# CHEN3600 – Computer-Aided Chemical Engineering Spring 2011

# Chemical Engineering Department FINAL EXAM (Excel/VBA)

**T.D. Placek Auburn University**

**LAST NAME, FIRST NAME (Print)**

**Excel Exam Component (100%)**

**Instructions:**

1. **Open book, open class notes, open personal notes, open personally written program code and code provided by the instructor.**
2. **Computer is not to be used to search for information or solution help on the web. (Automatic “zero” on exam).**
3. **Exam solutions from previous terms may not be consulted or used.**
4. **All announced course policies regarding Excel and VBA code are to be observed.**
5. **All announced course policies regarding the emailing and format of files and email messages are to be observed.**
6. **Only general code will be considered acceptable. Situation specific code that makes it “appear” the program fulfills the problem requirements will NOT BE considered acceptable.**

*Departmental Honesty Statement: By affixing my signature below, I acknowledge I am aware of the Auburn University policy concerning academic honesty, plagiarism, and cheating. This policy is defined in the current Tiger Cub Student Handbook, Code of Laws, Title XII, Student Academic Honesty Code, Chapters 1200-1203. I further attest that the work I am submitting with this exam is solely my own and was developed during the exam. I have used no notes, materials, or other aids except those permitted by the instructor.*

 *Signature\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

Instructions:

1. Begin by starting a new Excel worksheet called “email-final.xlsm”. For example, my exam would be named:

placetd-final.xlsm

1. Problems are numbered with the appropriate sheet number rather than a problem number. Work each problem on a separate Excel sheet but in one workbook. Each sheet MUST contain the following information in cells A1 and A2:

YOUR NAME (your-email)

CHEN 3600 Spring 2011 Final Exam

1. In this exam, it will be necessary to CLEARLY indicate your answers as well as any explanations called for. Use “cell comments” (unhidden) or “highlighting” as appropriate.
2. When you have completed this portion of the final take the following actions:
Make sure you have saved your work. Email your completed Excel Worksheet to placetd@auburn.edu as an attachment. Sign and return all paper exam pages (properly stapled) provided to you. Your email must be postmarked by the end of the exam period.

***It is suggested that you include yourself as a CC: to verify what you sent. Make sure you save and close all files before attaching file. Check your CC to assure it is the file you intend to have graded.***

***Submissions without correct filename will be penalized.***

1. All VBA code must be properly indented!
2. Numbers (such as 65) that represent problem concepts may NOT be employed in code.
3. Do not submit code that does not compile or produces runtime errors or endless-loops.
4. VBA code must represent general cases, not be custom developed for a specific case.
5. Special Note Concerning Probability and Statistics Questions: It is particularly important to identify both the formula or other calculations used to determine your answer as well as the value itself. In other words, you need to show your work VISIBLY and explain your thinking when necessary. The use of displayed cell comments or notations in adjacent cells required. (Translation: I will not be clicking on the cells of your spreadsheet to see what formula you typed in.) Employ one of the two techniques shown below!

Example:







1. Special Note Concerning Hypothesis Testing Questions: These problems will require you to cut and paste the appropriate test code from the Excel files provided for hypothesis testing. Work the problem in the original spreadsheet provided in class. Paste your work into your solution spreadsheet after you have obtained your result. Only paste the ONE TEST you employed (that is, two-tail, left-tail or right tail). NOTE: THE SPREADSHEET WILL NOT FUNCTION AFTER PASTING IF YOU COPY AS VALUES. IF YOU CHOOSE TO DO A STANDARD PASTE, YOU MUST PASTE YOUR WORK IN THE SAME CELL AS WHERE IT WAS COPIED FROM. Remember to explain hypothesis in appropriate “statistics language.”

Sheet1: (20 pts) VBA Function Operating on a String

Write a function called LocateVowels(s) that returns a string where all the vowels in the string supplied to the function are enclosed in parentheses. When uppercase vowels are detected, double parentheses are employed. Show the results of testing your function on the cases shown below. *Note: “blanks” and all other characters are maintained.*

|  |  |
| --- | --- |
| **Function Call** | **Output** |
| LocateVowels(“Apple Pie”) | ((A))ppl(e) P(i)(e) |
| LocateVowels (“Auburn University”) | ((A))(u)b(u)rn ((U))n(i)v(e)rs(i)ty |
| LocateVowels (“Chemical Engineering”) | Ch(e)m(i)c(a)l ((E))ng(i)n(e)(e)r(i)ng  |

Sheet2: (30 pts) VBA Subprogram (Passing Data In Arrays)

Write a **VBA subprogram** called SpaceOutArray(x, howManyIn) that takes the values in the array “x” and spaces them out by “inserting” the value of “0” between the original array elements. There are “howManyIn” values in the array “x” originally. YOU MUST EMPLOY THE TEST PROGRAM INDICATED BELOW TO TEST YOUR SUBPROGRAM. NO CREDIT WILL BE GIVEN IF THIS IS NOT DONE. (You can test that your subprogram is working properly by using the VBA Debugger).

For example: Consider the following test code:

Sub Test()

Dim x(100) as Integer

Dim i as Integer

For i = 1 to 10

 x(i)=i^2

Next i

Call SpaceOutArray(x, 10)

End Sub

*problem continued on next page…*

The resultant values stored in x(1) through x(19) would be: 1, 0, 4, 0, 9, 0, 16, 0, 25, 0, 36, 0, 49, 0, 64, 0, 81, 0, 100.

Remember, the above data is just “test data” and your subprogram must work with any appropriate data.

Sheet3: (50 pts) Monte Carlo Simulation

**(a) Use a Monte Carlo simulation to find the approximate value of the following integral:**

Implement your solution as a function called “MonteCarlo(n)” where “n” is the number of trials to be performed.

Further information: The Monte Carlo method would involve generating “n” random “x-values” between 0 and 2, and generating corresponding “y-values” between 0 and 2 (the maximum value of the function ) in the range of 0 to 2. If the value of “y” is less than or equal to the function, then it should be counted (area under the curve). The integral area can be established by use of this count, the number of trials, and other given information.

Test your function with the following cases:

MonteCarlo(500)

MonteCarlo(5000)

MonteCarlo(50000)

**(b) Use Excel to determine the analytical (true) solution (provided below)**

![(x*Sqrt[4 - x^2])/2 + 2*ArcSin[x/2]]()

Sheet4: (40 pts) EXCEL: Graphing and Euler Integration

**(a) Produce the following chart EXACTLY as shown below (on the next page) subject to the following limitations, parameters and hints.** The purpose of this problem is to demonstrate your ability to analyze the behavior of the function as well as to develop a graph meeting specifications. *(Failure to adhere to the problem specifics will result in significant deductions)*

**(b) Complete the caption in the middle of the graph by using Excel to determine the area in between the two functions using the Euler method and the data available from making the plot.**

Hints:

* The general nature of the graph is based on the sine function.
* You must use Excel formulas (not VBA functions).
* Use single cells for individual pieces of information (xmax, xmin, etc).
* All cells in columns must be obtained by copying the first cell formula to the other cells in the column (that is, they must all use the same formula). *I will perform this copying myself in grading your solution. SOLUTIONS WHICH DO NOT MEET THIS REQUIREMENT WILL BE GRADED “ZERO”.*

Sheet5: (30 pts) Poisson Distribution Function

Twenty randomly selected sheets of aluminum alloy were examined for surface flaws. The frequency of the number of sheets with a given number of flaws per sheet was as follows:

|  |  |
| --- | --- |
| Numberof Flaws | Frequency |
| 0 | 4 |
| 1 | 3 |
| 2 | 5 |
| 3 | 2 |
| 4 | 4 |
| 5 | 1 |
| 6 | 1 |

(a) Use the above data to estimate the mean rate of surface flaws assuming this is a “Poisson Process”

(b) Prepare an Excel plot showing the fit of the above data to the results obtained from applying the Poisson distribution.

Sheet6: (30 pts) Hypothesis Test

An aquaculture farm takes water from a stream and returns it after it has circulated through the fish tanks. The owner thinks that, since the water circulates rather quickly through the tanks, there is little organic matter in the effluent. To find out if this is true, he takes some samples of the water at the intake and other samples downstream the outlet, and tests for Biochemical Oxygen Demand (BOD). If BOD increases, it can be said that the effluent contains more organic matter than the stream can handle.

The following data are available for up and downstream BOD levels on 10 occasions.

Upstream Downstream

6.782 9.063

5.809 8.381

6.849 8.660

6.879 8.405

7.014 9.248

7.321 8.735

5.986 9.772

6.628 8.545

6.822 8.063

6.448 8.001

*problem continued on next page…*

1. Does a hypothesis test at a 95% confidence-level confirm the farm owner’s claim?
2. Using the wording of this problem, what error would be made 5% of the time?
3. Using the wording of this problem, what is the other error that might occur when making this judgment and how often does it occur?

Sheet7: (30 pts) Hypothesis Test

1500 randomly selected pine trees were tested for traces of the Bark Beetle infestation. It was found that 153 of the trees showed such traces.

1. Test the hypothesis that more than 10% of the trees have been infested. (Use a 5% level of significance)
2. Using the wording of this problem, what error would be made 5% of the time?