NOV – 7 2011

APPROVED

The University Of Toledo

NEW COURSE PROPOSAL

* denotes required fields

Level (check one)*
- ○ Undergraduate
- ◉ Graduate

Will this course impact program requirements? ○ Yes ◉ No If yes, a Program Modification must be completed.

Type of course (check all that apply)
- ☐ Academic Skills Enhancement ☐ Writing Intensive (WAC) ☐ Honors
- ☐ Univ Core ○ *English* ○ *Hum* ○ *Math* ○ *Nat Sciences* ○ *Social Sciences* ○ *Multicultural* ○ *Diversity of US Culture* ○ *Non-US Culture*
- ☐ Transfer module ○ *Arts&Hum* ○ *Engl* ○ *Math* ○ *Nat Sci & Phys* ○ *Soc Sci* *(to be considered as core curriculum, question 18 must be completed)*

1 College*: Engineering

Department*: Civil Engineering

2. Contact Person*: Defne Apul Phone: 530-8132 (XXX - XXXX) Email: defne apul@utoledo edu

3 Alpha/Numeric Code (Subject area - number)*: CIVE - 5690

If this is a renumbering, please request an electronic copy of the old course approval through the Register's Office at x4865, and attach it to #15 in this form Remember to delete the old course ID in #13

4 Proposed title*: Sustainability Engineering

Proposed effective term: Spring 2012

5 Planned enrollment per section: 15 per term: 15 DSA

6 Is the course cross-listed with another academic unit? ○ Yes ◉ No

Is the course offered at more than one level? ◉ Yes ○ No

If yes to either question, please list additional Alpha/Numeric codes, and submit a separate New Course form or Course Modification form for the course(s) referenced below

a CIVE - 4650 b - c -

Approval of other academic unit (signature)

Name and title

If course is to be offered at more than one level, attach an explanation of the different requirements that students must meet for each level If the requirements are the same for each level, justification must be provided

Administrative Use Only

Code:

Approved (senate or Grad Council)

Effective Date. / / (mm/dd/yyyy)

CIP Code:

Sub: Prog: Level:

7 Credit hours*: Fixed 3 or Variable to

8 Delivery Mode

	Primary*	Secondary	Tertiary
a Activity Type†	Lecture		
b Minimum Credit Hours	3		
Maximum Credit Hours	3		
c Weekly Contact Hours	3		

† Choices are Lecture, Recitation, Seminar, Regular Lab, Open Lab, Studio, Clinic, Field, Independent Study, Workshop, Computer Assisted Instruction, Other

9 Terms offered: ☐ Fall ☑ Spring ☐ Summer

Years offered: ◉ Every Year ○ Alternate Years

10 Are students permitted to register for more than one section during a term? ◉ No ○ Yes

May the courses be repeated for credit? ◉ No ○ Yes Maximum Hours

11 Grading System*

Undergraduate	Graduate
○ Normal Grading (A-F,PS/NC PR, I)	◉ Normal Grading (A-F,PS/NC PR, I)
○ Passing Grade/No Credit (A-C, NC)	○ Grade Only (A-F)
○ Credit/No Credit	○ Satisfactory/Unsatisfactory (G only)
○ Grade Only (A-F, PR, I)	○ Audit only

○ Audit only ○ No Grade

○ No Grade

12 Prerequisites (must be taken **before**) a [ ] - [ ] b [ ] - [ ] c. [ ] - [ ]

● PIN (Permisson From Instructor) ○ PDP (Permission From Department) Reset

Co-requisites (must be taken **together**)* a [ ] - [ ] b [ ] - [ ] c [ ] - [ ]

13 If course is to replace an existing, course(s) will be deleted, and when should that deletion occur?

	Course to be removed from inventory	Final Term to be offered (YYYYT i e use 20064 for Fall'06)
a	[ ] - [ ]	[ ]
b	[ ] - [ ]	[ ]
c	[ ] - [ ]	[ ]
d	[ ] - [ ]	[ ]

14 Catalog description* **(30 words Maximum)**

Course develops students' abilities to apply the principles of sustainability to engineered systems Course topics include sustainablity definition, life cycle engineering, green construction, ecological design principles, and energy and carbon footprint management

15 Attach an electronic copy of a complete outline of the major topics covered

Syllabus * [ ] Browse

Additional Attachment 1 [ ] Browse.

Additional Attachment 2 [ ] Browse ..

16 Where does this course fit in the University/College/Department curriculum? (Be specific by course level, if applicable) Indicate prospective demand

This course will be open to any MS student

17 If the proposed course is similar to another course in the College or University, please describe the difference and provide a rationale for the duplication (If this course duplicates material covered in another course within your department or college or in another college, attach a letter of endorsement from that area's dean and department chairperson indicating their support Clarify the manner in which this course will differ)

NA

18 If the course is intended to meet a University Undergraduate **Core** requirement, complete the following and submit a course syllabus using the *template*

Please explain how this course fulfills the general education guidelines (*Guidelines* are available in *Faculty Senate Website*)

Course Approval:

Department Curriculum Authority Ashok Kumar Date Month / Day / Year Oct 25/2011

Department Chairperson Ashok Kumar Date Month / Day / Year Oct 25/2011

College Curriculum Authority	Fatima A. Kelaw	Date Month / Day / Year
College Dean		Date Month / Day / Year

After college approval, submit the original signed form to the Faculty Senate (UH 3320) for undergraduate-level courses; for graduate-level courses submit the original signed form to the Graduate School (UH 3240). For undergraduate/graduate dual-level courses, submit the proposals to each office.

Faculty Senate Undergrad Curriculum Comm		Date Month / Day / Year
Faculty Senate Core Curriculum Comm		Date Month / Day / Year
Graduate Council		Date Month / Day / Year
Office of the Provost		Date Month / Day / Year
Registrar's Office		Date Month / Day / Year

Submit New Course Proposal

You will see a confirmation page after you press the "Submit" button. If you do not see the confirmation page, please call x 4320 or send an email to ProvostWebMaster.utoledo.edu. Thanks.

before Apr Oct 24 2011

Explanation of Extra Work that Students Taking CIVE 5690 will do compared to students signed up for CIVE 4690

Students taking the graduate level course (CIVE 5690) will be required to review a peer reviewed article and present it in class. The article will be a sustainability engineering article.

The University of Toledo
Department of Civil Engineering
CIVE 4690/56900 Sustainability Engineering and Science
3 Credits, Offered in Spring Semesters

Professor: Dr Defne Apul, NI3030, Defne Apul@utoledo edu (419) 530 8132

Meeting times: M, W 3 30-4 45pm (Subject to change based on student schedules) Palmer Hall 3060

Office hours: M, W 12 15-1 30pm. These are the times you are guaranteed to find me in my office You are also welcome stop by any other time, setup a time to meet or contact me by email

Resources Handouts from me, the internet, Google-Alert, Google-Scholar, Web of Science or other engineering online databases

Course Audience College of engineering or department of environmental science students interested in sustainability Students from other departments or working professionals are also more than welcome to take this class Please contact Dr Apul

Course format: This course is developed based on Fink's taxonomy of significant learning (Fink, 2003) As discussed in Fink's book I believe that good courses are courses that

- challenge students to significant kinds of learning
- use active forms of learning
- have teachers who care – about the subject, their students and about teaching and learning
- have teachers who interact well with students
- have a good system of feedback ,assessment, and grading

Based on this philosophy, my goal for the format of this class is to minimize lecture time and maximize active learning in this course Course will involve one semester long team project. We will use the class time to discuss assignments and the project Course involves extensive reading, extensive team work, and some quantitative assignments

A Taxonomy of Higher Level Learning

Type of Significance	*Key Component of Learning Involved*	*Special Value*
Learning how to learn	Learning	Provides capability for long-term continuation of learning
Motivation	Caring	Provides the energy (short term or long term) for learning without this nothing significant
Human Dimension	Self, Others	Connects one's self to oneself and to others, gives human significance to the learning
Integration	Connecting	Adds power by connecting different ideas, disciplinary perspectives and/or realms of life
Application	Thinking Acting	Allows other learning to become useful
Foundation	Knowing	Provides necessary information for other kinds of learning

Fink, L D (2003) Creating significant learning experiences An integrated approach to designing college courses San Francisco Jossey-Bass

Late assignments: 10 % will be deducted for every day the assignment is late

Academic Dishonesty: You are encouraged to work together on homework so you can discuss the problems and learn more than you would if you worked on your own While working with others, don t forget about academic dishonesty The idea is to learn together not copy from someone or let someone else do the thinking for you. You should read UT's policy on academic dishonesty available at http://www.utoledo.edu/dl/students/dishonesty.html

Course Objectives:

This course will improve your **foundational knowledge** on (understanding and remembering ideas, information)

- life cycle assessment
- life cycle impact assessment
- ecological footprint analysis
- water footprint analysis
- carbon footprint analysis
- climate action plan
- sustainability reporting
- ecological design principles
- sustainable engineering principles
- LEED, sustainable construction
- Biommicry
- natural step, backcasting
- energy savings
- global warming potential / characterization factors

This course will improve your **application** skills such as,

- Performing simple life cycle assessment studies for a given process using EIOLCA software
- Evaluating greenness' of products
- Conducting green house gas inventories and developing a climate action plan for an organization
- Critically reviewing articles and websites related to sustainability science and engineering
- Communicating technical information (in writing and orally)
- Managing your time
- Managing projects
- Creative, critical, and practical thinking and solutions

This course will improve your ability to **integrate and connect** ideas, people, realms of life such as,

- Connecting the engineering, environmental, social, and economic factors that make engineering analysis, design or solutions sustainable or not
- Developing diverse interactions and partnerships towards managing a project

This course will teach you about yourself and others **(human dimension of learning)**. You will,

- Learn how sustainability relates to your own life and to your profession
- Learn how to effectively contribute to project goals in a team effort
- Develop your own work ethic towards submitting deliverables on time
- Learn about how you communicate with others
- Learn about the stakeholders of your semester long project

This course will teach you new feelings, values, interests **(caring dimension of learning)**. At the end of the class you might,

- Get more interested in various sustainability problems and the connections among them
- Be more interested in following up-to-date advances on sustainable solutions and assessment techniques
- Recognize the un-sustainable practices within and around your life and profession and try to develop and implement sustainable solutions to improve them
- Feel overwhelmed but satisfied to have completed a meaningful project

This course will give you opportunities to **be a better student and a self-directed learner** by,

- Asking you to identify the problem, determine what information is needed to solve it, and develop a strategy to address the problem

Today's Activities

1 Change class time
2 Go over syllabus and discuss Dr Apul s teaching philosophy and Fink s taxonomy
3 Student introductions and expectations from this class Write on a piece of paper
   a. your name and something about yourself,
   b why you are in this class
   c what do you expect to get out from this class
   d where you want to be headed with your career,
   e what methods work best for YOU when you are learning something (e g reading, listening, doing projects work by yourself, watching something, internet etc)
   f some productivity tip you practice
4 Dr Apul hands out following documents
   a. Mihelcic et al 2003 Sustainability science and engineering the emergence of a new metadiscipline Environmental Science and Technology, 37(23), 5314-5324
   b World Commission on Environment and Development, 1987 Our Common Future, Brundtland report
5 Introduction to sustainability presentation by Dr Apul

Homework for next class

Browse through the Mihelcic et al And the Brundtland report I gave you. Answer the following questions Bring your typed answers to class

a. What is the most commonly cited definition of sustainability? Where in Brundtland report is this definition written?
b How does Mihelcic et al 2003 define sustainable engineering?
c What is a peer reviewed article and how is it different than a report or other articles?
d What do you think might be the significance of Mihelcic et al 2003?
e What do you think might be the significance of the Brundtland report?

Planned Schedule

Date	Discussion topic	In Class Activity	Deliverable for that day
January 10	Intro to sustainability	Presentation by Dr Apul	
January 12	Intro to sustainability	Presentation by Dr Apul discussion of assessment 1	Assessment 1 2 points
January 17	MLK day - no class	-	
January 19	Greenhouse gas inventory	Discussion of previous UT GHG reports	Assessment 2 2 points
January 24	Greenhouse gas inventory	Discussion of City of Toledo and Lucas County GHG	Assessment 3 2 point
January 26	Climate action plan	Discussion of UW and UMaine climate action plan reports	Assessment 4 2 points
January 31	Climate action plan	Project work, teams prepare for project launch	Nothing
February 2	Launch project	Project discussion, UT-CAPT visits class	Nothing
February 7	Project work	Project work	Nothing
February 9	Global sustainability	Guest speaker Dr Lauren Fry	Assessment 5 10 points
February 14	Life cycle assessment	Intro to LCA presentation by Dr Apul, teams prepare questions on LCA	Nothing
February 16	Life cycle assessment	Hands on EIOLCA exercise	Nothing
February 21	Life cycle assessment	Hannah presents on EEAST	Nothing
February 23	Life cycle assessment	Water Sustainability, LCA WE Credits	Assessment 6 10 points
February 28	General sustainability	Issues with population, food, fossil fuels	Nothing
March 2	Sustainable construction	Intro to sustainable construction and LEED presentation by Dr Apul informal feedback	Assessment 7 5 points Assessment 8 5 points
March 7	Spring break		
March 9	Spring break		
March 14	Sustainable construction	LEED site visit to UT field house	Nothing
March 16	Sustainable construction	LEED discussion	Nothing
March 21	Sustainable construction	LEED discussion	Nothing
March 23	Sustainable construction	LEED discussion	Assessment 9 10 points
March 28	Green product	Green product presentation	Assessment 10 7 points
March 30	Green product	Green product presentation	
April 4	Climate Change	Presentation by Dr Kumar	Nothing
April 6	Energy calculations	Presentation by Dr Kumar	Nothing
April 11	Practice presentation	GRI sustainability reporting ecological, carbon, water footprints	Final report for mock grading
April 13		Final report discussion, presentation discussion	Nothing
April 18	Practice presentation	Practice presentation	Assessment 11 10 points
April 20	Ecological Design Principles	Discussion on biomimicry and ecological design principles	Nothing
April 25	Practice presentation	Practice presentation, fill in bubble sheets	Assessment 12 10 points
April 27	Final presentation	Final presentation	Assessment 13 20 points
May 3 Tuesday	No meeting	Submit final report	Assessment 14 20 points Assessment 15 5 points
			Assessment 16 0 points
			Total available pts· 120

Assessment 1: Individual
Responses to questions related to Mihelcic et al and Brundtland Report

Assessment 2: Individual
You will need 5 resources for this assignment:

Resource 1 CIVE 4900 Spring 2010 students' report on Scope 1 emissions
Resource 2 CIVE 4900 Spring 2010 students' report on Scope 2 emissions
Resource 3 CIVE 4900 Spring 2010 students' report on Scope 3 emissions
Resource 4 CIVE 4900 Spring 2010 students' final presentation to UT President, UT community and Toledo Community
You can access resources 1-4 by going to the following page
http://www.eng.utoledo.edu/civil/newweb/sustainability/Sustainability_Curriculum.html

Resource 5 Local government operations protocol for greenhouse gas inventory You can access resource 5 at http://www.theclimateregistry.org/downloads/2010/05/2010-05-06-LGO-1.1.pdf

Prepare a typed document that answers the following questions

1. What are scope 1 emissions? (copy/paste is ok)
2. What are scope 2 emissions? (copy/paste is ok)
3. What are scope 3 emissions? (copy/paste is ok)
4. What is a carbon footprint? What does it involve?
5. What are some typical, expected subheading of technical reports? In other words, what subheadings do you think your report may involve at the end of the semester?
6. What are some strengths of the student reports (resources 1, 2, and 3)?
7. What are some weaknesses of the student reports (i.e. of resources 1, 2, and 3)?
8. What is included in the appendices of student reports (i.e. of resources 1,2, and 3)?
9. Using resource 5, answer the following questions
   a. What are the different sources of emissions from local governments (e.g. facilities, vehicle fleet etc.)
   b. What sources are to be considered for emissions from facilities?
   c. Look at Table D1 on page 185 of Resource 5. What do you get out of this table? How can it be useful for your project?
   d. Look at Table E1 on page 198 of Resource 5. What do these numbers mean?
   e. Look at Table G8 on page 211 of Resource 5. What do these numbers mean?
10. Write down some questions that came to your mind as you browsed through all the resources. Write down what is unclear to you.
11. Our library is a member of the OhioLink system. OhioLink has subscription to several databases that track peer reviewed publications. The database that I like is ISI Web of Knowledge. You can access this database by going to: http://www.ohiolink.edu/resources.cgi?by=subject → Click on Engineering → When list of databases come up, click on ISI Web of Knowledge. Use this database to locate the Mihelcic et al. (2003) article.
    a. How many times has this article been cited?
    b. Copy paste the list of references that cited this article. Browse through the references that cited Mihelcic et al. (2003). In what kind of journals, reports etc. were these other references published?
    c. Use Google scholar to determine how many times Mihelcic et al. has been cited and by whom. Do your results from ISI Web of Science and Google Scholar match?

Assessment 3:
Browse through the City of Toledo and Lucas County greenhouse gas inventory reports and presentation. Prepare and bring with you three questions on this work that can help with your understanding of your own project.

Assessment 4:
Browse through the two reports posted on WEBCT. Prepare your part of the discussion. Each student will have 5 minutes to lead the discussion. If you have a ppt, email it to me 2hrs before class. I will upload it to the web.

Cory Williams: Intro to climate action plan (U. Maine, p. 4-6, U. Washington, p. 2-4)

Kimberly Coburn: total emissions from U. Maine (p6) and Washington (p22)
Justin Batt: breakdown of emissions for U. Maine (p7) and Washington (p22, 24)
Michael Sheehan: projections of emissions for U. Maine (p9) and Washington (p. 23)
Erin Davis: campus energy supply (mainly from Washington)
James Marshall: campus energy supply (mainly from Washington)
Justin Snyder: campus energy demand (mainly from Washington)
Ben Griffis: information technology (mainly from Washington)
Ashley Frey: commuting (mainly from Washington)
Keith Morgan: professional travel (mainly from Washington)
Jonathan Lidgard: Looking beyond the inventory (land use, food and composting, RRR)
Travis Wenning: Maine commuter survey (p23, Appendix E)
Will Gharst: Short term, mid term and long term strategies (U. Maine, p. 9-12)

Project Starter Links You Should Browse Through Before January 20th

http://www.presidentsclimatecommitment.org/ (what UT president signed)
http://www.cleanair-coolplanet.org/toolkit/ (you will download the campus carbon calculator from here)
http://www.nwf.org/Global-Warming/Campus-Solutions/About/Contact-Us.aspx (contact info for Juliana who will introduce the excel sheet on the 20th)

Assessment 5 First deliverable for your project
Submit the introduction/problem statement, objectives section of your proposal. In addition, lay out team member roles and deadlines. Present tentative table of contents for your anticipated final report.

Assessment 6 Second deliverable for your project
Submit the GHG inventory part of your report.

Assessment 7 EIOLCA assignment
EIO-LCA problem.

A household is considering purchasing a washing machine and has narrowed their choice to two alternatives In addition to cost and other functional items, they wish to assess the energy consumption and greenhouse gas emissions over the lifetimes of the two alternatives

- Machine 1 is a standard top-loading unit with a purchase cost of $500 This machine uses 40 gallons of water and 2 kilowatt-hours of electricity per load (assuming an electric water heater) The household would to roughly 8 loads of laundry per week with this machine

- Machine 2 is a front-loading unit. it costs $1,000, but it can wash double the amount of clothes per load, and each load uses half the water and electricity

-Which machine should this household buy?

a) Estimate the total annual costs of water and electricity for each of the two machines Use these values along with the manufacturing costs to develop a purely cost-based comparison of the two machines over a 10-year period. Assume that electricity costs 8 cents/kWh and water is $2 per 1,000 gallons
b) Use the same cost values as inputs into EIO-LCA to estimate the relative energy consumption and greenhouse gas emission over their life cycles Ignore the disposal phase Be sure to express the comparisons of the two machines in terms of use versus manufacturing effects
c) Briefly discuss your results

Student solution worksheet

a. Calculate the total annual costs of water and electricity

	Machine 1	Machine 2
Cost ($)		
Water consumption per load (gal)		
Electricity consumption per load (kWh)		
Loads per week		
Electricity cost ($/kWh)		
Water cost ($/gal)		

Total annual cost of water
Machine 1
Machine 2

Total annual cost of electricity
Machine 1
Machine 2

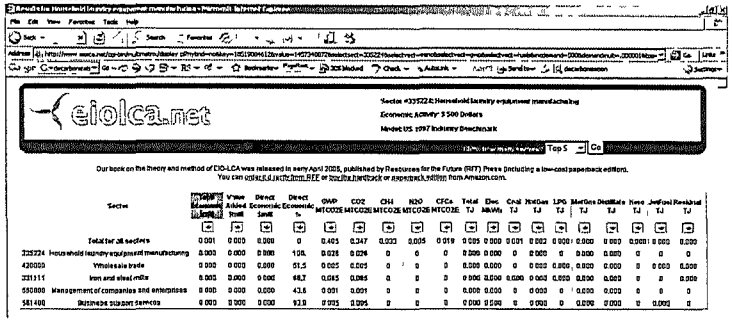
Total cost in a 10-year period
Machine 1
Machine 2

b Assume lifetime of washing machines is 10 years and ignore the disposal phase

Manufacturing
Goto EIO-LCA.net Choose "lighting, electronic components, batteries and other industry" Select "household laundry equipment manufacturing" sector Put in $500 and $1,000 as producer prices

Water use
Industry mining and utilities
Sector water, sewage and other systems
Dollar amount

Electricity use
Industry mining and utilities
Sector Power generation and supply
Dollar amount



Energy (Tj) consumption from	Manufacturing	Water use	Electricity Use	Total
Machine 1				
Machine 2				

GWP (mt CO2 equiv) from	Manufacturing	Water use	Electricity Use	Total
Machine 1				
Machine 2				

Assessment 8: EEAST assignment
Use EEAST to analyze the economic and environmental implications of using alternative sanitation technologies in different types of buildings Vary building type (home, dormitory, educational building and office)

Home (6 flushes /person /day)
Dormitory (5 flushes /person /day)
Educational building (3 flushes /person /day)
Office (4 flushes /person /day)

Turn in a mini report that includes a cover page, objectives, methods, results and discussion, and conclusions sections For purposes of this mini-study, we will skip the introduction, and abstract sections
In methods section describe the parameters you changed and their values.
In results present graphs of cost, energy, and CO_2 payback periods Discuss all figures/tables presented Think through which figures to present don't copy paste all EEAST output to the report
This is a mini report, so keep it to the point but include all necessary information.

Input Parameters:

- **Precipitation Data** – Toledo Ohio
- **Building Length** – 200 ft
- **Building Width** – 150 ft
- **Building Height** – 24 ft
- **# of Stories** - 2
- **# of toilets per floor** - 10
- **Irrigation area** – 2000 sf
- **Building Type** – Office (4 flushes/person/day)
- **Occupancy** – 150 ppl/day
- **Toilet type** – Standard (1 6 gpf)
- **Pressure Provided by City** – 30 psi
- **Discount Rate** – 3%
- **Loan required** – Yes to all (use assumed loan data)

Assessment 9: Third deliverable for your project
Submit an improved report that also includes discussion on projections (?) and reduction plans

Assessment 10: Green product presentation
Green product assignment (out of 50 points)
You will team up with a friend for this assignment Assignment grading is based on your in class performance You are more than welcome to share materials (e g links, ppt, etc) with the class ahead of time if you think it will make your presentation more effective

1. Select a 'green' product or technology and present it in class in 20 minutes
2. Things you should discuss
   a. (10 points)
   Introduce the product/technology and the functions/services it provides
   Explain why you picked this product
   Provide literature on the product (e g show its website, handout its specs, show articles related to it)
   b (20 points)
   Discuss what is green and what is not green about it
   c (10 points)
   Make a preliminary conclusion on whether you think the product is really green or not
   d (10 points)
   Answer questions from the audience

For part a, do your homework and know your product well Use google, google scholar, google news and other information finding techniques to fill in your knowledge gaps

For part b, present multiple perspectives

- do a preliminary life cycle assessment to estimate energy use and emissions from throughout product lifecycle
- compare 'sustainable product' to 'conventional alternative'
- consider economic, environmental, and social implications of the product
- consider waste associated with different life cycle phases
- consider whether it promotes sustainable lifestyles
- consider if it requires too much expertise or high tech materials
- consider if it requires a lot of water, land, materials, energy, and other resources throughout its lifecycle
- consider other points

Assessment 11 Energy and Climate Change Assignment by Dr. Kumar
Problem 1

A student living near The University of Toledo provided the following data on electricity consumption for his 2 bedroom apartment The size of the unit is 1100 sq ft.

Month	Electric Consumption (KWH)
Jan	639
Feb	971
March	910
April	426
May	343
June	295
July	275
Aug	283
Sept	258
Oct	269
Nov	252
Dec	277

The apartment was serviced by Toledo Edison Company in 2009 The apartment has a refrigerator, a furnace, an air conditioner, and a water heater All the appliances are run by electricity

You are required to examine and plot the above data. Draw general conclusions about the electric consumption through out the year about this apartment. State your assumptions for missing information

The student would like to reduce the energy consumption Any help

Problem 2

The following information was obtained for a 5000 sq ft. house located in Toledo, OH during 2009 The house is heated by a gas furnace and a heat pump The cooling is done by the heat pump

Month	Electric Consumption (KWH)	Gas Consumption (ccf)
Jan	1362	224
Feb	1184	228
March	1210	203
April	1252	186
May	1283	57
June	1145	19
July	2165	26
Aug	3020	52
Sept	3293	38
Oct	1575	18
Nov	1200	102
Dec	1386	200

The house has the following electric appliances

1 Two refrigerators
2 Dish washer
3 Stove
4 Washer/Dryer

There is an outdoor swimming pool on the property and the homeowner had a large party in late August

Examine the above information and provide general comments on heating and cooling of the house Support your comments using quantitative data.

Problem 3

You are required to estimate your personal carbon footprint by considering the use of electricity in your apartment, natural gas for heating, gasoline for transportation, and any other sources You are asked to answer the following questions

a. Calculate the yearly cost of purchasing carbon offsets from three services that are available on the internet.

b Develop a plan to reduce your carbon foot print by a third

c Discuss the limitations of the above two approaches to reduce your carbon footprint

d Suggest changes to the worksheet you have used, for a realistic calculation of the personal carbon footprint

Problem 4

Calculate the amount of CO2 produced by all the students studying at different Ohio universities in 2008 Assume that the CO2 production in the year 1900 was approximately 10% of the amount you calculated today Estimate the change in surface temperature in Ohio due to the increase in number of students at Ohio universities

Carbon Footprint Calculators on the Internet

American Forests http //www americanforests org/resources/ccc/
Be Green http //www begreennow com/

Bonneville Environmental Foundation (BEF)
https //www greentagsusa.org/GreenTags/calculator_intro cfm

CarbonCounter org http //www carboncounter org/
Chuck Wright http //www chuck-wright com/calculators/carbon html

Clear Water http //www clearwater org/carbon html
The Conservation Fund http //www conservationfund org/gozero

EPA http //www epa.gov/climatechange/emissions/
ind_calculator html

SafeClimate http //www safeclimate net/calculator/
TerraPass http //www terrapass com

Worksheet for Carbon Footprint

Note: This sheet is a revised version of a sheet taken from the internet. Please check.

A. Transportation

- miles = average number of miles driven in a month
- mpg = miles per gallon for your car (fuel efficiency)
- gal = average gallons of gas consumed in a month
- lbs CO2 = average pounds of carbon dioxide produced in a month
- lbs C = average pounds of carbon produced in a month

$$\frac{\text{\_\_\_\_\_ miles}}{\text{\_\_\_\_\_ miles/gal}} = \text{\_\_\_\_\_ gal} * \frac{19.4 \text{ lbs CO2}}{1 \text{ gal}} = \text{\_\_\_\_\_ lbs CO2} * \frac{12 \text{ lbs C}}{44 \text{ lbs CO2}} = \text{\_\_\_\_\_ lbs C}$$

B. Residential Electricity

- kwh = kilowatt hours consumed in one month
- assumes electricity is produced by a coal fired power plant

$$\text{\_\_\_\_\_ KWH} * \frac{2.095 \text{ lbs CO2}}{1 \text{ KWH}} = \text{\_\_\_\_\_ lbs CO2} * \frac{12 \text{ lbs C}}{44 \text{ lbs CO2}} = \text{\_\_\_\_\_ lbs C}$$

(Note Use appropriate factor if you are sharing the apartment)

C. Residential Natural Gas

- therm = 100 cubic feet of natural gas

$$\text{\_\_\_\_\_ therms} * \frac{11.7 \text{ lbs CO2}}{1 \text{ KWH}} = \text{\_\_\_\_\_ lbs CO2} * \frac{12 \text{ lbs C}}{44 \text{ lbs CO2}} = \text{\_\_\_\_\_ lbs C}$$

(Note Use appropriate factor if you are sharing the apartment)

D. Other activities, if any

_____ lbs CO2 * 12 lbs C/ 44 lbs CO2 = _____ lbs C

Activities: _____

E. Total Personal Carbon Footprint per Month

- sum A, B, C, and D in terms of lbs and tons

_____ lbs CO2 * 1/2000 lbs per ton = _____ tons CO2

_____ lbs C * 1/2000 lbs per ton = _____ tons C

F. Total Personal Carbon Footprint per Year

_____ tons CO2 * 12 = _____ tons CO2/year

_____ tons C * 12 = _____ tons C/year

Assessment 12: Practice presentation
You will present the final project but it will be a practice presentation

Assessment 13: Final presentation
Final presentation to stakeholders

Assessment 14 Final report
Submit final report and copy of Dr Apul's comments from mock grading

Assessment 15: Online Project log
Keeping Wiki page upto date will guarantee full points

Assessment 16 Peer evaluations
All students must submit peer grade I reserve the right to lower your letter grade if you don't submit the final peer evaluation