ME119:
Engineering Drawing & Graphics

0. Instructions

Department of Mechanical Engineering
Indian Institute of Technology Bombay

Preamble

- Maths is the Queen of Science. Similarly, Drawing is the Language of Engineers. To become a good engineer, you need have good
  - analytic skills (mathematical, numerical and computing skills),
  - Sketching skills (quick rendering of what you see or imagine – enables more iterations within limited time),
  - Drawing skills (formalized sketches) and
  - 2D/3D CAD modeling skills (CAD model becomes the core of all other downstream activities).
  - Physical realization skills (some ideas of various manufacturing processes including 3D Printing).

Preamble

- Iterate design to arrive at the best possible product.
- You should have an open and unbiased mind and team spirit that gives dues respect to all disciplines. Because, products today are too complex and requires multi-disciplinary teams. When ideas are generated, sincerely record and postpone their evaluation.

Preamble
Sketching skills

- Ideas come at high speed. Traditional CAD cannot capture all. So, grasp them quickly through sketches. (Analogy: Lord Ganesh helping Ved Vyas for recording Maha Bharat).

- Your sketch need not be beautiful or neat; but when you look at them, you will be able to recall most of the thinking of that time. Therefore, the sketches make more sense to the designer who sketched them than to the others.

Preamble

Sketching skills - Leonardo da Vinci (1452-1519)

- You need to sharpen your skills in sketching because sketching is faster; it matches with your thinking speed and enables several design iterations within limited time. This is a prerequisite to become a good designer. Example is Leonardo da Vinci – an artist (painter, sculptor, musician), architect, mathematician, engineer, inventor, anatomist, geologist, cartographer, botanist, and writer. He conceived many ideas, theories and contraptions that were far ahead of his time. So, he simply sketched them and left behind for next generations to pursue. Many of his ideas took centuries to become practical. Some of his contributions are:

  Paintings: Mona Lisa, Last supper

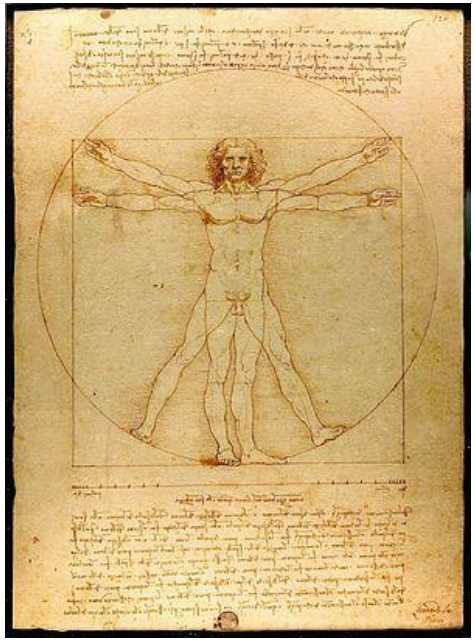
  Sc. & Engg: Helicopter, Battle tank, Solar power collector, calculator, bobbin winder, tensile testing machine for wire, anatomy, architecture, optics, hydrodynamics, …

Preamble

Sketching skills - Paintings of da Vinci

Mona Lisa

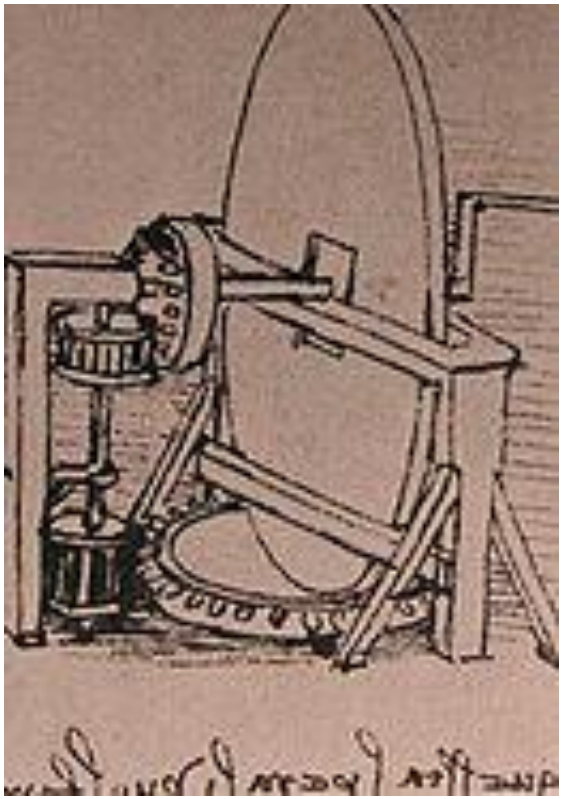
Last Supper



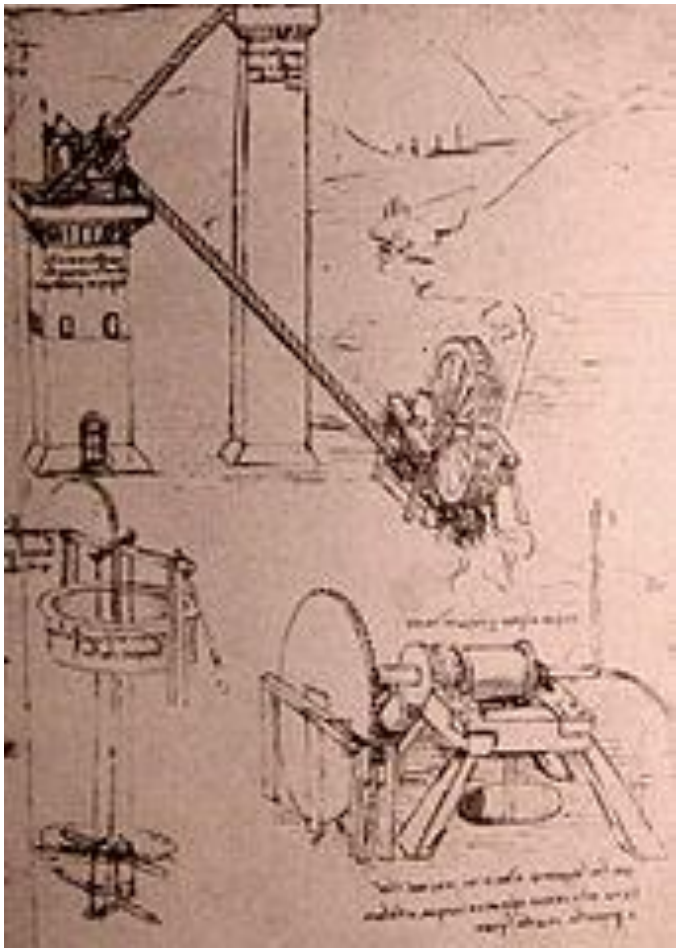
Vitruvian Man

Preamble

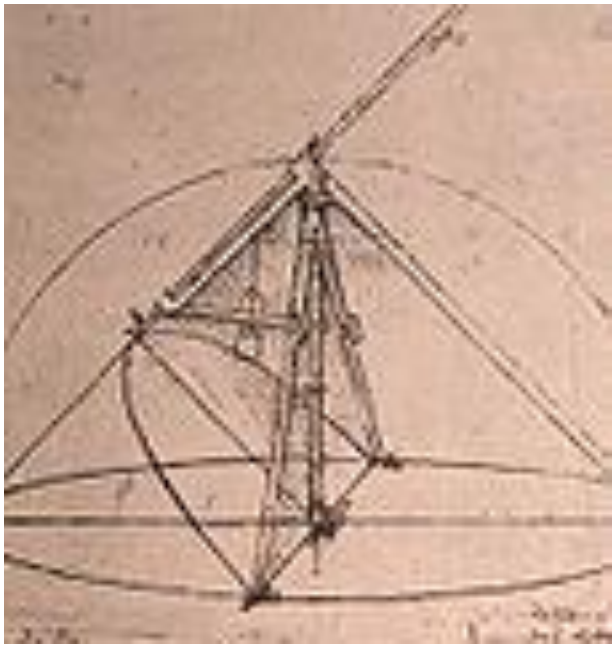
Sketching skills - Sc./Engg. Contributions of da Vinci



A machine for grinding convex lenses



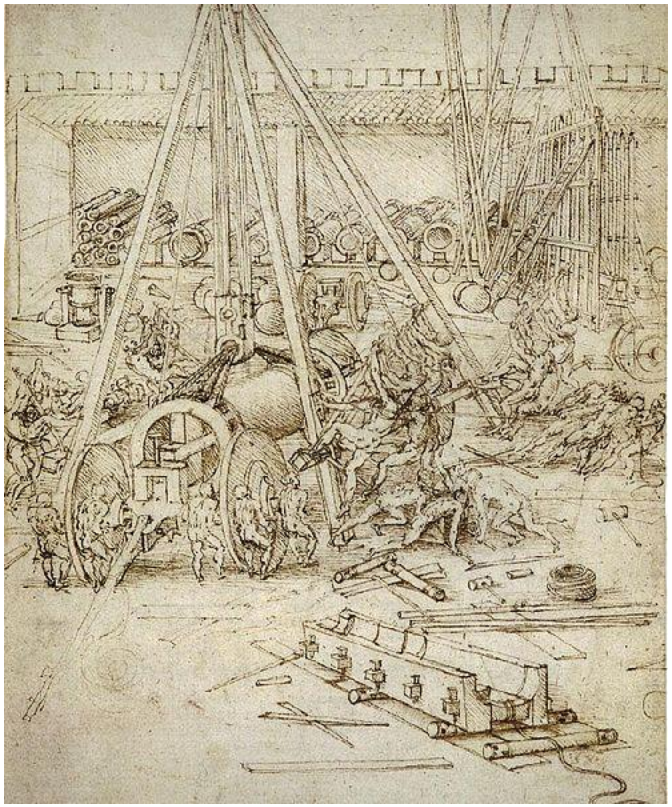
Various hydraulic machines



A parabolic compass

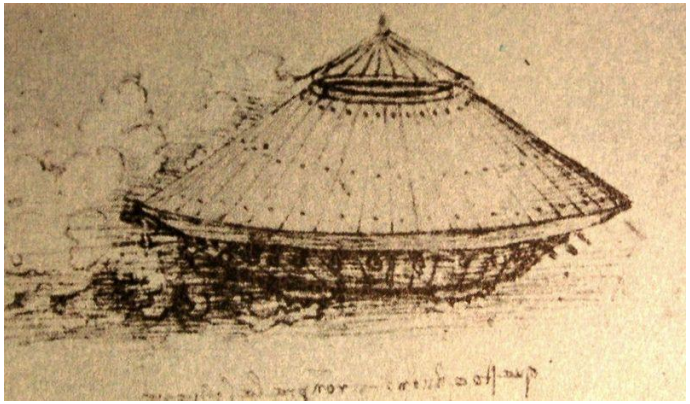
Preamble

Sketching skills - War Contributions of da Vinci



War machines

Cannons

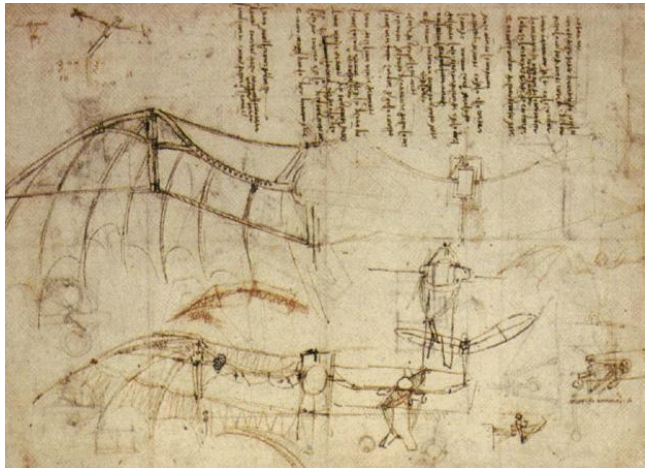


Battle tank

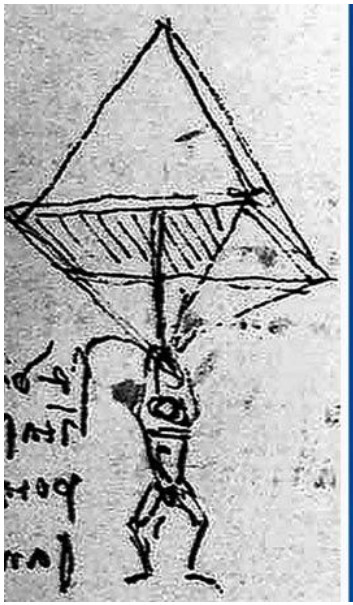
Preamble

Sketching skills - Flying Contributions of da Vinci

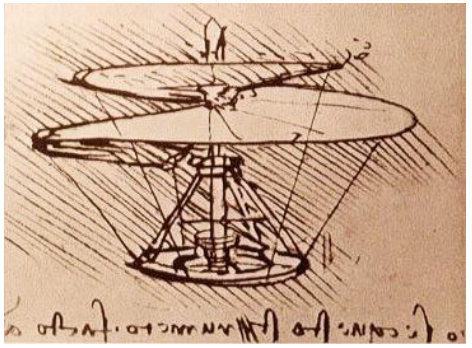
The flight of a bird



A Flying Machine



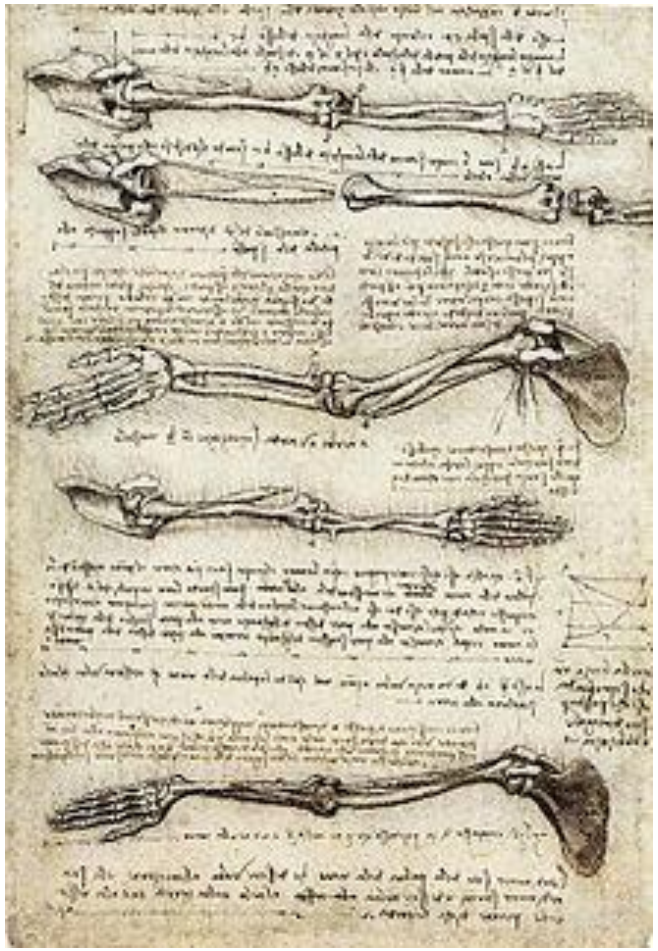
Parachute



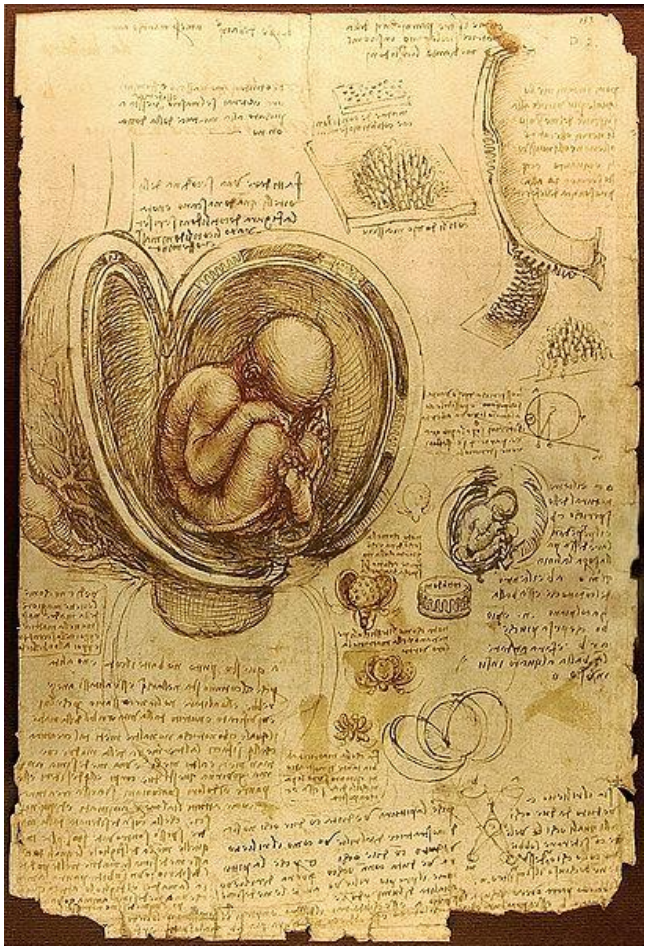
Aerial screw (Helicopter)

Preamble

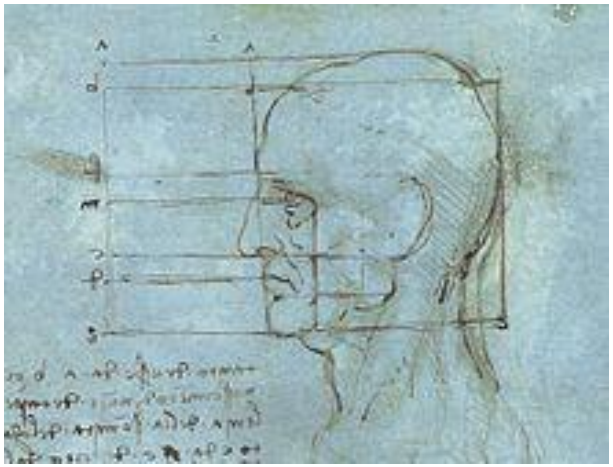
Sketching skills - Anatomical Contributions of da Vinci



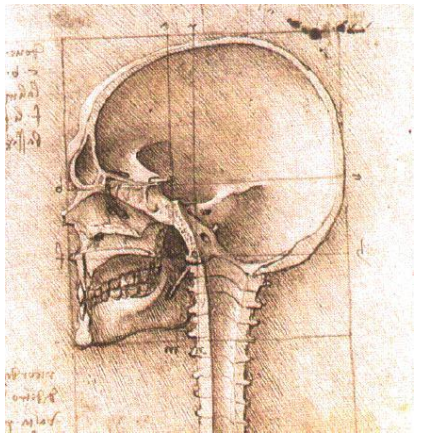
Anatomical study of the arm



Studies of Embryos



Study of the proportions of the head



Sectional view of skull

Preamble

Drawing tools and materials

1. Set-squares (45^o, 30^o-60^o)
2. Large sized compass
3. Small sized compass
4. Large sized divider
5. Small sized divider
6. Protractor
7. Scale
8. **Drawing pencils** (*H*, *HB*, , 2*H*)
9. Eraser/Rubber
11. Clips
12. Adhesive tape
13. **Mini Drafter**
14. Roll-n-draw
15. Old newspaper
16. Pen
17. French curves

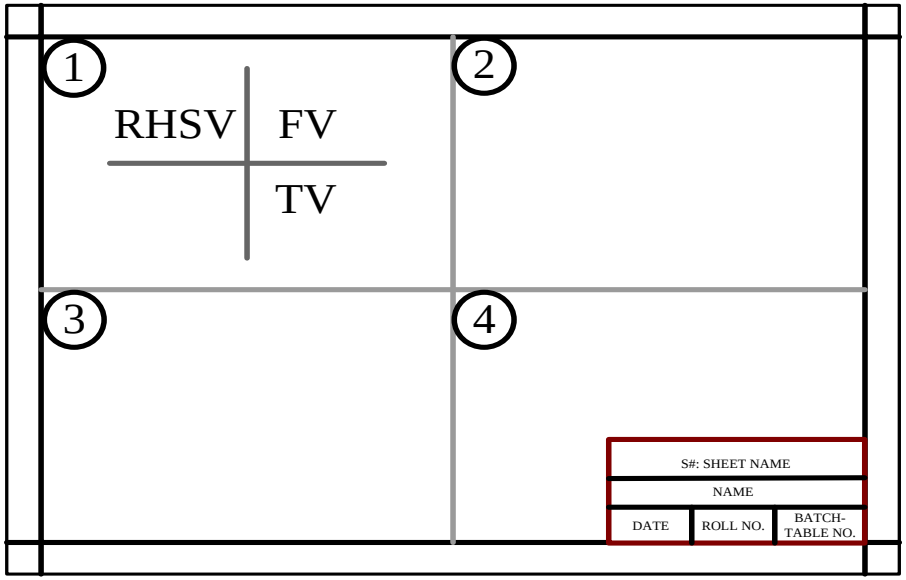
Drawing sheet (A3 size), Text book & class notes

All of these items are available at the IITB co-operative store or the two bookshops in campus

Preamble

Drawing tools and materials

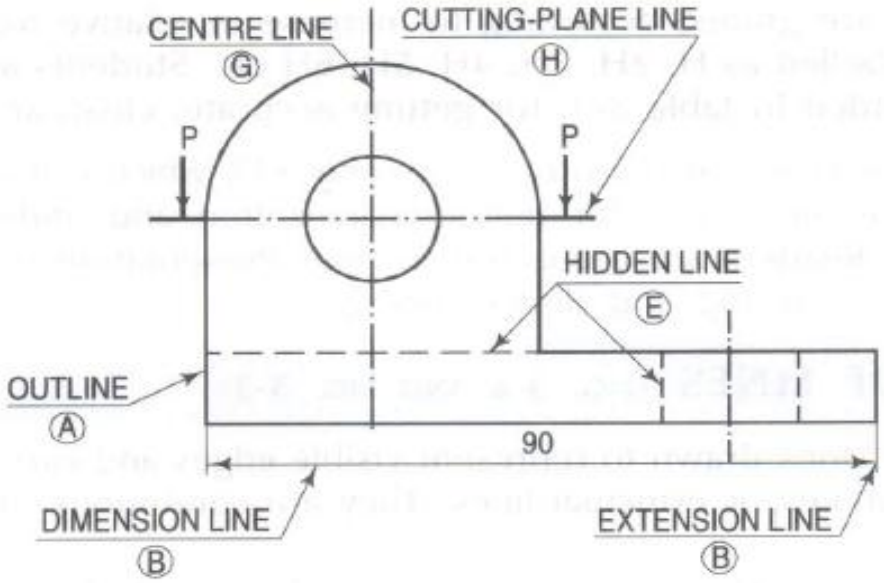
- Draw a 10 mm margin on all sides of the drawing sheet
- Draw a 150 mm x 45 mm rectangle in the bottom right corner and divide it into three smaller rectangles as shown.
- Write in INK/Ball pen the following:
- Sheet number and sheet name
- Name
- Date, Roll number and table number

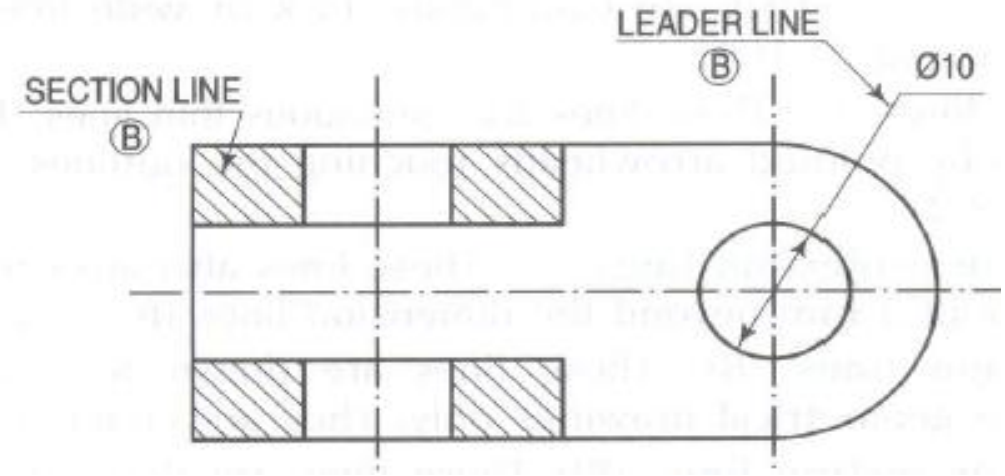


SHEET#: SHEET NAME		
NAME		
DATE	ROLL NO.	BATCH-TABLE NO.

Types of Lines

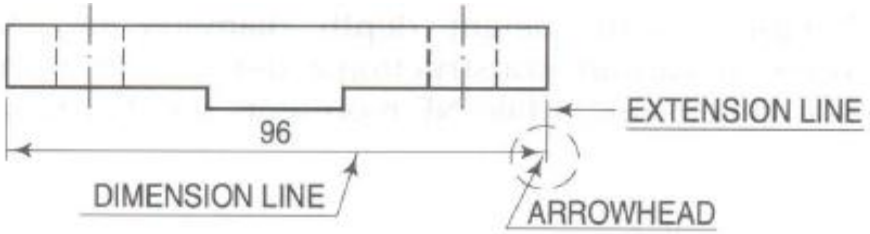
Ref: N.D. Bhatt et al., Engineering drawing

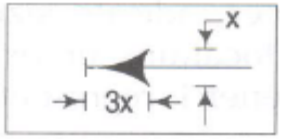


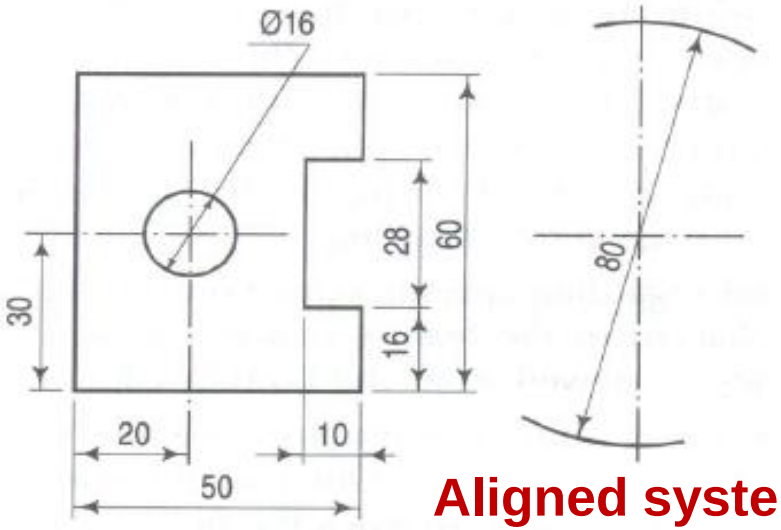


Continuous thick	Visible edges and surface boundaries of object
Continuous thin	Dimensions, extensions, construction lines, section lines, border lines
Dashed thick	Interior or hidden lines
Long-dashed dotted	Centre lines, lines of symmetry (Chain lines)
Chain thin with thick at the ends	Cutting planes

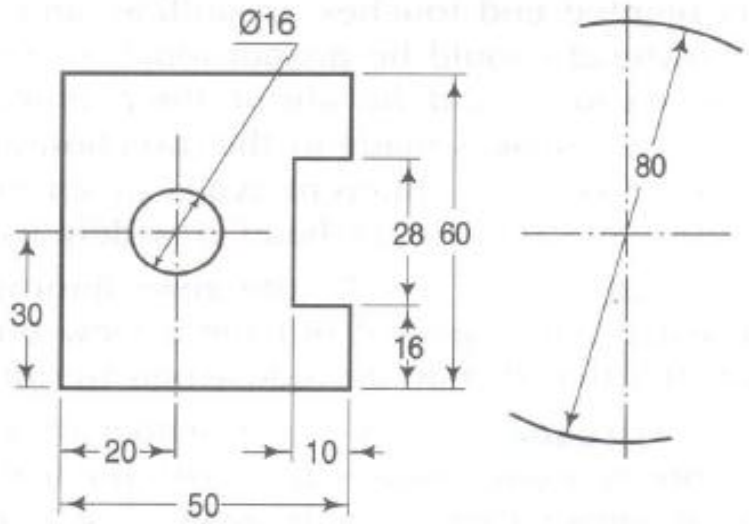
Dimensioning







Aligned system



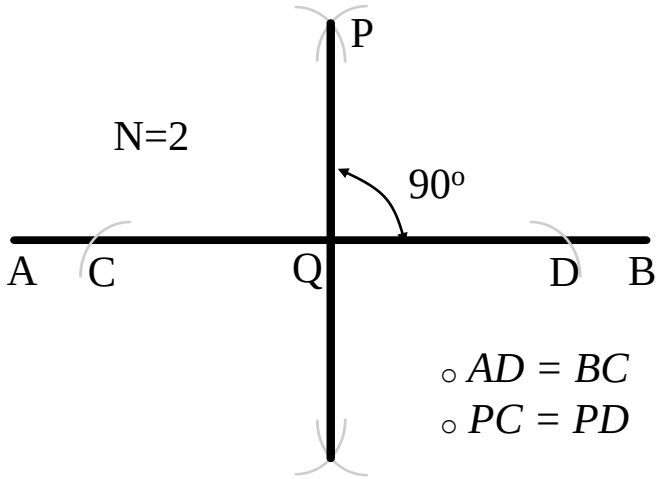
Unidirectional system

Rules for Dimensioning

- All dimensions are usually in SI units (especially in mm)
- All the necessary dimensions should be supplied
- No dimension should be repeated
- Dimension should be preferably written outside the figure
- Dimension lines should not cross any lines. Mutual crossing should be prevented
- **Aligned system** of dimensioning is recommended
- An outlines or centreline should never be used as a dimension line

Geometrical Constructions

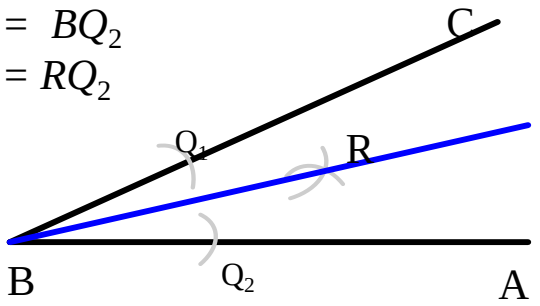
❑ ***Bisection** of line*



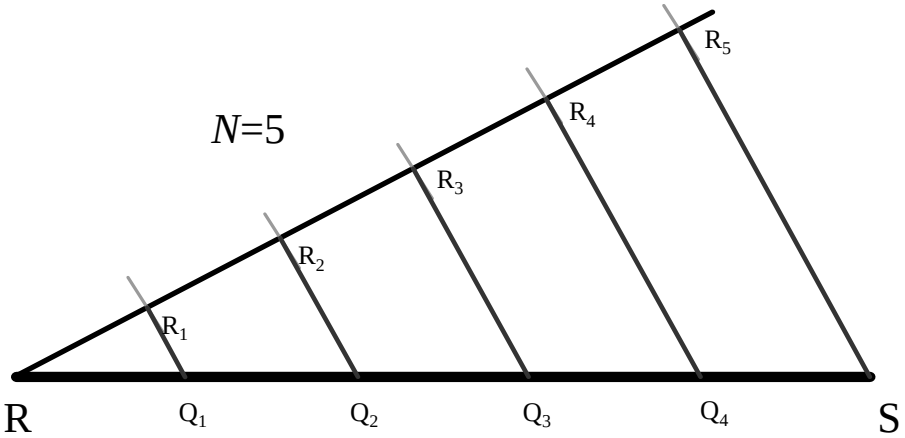
- $AD = BC$
- $PC = PD$

❑ ***Bisect** an angle*

- $BQ_1 = BQ_2$
- $RQ_1 = RQ_2$

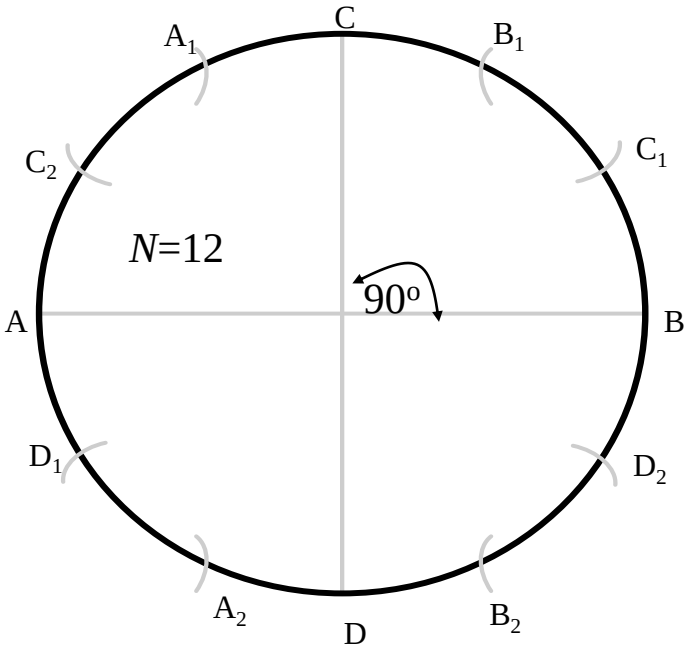


❑ *To divide line into "N>2" equal parts*



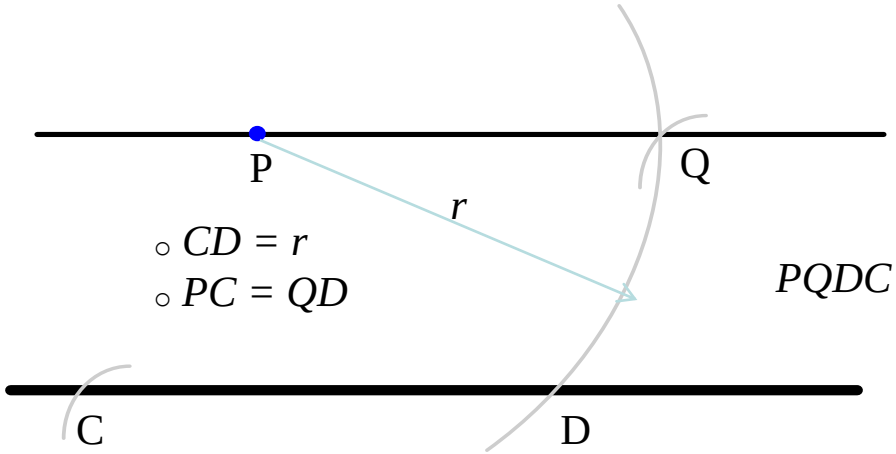
- $RR_1 = R_1R_2 = R_2R_3 = R_3R_4 = R_4R_5$
- $SR_5 \parallel R_4Q_4 \parallel R_3Q_3 \parallel R_2Q_2 \parallel R_1Q_1$

❑ *To divide circle into into "**N (12)**" **equal parts***



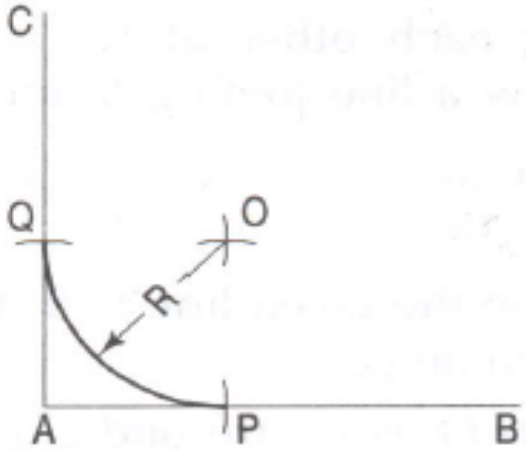
- $BB_1 = BB_2 = AB/2$
- Same for points *A*, *C* and *D*

❑ To draw ***parallel line*** at a given point to a given line

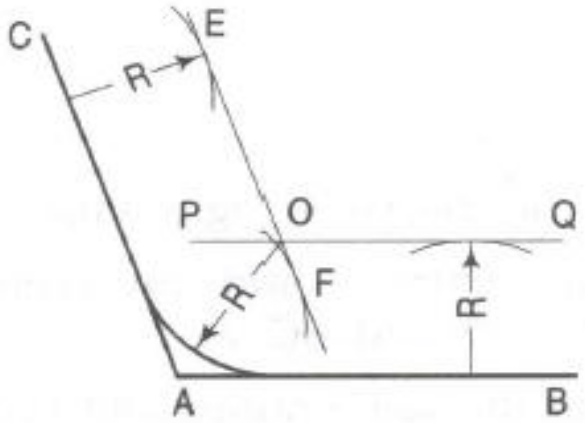


- *CD = r*
- *PC = QD*

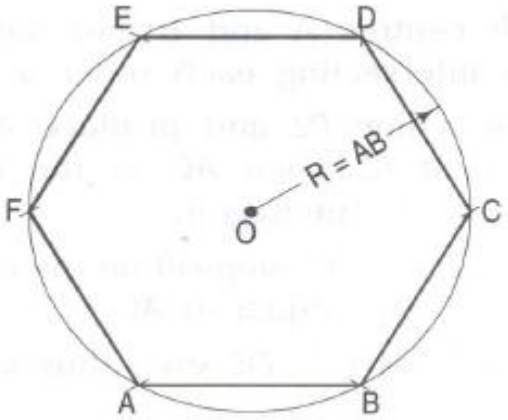
PQDC is a **parallelogram**

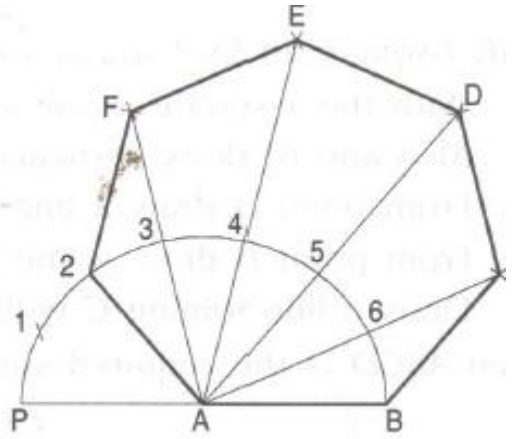


Arc of radius R to touch 2 straight lines which are perpendicular to each other

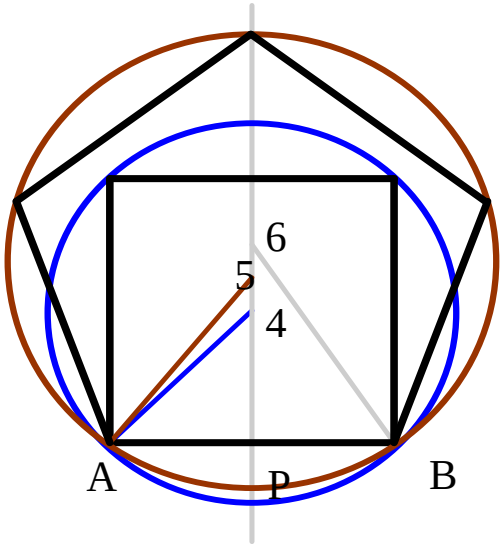


Arc of radius R to touch 2 straight lines which are perpendicular to each other



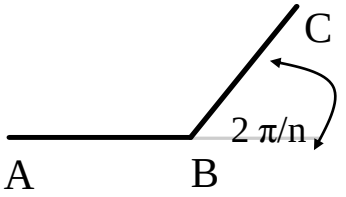


❑ *Regular polygon construction given the side*



For a regular polygon of "n" sides:

- External angle := $2\pi/n$
- Internal angle := $\pi(1-2/n)$



1. Draw ⊥ bisector "*P*" of *AB* (side of polygon)
2. Draw a line through A inclined to AB at 45º and a line through B inclined at 60º to intersect the ⊥ bisector at "4" & "6" respectively
3. Pts. "4" and "6" are the centre of the circle containing square and hexagon
4. Centre "5" for pentagon is the midpoint of "46“
5. "7" is given by "76"= "56" = "45"

Thank You!

K.P. Karunakaran
Professor
Department of Mechanical Engineering
Indian Institute of Technology Bombay
Powai, Mumbai-400076, INDIA
Tel.: 022-25767530/ 9869541570
karuna@iitb.ac.in
www.me.iitb.ac.in/~karuna