Engineering Drawing and Computer Graphics
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Module - 02
Lecture - 07
Conic Sections – I

Hello everyone, welcome to our Engineering Drawing and Computer Graphics course NPTEL online certification courses. I am Rajaram from IIT Kharagpur, and we are in lecture number 7. In the lecture 1 to 6, we have covered engineering drawing basics like scales and other things, from lecture 7 to 18; we will cover geometry constructions and conic sections; our textbooks are by N. D. Bhatt.

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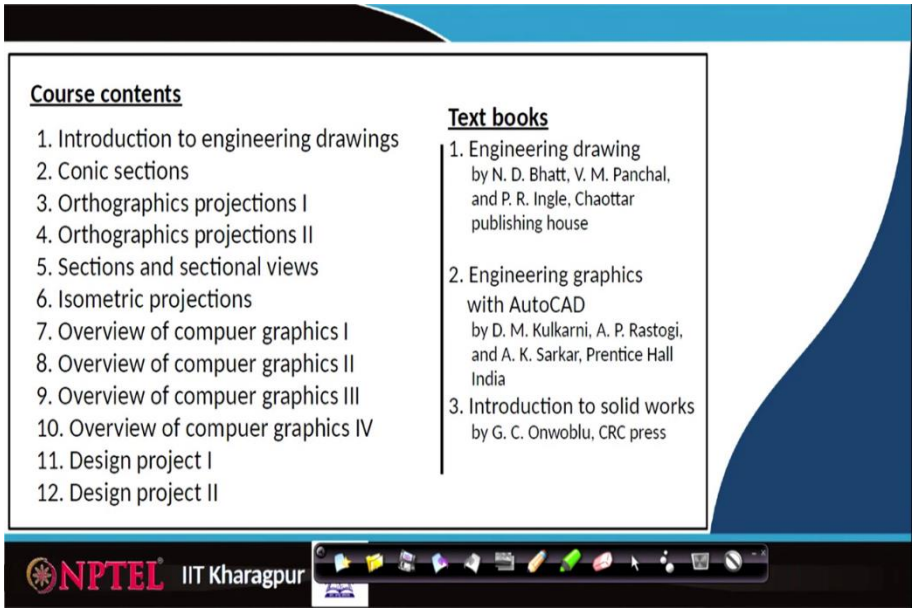

In today's class, We will cover on Conic Sections; how to construct these curves.

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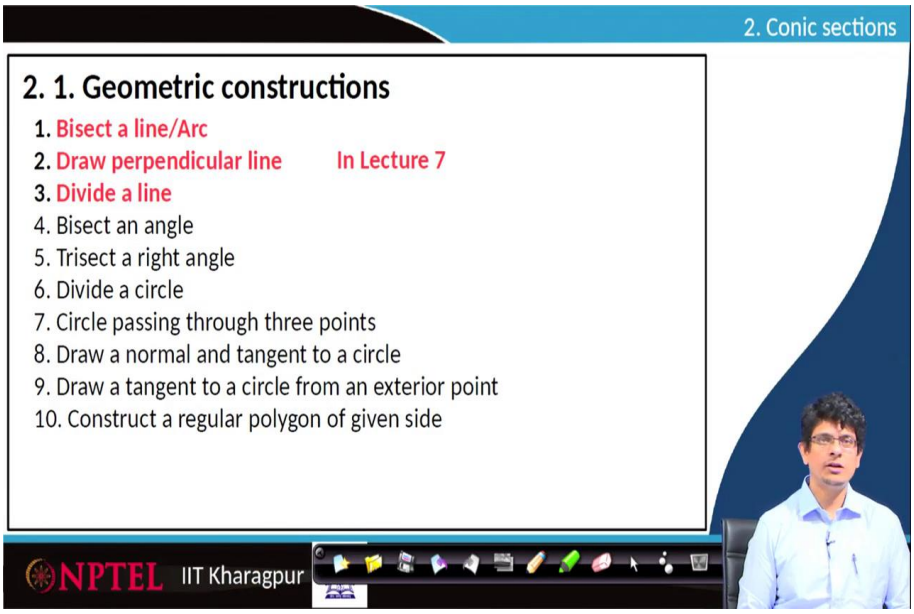

To draw any figure, we require typical geometrical construction using protractors compass pencil and so on things. In that geometric constructions, the first of all essential parts are how to bisect a line? How to bisect an arc and how to draw perpendicular lines and how to divide a line?

Similarly, how to bisect an angle, trisect an angle, and divide circles, if three points are given how to construct a circle passing through these three points? And if there is a circle on how to construct normal lines and tangent lines to the circle.

And also if an exterior point is there, connecting that exterior point as a tangent to that circle, how to do that? And how to construct regular polygons like square, pentagon, hexagon, and so on octagon and so on things; these are the things that we are going to cover in geometric constructions.

In today's lecture 7, we will look at the first three points, like how to bisect a line or an arc? How to draw a perpendicular line, how to divide a line?

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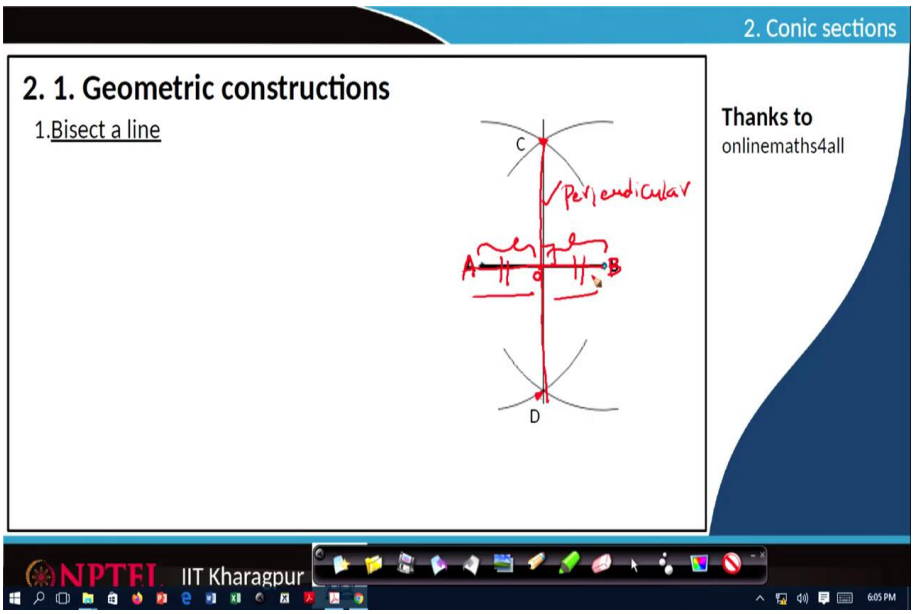

The first objective is how to bisect a line; here there is an AB line with points A and B. For this line, we would like to bisect into equal parts; that means if I am calling this point as O; AO distance and OB distance are equal to each other and that we construct it based on another perpendicular line.

So, the angle from C to D is 90 degrees; by constructing C point, D point, and joining lines C to D, we will be in a position to construct a bisected line segment.

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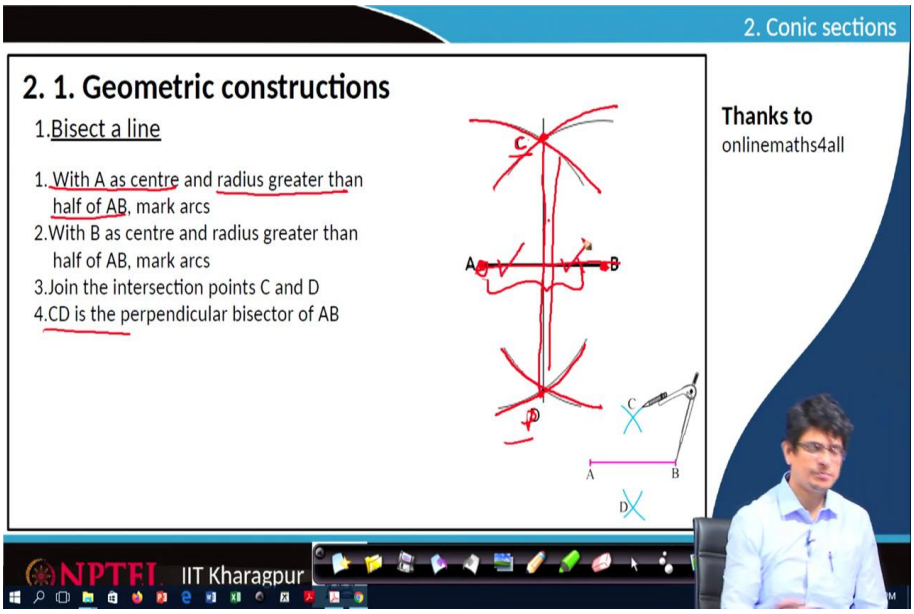

Let us look at the steps involved in constructing this bisecting line. The first step is to draw a line AB and then with A as centre; so here we will use our compass; keep it as a centre and radius greater than half of AB; the distance from A to B is that.

So, perhaps I pick this much radius, which is more than half of AB. Use compass from here, construct an arc; with the same radius from point B, also using a compass, I will construct one more arc.

Similarly, from B, I will try to construct on the other side one more arc with the same radius from A; again, construct another arc. So, wherever these arcs are intersecting, we call that point C and point D and join those lines. Once we construct CD; it is a perpendicular line to AB and this CD line; C to D line, whatever this will bisect AB into two equal parts.

Let us look at that on our drawing sheet; let us use a scale, construct a line segment.

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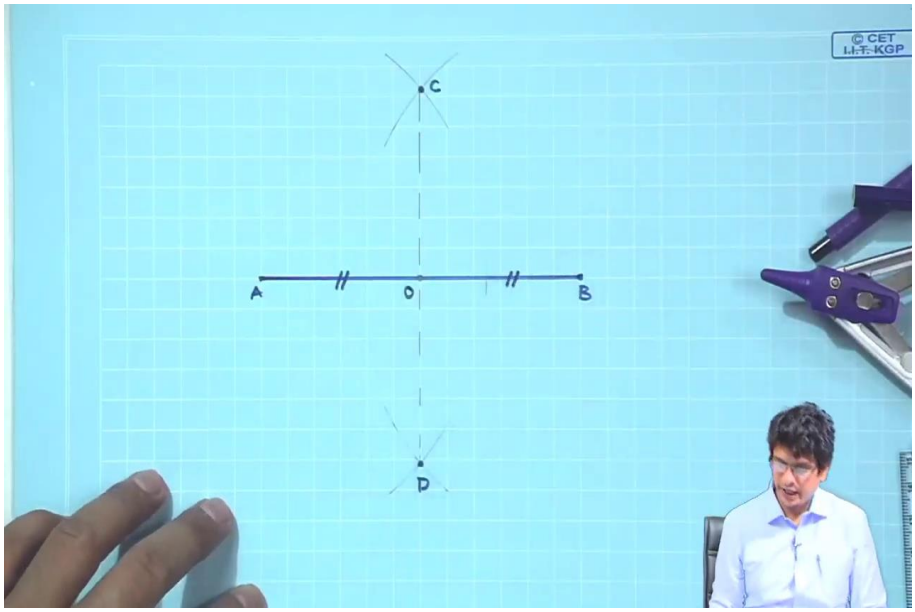

Let us mark A; perhaps let us mark point B, join them, mark it A and B.

Now, using our compass from A, what we have to pick a radius, pick a radius greater than half of AB. Perhaps arbitrarily, we are going to pick this one as the greater than half of AB. Now draw an arc on that side from A.

Similarly, use B point for the same radius; cut that first arc. Similarly, use B as centre on the other side construct an arc; similarly, from A side, construct an arc. So, whatever the points intersected; let us call C and D.

Now, join these points C and D; these are more like construction lines, very light lines. So, the point where it is intersecting dissecting that point let us call O. So if we are going to measure the distance from A to O, 6 units and O to B, 6 units, we are going to get.

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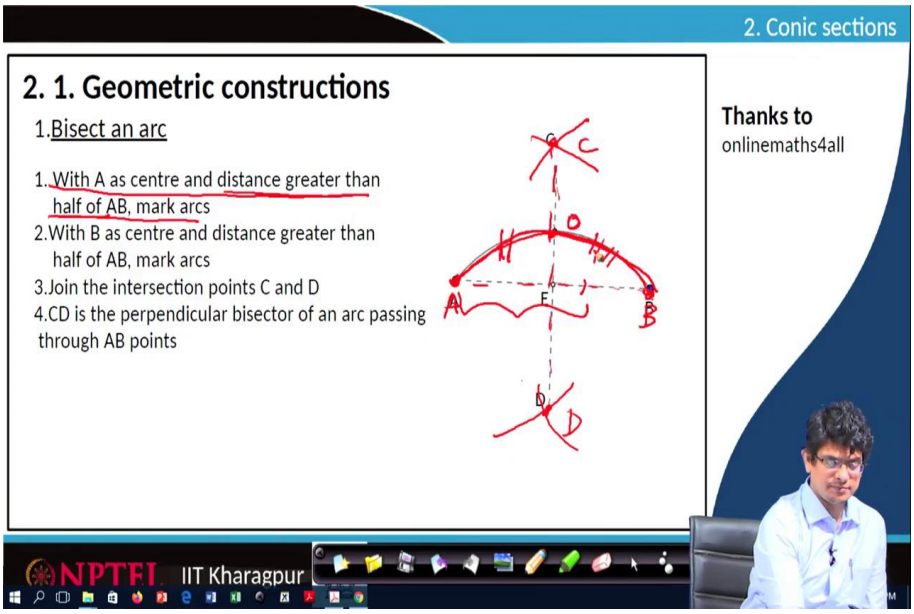

So, AO and OB are equal. Let us look at the next object 2; how to bisect an arc? Here we have an arc A to B; the first point is A, and the last point is B, and we would like to bisect this arc; that means, this point let us call O; AO arc length along the arc and OB arc length supposed to be equal.

Let us look at the steps involved in that; first, we have to use with A as centre and distance greater than half of AB; that means, point A is known B is known, and the arc goes along A, O, B but what we are trying to do is; from A to B, joined by a line.

So A to B half of that greater than that we are going to pick as radius; so that one distance greater than half of AB mark arcs. So, from A; picking these distance radius mark an arc

from A. Similarly, from A; mark an arc on this side, with the same radius; mark another arc with the centre B in that way.

Similarly, mark another arc in that way; whatever the points are intersecting, let us call C point and D point; join them. And the point through which it cuts A, O, B arc is O, and this is the point which bisects both the arcs. Let us look at the graph sheet.

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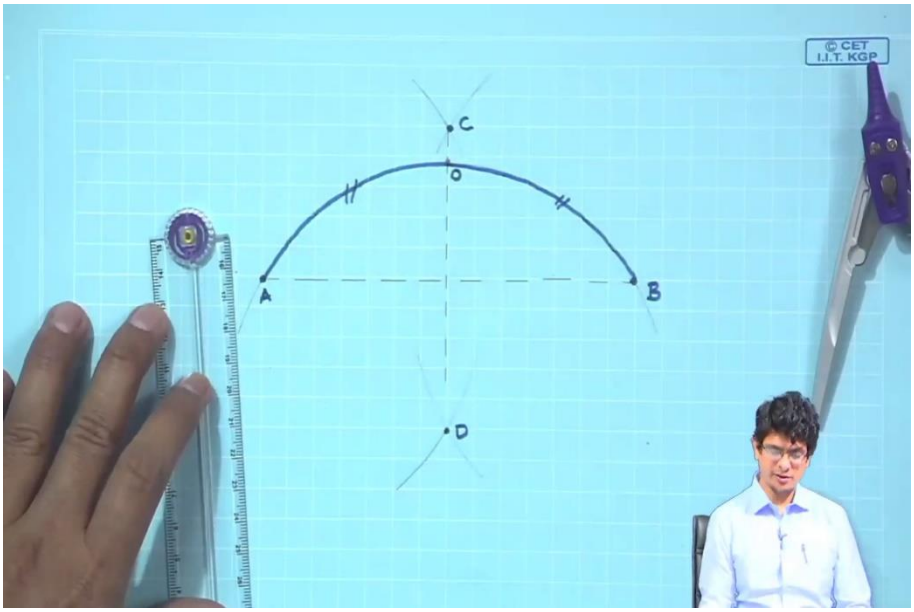

Now, we will pick an arbitrary; let us mark a point from this, we will construct an arbitrary arc. Let us call a point A, let us call another point B and this arc from A to B; we would like to dissect it.

So, the first step is: construct a dashed line joining A and B points. Now, pick a radius greater than AB distance; perhaps this one going to work, pick centre A, draw an arc on both sides. Similarly, pick an arc; cut the original arc. So, let us call points these as C and D; join these points C and D.

So, the point where this bisector is dividing; let us call O, A to O along this arc equal to O to B along this arc; this is how we construct bisecting an arc.

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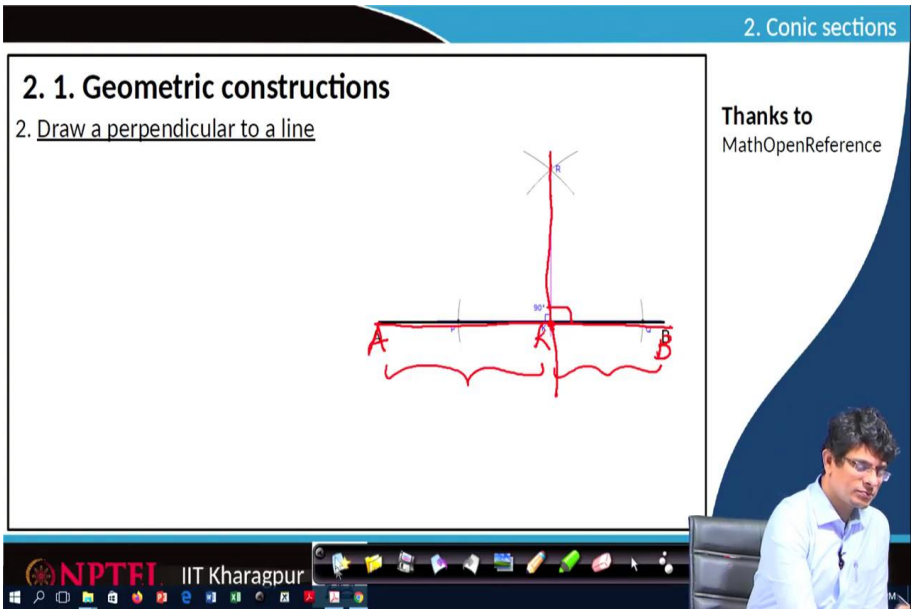

Let us take the next example, how to draw a perpendicular line passing through a particular point K, which is lying on the AB line. So, what is given is; we have a line AB; point A and point B. There is a special point K; this K point may not necessarily be at midway between A and B; it might be a bit an offset; that means, AK might be larger than KB. Now, we would like to construct a perpendicular bisector, the perpendicular line passing through K, which is going to intersect AB; so, this angle is AB; AK is greater than KB; how to do that? We are going to learn.

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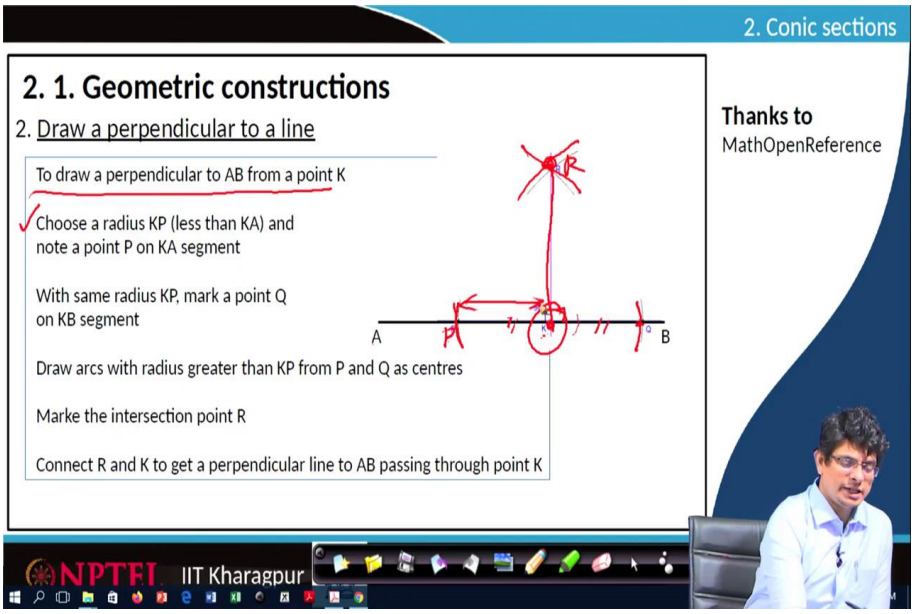

Let us look at the procedure; first of all, draw a perpendicular to AB from point K. This is the object to what we have to do. The first step is to choose a radius KP less than KA. From K point, pick another arbitrary point P such that AP is smaller than PK, so something like this is the greater distance.

So, from K; mark an arc on AK line; with the same radius, from K as centre; mark another arc Q. So, P point to K and K to Q; they are equal. Now, use the first principle; what we have done is to bisect a line because now K point bisects P and Q. So, from P greater than half of that radius, mark an arc on this side. Similarly, from Q point with the same radius, mark another arc so that the intersection point call it as R, from there join the line. Once we do that, we will get a perpendicular line passing through point K; let us look at that.

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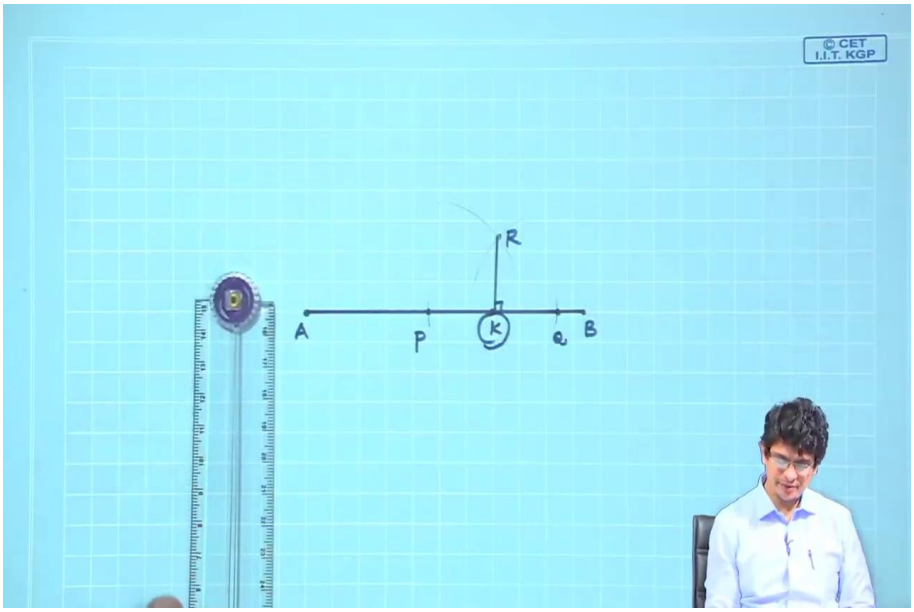

Let us first draw a line AB; maybe this is the line; let us join it. Call this point A, call this point B; now mark a point K somewhere here, and we would like to draw a perpendicular line through geometric construction.

The first step is from K because now B is a shorter line if we are picking a very large radius; from K, if I am going to mark, it will be extending. So, the greater distance, the smaller distance depends on how much length we have leftover. So, let us pick from K to B, a distance greater than that.

Similarly, from K, pick the same radius mark arc, so this one is point P, and this point Q. Now, from P; a distance I have to pick greater than Q, greater than K. This is the one that I

am going to pick; draw an arc. Similarly, from Q point, draw an arc, mark the point; now, join Q and K, and this angle will be 90 degrees. So, one has to be careful while drawing these arcs length and calling this point R. So, this is the way we construct a perpendicular line passing through point K.

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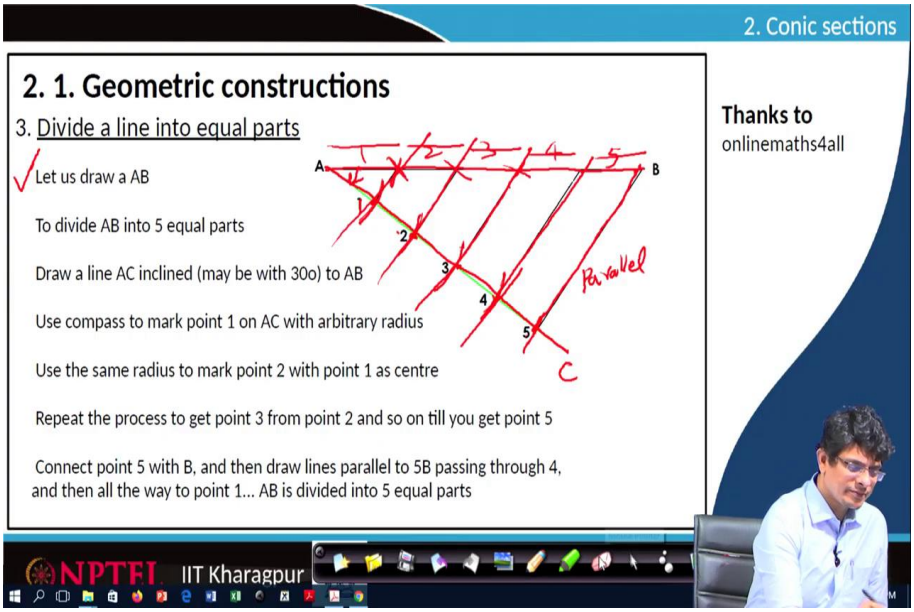

The third point objective for our today's session is; divide a line into equal parts. So, let us consider there is a line AB, and we would like to divide that into equal segments; perhaps 1, 2, 3, 4, 5 equal segments we would like to construct. The procedure to do this: after drawing line AB, draw an inclined line AC; this is the line, perhaps an acute angle like 30 degrees, 40 degrees, and so on to AB.

We use a compass to mark point 1 on AC, from A to 1; pick arbitrary arc, locate it, and then call this one as 1. Similarly, mark from this one as centre; mark one more arc, from this one as the centre with the same radius mark another one, with the same radius mark the other one, with the same radius mark the other one.

Once it is done, join point 5 to B. passing through 4th point, draw lines passing through 3, passing to 2, passing to 1. Wherever it is intersecting, this distance, this distance, all are equal; this is how one has to divide the line into equal parts. Let us look at that on the graph sheet.

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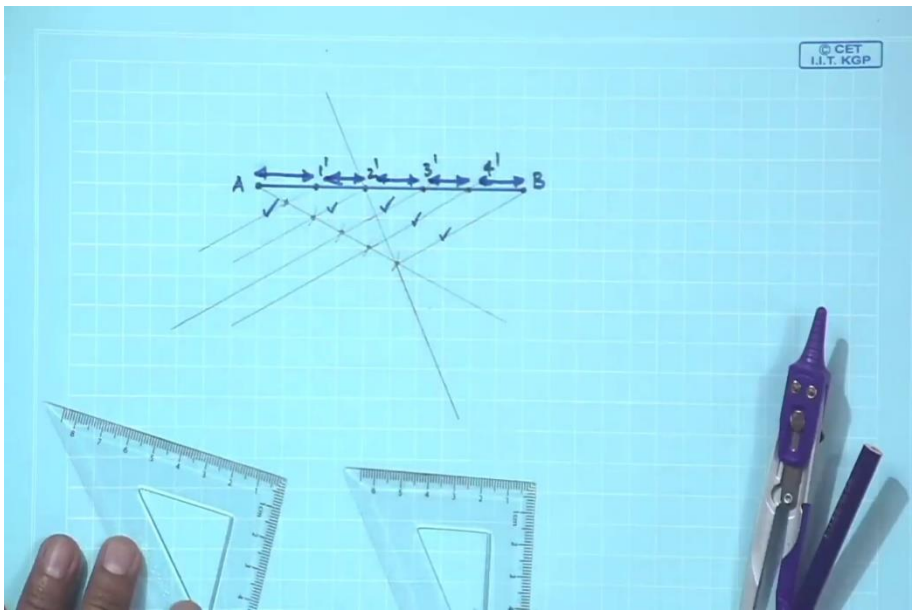

First of all, we have to draw a line, mark A and B points, draw an inclined line. Now on that line, pick radius an arbitrary one; mark these points, so use this point; let us mark this one, pick this one as centre; mark the second point. Similarly, use that one as centre; mark the other one.

Similarly, this point marks, so how many we have to make? If it is 5 points, in total 5 arcs, we have to construct; 1, 2, 3, 4, and the 5th one; this one; so, mark these points; now connect this 5th point with point B.Now, we have to go parallel to this line; usually, we have mini drafter adjusted in that direction to do that, but here we do not have any mini drafter. So, to construct parallel lines, first of all, we have to construct a perpendicular line to this. Carefully align your set squares; drafter is the right tool to use this.

So, parallel to that, we have to construct it; that means to align one of the set squares in that direction, something like that, and the point has to pass through our particular points. So, let us extend these lines. So, one has to be very careful; unless we use drafter, we cannot construct this; non-alignment may divide these lines into different parts. So, the first one; it is intersecting there, the second one is going to intersect there.

Now, this one extends these lines, so mark these points. So, let us call 1-prime, 2-prime, 3-prime, 4-prime. So, A-1 prime equal to 1-2 prime; is equal to 2-3 prime; equal to 3-4 prime; equal to 4 prime B. So, it depends on how careful you are in terms of constructing these parallel lines; we will be in a position to make it into 5 equal parts.

Thank you very much.