The goal of this memo is to let students know in a clear, plain and intelligible manner what is expected in 465.

- **Class Time:** Tuesday and Thursday 12:30 to 1:45 in Room B4
- **Instructor:** Prof. George Collins, Email: gcollins@engr.colostate.edu
- **Grader:** Manoj Kumar, Email: mkshivaswami@gmail.com
- **Text Book:** “Without the Hot air” from Cambridge Univ. UK. The course text is available free on the web: www.withouthotair.com
- **Class website:** 1200 pages of my notes are found at http://www.engr.colostate.edu/ECE465

I love questions from the class. You are paying to be taught and I am being paid to teach, so ask lots of questions. Do not act like a potted plant in the classroom.

Up to date in class announcements always supersede this preliminary guide.

**Thumbnail weekly sketch:**

**Week # 1: 20/22 Jan.** Chapter 1(climate change and energy units) text and my web notes
It’s an unfair fight between the majestic forces of nature and we miniscule humans scurrying to both blame and protect ourselves from changing climates.

**Week # 2: 27/29 Jan.** Chapter 2 (Energy Balance Sheet with energy for transportation) and my web notes
Note we skip Chapter # 4 and jump to chapters 3 & 5 (PLANES for transport of both people and freight), so that we can compare the various modes of transport for BOTH people and freight.

**WEEK # 3: 3/ 5 Feb.** Chapter 3 (CARS, buses trucks for transport) and appendix A (cars) and my web notes. We also cover Chapter 5(planes, trains and ships) and Appendix C (planes) and my web notes—
Week # 4 10/12 Feb. Chapter 4 (terrestrial wind) & 10 (Offshore wind) and appendix B (wind II) and my web notes—this week we go back to chapter 4 and ahead to Chapter 10

Weeks 5 and 6 (19-26 Feb.) for Group talk #1 on the topic of “Geothermal GREEN Energy”. Note on Tues.17 Feb. I will lecture on an overview of Geothermal Energy.

Read Chapter 16 of our text, “Geothermal” to get you started. In addition I will speak on geothermal the first day of talks. In 2014 we have 20 students so form THREE GROUPS of 6-7 students each. Each group presents for one class period between 19 to 26 Feb. Your talks should be crystal clear and the reasoning and conclusions sensible.

WEEK # 7: 3 / 5 March Chapter 6 (Solar) and Appendix D (Solar II) and my web notes

Week # 8: 10 March Tues. We start the HVAC (heating ventilation and air conditioning) lectures

NO CLASS Thur. 12 March before spring break
Week # 9: SPRING BREAK (14-21 March)

We return to lectures for HVAC the biggest energy user for homes and offices in week # 10.

Week # 10: 24/26 March Chapter 7 (Heating cooling and ventilation HVAC) and Appendix E (Heating II) and my web notes

Week #11: 31 March/ 2 April Chapter 8 (Hydroelectricity) and Appendix F (Wave Power) and G (Tide Power) and my web notes

Week #12: On 8 April Tuesday and Thur. 10 April, I give lectures on coal and natural gas fossil fuels, Chapter 23 of our text.

Check out this energy assessment link about hydrocarbon fuels for both transport and electrical generation: Link

I will give a general lecture on LED lighting on Tues. 14 April to set the stage for your LED lighting talks.

Thur. 16 April- Thur. 23 April, Group Talk # 2 on the topic of “LED Lighting Systems or in the trade language, “Luminaires”: Three GROUPS of 6-7 students are formed just as in Talk # 1, Each group presents for one entire class period from Thur. 16 April- Thur. 23 April if needed. Normally conventional LED lighting
uses AC to DC conversion to drive LED’s. Be sure to include DIRECT AC driven LED lighting such as the newest LED luminaire, the AC LED module, from Seoul Semiconductor.

**Week # 15: 28 April/ 30 April** After we finish hydrocarbons we start Chapter 24 and my web notes on Modern and old Nuclear Power.

**Week # 16: 5 / 7 May** Finish Nuclear Power

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**CSU CLASSES end Fri 8 May**

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**A-F with plus minus 465 GRADING SUMMARY**

Letter grades for ECE 465 are on an F to A scale with plus minus fine tuning on all letter grades.

- > 98 A+
- >95 A
- >92 A-
- > 89 B+
- >85 B
- >82 B-
- > 79 C+
- > 70 C-
- etc to < 49 F

**AIMS/Goals of the 465 Course**

This course will instruct undergraduates from all areas of study, about sustainable and green energy sources of energy as compared to traditional fossil fuel and nuclear energy sources. It will also cover transportation energies. An increasing energy need is related to the world’s population and economic growth. This brings associated energy and environmental needs as well as issues of sustainability and climate concerns with fossil fuels now the predominant energy source. To grasp why fossil fuels are king consider a single Kg of diesel fuel equals 13 kW –hr of energy. This is about 300 times the energy storage of lead acid batteries, which incidentally must be charged by some other energy source, likely hydrocarbon driven power plants. One megawatt of emergency electricity can be delivered by a single trailer mounted greasy diesel generator, which can run maintenance free for weeks. A megawatt of wind would require a remote area of 100 football fields’ area and only operate on average for 1/3 of the time at best. These proffered proposed realities from me are subject to your critical analysis during the course to affirm or deny in weekly Pop quizzes.

In short in the discussion of energy sources as well as energy savings, who is right and who is wrong is too simple. Each side is right in some sense but how do you parse that. Again pop quizzes attempt to give you practice doing just that.
You will learn in this course to use hard numbers, “metrics” with “units”, such as energy cost in $/Watt or $ per Joule as well as detail the land area and water volume needed to generate a GW of power from wind, solar, hydro, tides, waves, nuclear, and fossil fuels. This way, quantitative comparisons may be made between various energy pathways that we can pursue to be more sustainable. For fossil fuels the hidden costs of pollution and the remediation costs to reduce pollution will be covered in detail. There is no free lunch. Again the effort is to inform you, the future energy policy makers, of the visionary possibilities, the practical realities and the costs of different energy balance pathways forward.

“Cost” is a four letter word that makes visionary dreams face reality. I will conclude in class notes as does our text author, that sustainable renewable/green energy claims beyond 30% total energy generation are starting to be more “pixie dust” than reality because of COST considerations of intermittent energy sources and the inability of alternative energies to meet base load requirements reliably. In addition, total costs may lead to “green energy economic suicide”. But you and your group make your own determination in your TALKS, especially talk # 2. After listening to me and reading our text you do your own research and decide for yourself. You will be rewarded if you disagree with me and the author and use a cogent rational explanation why you disagree.

Sustainability is the art of balancing all engineering and scientific possibilities including ECONOMIC COST, a four letter word, which we learn from economics and double entry accounting. I believe that we do NOT have an energy crisis; we have a crisis as regards the cost of energy and the BEST economic choices to address climate warming. If you disagree with anything I present, tell me why in a cogent manner and earn extra credit points.

A major aspect of the course is INCREASED energy efficiency in units of “Negawatts”, “kill-a watts”, or energy saved. This concept is especially useful in discussing new technologies with increased efficiencies such as: transportation of people and freight, variable frequency power electronic motor drives and heat pipes employed in home and building HVAC, as well as LED lighting of buildings. Just increasing lighting or transformer efficiency by 1% would save energy costs, reduce greenhouse gas and CO2 emissions, and reduce the need to build new power plants.

Another focus in the course is on BIG energy savings and not little energy savings; unless the little saving is multiplied by say 1-3 billion such devices (e.g. charging inefficiencies for the wall warts for cell phones). But again the TOTAL energy saving must be substantial to be considered in the course. Therefore lighting is one example where energy savings are emerging as is variable frequency motor drives.
I hope by the end of 465 or even sooner, all students appreciate the old saw “to read without reflecting is like eating without digesting”. Or for the simple fools like me the shorter version is the difference between “knowing the facts versus knowing the truth”. More energy use correlates with higher GDP in every country. Hence the increased energy use in the third world as it grows economically. If we just use less energy we will live less well—better to target energy inefficiencies.

Energy, CO₂ and nuclear energy are three parts of a 100 part issue called Climate Change—see Bill Gates opinion on Nuclear Power go to: http://www.ted.com/talks/bill_gates.html

I will send out weekly emails to remind you of what is due. If the email is different from the syllabus schedule let me know as I may have changed assignments. Weekly memos trump the syllabus. We will cover in our text the listed chapters and my web notes the following topics in the weeks listed.

BELOW I give 465 guides for: grades, HW and lecture attitudes.

Guide through the 465 grade minefield: Four Parts

The 465 basic grading is in four parts with opportunity for both group and individual efforts counting roughly equally as follows. GROUP EFFORTS are required for all four parts, but with individual efforts taken into account.

1. Eight HW Q/ A assignments (20 points total).

Your Group creates each week, either a mix of both questions and answers (Q and A). Yes you get to form the HW questions some weeks and for variety I pose questions too. Each week will be unique and you will be notified in advance. As the course moves on, the students provide more challenging questions and answers based on Chapters in the Text and outside readings assigned weekly the 465 grader. That is questions with no simple answers as we start to compare various energy pathways.

2. Group Class Talk # 1 and paper (20 points total) on GEOTHERMAL ENERGY (15 points PPT slides and 5 points for WORD paper). Four GROUPS present each one for one class period.

The class notes are password protected
Username: Student
Password: Power!
3. Ten Pop Quizzes (30 points total).
   Ten take home or in class pop quizzes (3 points each) based on material
given in class presentations, summarized on the web notes for 465 and
text as well as Google Scholar searches. At minimum the pop quizzes are
tailored to both keep you current with my web notes and prepare you for
Talks # 1 and #2.
This is a chance to “drill deep” into a topic I assign with your group team
dividing the work. Use my class notes, the text and articles from the web.
Pop Quiz solutions are assigned a week in advance and are due the
following week on Thur. Pop Quizzes are to be done as a group effort
not as an individual effort. Split up the work among your group
members and put all answers in PPT format with cogent and to the
point bullets not windy paragraphs with large font sizes in say Arial
black.

4. Group Class Talk # 2: 30 Points Total (25 for PPT talk and 5 for WORD
   paper)
   I talk Tues 14 April on an overview of LED lighting.Three GROUPS
   present each one for one class period Thur.16- Thur. 23 April Talk # 2
   LED Lighting Systems: Luminaires. Normally conventional LED lighting
   uses AC to DC conversion to drive LED’s. Be sure to include DIRECT AC
   driven LED lighting such as thee Acrich2 AC LED module from Seoul
   Semiconductor.

Finally in preparation for Talk # 2 on LED lighting please research the
following and include these developments in your talk:

**Inductively coupled Fluorescent electrode less lighting** is now
available, as distinguished from voltage driven fluorescents with
inner electrodes and external electronic ballast. In particular visit
the website of “**New American Technology**” and investigate their
Induction fixtures or the website of Sylvania and Everlast
Induction Light. Induction driven fluorescents is a response to
LED technology and makes fluorescents a stronger competitor to
LED’s in HIGH CEILING applications as regards:
1. 80,000 hour lifetime without maintenance
2. Freedom from color shifts yet provide high color rendition
   light.
3. Large area light source as compared to LED small area light
   source
4. Low glare compared to LED’s and bathes objects in light with
   minimal shadowing
That totals 100 points but in addition for those interested in extra credit:

Class participation and Detailed Suggestions for Course Improvements: Up to 10 points extra for each area—if for some personal reason you are not keen about interacting in class—please see me to better allow for this portion of the grade to better serve you. Best way to accumulate points is to provide LOTS of daily questions in class or to provide me with outside materials relevant to the class. Another way is to ask MEANINGFUL questions during in class presentations by other groups. Folks who interrupt class or bring to lectures quality questions or important comments will earn these points.

GUIDE to getting maximum value from class lectures:
1. Just listen and ask questions in the class. Use lectures to get a wider angle view of ENERGY ISSUES than our text or any text can provide.
2. Take minimal notes in class—interrupt the lecture flow often with cogent questions. Be shameless but certainly not a potted plant during lectures.
3. Enjoy the wonder and sublime joy a wider angle view of ENERGY ISSUES for benefit to mankind,

ADVICE FOR SUCCESS IN 465

GROUP EFFORTS in ECE465 are the key to your success in 465 and also teach many soft skills needed in your future job where group efforts are the rule. Class participation and detailed Suggestions for Course Improvements are strongly encouraged: Up to 10 points extra for each area—if for some personal reason you are not keen about interacting in class—please see me to better allow for this portion of the grade to better serve you.

Best way to accumulate points is to provide LOTS of daily questions in class or to provide me with outside materials relevant to the class. Another way is to ask MEANINGFUL questions during in class presentations by other groups. Folks who interrupt class or bring to lectures quality questions or important comments will earn these points.
I love questions from the class. You are paying to be taught and I am being paid to teach, so ask lots of questions. Do not act like a potted plant in the classroom.

TWO GROUP TALKS/Papers count 50% of the grade so keep that in mind:

DATES and Goals OF THE TWO TALKS

You will all have two GROUP talks (to be done in Power Point) and two GROUP papers (to be done in WORD) during the semester.

Group TALK # 1: 20 % of the grade (weeks 5 and 6) and TALK # 2 (weeks 12 and 13) will integrate all learning to date and drill deep into a common NEW topic for ALL groups, as briefly summarized below. Read Chapter 16 of our text, “Geothermal” to get you started. The distance learning students will not be able to give TWO required oral talks, but only PPT slide work for the two talks. This amounts to 50% of your grade.

Goal of Talk # 1 is to improve communication skills. It will spot problems early in both presentations and papers and fix them, so you do not repeat mistakes in talk # 2. Presentations from ALL groups will occur BEFORE middle of March-exact dates TBA. Again you get a group grade with individual grades for extra credit, where merited. Written portion must be in Word format and oral presentation slides in PowerPoint Format. Talk # 1 and paper # 1 has a common theme for all groups, so your group can hear other groups cover the same materials and learn by positive or negative example of how to present materials.

Both talks/papers are done as group efforts to simulate your future environment in the workplace. Group/team efforts are required to get students familiar with the team efforts that they will encounter in the workplace and so they better understand the dynamics of team work. For group efforts Microsoft has versions of Word and Power Point that reside on servers at Microsoft Office Live — moreover this allows MULTIPLE users to log on and work on the SAME document together. I strongly recommend Microsoft SkyDrive for student cooperative projects/talks/papers that many students in a group can share edits as they occur. It is deeply integrated with Microsoft Office on both Windows and Mac’s and is free.

See a remarkable way to “see” data and try to use gapfinder.com in your talks http://www.youtube.com/watch?v=hVimVzqtD6w

If we have distance learning students in 465 they will not be able to give TWO required oral talks, but only PPT slide work for the two talks. So they
have less work, on the other hand they will have to do the Pop Quizzes and HW entirely on their own. It all evens out I judge.

I encourage campus students to form HW/pop quiz/presentation groups ASAP to reduce your work load in 465 by dividing the work and handing in a single group effort. Finally, distance learning students can hand in assignments after the deadline for in class students due to their work commitments.

SECOND Disclaimer Notice:

Up to date in class announcements always supersede this preliminary guide.

If you have further questions ask me in class so everybody benefits.

Please forgive this windy 13 page syllabus. It has both a time line schedule and grading breakdown as well as details on the two required GROUP presentations/Papers. In addition to keep it all clear and fresh, I will send out a weekly memo reminding you of: last week's material, this week’s materials and next week's material. This effort is for better detailing, I hope clearly three points:

1. What prior assignment is due that week (e.g. Pop Quiz, Chapter HW, upcoming talks etc). In general the weekly Pop Quiz is due the following week it was assigned and on Thurs. The HW is assigned as we cover materials and not weekly, it is due the following week it is assigned on Tues.

2. I highlight newly assigned material for that coming week and future due dates for all new assignments within a month’s interval. This is to better help students guide their time, as I know you have other courses. Due dates for ALL pop quizzes and HW are given below in the syllabus.

3. Finally this course is lots of work in the beginning of the semester but much less work in the final 4 weeks of the semester, to give you more time for TALK #2 and for other courses.

Thank you in advance for reading though this missive. Use it to guide you through the semester but realize that up to date in class or weekly email announcements always supersede this preliminary guide. My own EXTENSIVE daily lecture notes will also be available via links from the ECE 465 course webpage. In short, all items in this memo are subject to change by Prof. Collins in LATER class announcements and items are considered only a preliminary guide to the student.
One website to put the 465 course in economic perspective: See for example countries poor and sick versus rich and healthy over time which is all related to energy use: [http://dmarron.com/2010/12/02/200-countries-200-years-4-minutes/](http://dmarron.com/2010/12/02/200-countries-200-years-4-minutes/)

**Materials Included In THE TWO TALKS**

**Below I give topics for Talks #1 and #2 as well as general advice on the Content of Talks/ Papers**

In both talks for 465 the role of grants, legal mandates, feed-in tariffs, tax breaks, loans, subsidies should also be mentioned to help explain government’s role in fostering sustainable energy development and picking winners and losers of receiving the tax dollars of all of us. The two biggest energy generation and consumption countries are the US (1200 GW or 26% of world energy use) and China (1000 GW). To be economically competitive in the future each country has to MINIMIZE energy costs, as innumerable studies show that low cost energy drives Gross Domestic Product (GDP). Moreover slow global warming is a reality and most proposed energy saving or energy generation solutions to the problem, can have seemingly worse adverse economic effects than the warming itself might pose. Compromises need to be made on a realistic basis and this is open for your group to discuss, where 3-6 students each present a portion of the talk.

**Talk # 1 20 points total (15 points PPT slides and talk and 5 points for WORD paper).**

**WEEKS 5 and 6: Three GROUPS present each one for one class period from Feb 20 –Feb. 27, concerns a renewable energy source “Geothermal Energy” that operates 24/7/365, unlike solar or wind. I lecture on an overview of worldwide and USA Geothermal Energy on Feb 20th.**

In talk #1 comparison to traditional energy generation methods are essential in order to make meaningful discussions of geothermal. Read Chapter 16 of our text, “Geothermal” to get you better oriented. Your talks should be crystal clear and the reasoning and conclusions sensible.

**An old geothermal plant “Geysers” in California can be a baseline for thermal plants.** All groups must sign up for a day to talk. One group per day in WEEKS 5 and 6: Thur. Feb 20 – Thur. Feb 27. Read Chapter 16 of our text, “Geothermal” to get you a wide angle view.

In talk #1 quantitative comparison to traditional energy generation methods are essential in order to make meaningful discussions of geothermal energy possibilities. I suggest five guides for ALL GROUPS (Three GROUPS present each one for one class period) to use in discussing
geothermal energy: I suggest five guides to use in discussing geothermal energy:

1. Affordable Economics in two parts for construction of the energy source and operating costs together with prevailing costs for alternatives help determine breakeven dates.
2. Technical practicality of the energy source is needed, including economic impact of future energy prices.
3. Efficient use of limited and scarce capital for this energy source compared to others like natural gas fired energy and heat. The role of grants, legal mandates, feed-in tariffs, tax breaks, loans, subsidies should also be mentioned to help explain government’s role in fostering sustainable energy development.
4. Long term supply security of the need fuel for energy generation say compared to nuclear energy
5. Environmental effects of the energy source include for example “bird and bat kill” from wind generators.

The role of grants, legal mandates, feed-in tariffs, tax breaks, loans, subsidies should also be mentioned to help explain government’s role in fostering sustainable energy development. Get your background research on geothermal going now not at the last day or week. At minimum 6 principles should be covered in both the PPT talk and the WORD paper as compared to a natural gas fired power plant employed as a baseline:

1. Affordability or cost per MW-hr to both build and operate geothermal
2. Technical practicality of a GW level geothermal power plant
3. Long term fuel supply security of geothermal energy
4. Environmental issues that geothermal raises
5. Area required for a GW geothermal plant

Identify the “best of the breed commercial geothermal plant” PPT for each with highlights of capabilities.

TALK # 2  30 Points Total
Tues.15 April I will lecture on general lighting to set the stage for your talks.

Weeks # 13 and 14, Thur. 17 April- Thur. 24 April, Group Talk # 2 on the topic of “LED Lighting Systems or Luminaires”: Three GROUPS of 6-7 student are formed just as in Talk # 1, Each group presents for one entire class period. Normally conventional LED lighting uses AC to DC conversion to drive LED’s. Be sure to include DIRECT AC driven LED lighting such as the Ac rich2 AC LED module from Seoul Semiconductor.
Three GROUPS present each one for one class period (25 for PPT talk and 5 for WORD paper). Normally conventional LED lighting uses AC to DC conversion to drive LED’s. Be sure to include DIRECT AC driven LED lighting such as thee Acrich2 AC LED module from Seoul Semiconductor. Your talks should be crystal clear and the reasoning and conclusions sensible.

(17 April Thur.- 24 April Thur. only one group each day) Talk # 2 LED Lighting Systems and Luminaires by three groups of 6-7 students. Talk #2 must cover at minimum the following FOUR areas: LED sources and their color and intensity spectrum, conversion efficiency compared to fluorescent lights, heat removal in LED light fixtures called luminaire’s as this effects operating lifetime and power electronics drives that are separate from the LED or on the same IC chip for LED’s as this drives luminaire cost. Your talks should be crystal clear and the reasoning and conclusions sensible.

Normally conventional LED lighting uses AC to DC conversion to drive LED’s. Be sure to include DIRECT AC driven LED lighting such as thee Acrich2 AC LED module from Seoul Semiconductor.

Again, the LED lighting system includes: LED source characteristics such as color spectrum and intensity, heat sink technology and power electronics drives for both power factor correction of the lighting system and light dimming abilities from legacy dimmers via the power electronic drives. All of the power electronics must fit inside the legacy “Edison Screw”. Use Chapters 20-24 of our text, the DOE website (DALI initiative is an example) and LED luminaire manufacturers like Cree, Philips and Sylvania to get specific facts to better fathom “LED Lighting Energy Savings”. “Discuss and Justify Your Groups Choice of LED Lighting Pathways toward Energy Conservation / Savings that are Both Practical and Cost Effective”.

Look at an image of the earth at night to grasp the lighting energy use [http://antwrp.gsfc.nasa.gov/apod/image/0011/earthlights_dmsp_big.jpg](http://antwrp.gsfc.nasa.gov/apod/image/0011/earthlights_dmsp_big.jpg) to better any given evening. Keep this in mind when you tackle Group Talk # 2 “LED LIGHTING SYSTEMS”. **Group Talk #2 asks your 465 group to tackle** energy savings in the units of “Negawatts” for the specific case of “LED Lighting Systems and Luminaires” as opposed to conventional lighting. Lighting represents 20% of the use of electricity in the USA. A watt saved is a watt not need to be generated or a “kill-a watt”. It is the most economical way to attack the emerging energy crisis and emission of greenhouse gases from power plants.

Moreover surprising to some, inefficient energy use is becoming ILLEGAL, such as use of incandescent light bulbs in 2012. See for
example [www.energy.ca.gov/commision/commissioners/rosenfeld_docs/index.html](http://www.energy.ca.gov/commision/commissioners/rosenfeld_docs/index.html) and [www.efficientpowersupplies.org/efficiency_news.asp](http://www.efficientpowersupplies.org/efficiency_news.asp).

I repeat: Your group must compare and contrast the LED lighting energy saving approaches compared to fluorescent lighting the nearest contender. Both lighting schemes have three major technical issues: electrical to light conversion efficiency, cost of the luminaire and its operating lifetime, required heat sinking to achieve long life LED and electronics drive operating power factor correction requirements and for dimming light intensity using legacy SCR dimmers. Consider costs divided by the operating lifetime of the two luminaires. Estimate in 1 PPT slide the total amount of energy or greenhouse gas pollution saved by either fluorescent or LED lighting versus incandescent lighting.

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**CSU ACADEMIC INTEGRITY Policy**

This course will adhere to Academic Integrity Policy of CSU General Catalog and Student Conduct code. It is expected in this course that all students will not give, receive or use any unauthorized or undocumented assistance in their group efforts as well as individual efforts. All appropriate sources need to be referenced and it’s best to do in IEEE format for references/sources. Unauthorized audits violate the Student Conduct code.

**Accommodation for Students with disabilities:**

I will follow CSU policy given at [http://rds.colostate.edu](http://rds.colostate.edu) or call CSU telephone extension 6385

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**465 GRADING**

The 465 basic grading is in four parts with opportunity for both group and individual efforts counting roughly equally as follows. GROUP EFFORTS are required for all four parts, but with individual efforts taken into account.

1. **Class talk # 1 and paper (20 points total)**
   (15 points PPT slides and 5 points for WORD paper). Read Chapter 16 of our text, “Geothermal” to get you started. Note on Tues.18 Feb. I will give an introductory lecture on Geothermal Energy. Three GROUPS present each one for one class period from Thur.20- Thur. 27 Feb.

2. **Eight HW assignments (20 points total).**

   Your Group creates each week, either a mix of both questions and answers or just answers. Yes you get to form the HW questions some weeks. Each week will be unique and you will be notified in advance. As
the course moves on, the students provide more challenging questions and answers based on Chapters in the Text and outside readings assigned weekly the 465 grader. That is questions with no simple answers as we start to compare various energy pathways for the future and look back at old pathways (e.g. Ethanol).

**HW is assigned a week in advance and is then due in PPT form the following week on Tues. HW is to be done as a group effort not as an individual effort. Split up the work among your group members and put all answers in PPT format with cogent and to the point bullets not windy paragraphs with large font sizes in say Ariel black.**

3. Ten Pop Quizzes (30 points total).

Ten take home or in class pop quizzes (3 points each) based on material given in class presentations, summarized on the web notes for 465 and text as well as Google Scholar searches. At minimum the pop quizzes are tailored to both keep you current with my web notes and prepare you for Talks # 1 and #2.

This is a chance to “drill deep” into a topic I assign with your group team dividing the work. Use my class notes, the text and articles from the web.

Pop Quiz solutions are assigned a week in advance and are due the following week on Thur. Pop Quizzes are to be done as a group effort not as an individual effort. Split up the work among your group members and put all answers in PPT format with cogent and to the point bullets not windy paragraphs with large font sizes in say Ariel black

4. Talk # 2: 30 Points Total (25 for PPT talk and 5 for WORD paper)

On April 15th Tues I will give an introductory lecture on lighting technology. Three GROUPS present each one for one class period, Thur. 17-24 April Talk # 2 LED Lighting Systems: Luminaires. Normally conventional LED lighting uses AC to DC conversion to drive LED’s. Be sure to include DIRECT AC driven LED lighting such as the Acrich2 AC LED module from Seoul Semiconductor.

All that above totals 100 points but In addition for those interested in extra credit:

**Class participation and Detailed Suggestions for Course Improvements: Up to 10 points extra for each area—if for some personal reason you are not keen about interacting in class—please see me to better allow for this portion of the grade to better serve you. Best way to accumulate points is to provide LOTS of daily questions in class or to provide me with outside materials relevant to the class. Another way is to ask MEANINGFUL**
questions during in class presentations by other groups. Folks who interrupt class or bring to lectures quality questions or important comments will earn these points.

Synopsis of Eight Weekly HW Question and Answer (Q/A) assignments

Five text Chapter Questions your group either creates with answers or just answers if I provide the questions that week. The chapter/appendix key point questions is a pathway to see if the group members have read in depth the TEN chapters and appendices listed below as well as digested the facts and understands the major take away points:
The group either poses or answers text chapter and appendix questions, as detailed in the weekly memo you will receive from me, or just answers the questions I ask. I give lots of illustrative starter questions.

HW # 1 Chapter 1(Motivations) and my web notes
HW # 2 Chapter 2 (Balance Sheet concepts) and my web notes
HW # 3 Chapter 3 (CARS for transport) and appendix A(cars) and my web notes
HW # 4 Chapter 5(planes) and Appendix C(planes, trucks and buses) and my web notes—note we jump to chapter 5 (PLANES for transport)
HW # 5 Chapter 4(terrestrial) wind & 10 (Offshore wind) and appendix B(wind II) and my web notes—back to chapter 4 and ahead to Chapter 10
HW # 6 Chapter 6(Solar) and Appendix D (Solar II) and my web notes
HW # 7 Chapter 7 Chapter 9(Heating cooling and ventilation HVAC) and Appendix E (Heating II) and my web notes
HW # 8 Chapter 8(Hydroelectricity) and Appendix F (Wave Power) and G (Tide Power) and my web notes

The philosophy is too increasingly throughout the semester, judge the groups grade partially by the “quality and depth of the questions they both ask and answer” and by the answers to questions I ask for the ten chapters and appendices listed above. Again this is to better fathom what the group considers it learned that week and for me too to fathom your progress level.

OUTLINE of Detailed Weekly Topics

Week # 1: Pop Quiz # 1 20/22 Jan Energy Jargon and motivations for avoiding the POSSIBLE MAN MADE climate change path we are presently on and the economic cost to do so (chapter 1 of our text). We explore numerical metrics to compare all energy use and generation from transportation and electric generation. Electrical use is further broken down into motor drives, HVAC, lighting etc. The double entry balance sheet is introduced to match energy use and generation (Chapters 1 and 2 of our text must be read)
Week # 2: Pop Quiz # 2 27/29 Jan  Energy Units and Concept of an Energy Balance Sheet with Quantitative Debits and Credits in units of Joules or Watt-hours (Chapter 3 (cars) of our text and appendix A must be read)

Week # 3: Pop Quiz # 3 3/5 Feb  Transportation of both people and freight energy costs of cars, trucks trains, ocean ships and planes for both people and freight transportation. (Chapter 5 (planes) of our text and appendix C (planes II) must be read)

Week # 4: Pop Quiz # 4 10/12 Feb  Wind Energy Promise versus wind energy reality (Chapters 4 (terrestrial wind) and 10 (Offshore wind) as well as Appendix B (Wind II)

I lecture Feb 17 Tues. on an OVERVIEW OF geothermal electric and thermal generation

Weeks 5 and 6 (Two weeks): WEEKS 5 and 6 Three GROUPS present each one for one full class period: Thur. Feb. 20 – Feb 27 Thur., are reserved for group class presentations on the topic of geothermal electric and heat energy generation accomplishments and promise, to help solve or the worlds green energy quest. Read Chapter 16 of our text, “Geothermal” to get you started. In talk #1 include the fact that geothermal is a true 24/7/365 green energy source like hydro’ as compared to intermittent wind and solar. At minimum 5 principles should be covered in both the PPT talk and the WORD paper as compared to a natural gas fired power plant employed as a baseline:
   1. Affordability or cost per MW-hr to both build and operate geothermal
   2. Technical practicality of a GW level geothermal power plant
   3. Long term fuel supply security of geothermal energy
   4. Environmental issues that geothermal raises
   5. Area required for a GW geothermal plant

Identify the “best of the breed commercial geothermal plant” PPT for each with highlights of capabilities.

After group Talk #1 in week #7 we return to and continue Collins lectures on the topic of WIND POWER and start the topic of HVAC energy use.

WEEK # 7: 3/5 March  Chapter 6 (Solar) and Appendix D (Solar II) and my web notes

Week # 8: 11 March Tues.  We start the HVAC (heating ventilation and air conditioning) lectures

NO CLASS Thur. 12 March before spring break

Week # 9: SPRING BREAK (17-21 March)
Week # 10: **25/27 March:** We finish Chapters 7 & 9 Heating cooling and ventilation HVAC) and Appendix E (Heating II) and my web notes.

Week # 11: Pop Quiz # 8 (1 – 3 April) We start to discuss water power from terrestrial dams as the “best of the breed” renewable energy source available to date at high power, with 24/7/365 reliability and at low cost. Terrestrial hydro also has its unique “pumped water energy storage” capabilities. (Chapter 8: Hydroelectricity). Water Power from tidal barrages and ocean waves is feasible at MW levels as proven in several projects. GW-hr level wave or tidal power presents many intriguing dreams, but little GW-Hr reality has appeared to date. Stay tuned to latest research in class. Appendix F (Wave energy) and G (Tide energy) must be read.

Week #12: On **8 April Tuesday and Thur. 10 April**, I give lectures on coal and natural gas fossil fuels, Chapter 23 of our text.

Weeks 13 and 14: **Talk # 2 LED Lighting Systems and Luminaires,**

**15 April Tues.** I lecture on lighting before your three groups do so on LED Luminaires

(17 April Thur. - 24 April Thur.). Three GROUPS of students present each one for one class period. Normally conventional LED lighting uses AC to DC conversion to drive LED's. Be sure to include DIRECT AC driven LED lighting such as the Acrich2 AC LED module from Seoul Semiconductor. We focus on “LED Lighting Systems”. More specifically we focus on various LED light sources and their lumens per watt, required heat sinks to prevent thermal damage and power electronic drives. The prior three horseman or aspects of LED Lighting Systems must each be covered in detail during talk # 2.

**Week # 15 (29 April to 1 May)** Pop Quiz #9 Hydrocarbon based energy generation I spend special time on the energy game saver for the USA: “abundant and low cost natural gas and liquid hydrocarbons enabled from new “vertical and horizontal well “fracking” technologies developed by the private natural gas sector on private land with minimum government assistance”. My web notes and Chapter 23 (Sustainable Fossil Fuels and “fracking” revolution from my class notes) must be read

**Week # 16 (Tues. 6 May / Thur. 8 May)** and Pop Quiz # 10 “Nuclear” Energy, or changing just one letter, “Unclear” Energy: Long Term Friend or Foe?? Chapter 24 (Nuclear Energy: fission and fusion)) of the text and my web notes must be read. My call as the only long term solution to energy needs, but that might be >100 years from now when natural gas runs out. All of the above topics are
addressed in detail in our text. The course text is available free on the web:  www.withouthotair.com

CSU CLASSES WILL END FRI. 9 May

Deadlines for Homework’s and Pop Quiz’s

A tentative summary of all due dates for chapter HW assignments and Pop Quizzes for each week of the semester is given below. Remember the HW and Pop Quiz is due the week after we cover the topic in class. The team’s tasks also include weekly Pop Quiz assignments. All of these assignments are done as a team. You will get a team grade for all of the above. Still each student will have their portion highlighted as theirs, as for example when giving class talks EACH member will talk and in papers, if properly documented, who did what. Individual efforts will also be in POP quizzes and extra credit assignments. In summary, group efforts are encouraged as well as individual efforts. PLEASE FORM a GROUP ASAP in the first week of the semester. In an interdisciplinary class such as this one, students need to form diverse groups.

TALK #1  Fixed Topic for ALL groups Geothermal Energy WEEKS 5 and 6: Feb 19 – Feb 26 : one GROUP talk per day. Read Chapter 16 of our text, “Geothermal” to get you started.

<table>
<thead>
<tr>
<th>Dates</th>
<th>Home Work</th>
<th>Pop Quiz’s</th>
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<tr>
<td>Jan 20</td>
<td>Get Ready , for the fun work</td>
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<td>Jan 27</td>
<td>HW #1</td>
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<td>Feb 3</td>
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<td>Mar 3</td>
<td>Nothing due but your revised PPT slides from Talk # 1</td>
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<td>May 7</td>
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- Pop Quiz’s, Homework’s, Lab’s and paper Doc file to be sent to Grader. Email: Mkshivaswami@gmail.com
- REVISED PPT slides from both talks 1 and 2 to me.

At the risk of being tiresome: FINAL 465 GRADING SUMMARY

Letter grades for ECE 465 are on an F to A scale with plus minus fine tuning on all letter grades.

> 98 A^*
>95 A
>92 A^*
> 89 B^*
>85 B
>82 B^*
> 79 C^*
> 70 C^*

ONE MORE TIRESOME TIME, the grading is in six parts (four parts from traditional means and two extra credit portions) with opportunity for both group and individual efforts counting roughly equally as follows.

1. Class PPT based TALK # 1 (20 points total)
   (15Points)/Paper #1(WORD based 5 points)

2. Weekly Chapter HW Questions and answers (20 points on final grade): 8 assignments
3. Class participation: up to **10 extra points maximum**—if for some personal reason you are not keen about interacting in class—please see me to better allow for this portion of the grade to better serve you. Best way to accumulate points is to provide LOTS of daily questions in class or to provide me with outside materials relevant to the class. Another way is to ask MEANINGFUL questions during in class presentations by other groups.

4. Pop Quizzes (**30 points total**).
   Ten take home or in class pop quizzes (3 points each) on material from in class material. This is both a review of class topics and a chance to “drill deep” into a topic with your group. Use my class notes, the text and articles from the web. In general the pop quizzes will occur mostly in the first ten weeks of class to insure you keep current and so you are free at the end of the semester for other courses and your talk # 2.

5. Talk # 2: **30 Points Total** (25 for PPT talk and 5 for WORD paper).

6. Extra credit up to 10 points maximum for improving the course in a substantial way - You have to work with me and have your ideas approved by me in writing.

**YES you can easily earn more than 100 points if you apply yourself. Why not end senior year with a good grade.**

**ECE Students are the most important people at CSU.**
- Not dependent on faculty.
- Faculty is dependent on them.
- Not an interruption of our work.
- They are the purpose of being at CSU.
- Students are doing us a favor when they come to our office.
- We are not doing them a favor by serving them.
- Students are part of our business, not outsiders.
- Not just a CSU ID number.
- They are flesh and blood human beings with feelings and emotions.
- Students come to us with their needs and wants.
- It is our job to address them with courteous and attentive treatment.
- Students are the life blood of this and every university.
- Without them we would close our doors.
**DON'T EVER FORGET THIS!**