Name: _____ **Student ID** _____

Prince of Songkla University
Faculty of Engineering

Final Exam, Semester I **Academic Year: 2004 – 2005**
Date: October 1, 2004 **Time: 1:30 – 4:30 PM**
Subject: 230-434 – Safety **Room: R201**
(Safety in Chemical Engineering Operations)

OPEN BOOK SECTION (You can use the Case Studies and HAZOP Handout)

II. Short Answers (55 points)

1. If a new design for a plant must undergo HAZOP, who should be included in the HAZOP team? **(6 points)**

2. From the HAZOP study of the Olefin Dimerization Unit: Line Section from Intermediate Storage to buffer/settling tank, answer the following questions. What are the possible causes of Less Flow and the consequences that followed? **(4 points)**

3. If there is More Flow into the settling tank, what actions are required? **(2 points)**

4. In Figure 2.2 of the HAZOP handout, what do PG, LIC, PIC stand for? What are the reaction conditions for the olefin dimersation process? **(4 points)**

5. Which categories of seafood have the HIGH risks of infection upon consumption (when eaten)? Which categories DO NOT have potentials for growth of pathogens? Which group would "Pla-Rah" be considered in? **(5 points)**

6. What are the functions of flame arresters? What are the main process locations in which they are usually installed? What are the typical flame and detonation speeds? **(5 points)**

7. What does a control loop consist of? What is range of valve stroke that should be used when operating a control valve? What materials can be used to coat the inside of the valve to slow down erosion? **(4 points)**

8. In the Case Study presented in the MCAS article, which scenario of Ammonia release is the most dangerous? Which has the lowest probability of occurring? Which scenario lies in the uncertainty range? Which scenario leads to a boiling/liquid expanding vapor explosion? **(4 points)**

9. In MCAS analysis, for scenarios involving fires/explosions and toxic release, what factors must be considered for each? **(3 points)**

10. What are the common types of enclosure used in outdoor applications and indoor applications? What types of materials are recommended for Acids and Alkalies resistance? **(3 points)**

11. What are the 3 fluid properties that must be considered in thermal fluid systems? If a system circulates 1000 gal of fluid with a thermal expansion of 0.06 gal/gal of fluid per 100°F temperature rise and operates at 520°F, determine the size of the expansion tank for this system. Assume that room temperature is 70°F. **(3 points)**

12. What are the two types of floating roof tanks and when should they be used? What material (structure) is used support of large tanks with diameter of more than 15 feet? **(3 points)**

13. If regulations in your area requires a removal of VOC down to a range of 50-60 ppmv from a waste gas with a flow rate of 800 scfm, which VOC/HAP technology should you consider? If the flow rate has been increased to 40,000 scfm, which process must you consider? What are the three main economic measures for selecting a cost-effective VOC/HAP control device? **(5 points)**

14. Using the 3E+ software, what did Georgia Pacific Corp.'s plywood plant in Madison, GA do, to reduce its operating cost? What was the result? **(4 points)**

III. Discussion (35 points)

1. Considering the Department of Chemical Engineering at PSU, discuss various ways in which you can make it safer for its students, staff, and visitors. **(20 points)**

2. What are the major benefits of the procedure or advices presented in your Case Study? How can the topic of your case study be implemented in the industries or universities of Thailand? **(15 points)**

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ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

Instructions: There are a total of 3 parts 9 pages not including the cover sheet. Place your name and the student ID number on every page. Students are allowed to use only a pen or pencil. After you finish the Closed Book Section, I will give you the Open Book Section. No exams are allowed to leave the room.

Points Distribution (For Grader Only)		
Part	Points Value	Score
I	90	
II	55	
III	35	
Total	180	

Exam prepared by
Ram Yamsaengsung
September 27, 2004

PLEASE CHECK TO MAKE SURE THAT
YOU HAVE ALL 9 PAGES OF THE EXAM BEFORE BEGINNING
(not including the cover sheet).
GOOD LUCK!

HAVE A GOOD BREAK!!!

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CLOSED BOOK SECTION (No books or notes allowed)

I. Shorts Answers: Process Safety Beacon, HAZOP, Recent Chemical Accidents, and Case Studies (90 points)

1. According to the Recent Chemical Accidents article, what are the 5 common factors of these accidents? **(5 points)**

2. What should you do when you discover a "blocked-in" pump in operation? **(3 points)**

3. List 4 things that a worker must do to prepare for incidents such as terrorisms. **(4 points)**

4. In the article "Faster than a Speeding Bullet", what was the equipment being inspected for during the pressure check when the workers were injured? What struck one of he employees in the leg? What can be done to improve the overall strength of a joint? **(3 points)**

5. Why do "seals" leak? **(4 points)**

6. From the article "...And He Blew the House Down", what was the source of the hydrogen fuel that led to the explosion? What basic 3 steps lead to an explosion? **(4 points)**

7. From the article "What Has Your Steam Up?", what was being added to trailer? Why was the result? What determines the amount of damage that occurs when a hot fluid is added to a vessel containing liquids with a lower boiling point? **(5 points)**

8. From the "Recent Chemical Accidents" article, name 2 accidents that took place and the location (state) in which it occurred. **(4 points)**

9. List the Safety Precedence Sequence listed in the Recent Chemical Accidents article. **(6 points)**

10. List 4 Guide Words and 4 Parameters that are used in HAZOP. **(8 points)**

11. Write the meaning of each of these acronyms. **(11 points)**

    1. NEMA _____
    2. EFR _____
    3. AIT _____
    4. MCAS _____
    5. BLEVE _____
    6. MSDS _____
    7. GMP _____
    8. HAP _____
    9. MOC _____
    10. DOE _____
    11. TVP _____

12. What are the two risk assessment criteria that are generally used? **(2 points)**

13. Draw a diagram of a typical storage tank and the safety devices that must be installed. **(8 points)**

14. Which software program can be used to calculate the optimum insulation thickness for steam pipes? **(2 points)**

15. What are the components necessary for a dust explosion to occur? **(5 points)**

16. What is the title of your semester project? Name 2 other semester projects that were presented by your classmates. **(6 points)**

17. Draw a schematic diagram of a control valve and the necessary components involved. **(5 points)**

18. Match the following information with the article that it was from? **(10 points)**

(a) Reactive Chemistry: Not always when or where you want it!
(b) What? No Spark?
(c) A "Good Idea" Can Turn Bad...when you ignore Management of Change
(d) Interlocked for a Reason...a Very Good Reason!
(e) Static Electricity + Flammables + Air = ??
(f) Simple Mixing Chemicals...can be Hazardous to your Health
(g) Dust did This?
(h) Don't pop your top...
(i) But the pressure rating was okay...!?

____ 1. A heater exploded because the operator skipped one of the operating procedure.
____ 2. The air purge system was not interlocked to the sieve operation.
____ 3. A fire water system was used in the operation.
____ 4. The instrument failed because it could not withstand the steam pressure at the elevated temperature.
____ 5. Pipe was FULL of peroxide.
____ 6. An exothermic reaction took place when organic materials passed through activated carbon.
____ 7. A man was draining oil from a large gear box using an air hose.
____ 8. A worker did not study the MSDS and his hand was severely burned.
____ 9. A second explosion took place.
____ 10. Beads containing trace amounts of pentane falling through sieve trays.