Prince of Songkla University
Faculty of Engineering

Exam: Final Exam, Semester I   Academic Year: 2005 – 2006
Date: October 6, 2005   Time: 13:30 – 16:30
Subject: 230-591 - Special Topic   Room: R 300
  (Food Unit Operations)

ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

Instructions: There are a total of 2 parts. After you have completed the CLOSED BOOK SECTION, you may obtain the OPEN BOOK SECTION from the instructor. Place your name and the student ID number on every page. Students are allowed to use <u>only</u> a pen or pencil. Students may use <u>only</u> class notes and homework materials in the Closed Book Section of the exam. No exams are allowed to leave the room. No exams are allowed to leave the room.

Points Distribution (For Grader Only)		
Part	Points Value	Score
I	15	
II	13	
III	41	
IV	16	
V	35	
VI	50	
Total	170	

Exam prepared by
Ram Yamsaengsung
September 29, 2005

**PLEASE CHECK TO MAKE SURE THAT
YOU HAVE ALL 5 PAGES OF THE CLOSED BOOK SECTION BEFORE
BEGINNING
(not including the cover sheet).
GOOD LUCK!**

Prince of Songkla University
Faculty of Engineering

Exam: Final Exam, Semester I **Academic Year: 2005 – 2006**
Date: October 6, 2005 **Time: 13:30 – 16:30**
Subject: 230-591 - Special Topic **Room: R 300**
 (Food Unit Operations)

ทุจริตในการสอบโทษขั้นต่ำคือ *ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา*

CLOSED BOOK SECTION (70 points)

Part I. True and Faults (T/F) (15 points), If the statement is false, make it true.

____ 1. Under ideal conditions, some Newtonian fluid can become turbulent at Reynolds number of 1,350.

____ 2. Convective heat flux is proportional to the conductivity of the material and inversely proportional to the thickness of the material.

____ 3. Sterilized products do not require refrigeration.

____ 4. It is easier for material with low yield stress to achieve turbulence.

____ 5. For turbulent flow to occur in Power-Law and Bingham Plastic fluids, the Reynolds ($N_{Re,PL}$ or $N_{Re,B}$) number must be less than the Critical Reynolds number.

____ 6. The metabolic activity of microorganisms can decrease the pH of foods.

____ 7. The thermal resistance constant can be obtained by plotting a log-log plot between the decimal reduction time and temperature.

____ 8. During thermal processing, the population of the microorganisms is reduced in a linear manner.

____ 9. For laminar flow, the kinetic energy correction factor (α) is always 2.0.

____ 10. The decimal reduction time is the time required to cause a 90% reduction in the thermal resistance constant.

____ 11. The negative sign in the heat conduction equation indicates that heat flows from low temperature region to high temperature region.

____ 12. Most microorganisms can grow best at intermediate pH and high a_w.

____ 13. The friction loss coefficients (k_f) values decrease with increasing pipe diameter.

____ 14. Products in glass containers require slow heating and cooling for an effective thermal treatment.

____ 15. Rapid freezing increases the number of nuclei formed.

Part II. Fill in the blanks (13 points)

1. _____ convection is due to the density difference caused by temperature gradients or turbulent flow, while _____ convection involves the use of some mechanical means, such as pumps or fans, to induce the movement of the fluid.
2. _____ is the process of using heat from the processed product to raise the temperature of the incoming "raw" product.
3. _____, such as benzoic and sorbic acids, can be added to foods to help prevent microbial growths.
4. The thermal process that produces products that require refrigeration is called _____.
5. There are two major types of heat exchangers. The _____ type includes the steam infusion and surface injection, while the _____ type includes the plate, tubular, shell-in-tube, and scraped surface.
6. The _____ is generally 12 times that of the decimal reduction time.
7. The two types of flow direction that can occur in a double-pipe tubular heat exchanger are _____ and _____.
8. The _____ heat exchanger is useful in removing fouling from the tube wall.
9. The decimal reduction time _____ (increases/decreases) with increasing process temperature.
10. _____ is generally used to heat mushrooms in canned containers.

Part III. Shorts Answers (41 points)

1. What are the two major types of friction losses that occur in the flow of fluid through a pipe? **(2 points)**

2. What is the Biot number a ratio of? What does a Biot number < 0.1 mean? **(3 points)**

3. Name 2 examples of direct contact freezing systems. What type of freezing system is used for hardening (making) ice cream? Name 2 types of refrigerants that are commonly used in freezing systems. **(5 points)**

4. Name 5 different units or ways that can be used to cook chicken. **(5 points)**

5. What is the difference between PSL and HQL? **(4 points)**

6. Name 4 advantages of vacuum frying? Mention 4 products that can be fried using this type of system. **(6 points)**

7. Name the 4 products that were cooked in this class by your classmates. Discuss briefly how to make one of the products that your classmate presented. **(8 points)**

8. Discuss the heat and mass transfer processes that take place during the frying of French fries. Draw a diagram and use arrows to show direction of heat and mass transfer. What are some major differences between French fries and potato chips? Which contains more oil? **(8 points)**

Part IV. Short Calculations (16 points)

1. For the pasteurization of orange juice, a regenerative heating/cooling section is used. After the "starter" raw juice has been heated to 83°C, it is passed through a holding loop and into a regeneration section. The juice then heats up the incoming raw juice from 27°C to 75°C. While the "starter" juice temperature decreases to 40°C. Compute the % regeneration of the system. **(4 points)**

2. For problem 1, what is the flow rate of the chilled water required to reduce the temperature of pasteurized juice from 40°C to 5°C? The specific heat of guava juice is 3.67 kJ/kg°C and the specific heat of the chilled water is 4.18 kJ/kg°C, and the mass flow rate of the guava juice is 300 kg/hr. Chilled water enters the heat exchanger counter-currently at 2°C and leaves at 10°C. **(4 points)**

3. What does LMTD stand for? For a countercurrent flow regime, if milk enters the heat exchanger at 35°C and leaves at 60°C, while hot water enters at 80°C and leaves at 50°C, what is the LMTD of the system? **(4 points)**

4. If the decimal reduction time at 110°C, D_{110}, is 5.5 minutes, how long does it take to reduce the number of microorganisms from 5,850,000,000 to 1 at 124°C if the thermal resistance constant equals 7°C. **(4 points)**

Prince of Songkla University
Faculty of Engineering

Exam: Final Exam, Semester II   **Academic Year: 2004 – 2005**
Date: March 1, 2005   **Time: 13:30 – 16:30**
Subject: 230-591 - Special Topic   **Room: R 200**
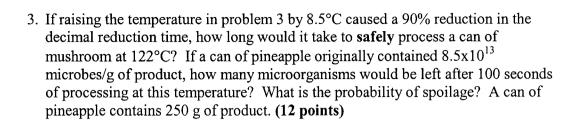 **(Food Unit Operations)**

ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

OPEN BOOK SECTION (85 points)

Part V. Calculations (35 points)

1. If the maximum velocity of a power law fluid flowing through a pipeline system is 1.8 times that of the average velocity, what is the flow behavior index of the material? **(4 points)**

2. The results of a thermal resistance experiment gave a D value of 6.5 minutes at 105°C. If there were 3.5×10^4 survivors after 13.0 minutes of processing, determine the microbial population, N, at 10, 20, and 30 minutes. **(8 points)**

3. If raising the temperature in problem 3 by 8.5°C caused a 90% reduction in the decimal reduction time, how long would it take to **safely** process a can of mushroom at 122°C? If a can of pineapple originally contained 8.5×10^{13} microbes/g of product, how many microorganisms would be left after 100 seconds of processing at this temperature? What is the probability of spoilage? A can of pineapple contains 250 g of product. **(12 points)**

4. If the thermal death time is F^7_{110}, what is the spoilage probability of a 20-seconds process at 131°C, when $D_{110} = 35$ minutes and the initial population is 10^9 per container. **(6 points)**

5. What is the freezing point depression if 350 g of sucrose is added to 1 kg of water? Sucrose is $C_{12}H_{22}O_{11}$. **(5 points)**

Part VI. Long Answers (50 points)

1. You and your business partners just bought an orchard in Krabi. The orchard is able to provide 1,000 kg of pineapple, 1,500 kg of pumpkins, 1,500 kg of rambutan, and 500 kg of bananas per month. Assuming you have the capital (money for investment) to construct a food processing facility, describe at least 5 different products that you would produce and the major equipment that you will need. **(20 points)**

2. You just won the Thailand lottery worth 5,000,000 baht and have inside news that countries in Europe and China are very interested in Thai desserts and snacks. Since you live in the Southern region of Thailand, you have plans to develop products that you can find raw materials easily and at low cost. Discuss your new dessert or snack products that you plan to export to Europe and/or China. List the major ingredients, how to make it, what processes will you need, how to package it, the price per unit, the units per package, etc. Finally, discuss additional **marketing strategies** that could be used to increase profit. **(30 points)**