Mathematical Methods and Techniques in Signal Processing-1
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Lecture - 22
Problem on Orthogonal Complementing

So, let us have some interactive problem solving sessions by students have taken this course. So, you will see some illustrations and examples into problem solving which is useful to understand and digest the concepts learnt during the lectures. So, this problem appeared in MMTSP course in IISC in fall 2016 in the midterm exam 1, so the problem is as follows.

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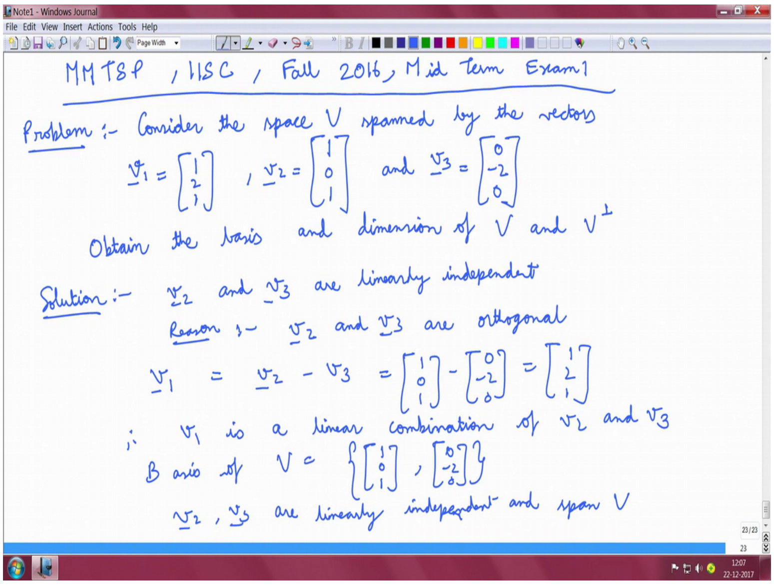

So, consider the space v spanned by the vectors v 1 is equal to 1 2 1, v 2 is a column vector 1 0 1 and v 3 is the column vector 0 minus 2 and 0. So, we have to obtain a basis for the space v and also a basis for the vector space v pub. So, the solution is as follows.

So, we can clearly see that v 2 and v 3 are linearly independent; the reason is that v 2 and v 3 are orthogonal and any 2 orthogonal vectors are linearly independent and is also clear that v 1 is equal to v 2 minus v 3. So, therefore v1 is a linear combination of v2 and v3. So, a basis for the space v will contain the vector v 2 and v 3. So, the reason is that v 2, v 3 are linearly independent and they span the vector space V.

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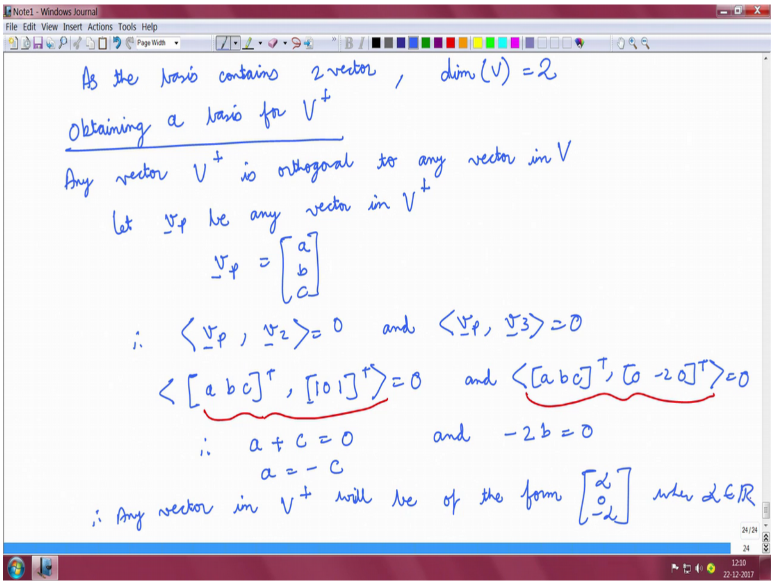

So, as the base the basis contains 2 vectors dimension of v is equal to 2.Now, the next step is to obtain a basis for v pub. So, this v pub any vector in v pub is orthogonal to any other vector in the original space V. So, let us say let Vp be any vector in v pub, so let v p assets a b c and a b c are some real numbers. So, therefore as this v p is orthogonal to any other vector in v, so it should be orthogonal to the basis vectors of v. So, we can write it as so inner product of v p and v 2 will be 0 and the inner product of v p and v 3 is would be 0.

So, if you find any of the products from this 2 equations, we obtain that a plus c is equal to 0 and minus 2 b is equal to 0. So, a is basically minus c therefore, any vector in v pub will be of the form let us say alpha 0 minus alpha. So, a basis for v pub would be taking alpha to be 1, you take any value of alpha it will be a basis of v pub.

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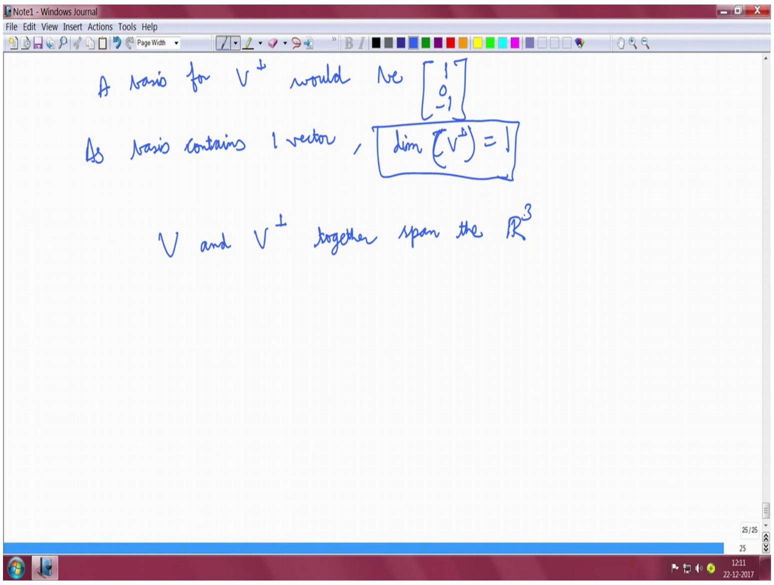

So, as basis contains 1 vector dimension of v pub is equal to 1 and you can see that this v and v pub together span the so this ends.