WELCOME TO
MECH 211, Mechanical Engineering Drawing

Time: M _ W _ _ 10:15 - 11:30
Credits: 3.5  Session: Fall 2013

Introduction
Lecture 1
Whatever area you will choose...

This course is fundamental.
A bit of history

• The objective need to communicate
A bit of history

- The time line

```plaintext
HISTORICAL TIMELINE

          |          | Perspective and Aerial Perspective | Descriptive Geometry | Isometric | Practices | Machine | Ivan Sutherland | "Sketch Pad" |
          |          | Durer da Vinci Francesca Alberti Brunelleschi
```
History in images
"Paper could take about anything"

Observe the way the posts are crossing

Have you ever seen such a construction?
The fundamental difference?

Artistic Drawing  Mechanical/Technical drawing

“On the Internet, nobody knows you’re a dog.”

© Cartoonbank.com
Content of the Course

A, B, C, D ARE POINTS
Content of the Course

A, B, C, D are points

AB, BC, CD, DA, CA are lines
Content of the Course

A, B, C, D ARE POINTS
AB, BC, CD, DA, CA ARE LINES
ABC, CDA ARE PLANES
Content of the Course

A, B, C, D ARE POINTS

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ABCD IS A SOLID
Content of the Course

A, B, C, D ARE POINTS
AB, BC, CD, DA, CA ARE LINES
ABC, CDA ARE PLANES
ABCD IS A SOLID

Link what you have learnt to what you are about to.....
Mission of the Course

• Enables the students to learn the techniques and standard practices of technical graphics

• At the end of the lectures, one would be able to:
  – Read a working or assembly drawing (blueprint)
  – Represent mechanical components in multiview orthographic representation
  – Create conceptual design sketches
  – Create assembly drawings (limited)
  – Capability to use AutoCAD for 2-D representations

* The amount of acquired skills will be proportional to the capabilities, will and effort of the individuals
Main Objective of the Course

• To acquire essential skills that are part of the mechanical engineering practice

• To be able to communicate with other mechanical engineering professionals regardless their spoken language

• To be able to communicate with manufacturers of mechanical systems
Class Logistics

- 3 teaching hours/week M-W-- 10:15 –11:30
- 12 weeks and one Review week
- 2 hour of tutorial – following the class
- 4 hours of laboratory – every 4 Weeks
- 3 parallel sections
Class Materials

http://users.icens.concordia.ca/~nrs.kumar

Required textbook

Recommended textbook
Class Materials

- Tutorial materials – handed in during tutorial periods, also available on the web. Tutorials will be held in AUTOCAD labs and set of practicing drawings available on the web site to learn AUTOCAD

- Assignments: 8 – available on the internet

- Solutions to the assignments will be with PODs after assignment due date

- RECOMMENDATION: Attend the classes!
## Class Materials

<table>
<thead>
<tr>
<th>Lect #</th>
<th>Textbook Chapter</th>
<th>Description</th>
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| 1      | 1, 6             | Introduction to graphic language and design, means and techniques, views of a geometric object, multiview projections, applications and examples -  
| 2      | 2, 3, 4          | Instruments, geometric constructions, CAD tools, demonstration examples -  
| 3      | 5, 7, 8, 10      | Sketching and shape description, shape generation, sectional and auxiliary views, examples and applications -  
| 4      | 19               | Descriptive Geometry – Points and lines, examples -  
| 5      | 19               | Descriptive Geometry – Points and lines, examples -  
| 6      | 20               | Descriptive Geometry – Parallelism & perpendicularity – examples -  
| 7      | 21               | Descriptive Geometry – Solids in space and Intersections – examples -  
| 8*     | 21, 22           | Descriptive Geometry – Intersections, examples,  
| 9      | 22               | Descriptive Geometry – Developments, examples, -  
| 10     | 11, 12           | Dimensioning and tolerancing, examples and applications -  
| 11     | 13               | Threads, fasteners, springs, gears, examples -  
| 12     | 14               | Design and working drawings – examples, Design case study -  
| 13     | ----             | Makeup class, Review –  

* During the tutorial period of week # 8, the midterm test will be carried

- **PowerPoint presentation**,  - **Material available on course website**,  - **Lecture to be done on board/screen**
Class Instructor and Contacts

Instructor: Dr. S. Narayanswamy

Office: EV Building

Room: 004 –124

Phone: 848-2424 (7923)

Office Hours: _ _ _ J _ 10:00 –12:00 or by appointment

e-mail: nrskumar@encs.concordia.ca

Course Web Site: http://users.encs.concordia.ca/~nrskumar/
What you have to do

• Attend the lectures, laboratories and tutorials – try to understand the objectives as well as the procedures

• Use time at home to read and study the chapters in the book – use the material posted on the internet

• Do your home-work by yourself – consult only your colleagues, tutor, lab instructor or class instructor

• Submit on time your assignments

• Write the midterm test – this is a good measurement means for your performance in the class

• Write the final exam with confidence that you will do very well
Midterm Exams

- Scheduled for October 28th, 2013 and it will be conducted during the tutorial period.

- The midterm test is not mandatory but is recommended.

- If the midterm result is better than the final, it will be counted for 10% towards final grade.
Laboratory

• There is lab component to this course
• You will be learning about few machineries
• There are four of them done in H-1067 once 4 weeks (4 hours a week).
• Safety is important and the details are available in the course outline.
Grading Scheme

• To pass, it is imperative to work during the term.
• The following grading scheme will be used for those who wrote the midterm and their grade is higher than the grade in the final:
  – Assignments: 16%
  – Midterm Examination: 10%
  – Laboratory 14%
  – Final Examination 60%
• who do not write the midterm or their midterm grade in below the final:
  – Assignments: 16%
  – Laboratory 14%
  – Final Examination 70%
Content of the first lecture

• Graphics as communication means
• A bit of history
• Multiview representation and orthographic projections
• Technical procedures
• How to generate multi-view orthographic projection
• Representation rules
Mechanical components
Geometry is a fundamental thing!

In Nature

In Human Need

• http://www.webshots.com/g/55.html
Introduction to Graphic Language and Design

• Why graphics is necessary?
  – Communicate information that would not be possible to exchange in writing

• Why not use pictures to communicate visual information?
  – Usually, a drawing represents something that exists just at conceptual level

• Why not use pictorial representation?
  – The information contained in a drawing must be used to build an accurate component/system.
What is Drawing?

- Drawing is a graphic representation of a real thing, an idea, or a proposed design.

- Why graphic representation?
  - Graphic method of representation is a basic natural form of communication of ideas that is universal and timeless.
  - It is impossible to explain things through text.
Graphic Language

A simple component!

• How hard to define in words?

• Try to describe in words the following representation: A MECHANISM
Graphic Language

- Graphics language is universal
Graphic Language

- The information can be conveyed regardless the spoken language
Graphic Language

• When spoken language is known, the information is more accurate
Essentials of a good drawing

• Should represent the concept/idea/geometry clearly
• Should be able to communicate with others without doubt
• Should respect the manufacturing feasibility
• Should favor a lot standardization

Let’s see how to make a good mechanical drawing!
Views

• An object could be represented in more ways:

Isometric  Oblique  Multiview
Projections/ Drawing Basics

- The way one is visualizing an object
  (Simple and sufficient)
- Two basic projection types – use parallel projection

Perspective

Parallel
What is perspective representation

- Representation of objects based on the rule of distance: 2 identical object are seen different from different distances – shape is deformed too
- This type of representation is not used for technical purposes in Mechanical Engineering
What should be drawn?

- What is seen – follow certain rules
Views - Multi-view representation

Top view

Front view

Right side view

Project the visible and hidden edges/corners

Plane of projection from (l)

Projectors perpendicular to plane
Views - Multi-view representation
Multi-views

• A part is represented in multiple views (a single part is seen as more than one part)

• The representation makes the user to fully understand the shape of the part, to perceive the relative proportions of the geometric features and to position the features one with respect to another

• The parallel projection principle and the alignment of the features is used in the representation
Type of Projections

**FIGURE 6.47** First-Angle Projection. An object that is above the horizontal plane and in front of the vertical plane is in the first angle. An observer looks through the object to the planes of projection.
Projection planes

- The component is aligned with respect to the principal projection planes
  - Top (T) or Horizontal (H)
  - Front (F) or Vertical (V)
  - Side (S) or Profile (P)

- The projection is carried such that each feature parallel to the projection planes to be seen as true length
Object orientation
Projection principles
Projection principles
Projection Types

Third angle projection

First angle projection
Relative position of the views

- All views must be aligned with respect to each other – feature to feature
Drafting strategies (3 view)
Technical procedures

- When representing the third view, scale, divider of miter line is used to ensure the alignment of the three views.
Example

- Represent the shown component using multiple view representation
Example

• Start with the front view
• The edge C cannot be seen but is represented by a dashed line (hidden feature)
Example

- Align the top view with respect to the front view
Example

- Complete the representation
- Later, dimensioning and comments will be added to the drawing
The principal projection planes

- The object should be aligned with respect to the projection planes
The principal projection planes
- unfolded

- Notice the relationship between the features

- The depth – distance from the front to the object is measured in the Horizontal and Profile
Multi-view Projection Drawing

How to generate

• Assume the given part as shown besides.

• Position the part in a convenient way, to simplify the representation as much as possible
Multi-view Projection Drawing

How to generate

- Select the position of the projection planes
- Start with one of the projections – usually the front view
- Each edge is represented based on the principle of the parallel projection
Multi-view Projection Drawing

How to generate

- Complete the first view.
- Use the basic representation Principles:
  - visible edge is seen as a full line
  - non-visible feature is represented by a dash-line
  - axes of symmetric features are represented by dash-dot lines
Multi-view Projection Drawing

How to generate

- Continue with the second view
- Make sure that you have accurately align the two views.
- Use the same rules for representation.
- The alignment lines must be perpendicular to the edge of the projection planes
- (The lines of sight are always perpendicular to the fold line).
Multi-view Projection Drawing

How to generate

- Continue with the third view
- Make sure that you have accurately align all views.
- Use the same rules for representation.
- The alignment lines must be perpendicular to the edges of the projection planes
- (The lines of sight are always perpendicular to the corresponding fold lines).
Multi-view Projection Drawing

How to generate

- **Complete the representation**
- Separate the top from the profile view along the edge (fold line)
- Unfold the three views to lay them on the same plane
Multi-view Projection Drawing

How to generate

- This is the 3-view orthographic representation of the selected part (FLANGE)

- * Do not erase any of the lines when writing a test
Orthographic multi-view

- The above part will be projected on all 6 projection planes
Orthographic multi-view
Orthographic multi-view
Orthographic multi-view
Orthographic multi-view
Orthographic multi-view

Solid models
Minimum number of views

- Certain shapes could be described in less number of views
- One must use the minimum number of views for representation
Minimum number of views

- Do not produce more views than necessary
Centerline

- Axi-symmetric features are indicated with a dash-point line - CENTERLINE
Hints on understanding shapes

- Try to “see” the way a solid is created out of primitives
Hints on understanding shapes

• Complex shapes could be generated using Boolean operations
Pay attention to edges
Projections and views (brief)
Where drawing is used?

• It is important to know the rationale of drawing
• Drawing is an international communication language
• Fast way to convey certain type of information
• Limited number of concepts are better represented by drawing, but not all
The design process

- Drawings are created to represent parts that do not exist yet
- The designed parts are intended to be manufactured
- The drawings must carry all the necessary information that enables the fabrication of the part
The design process

• Design involves constrained creation
• Constraints:
  • Technology limits
  • Human and environment concerns
  • Durability and reliability
  • Cost
  • Market requirements
  • Etc.
The design process

- REPRESENTATION
- PERCEPTION
- KNOWLEDGE
- INTUITION
- CONCEPT
- PURE CONCEPT
- EMPIRICAL CONCEPT
- NOTION
- IDEA

Basic requirements to be able to perform a design

All the above interacts in your judgment even if you are not aware of it

You have to train your judgment to be able to perform solution-solving based thinking

The graphic helps you to do so
The design process

• A design is created after analysis, full understanding of requirements and constraints and synthesis

• Two individuals may not come with the same solution to the same problem
  
  • Example: Connect two straight pipes ND 4” to avoid leaking of the gas and to permit easy maintenance of the segment
Solutions to the problem

- Multiple: flanges, clips, clamps, seals, etc.
Concurrent engineering approach

1. Problem Defn.
2. Concept and ideas
3. Solutions
4. Models/Prototype
5. Production and working drawings

The design process

Concurrent engineering approach
The design process
The design process

- Input
  - Customer Needs/Demands
  - Material
  - Capital
  - Energy
  - Time
  - Human Knowledge
  - Human Skills
  - People

- Processes
  - Designing
  - Planning
  - Producing & Constructing
  - Managing
  - Marketing
  - Financing
  - Documenting

- Output
  - Products, systems, or structures for various markets
  - Support Activities
    - Training
    - Service
    - Customer Satisfaction
  - Company Profits
Drawings in product development

Designer

Functional Drawings

Sketches

Mechanical Engineer

Vendors/Customer

Quality Assurance

Assembly Drawings

Assembly Drawings

Production Shops

Assembly Drawings

Assembly

Prod. drawings

Production Shops
Drawings in product development
A Component!