of ways in which you can have a 4 lettered word it happens to be 6 in number, that is because the number of ways in which you can make a 4 lettered word here QU from here A and D, QU from here I and D, SACK, SICK, TACK, and TICK is precisely the number of ways in which you can get an X to the power of 4 in the expansion of this polynomial, so, so, so think about it if you want to count the total number of ways in which you can have a K lettered word here simply write the corresponding polynomial very carefully that is and then ask this question what is the coefficient of X to the K,
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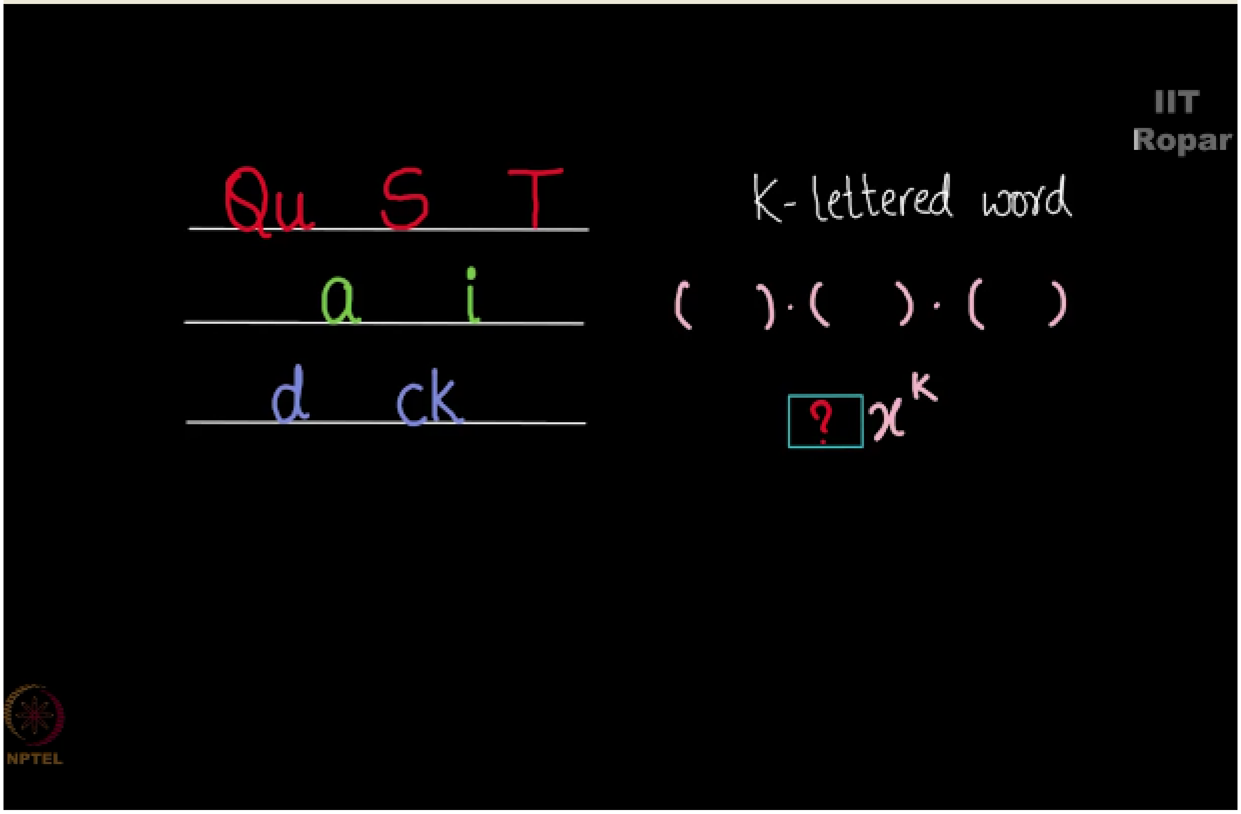
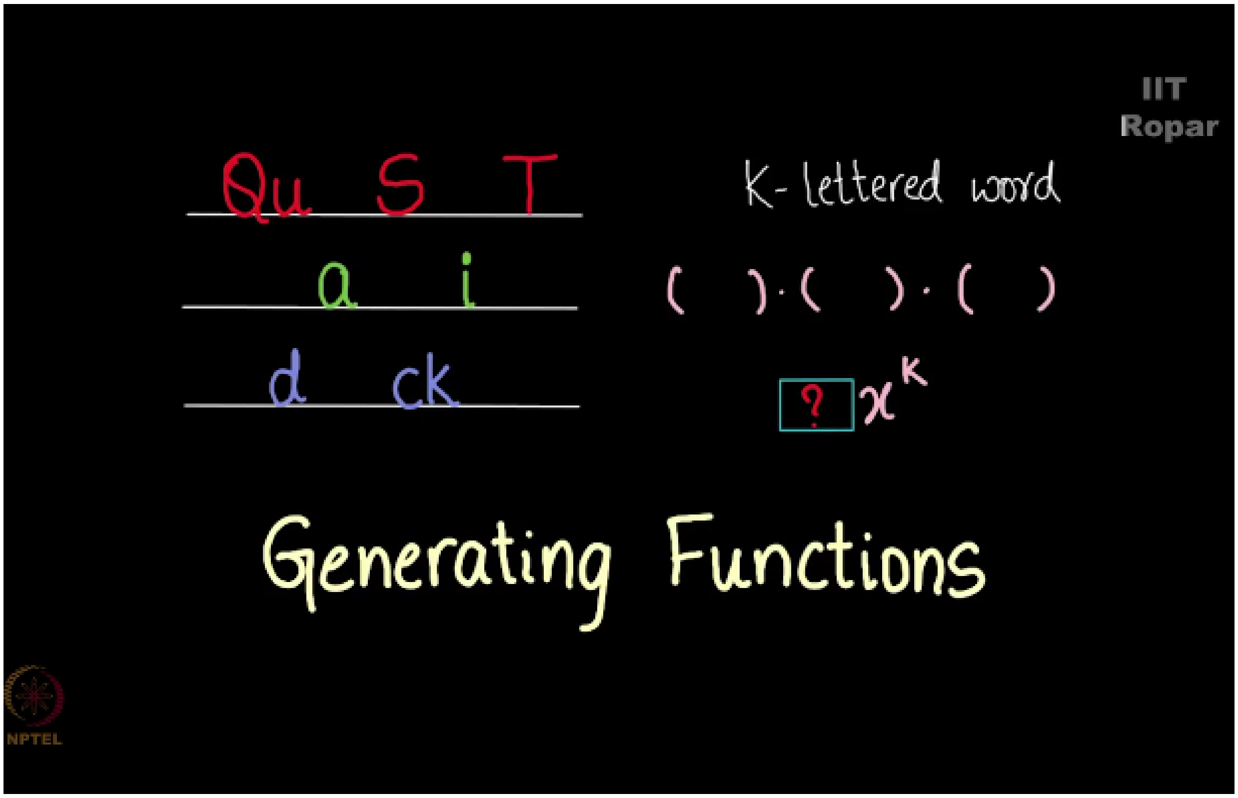


think about it, write this down, let this work in your mind, you will clearly see a connection between this problem and the problem of polynomials.

The entire chapter is going to be this very, very novel and very counter intuitive way of counting by using polynomials, what has polynomials to do with counting? The way we multiplied 2 mop polynomials is the way in which we count in some circumstances, so this chapter by name generating functions will be full of such examples.



Did you see the beautiful interplay between accounting question and the notion of polynomial multiplication, sounds like we are using a very heavy duty tool to achieve something very straightforward, that's not true, you will see the power of using polynomials in counting in different aspects of discrete maths, we'll see more of these examples in the rest of the chapter.

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