NPTEL

NPTEL ONLINE CERTIFICATION COURSE

Discrete Mathematics
Graph Theory – 3 &
Generating Functions

Generating functions - Problem 3

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Consider this set S = A, B, C, so we have 3 elements in the set S,
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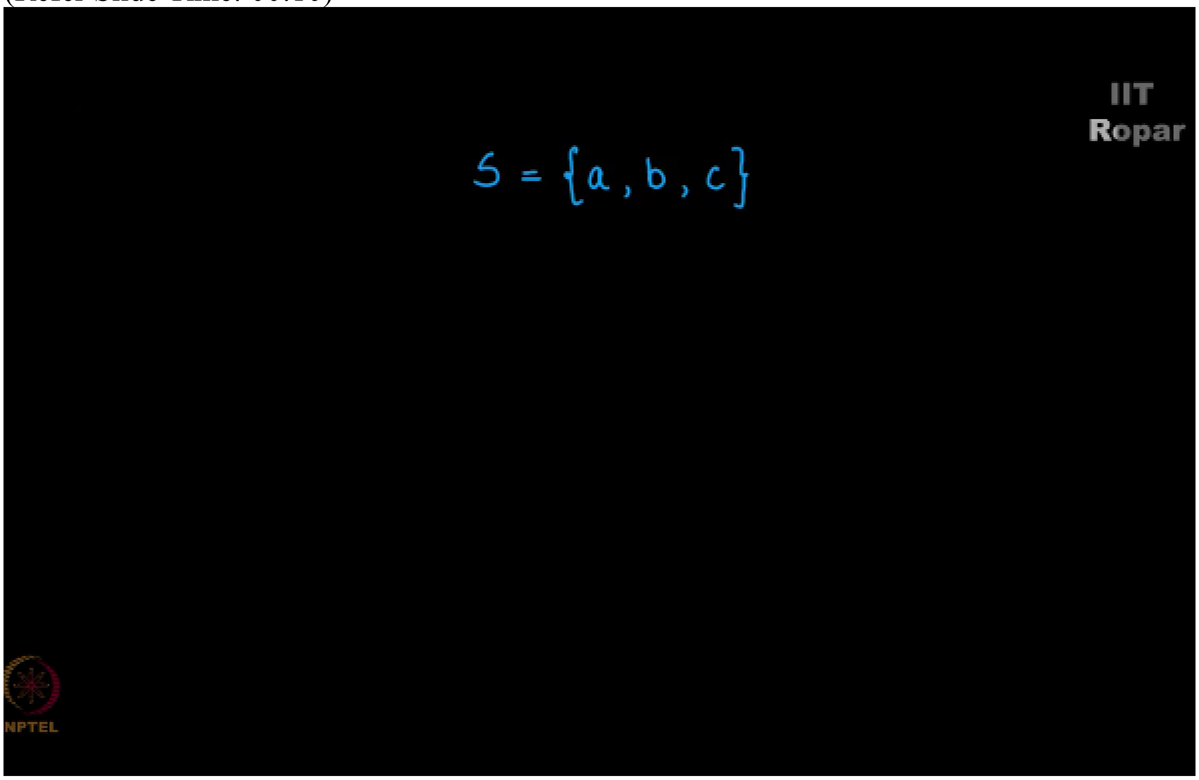

now consider this function F(x) as (1+AX) (1+BX) (1+CX), so the product of these three expressions (1+AX) (1+BX) (1+CX) is my function F(x),
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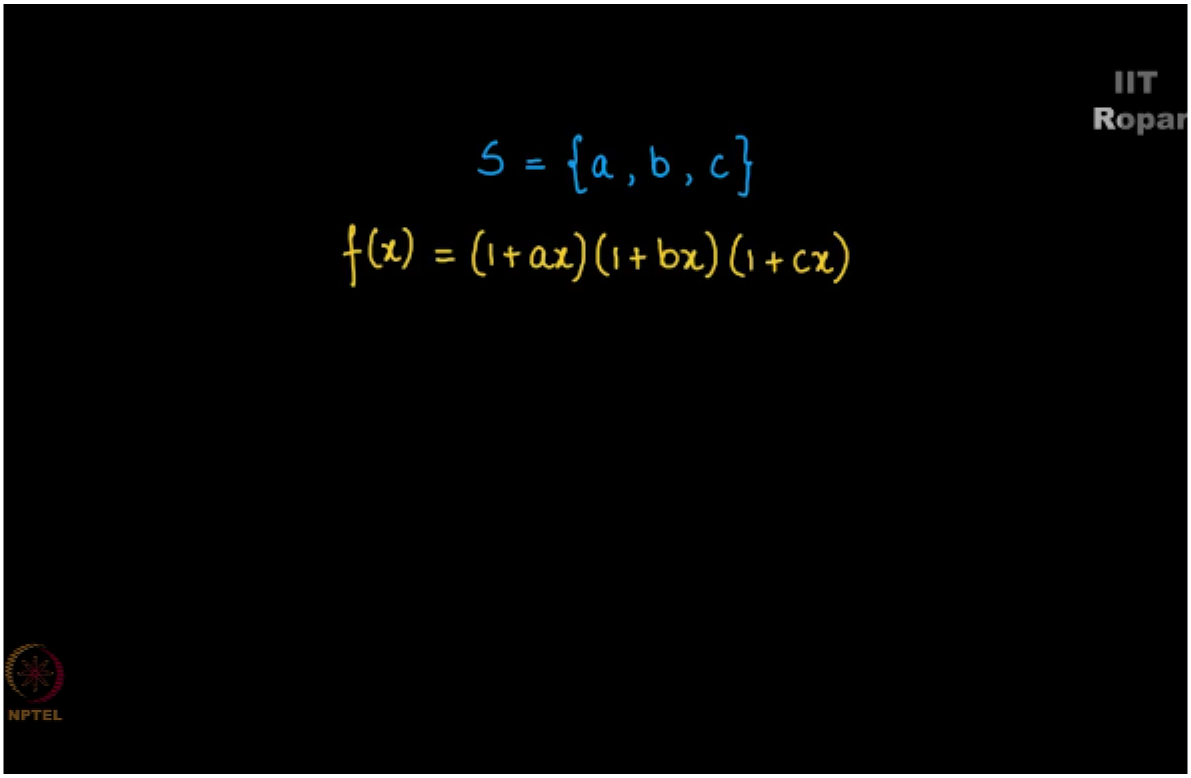

now what is the product of these polynomials? It is going to be 1+AX+BX+CX+ABX square + ACX square + BCX square +ABCX cube, on simplification this becomes 1+A+B+C into X square + AB + AC + BC into X square + ABCX cube,

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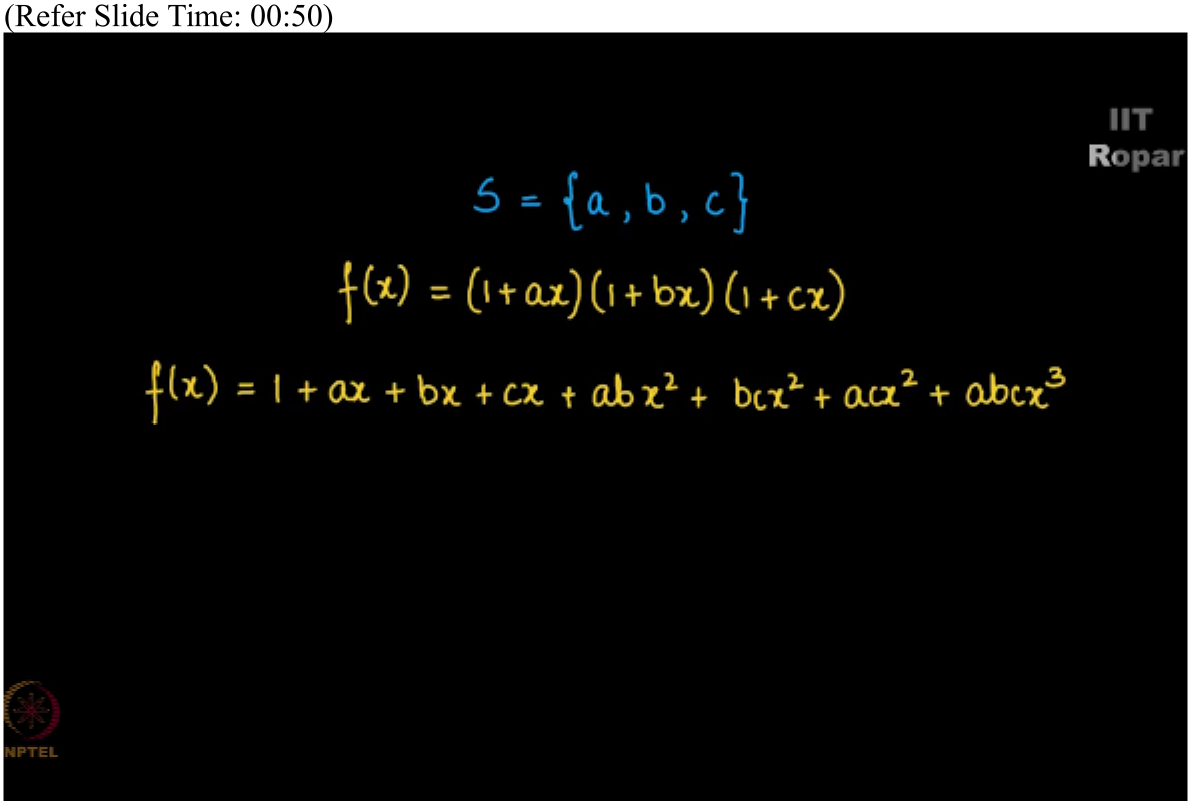

on simplification we get it as 1+ I take out X common A+B+C into X+ X square I take out common AB + AC + BC into X square + ABCX cube, now do you see that 1 is actually X to the 0 here, right,

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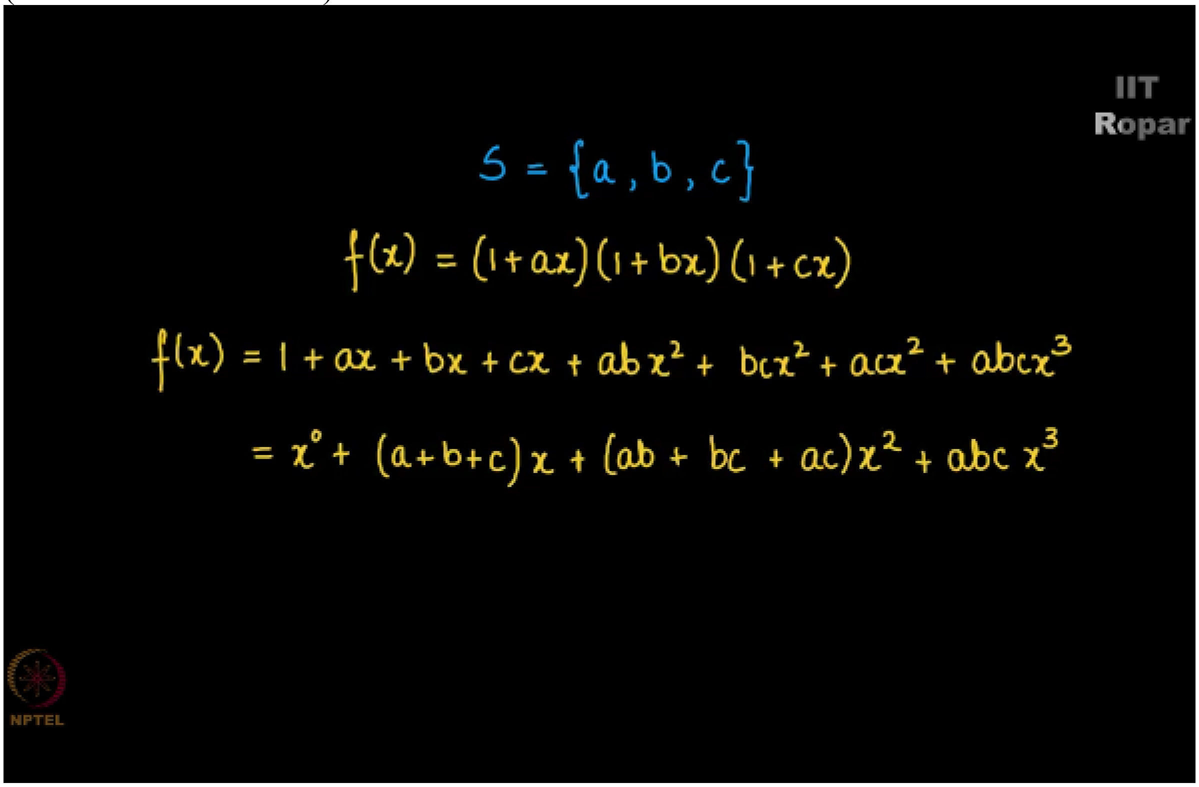

so we have X to the 0 + A+B+C into X + AB + AC + BC into X square +ABCX cube, now keep this aside for a while, we have the set S as ABC, I'm going to consider all the subsets of ABC, I'm going to take the power set of S that S, what are the elements in the power set of S? I have singleton A, singleton B, singleton C, A,B, A,C and B,C and the last one as ABC, I have missed out one that is the empty set.

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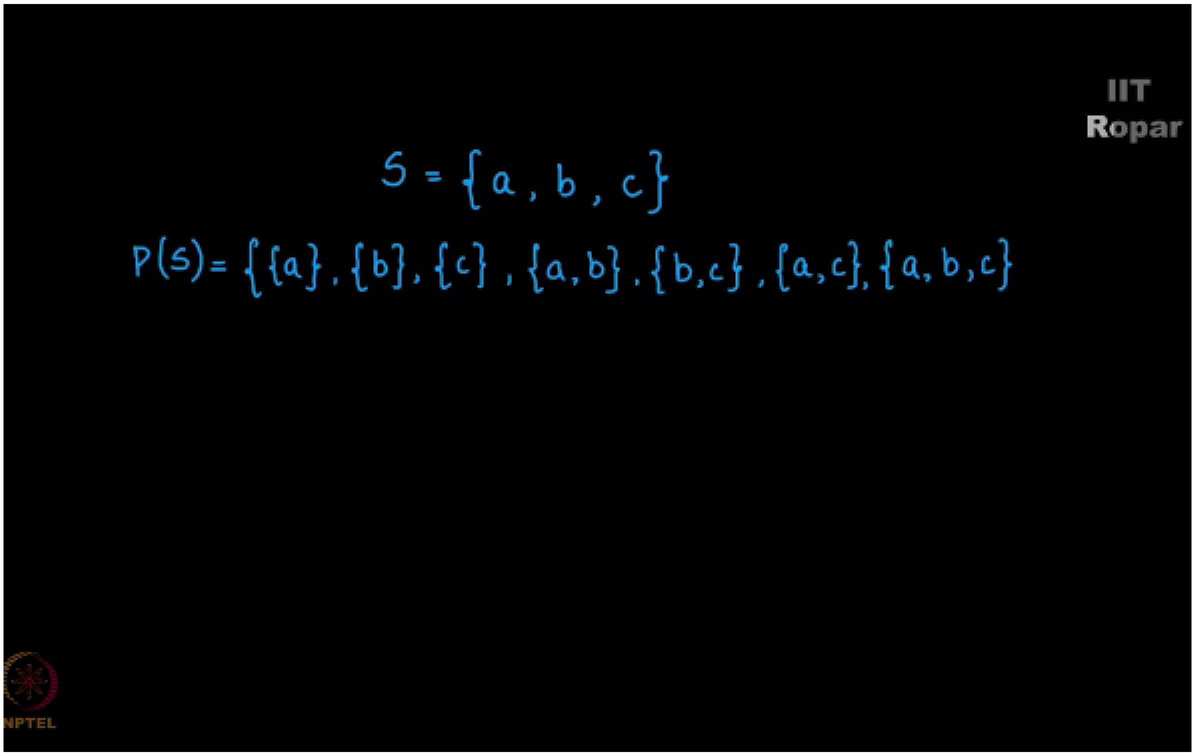

So these are the elements in my power set, I'm going to take the polynomial pack now, I have the function, the coefficient of X to the 0 is 1, do you see that? Now observe the beautiful representation or the relation between the coefficients and the power set, the coefficient of X to the 0 is 1, it represents the subset phi of S, you have only 1 phi as a subset of S.

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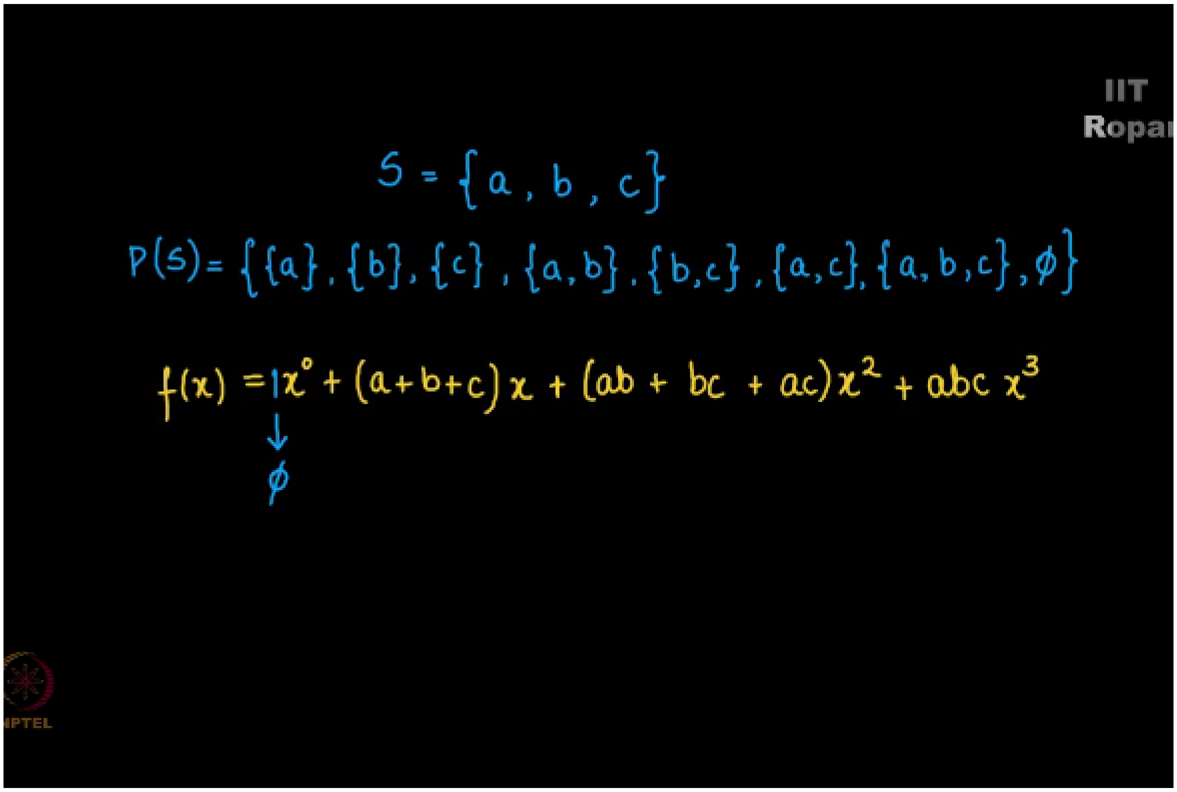

Now the coefficient of X to the 1 or X is A+B+C that represents the singleton A, singleton B and singleton C, these 3 subsets of S, and a coefficient of X square is AB + BC + AC, now this represent the sets A,B, A,C and B,C, and the last one the coefficient of X cube is ABC, now this represents the set A, B, C, did you observe the beautiful relation between the coefficients of the function and the subsets of the set S,

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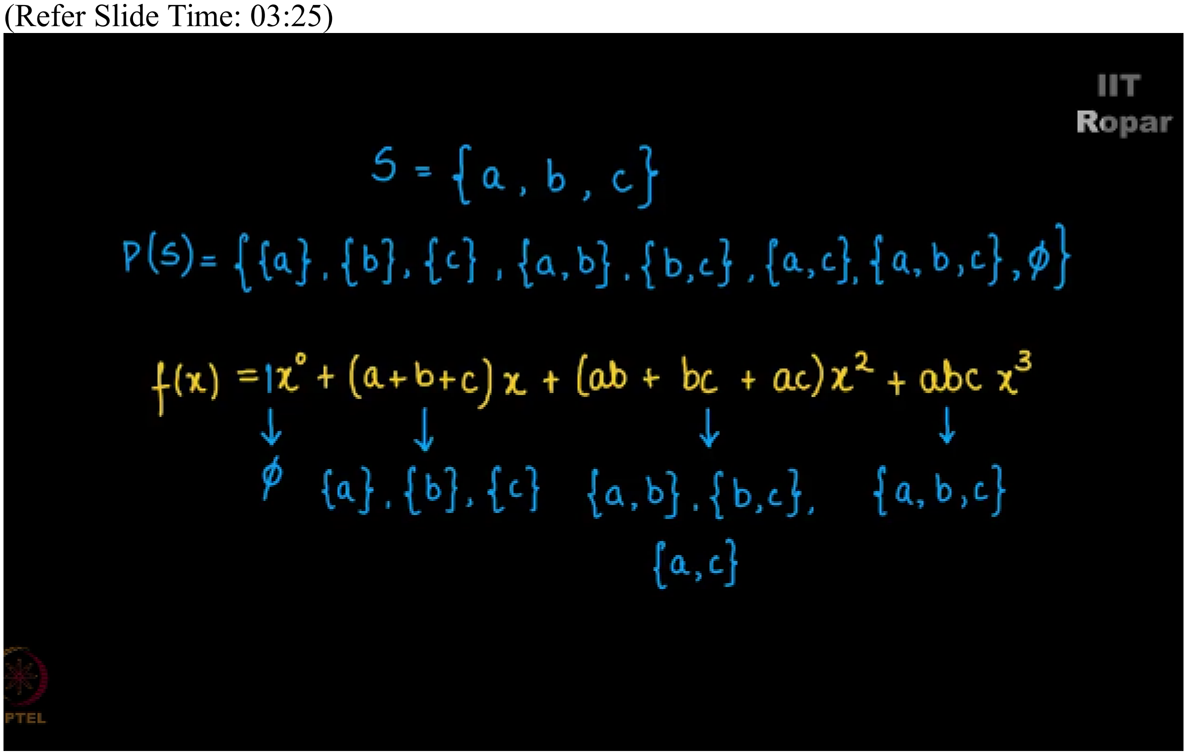

well the generating function for the subsets of S is given by F(x) = the product of (1+AX) (1+BX) (1+CX) where these elements ABC are the elements of the set S.

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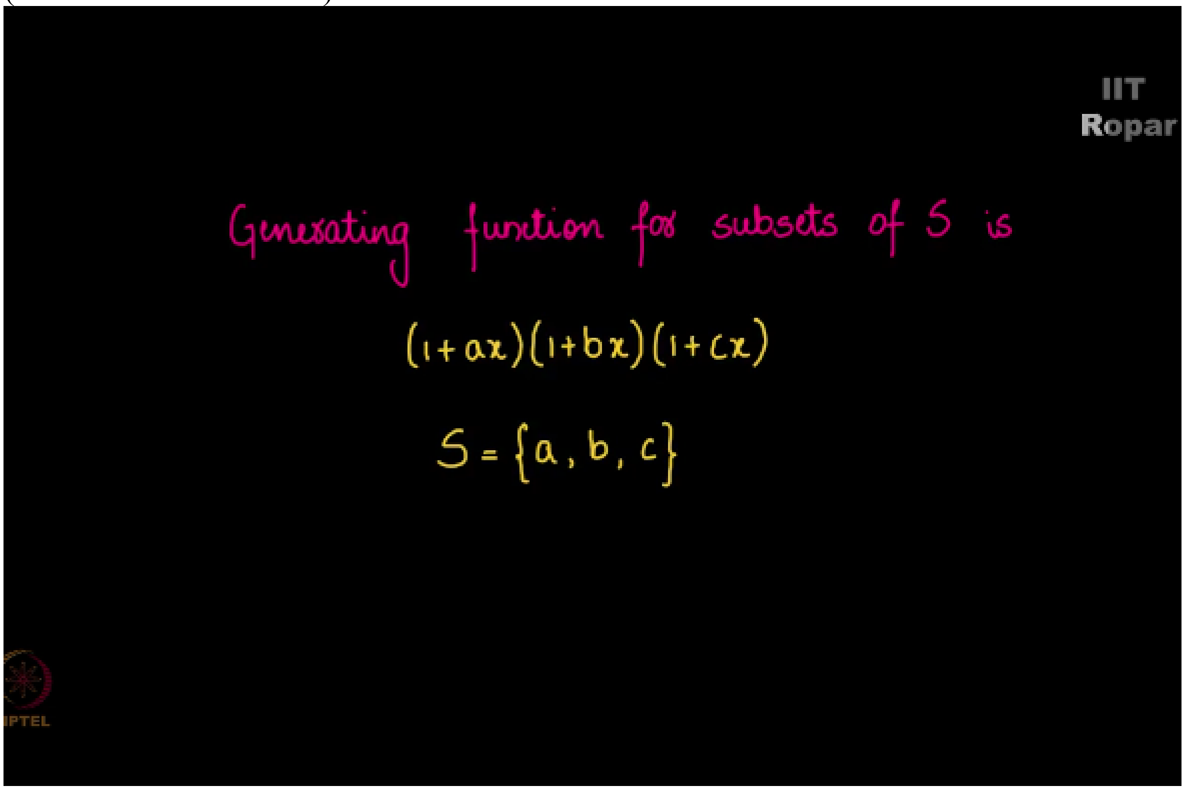

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