Theory of Yarn Structure
Prof. Dipayan Das
Department of Textile Technology
Indian Institute of Technology - Delhi

Lecture – 15
Mass Irregularity of Yarns (contd.,)

Welcome to you all to these MOOCS online video theory of Yarns structure in the last 3 lectures we were discussing about mass irregularity of yarns though we majority spoke about slivers however the basic concepts of marginal theories as well as bundles theories are also valid for yarns so the same expressions we can use for mass irregularity of yarns also now we will discuss about some numerical problems based on what we learned so far in this model. So, we start with our first numerical problem 1.

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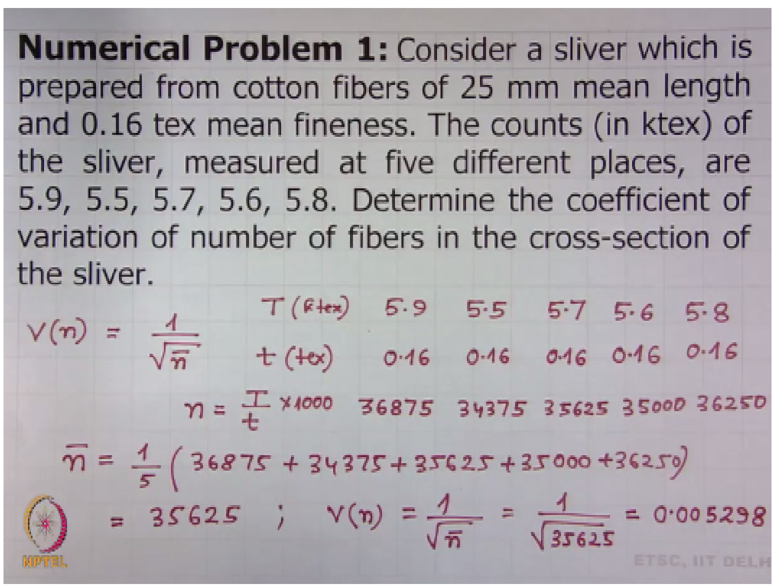

So, consider a sliver which is prepared from cotton fibers of 25 millimeter mean link and 0.16 tex mean fineness. The counts (in ktex) of the sliver measured at 5 different places are 5.9, 5.5, 5.7, 5.6 and 5.8. Determine the coefficient of variation of number of fibers in the cross-section of the sliver. Coefficient of variation of number of fibers in the cross-section of this sliver so if you study module 5.

Then you will realize at 1 point of time we have derived that coefficient of variation of fiber number = under poisson distribution this so we need to basically find out n bar and then square root so what are the data given T kilo tex 5.9, 5.5, 5.7, 5.6, 5.8 and we need to find and we need to see fiber fineness is also given 0.16 and same for all 5 readings then we need to find out number t *1000.

So, 5.9 ktex means 5900 tex/0.16 this will give you this number then 5500/0.16 will give you 34375 then 5700/0.16 will give you then 5600/0.16 will give you very nice number 35000 last 1 5800/0.16 will give you this so 5 readings of number we can find out average this will be equal to 35625 so this is the average number of fiber present in the cross – section of the sliver then vn = 1/ square root of this will give you 8.

So, this is the answer if you wish to express it in terms of % then 0.5298% so the coefficient of variation of number of fibers in the cross-section of sliver = 0.5298 percent so this was your numerical problem 1 and solution now we proceed to numerical problem 2 so this is your numerical problem 2.

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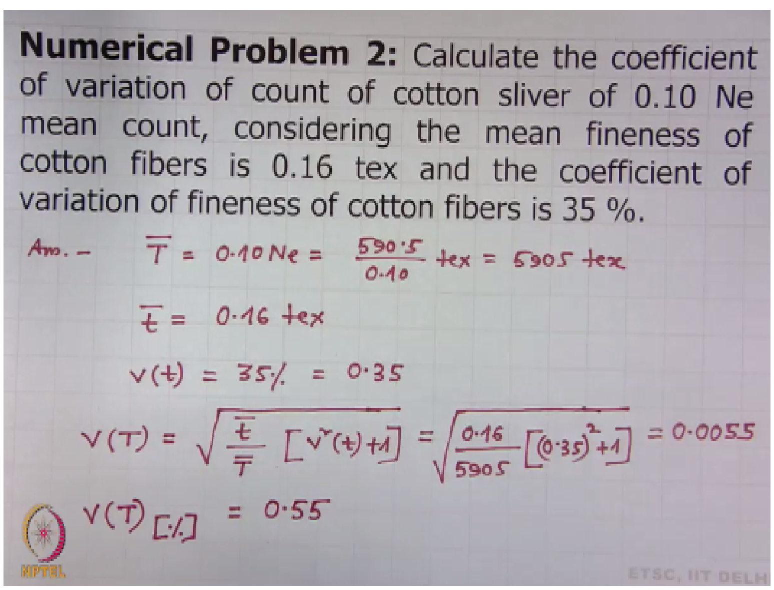

Calculate the co-efficient of variation of count of cotton sliver of 0.10 Ne mean count so 5.905 kilo texs and fiber mean fiber fineness is given tex coefficient of variation of fineness of fiber is also given in terms of dimension less it is 0.35 now you are asked to calculate the coefficient of variation of count of cotton sliver so martindales formula so this formula if you substitute the data it will give you the required value right.

So, this will lead to dimension less if you wish to express in terms of %55 right so this is the required answer the coefficient of variation of count of flavor is 0.55% now we will go to problem number 3.

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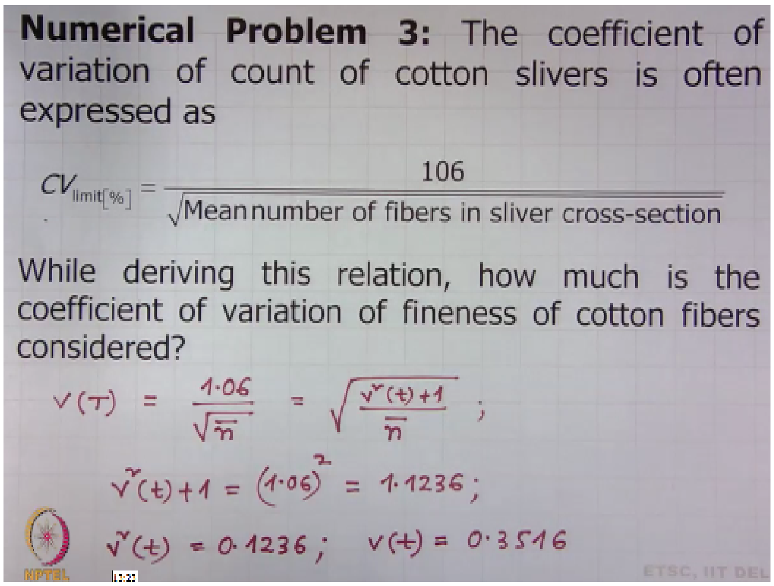

The Coefficient of variation of count of cotton slivers is often expressed as CV limit = 106 root /N bar this expression is often found in textile literature while deriving this relation how much is the coefficient of variation of fineness of cotton fiber considered so you are asked to calculate coefficient of variation of fineness of cotton fiber if this is the expression for coefficient of variation of count of cotton fiber.

So, we rewrite this expression in our symbols VT = dimension less given write the formula used to calculate this was this so if we equate we have to find out the small t so square so 0.3516 so you see that this particular expression is valid for cotton sliver and when coefficient of variation of fiber fineness is 35.16% but often we think that this expression is valid for all cotton fibers irrespective of the variety of cotton fibers used to produce those flavors which is not correct.

So, this expression is true if this is the CV of fiber fineness changes of course this value will not be 106 instead of 106 it can be some other value however there is a tendency among us to use this expression for all cotton flavors or all cotton yarns which is not correct so you have to 1st find out reality in practice you have to 1st find out the coefficient of variation of fiber fineness then you have to use martindales expression then you have to find out CV limit.

Similarly there is another problem associated with wool fiber based on that problem number 4 is designed.

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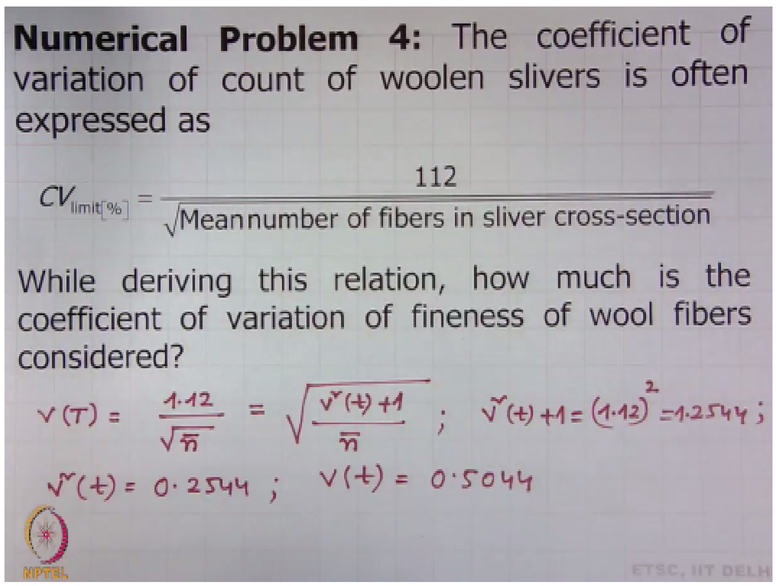

The coefficient of variation of count of woolen slivers or woolen yarn also is often expressed as CV limit 112 root of bar n bar in case of yarn it will be yarn cross section right then you are asked to find out the fineness of wool fibers so we write this expression using our symbols right square which is = 2544 then 0.5044 so also we have observed that this expression is frequently used for all woolen flavor which is not correct.

Because this expression is valid only when wool fiber has a mass CV of around 50% if this number changes then this number will change so what we have to do in practice when you need to find out the limit CV of woolen slab or woolen yarn you have to first find out the fineness of CV of fineness of wool fiber then you have to use martindales formula then you have to find out the correct quantity here. Right in this way you need to do in reality now we can come to problem number 5.

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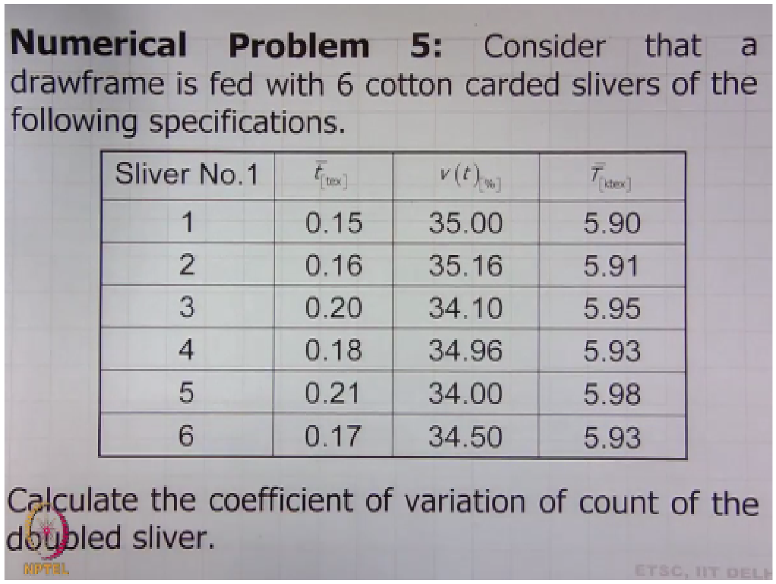

It is quite long problem consider that a draw firm is fed with 6 cotton carded sliver of the following specifications sliver number 1 mean fiber fineness 0.15takes sliver finest fiber fineness 35% and mean sliver fineness is 5.90 kilo tex 2 nd slabber is different from 1 st mean fiber fineness 0.16 tex CV of fiber fineness 35.16 percent and mean sliver fineness 5.91 takes 3 rd slabber is different from 1 and 2 mean fiber fineness 0.20 tex.

CV of fiber fineness is 34.10 percent and means fiber fineness 5.95 to x similarly all other slabbers are different so these 6 different flavors are fed in it often and as a result we double it we obtained 1slabber double slabber you need to find out the CV of count of the double flavor right so how do you find out this problem so let us solve this problem. What we have to do is that we have to find out the variance of the double sliver.

Mean of the double sliver and from their CV but before that we have to use Martindales formula find out the CV of individual slivers is not so let us do that.

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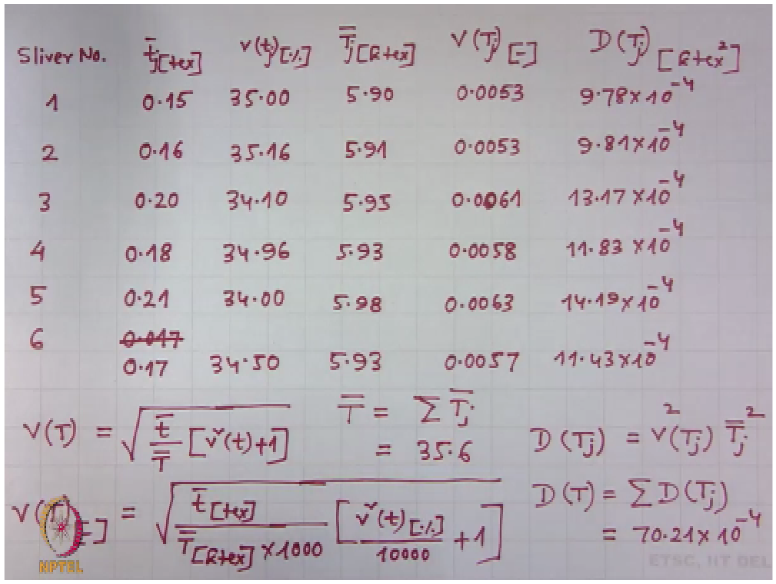

Sliver No.	$\bar{t}_j$ [tex]	$v(t)$ [%]	$\bar{T}_j$ [ktex]	$V(T_j)$ [-]	$D(T_j)$ [ktex^2]
1	0.15	35.00	5.90	0.0053	9.78×10^{-4}
2	0.16	35.16	5.91	0.0053	9.81×10^{-4}
3	0.20	34.10	5.95	0.0061	13.17×10^{-4}
4	0.18	34.96	5.93	0.0058	11.83×10^{-4}
5	0.21	34.00	5.98	0.0063	14.19×10^{-4}
6	~~0.047~~ 0.17	34.50	5.93	0.0057	11.43×10^{-4}

$V(T) = \sqrt{\frac{\bar{t}}{\bar{T}}\left[v^2(t)+1\right]}$ $\quad \bar{T} = \sum \bar{T}_j = 35.6$ $\quad D(T_j) = V^2(T_j)\,\bar{T}_j^2$

$V(T)[-] = \sqrt{\frac{\bar{t}\,[tex]}{\bar{T}\,[ktex] \times 1000}\left[\frac{v^2(t)\,[\%]}{10000}+1\right]}$ $\quad D(T) = \sum D(T_j) = 70.21 \times 10^{-4}$

Now sliver number this was given this was given this was given 1 2 3 4 5 6 sorry so we have to 1 st find out this dimension less using martindales formula what is martindales formula right so using this formula t bar is given 0.15 capital T bar is given 5.90 kilo tex you have to convert in to index that is multiplied by a 1000 and VT is given in % so dimension it will be 0.35 square + 1 so this value will obtained as 53 let me write it in terms of unit.

This is dimension less this is in tex given and this is kilo tex given so you have to multiply by 1000 then V square t in % given so root square quantity right abra square +1 so the 1 st reading I will tell you .15/5.90 * 1000 * 35 square /10000+1 this will lead to .0053 similarly for the next 1 roughly same reading 0061 then you will get 0058 then you will get 0063 and the last 1 you will get this so this is the individual you will get then you have to find out the variance.

So, from this table you will find out the variance precisely now how to find out variance square so for the first 1 square up 0.0053*5900 5.90 square its unit will be kilo tex square so this reading you will see you will get this value for the second flavor 0.0053 square multiplied by 5.91 square this will give you little different for the 3 rd 1 0.0061 square multiplied by 5.95 square.

You will get this value for the 4 th 1 0.0058 square multiplied by 5.93 square which will lead to for the 5 th 1 0.0063 square * 5.98 square for the 6th the last 1 0.0057 square * 5.93 square this then what you have to do you have to basically sum all this so if you sum of all these readings all the 6 readings what you will get is 70.21* 10 to the power - 4 kilo tex square and also you have to sum the means fiber fineness.

This will give you 30.5, 35.6 kilo tex so you know variance you know mean you will be able to find out CV how you will find out CV. Let us go to next page.

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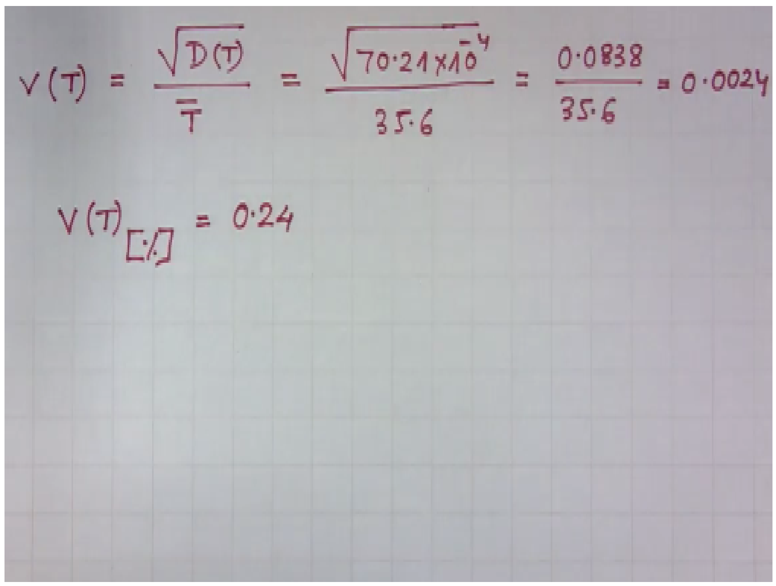

So, double sliver / this so this is your 70.21* 10 to the power – 4and t bar is here 35.6 okay so you will see this will probably come this so 0.0024 so in terms of % if you wish to write 0.24 what is interesting you see not a single individual sliver has < 0.0024 so all individual sliver had a higher mass irregularity because of doubling the CV becomes 0.0024 which si why doubling is cut out right. So, this was the solution of problem number 5. Now we proceed to problem number 6.

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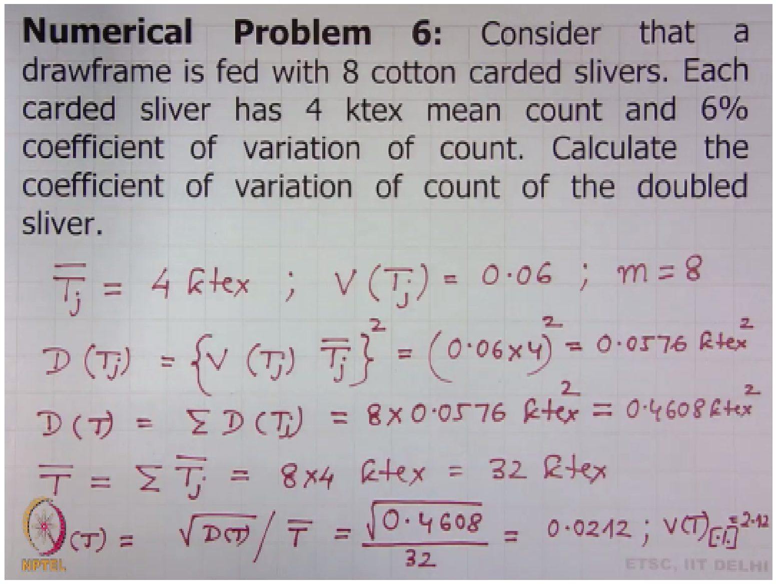

Consider that a draw fame is fed with 8 cotton carded slivers each carded sliver has 4 kilo tex mean count and 6% coefficient of variation of bound so what is given here is 4 kilo tex and is given doubling is 8 okay so what will be the variance of individual 1 this will be the unit kilo tex square and right what will be the summation of all variance is basically which is = 0. Square and what is the finest of double slaver 32 ktex.

So, you know variance you know mean you have to find out CV this will give you 0.0212 if you wish to express in terms of % 2.12 percent so the coefficient of variation of count of double sliver is 2.12 percent so this was your problem number 6 now we proceed to problem number 7.

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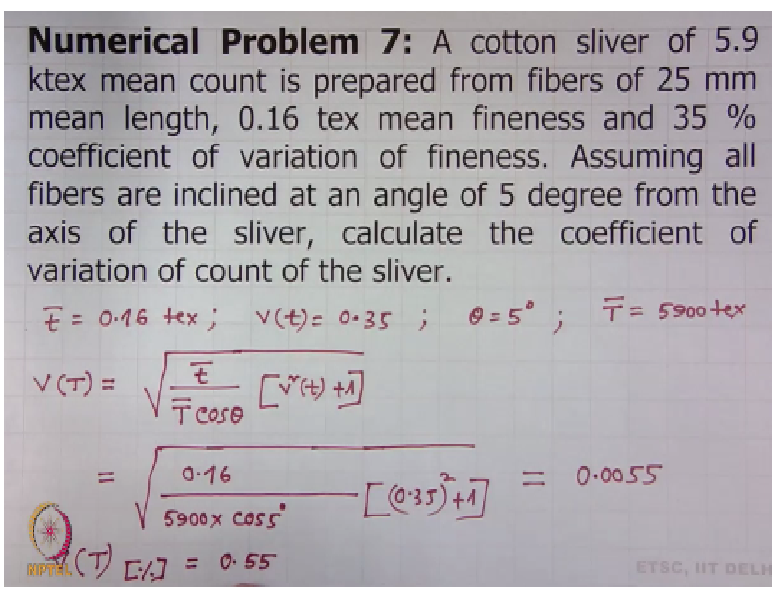

A cotton sliver of 5.9 kilo tex mean count is prepared from fibers of 25 millimeter length 0.16 tex mean fineness and 35% CV of fiber fineness so let us see what is given this is given tex this is also given as I mean all fibers are inclined at an angle of 5 degree from the axis of the sliver calculate the coefficient of the count of the sliver so you remember the theory when theory of CV of sliver fineness when all fibers are inclined.

At a same angle from the axis if the sliver we derive this relation VT = small t bar by capital T bar cos theta v square t+1 this theory we have derived so if you substitute T/ is also given tex so of you substitute capital T /0.16 5900 cos 5 degree 0.35 square + 1 this you will see value will come up approximately = 0.0055 so if you wish to express in terms of % 0.55. This problem seems to be very similar to the problem number 2 except the fact that the angle is 5 degree.

In problem number 2 angle is 0 degree we found this value when the angle is 5 degree we found the value remains the same instead of 5 degree this value would have been little higher 15 degree 20 degree then this value would have been higher as the angle is very small near to 0 sp it is impact on the mass CV of the sliver is not seen however if the angle will be higher than this value will be higher will be different from 0.55. So, problem number 7 is completed now we proceed to problem number 8. This is problem number 8.

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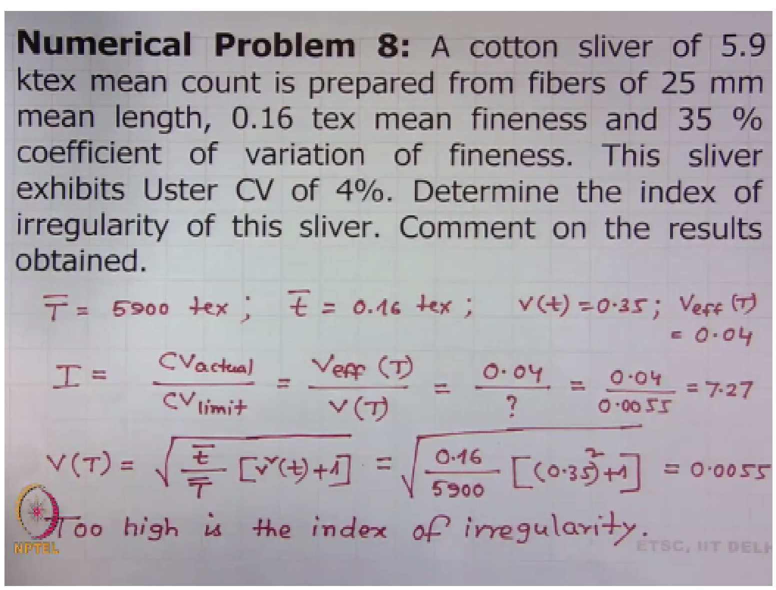

A cotton sliver of 5.9 kilo tex mean count is prepared from fibers of 25 millimeter mean length 0.16 tex mean fineness and 35% coefficient of variation of fineness these sliver exhibits uster CV of 4%. Determine the index of irregularity of this sliver comment on the results obtained. So, this is your problem number 8 let us see what is given so capital T bar is given tex small t bar is required tex Vt is given and actual is given you have to find out index of irregularity alright.

Index of irregularity actual/ limit in terms of our symbol by limit so this value is given this value is not given so you have to find out this value using martin dales model right this is given 0.16 this is given 5900 this value is given squared this value is given so this will be = we have already solved this problem 0.0055 so if we substitute 0.04/0.0055 which will be = 7.27 it should have been near to 1 if martindales theory was correct.

But it is becoming 7.272 high index of irregularity that is the comment right let us apply 40.46 and we would like to find out this value using bonnets expression and also index of irregularity using bornets expression and you would like to see if using bonnets empirical correction index of variability will be less than this or what so let us continue.

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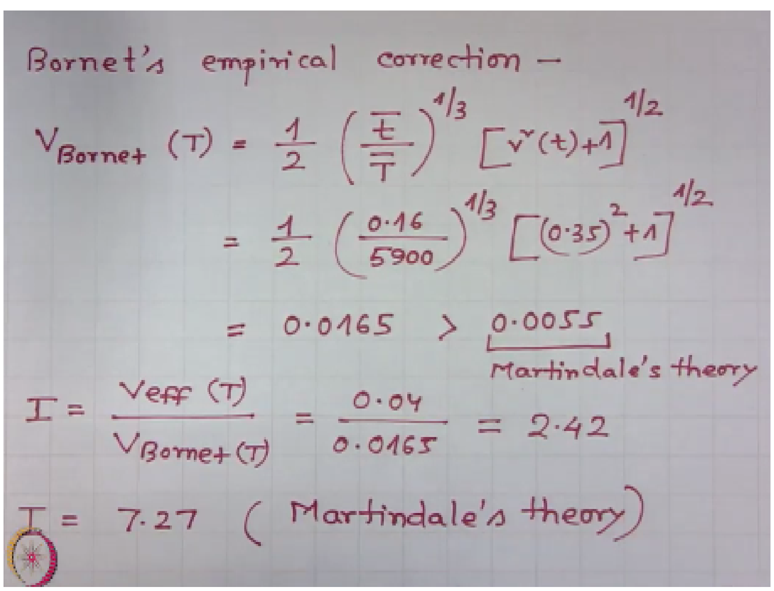

Bornets empirical correction so what was bonnet 1/ 2 t bar / T bar 1/3 t+1 to the power ½ this was the expression given by bonnet so we use the data given in the problem T bar 0.16 and 5.9 kilo tex so 5900 tex and 0.35+ 1 to the power ½ so this value you will get 0.0165 see limit irregularity is > 0.0055 this came from martindales theory right now index of irregularity V effective / bornet show these value 0.04 0.165 so what will be this value 2.42.

And what was the value using martindales 7.27 so index of irregularity is remarkably less we found using bornets theory 2.42 and here it is 7.27 right so this was the solution of problem number 8 now we proceed to problem number 9.

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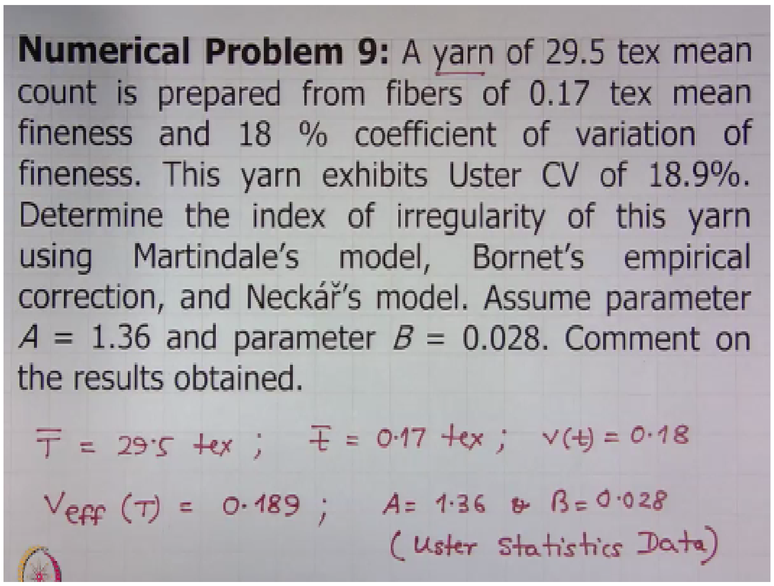

A yarn of 29.5 tex mean count is prepared from fibers of 0.17 tex mean fineness and 18% coefficient of variation of fineness so what is given here is T bar 29.5 tex t bar 0. this Vt 0.18 and also 9 actual measurement measured CV of yarn is given as I told you earlier all the expressions what we found for sliver they are also valid for yarn so practice Martindales formula, Bornets formula, bundle theory formula are applied in case of yarn also.

So, we will use those formulas for yarn as well and 2 parameters are given A from this and B from this these parameters are obtained from uster statistics data these 2 parameters were obtained based on uster statistics data so here actually we have to compare these 3 theories martindales model bornets empirical collection and Neckars model so these 3 theories what we have learned so far will be compared in this numerical problem so let us do that 1 by 1. First let us find out Martindale.

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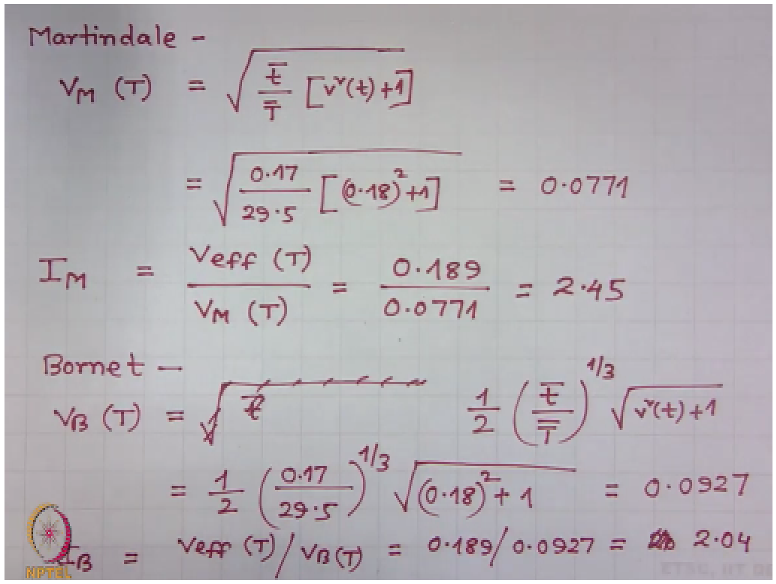

Martindales formula as we know right so fiber fineness is 0.17 tex and yarn fineness 29.5 tex and your CV was 0.18+1 okay so this will lead to 0.0771 then index of irregularity using Martindale 2.45 significantly higher than 1 okay let us use Bornet's expression Bornet's VBT B stands for Bornet and M stands for Martindales which was not 1/2 t bar by this to the power 1/3 * V square t +1.

That was Bornets right sure 1/2 what is T bar 0.17 and this 29.3 to the power 1/3 squared +1 so this will lead to 0.0927 then index of irregularity using bornet V effective by V bornet there is equal to 0.189/0.0927 which = 2.04 this value is less than this value so the Bornets idea of clusters forming sliver is probably correct now we have to use neckars model bundle theory.

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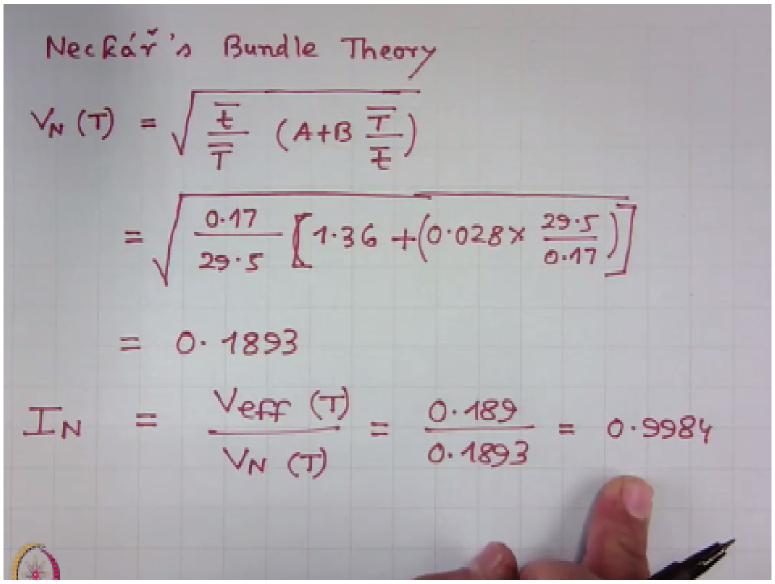

So, what was this bundle theory data so it has right VN T you remember t bar by this A+B that was the formula so what is T bar given this by this and what is the value of A given 1.36+ B is 0.028 * 29.5/0.17 right so this will lead to 0.1893 and then index of irregularity using Neckars theory by this so 0.189, 0.1893 close to 1 right. So if we compare this

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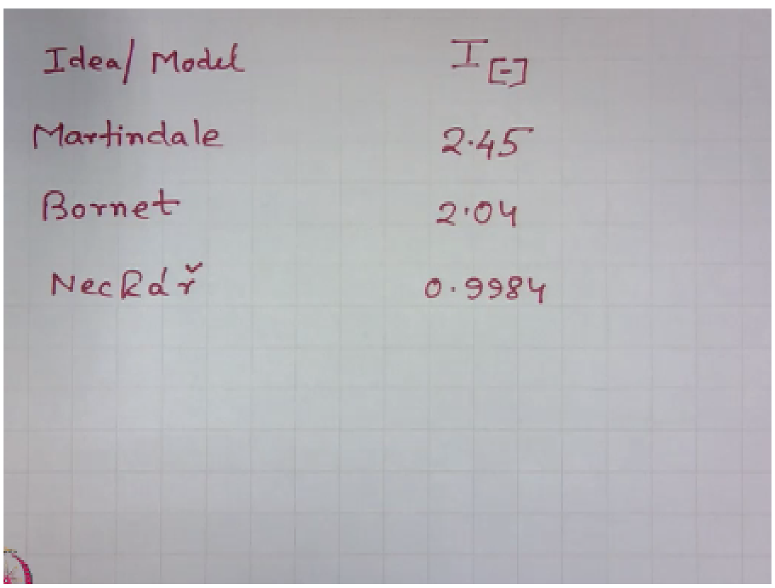

Idea or model and index of irregularity I and I means – Martindales Bornets idea and Neckars model so Martindale it was 2.45 this was 2.04 and this was 4 so what we see is that this index of irregularity is list in case of neckars bundle theory and highest in case of Martindale's theory so probably these Neckars theory is quite well so problem number 9 is over now we proceed to last problem number 10.

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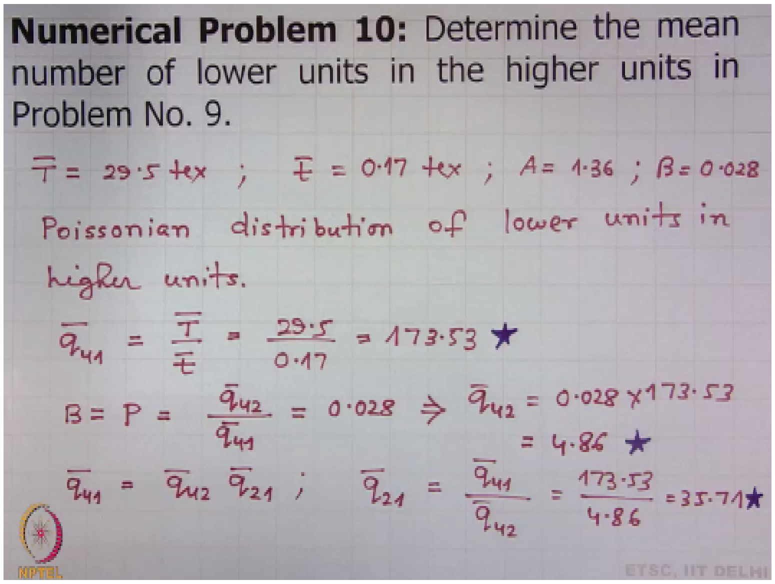

Determine the mean number of lower units in the higher units in problem number 9 so it is a continuation of problem number 9 so let us see what is given this was given and also A and B given right now we use Poissonian sliver so 1st we find out this value from the given data this is basically 173.53 so this is our 1 value right 2 nd as it is poisson distribution that we remember this becomes = to this so by q41.

And this value = 0.028 so this leads to the value of 4 2 2 8 * 173.53 which will be = 4.86 we get the 2nd reading right then we will find out the 3rd 1 by using this formula *q21 right so q21 will be = 41/4241 is 173.53 and 42 is 4.86 right so this value will be = 35.71 okay then we use this expression.

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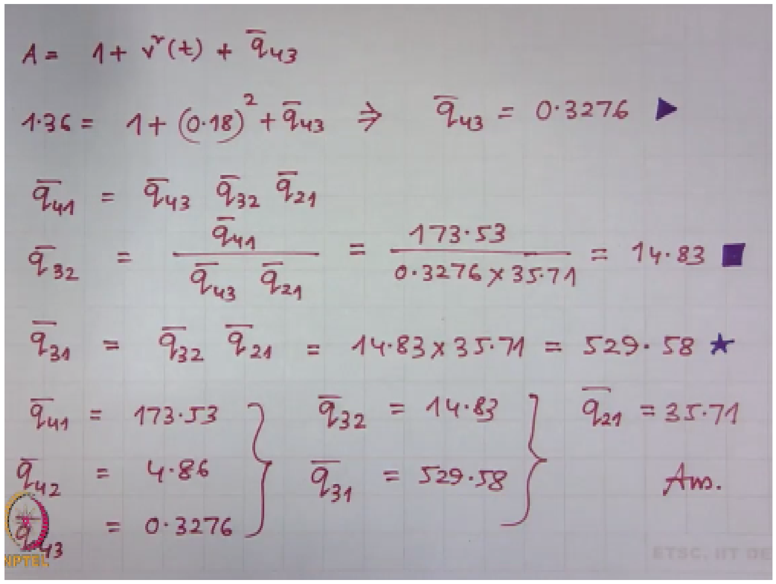

A = 1+ V squared T +q43 now A is given and A is your 1.36 1 V squared t is also given in this problem 0.18+q43 this will lead to q43 = 1.36- this and this so 0.3276 so we get the another 4 th reading okay then we use this expression q43 q32 q21 then q32 will be = 41/43 21 now what is 41 is we have calculated for 1 is 173.53/43 we have calculated 0.3276 and 21 also we have calculated 35.71 so this ratio will give you 14.83.

So, this is our another unit we found okay then we use another expression q31 = q32 q21 then q32 is 14.83 and q21 is 35.71 529.58 so large number at first sight this seems to be **i**mprovable however there could be many bundles that are empty look at the value of q43 is 0.3276 is very less value so that means in the sliver there are huge number of bundles but the number of fibers in the bundle is very less.

So, there are very few fibers there could be possibility that many bundles are empty that is why you get so large reading so now if we summarize all links we have 41 is 173. this 42 we have 4.86 43 we have 32 this then we come to 32 we have 14.83 31 we have 539.58 and also we have 21 we have calculated this so this is the mean number of lower units in the higher units this is the answer to the problem.

This ends the numerical problem 10 and also this ends module number 5. Thank you very much thank you for your attention.