GOAL

You will write a technical memorandum to communicate to your boss about the progress/results of your design for **_one_** of the following subsystems of the proof-of-concept process:

1. tubing and pressure transmitter;
2. evaporator structure/container;
3. condenser;
4. control loop for liquid flowrate.

You should select the subsystem for which you think you have provided a significant contribution to the group. Multiple group members may elect to write about the same subsystem.

Your boss has a PhD in Chemical Engineering and is very familiar with your project, but she doesn't know – or remember – all details. She has a good understanding of desalination, pumping, evaporation and condensation, and doesn't need a detailed explanation of physical mechanisms of these processes.

You could write multiple pages on these topics, but your technical memo will be only one page of text! You must be complete, concise, clear and correct.

Save your technical memo (with attachment) as a .pdf file and submit it by sending an email to vicic@caltech.edu by **_8pm on Monday, Nov. 2, 2015_**. Use 'ChE126: Technical Memo' for the subject line.

COLLABORATION POLICY

You may discuss the contents of the technical memo with any student in class, even if that person is in another group. You may give each other feedback about contents, grammar and writing style, but your memo must be in your own words. You may ask TAs/instructors for clarification about the assignment, but they will not read your memo nor provide specific feedback before you submit your work.

GRADES

Your technical memo will be graded in six different categories:

1. Memo Format & Overall Contents (10%): Did you follow instructions for the assignment?
2. Purpose & Summary (10%): Did you properly convey why you are writing the memo and properly summarize the contents that follow?
3. Discussion (45%): Did you address pertinent issues in a way that was concise, clear, complete and technically correct?
4. Action (5%): Were the actions clearly and correctly communicated?
5. Table (20%): Was the table complete, relevant and easy to read?
6. Grammar and Writing Style (10%): Includes spelling, punctuation, word usage, grammar, etc.

DETAILS ABOUT A TYPICAL TECHNICAL MEMORANDUM

A technical memo is a memorandum that focuses on the scientific and/or engineering issues of the topic being discussed.

Memos never include a salutation or a closing. Less formal salutations (Mike:) and closings (Thanks,) are used for informal communications like e-mail. More formal salutations (Dear Dr. Vicic:) and closings (Sincerely,) are reserved for formal communications like business letters.

A memo typically has this structure:

> MEMORANDUM
>
> Date: [Date]
>
> To: [Name], [Title, if necessary]
>
> From: [Name], [Title, if necessary]; [Name], [Title, if necessary];…
>
> RE: [Subject]
>
> [Body]

Use double-line spacing between elements of the memorandum. For the body of the memo, use single-line spacing within a paragraph and double-line spacing between paragraphs. Don't indent paragraphs in the body. Use reasonable page margins (one inch), font size (between 10- and 12-point) and font.

The [Subject] should not exceed one line of text, but it should be long enough that it provides a very brief summary of the contents. Sometimes the [Subject] even includes a short summary of the conclusion or take-away message.

The [Body] is comprised of four unlabeled parts, each with its own paragraph:

> Purpose of Memo (often just a single sentence)
>
> Summary (it's included early so managers with short attention spans still read your
>
> > important findings and know what you did)
>
> Background/Discussion (sometimes more than a paragraph, but brief)
>
> Action (usually a sentence or two, describing the next actions and followups)

DETAILS ABOUT YOUR TECHNICAL MEMORANDUM

See the previous page for more details about format, font, font size, margin, etc.

Your one-page memo should resemble the general technical memo format on the previous page. For this assignment you should address the following items in each unlabeled section of the body:

- ***Purpose of Memo***: In one sentence, state clearly why you are writing the memo. Include your use case/application as part of this sentence.

- ***Summary***: In one sentence (or two at most), state what item(s) you propose should be purchased (or that have been purchased) for the proof-of-concept process, and ***briefly*** justify your selection(s).

- ***Background/Discussion***: In one paragraph that is comprised of multiple sentences, describe in greater detail why the item you selected is best suited for the proof-of-concept process. Refer to the attached table of requirements at some point in this paragraph.

- ***Action***: Use one paragraph with two sentences. In the first sentence, briefly state what major tasks must still be completed for this subsystem, including approximate completion/delivery dates. In a second sentence, state how and when you will communicate future updates, findings and recommendations.

You may not use a second page for text. One of the objectives of the assignment is for you to learn how to be clear and complete while writing concisely.

DETAILS ABOUT YOUR ATTACHMENT

Attach a page that includes a table of requirements FOR THE PROOF OF CONCEPT PROCESS and any references used in the memo or the table. The requirements table for the critical aspects of your subsystem should have a format similar to:

	Attribute	Brief Description about Attribute for Proof-of-Concept Process	Measurable Quantity & Units	Priority (1: lowest – 5: highest)	References (If Necessary)
1					
2					
3					
…	Temperature	Item must withstand temperatures between room temperature and max operating temp of previous subsystem.	70-250°F 70-200°F	3 5	3
n					

Table 1. *Requirements for []*. [Caption text].

There is no min/max number of requirements for this assignment, except that the table should fit on a single page and include all critical requirements. Some notes:

- *__Attributes__*: Use a word or a few words.
- *__Brief Description__*: You do not need to use full sentences, clauses are OK. Use as few numbers as possible, instead describe the requirement in words.
- *__Measurable Quantity__*: Now use numbers that correspond to the words in the previous column. You may have more than one set of numbers, each with its own priority.
- *__Priority__*: Rank the priority of requirements on a scale of 1-5. If an attribute has more than one line for measurable quantity, make sure there are an equal number of lines for priority. (In the example above, the item might be optimal if it can withstand a temp range of 70-250°F, but it might not be operable if can't withstand a temp range of 70-200°F.) Priority lets you select amongst different criteria for the same attribute and make decisions about competing requirements for different attributes.
- *__Reference__*: Use a number or first author's last name, and then use the same convention in the reference section below the table. If somebody in the group did a calculation or provided info, list that as a personal communication in the references. If there are no references, simply put N/A. If there are multiple references for the same attribute, separate them by commas.

HELPFUL HINTS/REMINDERS ABOUT WRITING

In the rest of this document, I'm including some helpful hints about writing. You might find some of these tips useful when writing this memo. You'll also find an explanation on the next page about the caption for the table shown above.

Tips & Helpful Hints for Tables

Table Captions

If you are submitting your work to a journal that has clear specifications for table captions, then you should follow that publication's style. If you have good reason to deviate from that style, contact the editor or editor's assistant for advice. For instance, some journals require that you use only standard text in captions, while other publications may allow special symbols.

Your caption should follow the general rule about being clear, concise, complete, and correct. Conciseness is more important than completeness since you have limited space for captions, but the captions should be complete enough that the reader can understand your point by just looking at the table and reading the associated caption. Remember, your adviser won't actually read the article unless tables and their captions present a compelling enough story. Your boss doesn't have time to read everything, and generally just looks at pictures and tables.

For this course, each caption should have the following format:

> **Table #**. *Caption Title*. Caption text.

> Tables are numbered consecutively as they are referenced in the text. The number is an Arabic number (e.g., 1, 2, 3, etc.). "Table #" is in regular bold text.

> The caption title should be no more than ten words. The caption title is shown using title case, with the first letter of each important word in uppercase and the remaining letters in lowercase. "Caption Title" should be in italics text.

> The caption text is in paragraph case, with the first letter of each sentence in uppercase. The caption text includes complete sentences. "Caption text" should be in regular text.

> All parts of the table caption use the same font style and the same font size.

> The total length of the table caption, including the title and the text, should be no more than four lines of text.

Writing Tips & Helpful Hints

By Sentence

Keep the subject and the verb close together: When you place multiple prepositional phrases, adverbs and other clauses between a subject and the verb, the resulting phrase or sentence is often confusing because it's often not clear who or what is performing the action.

Make sure the subject and predicate agree: If your subject is plural, your verb should be plural. Likewise, if your subject is singular, your verb should be singular. These statements sound obvious, but so many students make this mistake. Usually, it's clear whether your predicate should take its singular or plural form. Unfortunately, there are words like group and family, for which it is unclear and depends on context. If you talk about the group acting as a whole, then 'group' is singular. If you talk about the group acting as individuals, then 'group' is plural.

Make objects/modifiers very clear: When using words like 'this' and 'it' by themselves, readers may not quickly understand what you write; instead, you should use 'This _____' so that _____ is a noun. Make sure that words like 'it' appear close to the object to which it refers.

Use active voice, not passive voice: Active voice is much easier to read because the verbs are dynamic and because you'll be more concise. I should not read many sentences that state "It was shown that…"

You may use first person: You may use 'we' or 'I,' but don't start every sentence with those words. You'll find you more frequently write concise sentences in active voice when using 'we' or 'I' by avoiding really complex sentence structures. Also, the words 'we' or 'I' are more appropriate for the methods section – the section where you describe what *you* did – than they are for the discussion section.

Avoid run-on sentences: If you write a sentence that is longer than three full lines, you've likely written a run-on sentence. While it's true that you can write a properly constructed sentence to be of any length that you want, I typically find that students don't properly use punctuation and connecting words appropriately to write a proper sentence longer than three lines.

Avoid using more than four consecutive adjectives: If you use more than four consecutive adjectives to describe a noun in scientific writing, then you're probably using too many modifiers, making it difficult for your readers to follow your writing – or your writing is just too flowery.

Avoid parenthetical statements: If you think the statement is important enough to include, then you should include it in the body of the paragraph. If the statement truly is not critical to make your point in that paragraph, then you can either eliminate it or reference it to a source material.

Be quantitative, not qualitative, whenever possible: Don't just say that something 'increased dramatically.' The word 'dramatically,' while descriptive, is biased and inexact since it means different things to different people. That's your opinion that it's dramatic. You should instead be quantitative and say 'increased by 500%.' If you *really* want to convey to the reader that this number is dramatic, then you can say 'dramatically increased by 500%' or 'increased by 500%, which is a dramatic difference compared to….' We often save these opinion words for the conclusion.

Use assertion and speculation appropriately: When making claims, be sure to use an appropriate tone, based on quality and quantity of data to support a statement.

By Word

Define abbreviations on first use in the body of the report: If you use an abbreviation, you must define it the first time you use it in the report. On subsequent uses, you can just use the abbreviation. For instance, first use 'Principal Component Analysis (PCA)' and 'PCA' for later uses. Choose abbreviations carefully – make sure they are unique and easy-to-understand. Don't define an abbreviation if you don't use it again. Don't define an abbreviation in an abstract unless you use it multiples times in the abstract. If you define an abbreviation in the abstract, you must define it again in the body of the report.

Always reports units for measurements: This statement seems obvious, but so many students report a value without units. Check every number. Check every column of every table to make sure you've included units in the column heading.

Use the appropriate number of significant figures: When reporting values in the text or in tables, only use the appropriate number of significant figures.

Write out counting numbers less than 10; use values for all continuous variables: You should write three flow controllers, 12 flow controllers, and a length of 3 inches. Length is a continuous variable – you don't count inches since you can have fractions of inches – and you'll always use numbers for continuous variables. You can't have fractions of flow controllers; so that number is a counting number.

Write out numbers that start a sentence: Regardless of the type of number, you should start a new sentence by writing out that number, or you can rewrite your sentence so that the number is no longer first. Example: "Fifteen hours earlier,…." is correct. "0.56 ml of benzene…" is not correct. In general, if you start a sentence with a non-counting number, you are writing in passive voice and you should rewrite the sentence.

Use a leading zero for written numbers, if necessary: If a number has a decimal point and there are no non-zero numbers to the left of the decimal point, then you should add a leading zero to the left-hand side. Correct: "0.56 ml" Incorrect ".56 ml"

Be careful with affect vs. effect: 'Affect' is a verb. 'Effect' is a noun. Use them appropriately.

Use apostrophes correctly to indicate possession: So many students use apostrophes incorrectly – or don't use them at all – making the word plural instead of possessive. If you use Word, that word processor does a reasonable job of identifying these issues.

Be careful with "there," "their" and "they're" and similar words: Tools for checking grammar will almost always find issues with these words, but I still see students use the wrong word.

Use your word processor's spell check and grammar check: These tools catch most common errors you'll make, but there are many issues the checks won't find. To find these additional errors, you should read each sentence backwards. When we read forward, our brain skips over words or adds words, as needed, so that the sentence makes sense. If you read text backwards, our brain can't do that since there is no flow to the series of words. You'll find some mistakes this way.

> ***Check for double words***: One of the most common mistakes is typing the same word twice in a row. Grammar check usually finds the error, but you'll often read right past the double word when you proofread.

> ***Check for homonyms that are the same part of speech***: Grammar check will hardly ever find these. If you say that your data shows a *peek* at a time of 10.2 seconds, common word-processing tools will not find this error. You won't find these issues proofreading either, since you're reading quickly and your brain will put *peak* instead of *peek*. You might find the error reading backwards.