

CM3215

MichiganTech

**Fundamentals of Chemical Engineering
Laboratory**

Professor Faith Morrison

Department of Chemical Engineering
Michigan Technological University



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CM3215 Fundamentals of Chemical Engineering Laboratory

Course Description: An introduction to basic laboratory methods and instrumentation used in the measurement of fluid flow and heat transfer

Skills:

- | | |
|---|--|
| <ul style="list-style-type: none">•Lab Safety•Viscosity, density measurement•Differential pressure measurement•Use of control valves•Fluid flow measurement•Heat transfer measurement•Process modeling•Pumping | <ul style="list-style-type: none">•Visio for Piping & Instr. Diagram•Teamwork•Good lab practice•Data presentation•Statistical analysis/Error Anal•Report writing•Computer skills |
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Course Structure:

- Monday and Wednesday 10am (lecture/lab)
- Tuesday in lab
- Lab groups of two persons; assigned by Dr. Morrison
- Lab reports due, in person, the week after lab session (Wed)
- 6 lab reports (5-10-15%); 8 assignments+1 quiz grade (30%); lab performance (10%)

Lab Materials:

- Bring **bound laboratory notebook** to lab every lab day **starting Tuesday** (Start TOC; tape P&ID sketch into notebook)
- Bring blue or black pen (not pencil)
- Safety glasses are provided
- Do not wear shorts, sandals; follow dress code

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CM3215 Fall 2014 Course Schedule

Week	Monday		Tuesday		Wednesday		Friday	Week	
	1 hour Lecture		A groups	B groups	Lecture	peer evals	Reports due		Assmts due
cycle 1	1	Labour Day no class	Excel A	P&ID B	Intro reports metrics SP meter				P&ID Assent 1 due
	2	Statistics Lecture 1	Pressure A	Replicates B	Viscosity lecture			Replicate Assignment 2 due	
	3	Statistics Lecture 2	Replicates A	Pressure B	no lecture		Pressure Report 1 due		
	4	Statistics Lecture 3	Viscosity A	Error Prop B	Flowmeter			Error Propgn Assmt 3 due	
cycle 2	5	Statistics Lecture 4	Statistics Project A	Rotameter B	no lecture	peer evals	Viscosity Report 2 due		
	6	no lecture	Rotameter A	Statistics Project B	Control Valve Lecture				Statistics Assent 4 due
	7	no lecture	Contr Valve A	no lab D	Friction in Pipes Lecture			Rotameter Report 3 due	
	8	no lecture	Friction A	no lab B	no lecture				Control Valve Assent 5 due
	9	System Curve Lecture	no lab A	Friction D	Pumping lecture				System Curve Assent 6 due
cycle 3	10	no lecture	Pump A	no lab D	Heat Exchanger Lecture	peer evals	Friction Report 4 due		
	11	no lecture	no lab A	Heat Exchanger B	no lecture		Lossy Pump Report 5 due		
	12	no lecture	Heat Exchanger A	no lab B	no lecture				
	THANKSGIVING BREAK								
13	RTD Modeling Lecture	no lab A	RTD B	no lab G	no lecture		Heat Exchgr Report 6 due		RTD Modeling Assent 7 due
14	Heat Transfer Model Fit Lab	Heat Xbr A	no lab B	Heat Xbr B	peer evals				Heat Xbr Assent 8 due
15	Finale								

Lab handouts are on the class website:

www.chem.mtu.edu/~fmorriso/cm3215/cm3215.html

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Lab handouts are on the class website:
www.chem.mtu.edu/~fmorriso/cm3215/cm3215.htm
 ***If the date on the document is not the current semester, it is likely to be updated in the near future

Week	topic	Lecture notes	Lab Procedures	Assignment Instructions	Handouts
1	Laboratory Orientation (Visio P&ID)	Lecture: Class Introduction updated 12 January 2014	none	Assignment 1: Create a P&ID for the laboratory station updated 2 Sept 2013	Visio Instructions 2007 Handy Sheet for Units Guide to P&ID Symbols

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- Lab groups assigned by instructor
- Serve as safety team once or twice in the semester
- Station assignment depends on student number assigned

Lab Group and Safety						
1pm	station cycle 1	station cycle 2	station cycle 3	student number	safety assignment	week (A)
		10	10	10	1	Pump
	10	2	3	2	Special Topic: MIOSHA	13 13
	2	2	2	3	Viscosity	3 4
	2	3	4	4	Viscosity	3 4
	3	3	3	5	Special Topic: MIOSHA	13 13
	3	4	5	6	Rotameter	6 5
	4	4	4	7	Rotameter	6 5
	4	5	6	8	Control Valve	7 7
	5	5	5	9	Control Valve	7 7
	5	6	7	10	Friction	9 8
	6	6	6	11	Friction	9 8
	6	7	8	12	Heat Exchanger	12 11
	7	7	7	13	Ladder safety	3 3
	7	8	9	14	Ladder safety	3 3
	8	8	8	15	Heat Exchanger	12 11
	8	9	10	16	Pump	10 10
	9	9	9	17	Pressure	2 2
	9	10	2	18	Pressure	2 2

See:

www.chem.mtu.edu/~fmorriso/cm3215/safetyandlabgroups.html

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Safety

•Laboratory Safety Manual is on the web (PRINT IT)

www.chem.mtu.edu/~fmorriso/cm3215/CM3215SafetyManual2007.pdf

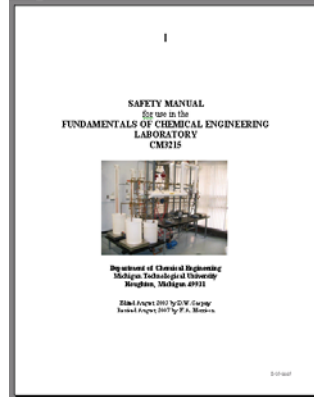
•You must follow all instructions in the Safety Manual at all times

•Required:

Wear Safety glasses/goggles
Name tag

•Prohibited:

Open-toed and open shoes
Shorts, skirts
Eating, drinking, water bottles
Backpacks on the floor



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PAWS Program

•Prevent Accidents with Safety

•Read up on it in Safety Manual

•Goal: prevention

•Report unsafe acts/conditions

•A more in-depth version is followed in Unit Operations Lab

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Department of Chemical Engineering
Fundamentals of Chemical Engineering Laboratory

PAWS
Prevent Accidents With Safety

Unsafe Acts:
 Chemical Safety problem
 Improper PPE
 Unsafe Act in Lab or Improper Use of Equipment
 Other: _____

Equipment or Facility Problems:
 Violation of Hazard Communication Standard
 Leaks
 Safety Equipment problem
 Electrical problem
 Faulty Equipment
 Hot Surfaces
 Odors
 Missing Guards

____ Safety Suggestion (describe below)

Explanation (where, when, how, what, equipment name, etc.):

Action Taken:

Your Name: _____

Date: _____

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PAWS Program

Safety Team

- Responsible for presenting a summary of safety points at the beginning of a lab day
- Responsible for taking a special interest in hazards and safe operation of all the laboratory stations
- Reviews PAWS reports, follows up on open PAWS reports
- Team must submit separate printed one-page **Safety report** (memo) to TA (due same day and time as reports) (*there is a sample safety report on the website*)

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Email in a Professional Setting

- Include a salutation (Good Morning, Good Afternoon, etc.)
- Include sentences, punctuation
- Leave off emoticons
- Be conscious of tone
- Include units with data
- Sign your name(s), group #
- Avoid attachments, especially if ASCII (plain) text would do

From: Jane Stewart" <janest@mtu.edu>
Subject: Lab 04, Group 3 Viscosity Data
Date: Thu, September 20, 2007 11:01 am
To: fmorriso@mtu.edu

Good Morning Dr. Morrison,
As you requested, we are sending your our
viscosity data from lab 3.

soln
conc T Viscosity (cP)
0% @ 23C: 0.932
0% @ 40C: 0.664

40% @ 23C: 5.252
40% @40C: 3.149
40% @ 60C: 1.998

65% @ 23C: 103.647
65% @ 40C: 41.346

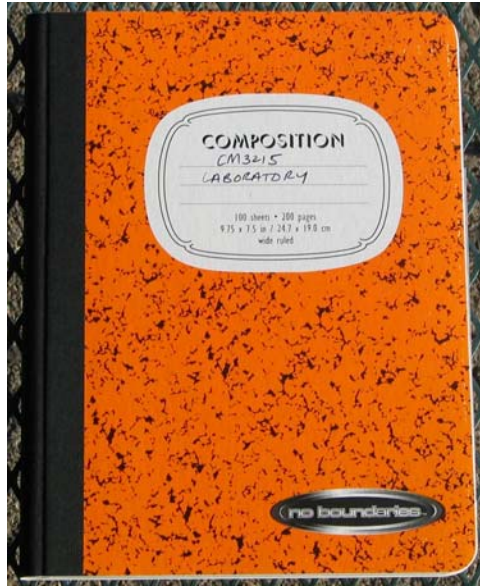
Thank you,
Jane and Yangsoo
Group 4 Lab section L02

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Laboratory Notebook

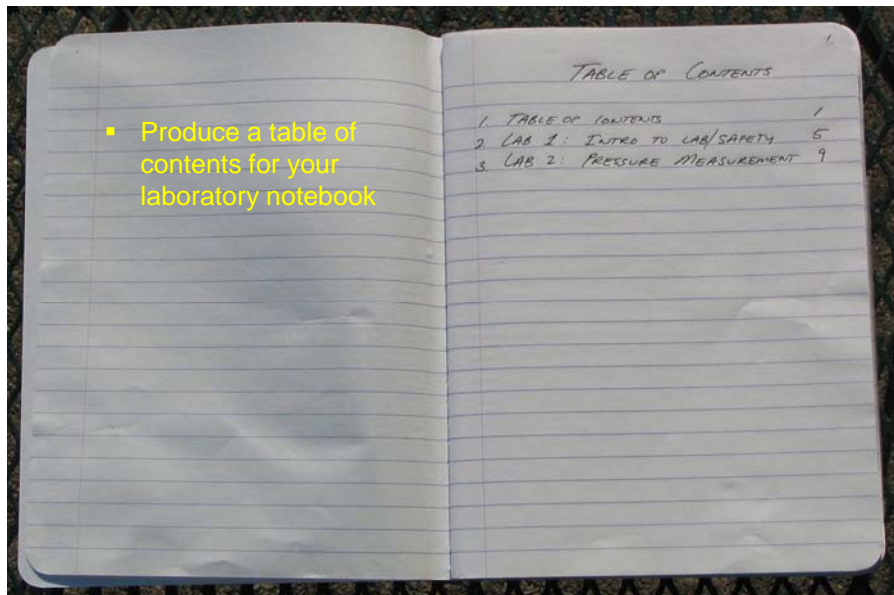
- Bound – preserves the order of events, keeps things organized
- Cross out pages or items that need to be deleted – do not remove pages
- Use black or blue pen, not pencil (this is meant to be an archival record of your activities; colored inks fade and pencil smudges)



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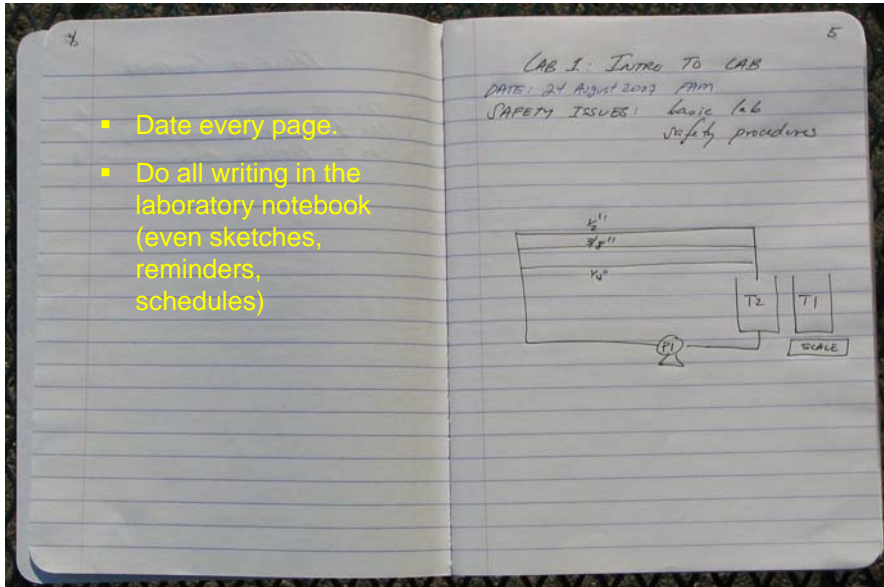
- Produce a table of contents for your laboratory notebook



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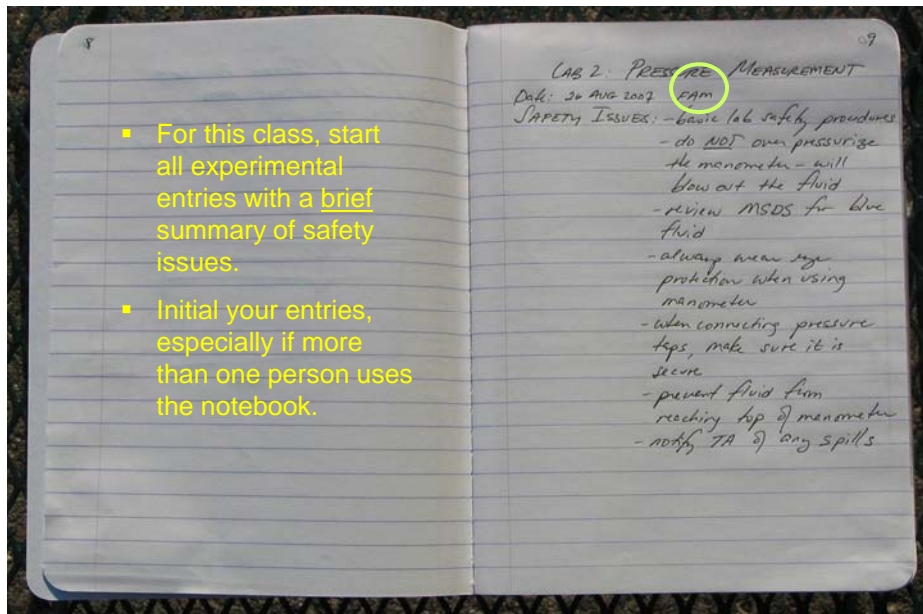


- Date every page.
- Do all writing in the laboratory notebook (even sketches, reminders, schedules)

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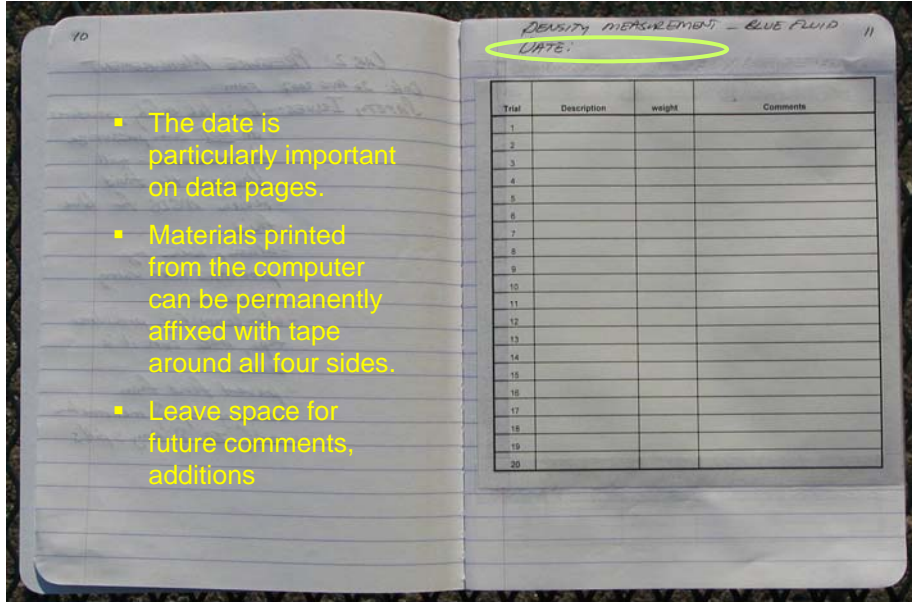


- For this class, start all experimental entries with a brief summary of safety issues.
- Initial your entries, especially if more than one person uses the notebook.

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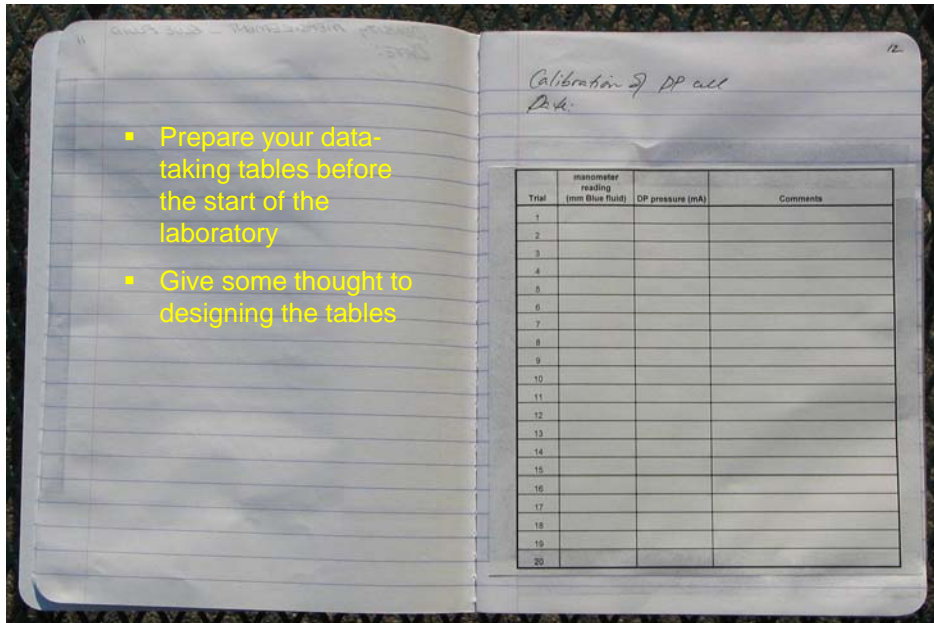


- The date is particularly important on data pages.
- Materials printed from the computer can be permanently affixed with tape around all four sides.
- Leave space for future comments, additions

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- Prepare your data-taking tables before the start of the laboratory
- Give some thought to designing the tables

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Letter (memo) of Transmittal

- Purpose is to “transmit” an item
- Short, simple; gets reasons for submission down on paper

Memo

To: Professor Faith Morrison
From: Silvia Smith
Date: September 4, 2007
Subject: Report on Status of 30-Gallon Reactor

Attached please find my report on the current status of the 30-gallon reactor in B001. Per your request of 5 August 2007, we have inspected the instrument and determined what steps are necessary for putting it into service. The details are found in the attached report.

If you have any questions, please contact me at ssmith@industry.com or 906-487-2050.

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Assignment 1: (group assignment)

- Create P&ID Diagram for the CM3215 Laboratory Station; you may consult with other groups; submit your own team work
- In your cover memo, list all the valves and devices in the path that would direct water from the feed tank, through the ¼” line and back to the discharge tank.
- Submit to your results with memo of transmittal (Due this Friday, 10am, Homework Box A, 2nd floor ChemSci)
- Affix a copy of P&ID in your lab notebook
- Affix a copy of unit conversion table to your lab notebook:
www.chem.mtu.edu/~fmorriso/cm310/convert.pdf

Laboratory Orientation

Pre-laboratory Assignment
Review the software MS Visio 2007, which is part of the MS Office suite of software products and is available on laboratory computers.

Introduction
There are several types of engineering drawings that are commonly created in the engineering, design, construction, and operation of chemical-processing equipment. Each drawing has a specific purpose and each is necessary to communicate information to others working on the same project.

A block flow diagram is developed during

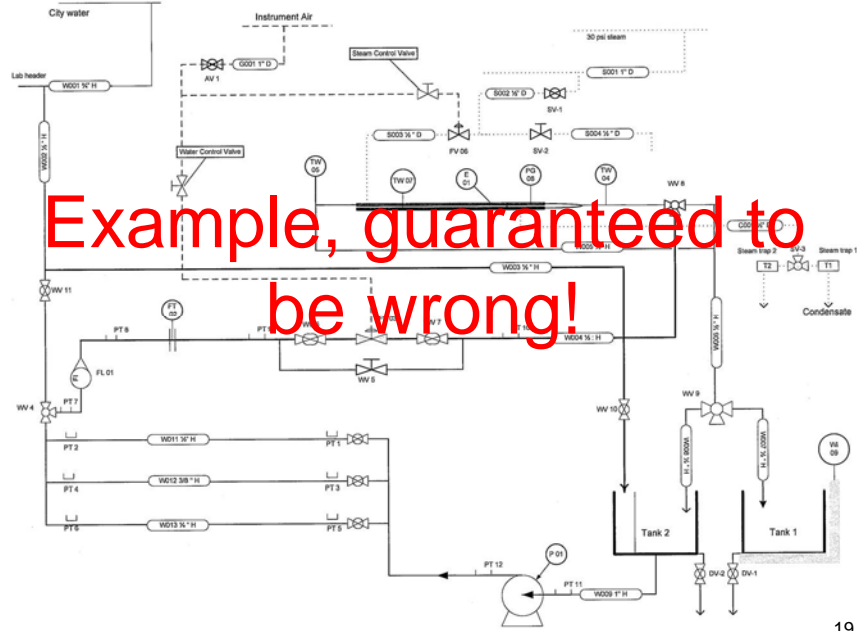
sheet and piping specifications.

Although other a typical process installation details is the master documents reference process “from current with all of the process.

The Instrument Automation Society publishes a set symbols for con

Experimental
Create a P&ID
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Now, on to Laboratory 1: Calibrating the DP Meter

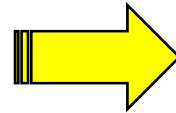
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Calibrate the Differential Pressure Meter



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