

Engineering Drawing and Computer Graphics

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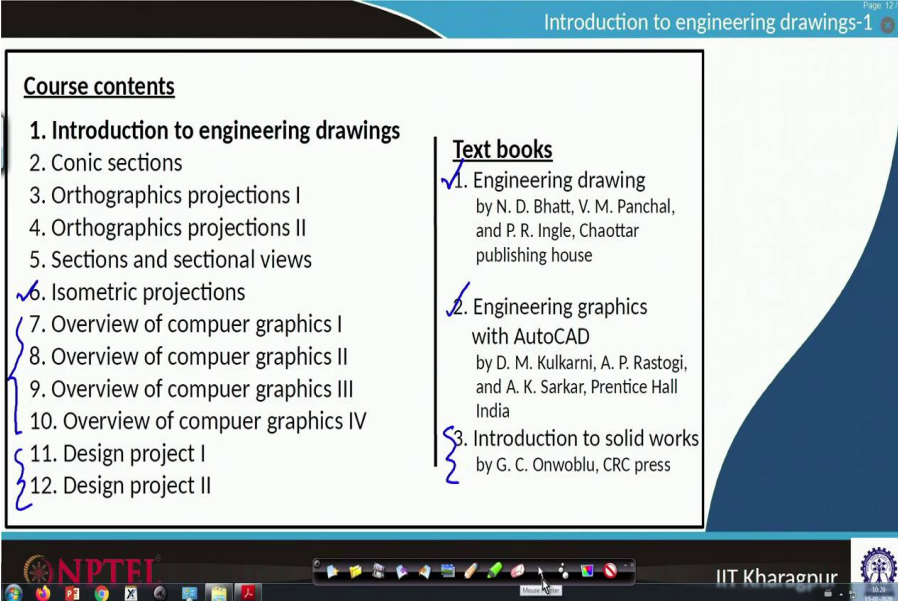
Indian Institute of Technology, Kharagpur

MODULE 01

LECTURE 02: INTRODUCTION TO ENGINEERING DRAWING -II

Hello everyone, welcome to our Engineering Drawing and Computer Graphics course; we are in module 1 and lecture 2 in Introduction to Engineering Drawing.

(Refer Slide Time: 00:30)



The screenshot shows a presentation slide with the following content:

Course contents

1. Introduction to engineering drawings
2. Conic sections
3. Orthographics projections I
4. Orthographics projections II
5. Sections and sectional views
- ✓ 6. Isometric projections
7. Overview of computer graphics I
8. Overview of computer graphics II
9. Overview of computer graphics III
10. Overview of computer graphics IV
11. Design project I
12. Design project II

Text books

- ✓ 1. Engineering drawing by N. D. Bhatt, V. M. Panchal, and P. R. Ingle, Chaotter publishing house
- ✓ 2. Engineering graphics with AutoCAD by D. M. Kulkarni, A. P. Rastogi, and A. K. Sarkar, Prentice Hall India
3. Introduction to solid works by G. C. Onwoblu, CRC press

The slide also features the NPTEL logo in the bottom left corner and the IIT Kharagpur logo in the bottom right corner. The title bar of the presentation window reads 'Introduction to engineering drawings-1'.

To briefly recap our course contents are an introduction to engineering drawing and conic sections, orthographic projections, sections, isometric projections, an overview of computer graphics in this part we will cover, and a design project. Our standard textbooks are Engineering Drawing by N.D. Bhatt and Engineering Graphics with AutoCAD.

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Introduction to engineering drawings-1

1. Introduction to engineering drawings

- Introduction
- Drawing instruments ✓
- Lettering ✓
- Layouts
- Geometrical curves
- Dimensioning and tolerances

} in the next class

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And when we are learning about computer graphics, we use an introduction to solid works, in the first part introduction to engineering drawings. In the second lecture, we cover drawing instruments and lettering used in our drawing course.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- ✓ Drawing sheets
- ✓ Drawing board
- ✓ Drafter and T-square
- ✓ Set-squares and protractor
- ✓ Compasses and dividers
- ✓ Pencils and eraser
- ✓ French curves
- ✓ Paper clips/pins
- ✓ Sand paper/sharpner/blade

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The standard drawing instruments and accessories used are drawing sheets, a drawing board to cover drawing sheet, a drafter or a T square, set squares, and protractor; occasionally, we use compasses and dividers also. The essential part of a drawing is pencils and eraser; rarely, we use French curves to connect points; usually, we go with freehand sketches, but required we go with French curves. To hold the paper, we require paper clips and pins; and to sharpen the pencil, sandpaper, sharpener, or blades are required.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Drawing sheets

Designation	Dimensions (mm)	
	Length	Width
✓ A0	1189	841
✓ A1	841	594
A2	594	420
✓ A3	420	297
A4	297	210

Many variables, diagrams, letters etc.

thanks to resources

Siemens automation and cadcrowd for drafting materials

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In the drawing instruments and accessories, the essential component is using a drawing sheet. Here, we can see a drawing sheet template having a certain width and a length; it is a very long rectangular sheet drawing paper. The typical standards bureau of Indian standards recommends any drawing, categorizing these drawing sheets into different formats like A0, which has a length of 1189 millimeters and a width of 841 millimeters.

Usually, we keep a longer side in the horizontal direction and the vertical shorter side. Other sheets are also available A1 i.e. 849 millimeters by 594 millimeters. So, if you are seeing, there is a diagonal repetition we can see for this drawing sheets; A2 i.e. 594mm to 420mm, A3 i.e. 420mm to 297mm, and A4 i.e. 297mm to 210mm. So, we can say this repeated pattern in the drawing sheets.

Typically drawing sheets contain the three-dimensional objects on their projections. If you are looking from the frontal view, how that drawing looks like, side views how it looks like. From the side, if we are looking at that object, that means, perhaps in this direction, how the object really looks like inclined projections and also if there are any cut sections by showing it as a hash with material portion.

And also, it might be having pins, joints, and a variety of cut sections. Those things can also be represented, and a certain kind of lettering will represent each of these parts. And we will see something like ownership of that drawing sheet; contains names and whoever so made it and the objects, properties, and so on so things; it contains many variables, diagrams, and letters.

Even for electrical engineering electronics, if someone wants to manufacture a component that component has to be represented, the dimensions, the size, the intricate details, everything has to be represented. And to summarize, a drawing sheet is the one on which we draw these sketches. And usually, we recommend BIS standards; in that drawings and title, always be there.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Drawing sheets

Designation	Dimensions (mm)	
	Length	Width
A0	1189	841
A1	841	594
A2	594	420
A3	420	297
A4	297	210

thanks to resources
BIS standards, and edpstuf.blogspot.com

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To represent the size A0, A1, A2, A3, A4 pictorially, we have represented a very long drawing sheet; half of that gives you A1, in that half gives you A2, further A3, and A4. So, A4 is the sheet that we traditionally use for writing answer scripts or perhaps printing our material; the standard page we use is this A4; with respect to A4, A0 is way large.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Drawing sheets

The smallest drawing sheet permitted for necessary clarity and resolution is used as a sheet

Designation	Dimensions (mm)	
	Length	Width
A0	1189	841
A1	841	594
A2	594	420
A3	420	297
A4	297	210

thanks to resources
BIS standards, and edpstuf.blogspot.com

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What is the best drawing sheet one should use? One has to use the smallest drawing sheet, which can give complete clarity about the drawing and resolution; that is the best drawing sheet one has to use. If the object is small and a small number of elements are involved in that, it is ok to use A2 sheet; if the object

is very large and have many components would like to give detailed expressions details, then A0 is required.


As I mentioned, drawing sheet involves a drawing space, few borderlines, and a title block; the longer side is in a horizontal direction, shorter side always be in the vertical direction.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Drawing board To support drawing sheets



thanks to resources
vistaplan drawing management, wood studio designs

Type of Drawing Board	Length X Width X Thickness (mm)
D ₀	1500 X 1000 X 25 A ₀
D ₁	1000 X 700 X 25
D ₂	700 X 500 X 15
D ₃	500 X 350 X 15 D ₃

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After the drawing sheet, the next one is to hold that is the drawing sheet. We require a drawing board. Here we have shown different varieties of drawing boards; the classical one is using a wooden structure. So, an inclined plane on which one will be going to fix a drawing sheet and a compartment to keep your reserves like a pen, pencils, and drawing equipment.

So, these drawing boards can be made even with metallic surfaces and also plastics. The drawing board size is always larger than this drawing sheet. For example, if we are using the A0 sheet, the drawing board size should be larger than that 1500 mm by 1000 mm width, thickness supposed to be 25 millimeters. If one uses A3 sheet, then the drawing board required is D3 size.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Drafter and T-squares

To draw horizontal, and vertical lines

thanks to resources

Isomars drawing products and other online resources

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Next to the drawing table, we require a drafter or a T square for drawing lines; for example, here, a mechanical drafter has been shown. A drafter features a clamp is through which one can fix the drafter to the drawing board. By screwing unscrewing, one will be in a position to connect that clamp, and it has mechanical bars through which one will be in a position to achieve horizontal and vertical directions. By unscrewing this, this measuring scale can be rotated and any incline direction can also be assembled. The objective of the drafter is to draw a horizontal line, in line with that drafting table or the drawing sheet. Using this drafter, one can draw complete vertical lines.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Drafter and T-squares

To draw horizontal, and vertical lines

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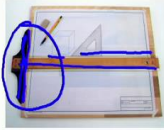

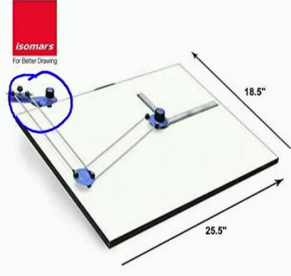
Wherever you move this drafter, it always shows only horizontal and vertical directions. These drafters can be of different types also; the simple drafter which we call mini drafter is shown here.

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Introduction to engineering drawings-1 Page: 22/22

Drawing instruments and accessories

- Drafter and T-squares



To draw horizontal, and vertical lines

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Most sophisticated drafters are also there, and those are shown here. So, these slider goes front and back, so that this horizontal, vertical lines can be drawn in that direction on the table. In earlier days, people used to go with T squares, so it is in the form of T.

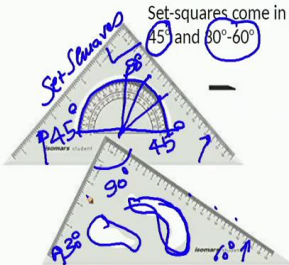
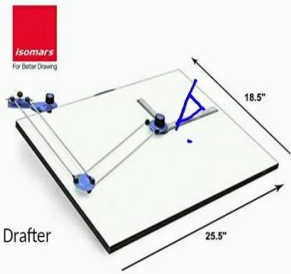
So, once this block is aligned with the drawing table, one can draw a horizontal line.

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Drawing instruments and accessories

- Set-squares and protractor



Set-squares come in 45° and 90°-60°

Drafter

To draw parallel, perpendicular and inclined lines
-drafter together with set-squares and protractor are used

thanks to resources

Isomars drawing products and other online resources

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Along with drafter, the other essential components are set-squares; these usually come in 45 degrees and 30, 60 degrees, here the inclination angle is 45 degrees, and this one is also 45 degrees, and this one is 90 degrees.

If one wants to draw an inclined line with mini drafter, one will one will keep the set square there and draw a line in that direction. The other set-square comes with 30 degrees on this side and 60 degrees on this side; the remaining angle is 90 degrees; some of the set-squares consist of this kind of complicated curve patterns also.

Usually, these are acrylic plastics, so that transparent and one can note the scale and put the lines along with these slots also. The other essential component is protractor through which one can note the inclination angle made by that point. To draw a parallel, perpendicular, and inclined lines, we use these drafters and set squares.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Compass and divider

Divide r
Compass
arc
metal
lead
lead

Sheet Metal

ENGINEERING COMPASS & DIVIDERS

Compass- To draw circle and arcs
Divider- To track and transfer lengths

thanks to resources
Various online resources

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The other drawing components are compasses and dividers; the standard geometrical box consists of this compass through which one can draw a circle by keeping this object at the middle and keeping a pencil through that slot. One can draw a perfect circle an arc. The other one is the divider, using a divider, one can track and transfer lengths. For example, there are two points; instead of directly measuring what that length is, we would like to transfer the distance between that, so we use the divider.

Once that is fixed, use another point at the same location and transfer that length; further purpose, we usually go with dividers. These compasses are of different quality and also strength; the sophisticated

ones have nice metallic frames so that the grip always be good, and this is the part where pencil lead can be inserted. And this is another style of the compass, bow compass usually we call through which a lead can be kept there.

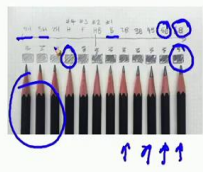
And this is a joining part of the compass, which one can insert a pencil lead. And here the pencil leads are shown. Typical engineering compass dividers come in different formats; based on the application, one uses this compass.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Pencils and lead sticks



Grade of Pencil	Hardness of Pencil
9H	Hardest
8H, 5H, 4H	Extremely Hard
3H	Very hard
2H	Hard
H	Moderately hard
F	Firm
HB	Median hard
B	Moderately soft and black
2B	Soft and black
3B	Very soft and black
4B, 5B, 6B	Very soft and very black
7B	Softest

16 grades based on hardness

thanks to resources
theconstructor.org,
cwpencils.com and
other online resources

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Now the key component for any drawing is pencil; compared to the ordinary pencils, the engineering drawing sketch pencils consist of different grades. Usually, 16 grades based on the hardness of that graphite lead we will use.



For example, a 9H is very hardest kind of graphite one will having 6H, 5H and 4H extremely hard; if it is 3H very hard pencil and if it is H moderately hard if it is a B type moderately soft and black, 2B pencils are soft and black, 3B pencils are very soft and black and 7B pencils softest of all. So, here on the left-hand side, we have shown different pencils like 6B, 5B, B, maybe 5H, 3H, and 4H notations; below that we have shown the color made by the pencil, the contrast made by that pencil.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Pencils and lead sticks



Grade of Pencil	Used to Draw
3H	Construction lines ✓
2H	Dimension lines, center lines, sectional lines, hidden lines ✓
H	Object lines, lettering ✓
HB	Dimensioning, boundary lines ✓


Grade of Pencil	Hardness of Pencil
9H	Hardest
6H, 5H, 4H	Extremely Hard
3H	Very hard
2H	Hard
H	Moderately hard
F	Firm
HB	Median hard
B	Moderately soft and black
2B	Soft and black
3B	Very soft and black
4B, 5B, 6B	Very soft and very black
7B	Softest

4 grades are recommended

16 grades based on hardness

B grade: more graphite, and will make a bolder, darker line, and also be a little smudgier than a light pencil
H grade: more clay, and will make a lighter, finer line, and will be less smudgy than a dark pencil

thanks to resources
theconstructor.org,
cwpencils.com and
other online resources



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The recommended pencils for this course are these four grades; grade of the pencil where 3H, 2H, H, and HB are mentioned. And the purpose of the pencil to construct lines, perhaps dimension lines and center lines constructed using 2H; if it is object lines and lettering, it has to be done with H, and if it is something about dimensioning and boundary lines, one has to use HB pencil.


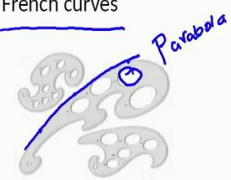
Overall, B grade pencils contain more graphite; if we are looking at the table, B always contains more graphite and makes a bolder and darker line, and these lines are little smudgier than a light pencil. Whereas an H grade pencil, if we are using it, this contains more clay, lighter and finer lines can be drawn and less smudgy than dark pencil.

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Introduction to engineering drawings-1


Drawing instruments and accessories

- French curves



They are segments made from Euler spirals and used to draw free form curves
Example: a smooth curve passing through a number of non-collinear points may be hyperbola, ellipse and parabola can be drawn

thanks to resources
Various online resources



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Now, we will learn about French curves; for example, if I have three data points, one can draw an arbitrary freehand sketch like that or perhaps use a French curve, so that the point can be passing through that curve and connect it by a nice smooth line.

The further purpose we require these French curves and this French curves are segments made from Euler spirals; part of the Euler spiral will be taken, and this French curve will be made and meant for drawing the free form of curves.

For example, a smooth curve passing through several non-collinear points. To represent a curve, we use French curves; usually, the longer ones are used for parabola; the shorter ones used for ellipse and the medium ones are used for hyperbolas, and it contains different elliptic curves also.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Paper clips/pins

They are used to hold the drawing sheet at correct location

thanks to resources

Various online resources

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So, whenever a free form of the curve is required, we use these French curves; even for wood making and cutting, people use metallic French curves to get a nice finish. The other drawing instruments and accessories are paper clips and pins.

So, whenever we have a drawing board, to hold this is the board; we will like to hold the drawing sheet on that drawing board, this is the paper. To hold it, we use this clip arrangement; to hold it tightly, we require these clips, sometimes people use pins also.

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Introduction to engineering drawings-1

Drawing instruments and accessories

- Sand paper/sharpener/blade/eraser

They are used to hold the drawing sheet at correct location

thanks to resources
Staedtler erasers and various other online resources

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To sharpen the pencil sometimes, we require sandpaper and also to make it a bit wider kind of lines on this sandpaper, we usually rub this pencil. To have very sharp corners, we use this sharpener, and the recommended eraser is Staedtler, which always has this very smooth kind of erase.

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Introduction to engineering drawings-1

Letter styles

Lettering is the style of writing of alphabets and numerals such as A, B, C, D... Z and 0, 1, 2, 3... 9

Most freehand lettering is done in a "gothic" style with a constant line thickness either "straight gothic" with vertical strokes perpendicular to the baseline or "inclined gothic", with vertical strokes at about 75°

To regulate lettering height, commonly 3 mm, guidelines are drawn.

Characteristic	Parameter	Ratio	Dimensions(mm)
Lettering Height (Height of capitals)	h	(14/14) h 2.5	3.5 5 7 10 14 20
Height of lower case letters (without stem or tail)	c	(10/14) h 2.5	3.5 5 7 10 14
Spacing between characters	a	(2/14) h 0.35	0.5 0.7 1 1.4 2 2.8
Minimum spacing of base characters	e	(20/14) h 3.5	5 7 10 14 20 28
Minimum spacing between words	e	(6/14) h 1.05	1.5 2.1 3 4.2 6 8.4
Thickness of lines	d	(1/14) h 0.25	0.35 0.5 0.7 1 1.4

thanks to resources
various online resources

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After these essential drawing instruments like bold, sheet, pencils, sharpener, clips, compass, divider, and set squares, the first objective is how to draw letters. In this section, we cover the lettering styles involved in drawing are; lettering is the style of writing alphabets and numerals. For example, we use capital letters A, B, C, D, and Z kinds of things and 0, 1, 2, 3 to 9 kinds of elements. Usually, it is recommended most freehand lettering, and that's also in a gothic style.

This style supposed to consist of a constant line, thickness either straight gothic with vertical strokes perpendicular to the baseline or inclined gothic. So, either we use straight vertical A or an inclined A; if this is inclined is supposed to be 75 degrees, and there will be a guide line, in that guide lines we draw any lettering. To regulate lettering height, commonly 3 millimeter guidelines will be used; so your letters supposed to be lower than 3-millimeters.

If it is something like lettering height capitals, we use 2.5 millimeters; if it is something like the thickness of lines, we use 0.18 mm. To understand that, on the right-hand side, we have this I letter, which is having a height of h and a width of d, so here h is 2.5 millimeters, and d is 0.18 millimeters.

Similarly, if we are using lowercase letters, one has to use 2.5 millim[eter]- 2.5 millimeters or lower than that. Spacing between characters; for example, this character and that character whatever this spacing has to be used 0.35 millimeters. If we are using 2.5 millimeters and 0.18 millimeters as the thickness, then the gap between the letter to letter is supposed to be 0.35 millimeters.

And there are other varieties like the minimum spacing of base characters, and the minimum spacing between words is also mentioned. With that kind of lettering style, we can go ahead and draw sketches and represent them.

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Introduction to engineering drawings-1

Letter styles

Suggestive guidelines

ITEM	SIZE h, mm
Drawing number in <u>Title Block</u> and letters denoting Cutting Plane Section	10, 12
Title of Drawing	6, 8
<u>Sub-titles and Headings</u>	3, 4, 5, 6,
Notes, such as <u>Legends</u> , <u>Schedules</u> , <u>Material list</u> , Dimensioning	3, 4, 5
Alteration, Entries and Tolerances	2, 3*

[thanks to resources](#)
edengdrawing resources



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The typical letter in style involves writing it for title blocks, subtitles, headings, notes such as legends, schedules, material lists. For example, if it is title block, we use 10 millimeters kind of letters; title drawings we use 6 millimeter kind of things, any subtitles we use 3 millimeters and any tolerances and so on represented it in terms of 2 millimeters.

In today's class, we have covered drawing instruments and lettering of these drawings. In the next class, we will learn about layouts involved in drawing, the geometrical curves we can construct, and how to represent dimensioning and tolerances. See you in the next class.

Thank you very much.