

Name: \_\_\_\_\_ Student ID \_\_\_\_\_

**Prince of Songkla University**  
**Faculty of Engineering**

**Exam: Mid-Term, Semester II**  
**Date: March 14, 2015**  
**Subject: 231-334 – Safety**  
**(Safety in Chemical Engineering Operations)**

**Academic Year: 2014 – 2015**  
**Time: 13:30 – 16:30 PM**  
**Room: S817**

ทฤษฎีในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทฤษฎี และพักการเรียน ๓ ภาคการศึกษา  
**CLOSED BOOK EXAM: No notes and no sheets are allowed.**

<b>Points Distribution (For Grader Only)</b>		
<b>Part</b>	<b>Points Value</b>	<b>Score</b>
<b>I</b>	<b>35</b>	
<b>II</b>	<b>36</b>	
<b>III</b>	<b>24</b>	
<b>IV</b>	<b>35</b>	
<b>V</b>	<b>28</b>	
<b>VI</b>	<b>30</b>	
<b>Total</b>	<b>188</b>	

**Exam prepared by**  
**Ram Yamsaengsung**  
**March 6, 2015**

**PLEASE CHECK TO MAKE SURE THAT**  
**YOU HAVE ALL 11 PAGES OF THE EXAM BEFORE BEGINNING**  
**(not including the cover sheet and attachment).**  
**GOOD LUCK!**

**Prince of Songkla University**  
**Faculty of Engineering**

**Exam: Mid-Term, Semester II**  
**Date: March 14, 2015**  
**Subject: 231-334 – Safety**  
**(Safety in Chemical Engineering Operations)**

**Academic Year: 2014 – 2015**  
**Time: 9:00 – 12:00 PM**  
**Room: S817**

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**CLOSED BOOK EXAM (No books or notes allowed)**

**I. FILL IN THE BLANKS (35 points)**

1. The \_\_\_\_\_ appoints the laboratory safety officer and is usually the head of the department.
2. The \_\_\_\_\_ acts as the secretary of the laboratory safety committee.
3. The \_\_\_\_\_ maintains proper keeping of all documents, calculations, reports, procedures and operational logs.
4. The \_\_\_\_\_ acts as a liaison with the site safety officer, inspectors of the Health and Safety Executive, and insurance inspectors.
5. The \_\_\_\_\_ acts as the chairperson of the laboratory safety committee.
6. The \_\_\_\_\_ should arrange for an inspection of the equipment and factory every \_\_\_\_\_ months.
7. The \_\_\_\_\_ ensures that equipment used in work under their direction is of safe design and construction.
8. Two types of human indiscipline that could cause hazards include \_\_\_\_\_ and \_\_\_\_\_.
9. The \_\_\_\_\_ maintains scheduled and recorded inspection, examination, repair and replacement according to statutory, organization, and insurance requirements.
10. An inflammation of the skin that causes an allergic reaction is called \_\_\_\_\_.
11. \_\_\_\_\_ are highly toxic by ingestion and are rapidly absorbed by the skin producing intensive burns.
12. For high pressure equipment, the safety devices that must be installed include \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
13. A signature on behalf of the \_\_\_\_\_ must be present on the safety policy.
14. The \_\_\_\_\_ area and the \_\_\_\_\_ area are in charge of ordering and purchasing.
15. For vibration and noise, damage occurs at about \_\_\_\_\_, for a short period of exposure and \_\_\_\_\_ for continuous noise.
16. Steel supports should give a fire resistance of \_\_\_\_\_ hours.
17. In a well design facility, the equipment should only take up about \_\_\_\_\_ % of the entire floor space.
18. The sudden release of vacuum is called \_\_\_\_\_.

19. The storage of bulk amount of toxic and chemical liquids is preferably stored in \_\_\_\_\_.
20. Tanks containing \_\_\_\_\_ have a red band and tanks that contain \_\_\_\_\_ have yellow band.
21. Bulk storage of toxic or flammable liquids in excess of \_\_\_\_\_ is not recommended on site.
22. The preferred method of stacking drums in the open air is to stack them \_\_\_\_\_.
23. Metal containers should have about \_\_\_\_\_ % extra space to allow for liquid expansion.
24. LPG is an abbreviation for \_\_\_\_\_ and must be stored in properly designed vessels, in which at least \_\_\_\_\_ unfilled space must be allowed to prevent the development of dangerous pressure.
25. Quantities of flammable liquid more than \_\_\_\_\_ should be kept in outside stores.
26. For transporting or transferring gas tanks within the lab, a \_\_\_\_\_ should be used. If a large quantity like large cases (big boxes) must be moved, a \_\_\_\_\_ or a crane may be used.

## II. SHORT ANSWERS (36 points)

1. Name 4 major dangers from electrical hazards. **(4 points)**
  
2. With long term exposure to toxic hazards, what are the damages that may be caused to the body? **(2 points)**
  
3. List 10 Protective Personal Equipment presented by your classmates in Facebook that must be worn when working in an industrial site, chemical facility, chemical laboratory, or a metal shop. (10 points)

4. List 8 safety equipment, instruments, or devices that were posted by your friends in the Safety Facebook group (not the personal protective equipment). **(8 points)**

5. From the **MSDS assignment**, list 6 chemicals that you and your classmates posted in Facebook. Select 2 chemicals and list 2 of their main hazards (i.e. flammable, carcinogenic, toxic, etc.). Also indicate 2 prevention methods or first aid procedures related to each of these chemicals (i.e. if in contact with eyes, what should you do?) **(12 points)**

<b>Chemical</b>	<b>Hazard (2)</b>	<b>First Aid (2)</b>
1.	1. 2. 3.	1. 2.
2.	1. 2. 3.	1. 2.

### III. CSB VIDEO (24 points)

1. Match the following information with the safety video that it was from?  
(24 points)

- (a) Union Carbide, Bhopal
- (b) Cyntron Manufacturer (Acrylic Polymer)
- (c) BP Amoco Polymer Plant (High Performance Nylon)
- (d) Explosion at BP Refinery, Texas City
- (e) Death in the Oil Field

- \_\_\_\_\_ 1. A 12% increase in production caused a runaway reaction leading to the release of toxic vapor clouds and a violent explosion.
- \_\_\_\_\_ 2. A ladder was used as a platform during "Hot Work" operation.
- \_\_\_\_\_ 3. The level indicator of isomerization unit gave incorrect values, several alarms failed and tower overflowed.
- \_\_\_\_\_ 4. A lid acetylene torch was inserted into a storage tank to test for the presence of hydrocarbons.
- \_\_\_\_\_ 5. Control Board Operators worked for 30 straight days at 12 hours shift.
- \_\_\_\_\_ 6. A toxic chemical release from a pesticide plant in India killed thousands of people and led to the establishment of the CSB.
- \_\_\_\_\_ 7. The overhead heat exchanger could not handle the amount of heat produced by the production process.
- \_\_\_\_\_ 8. Three maintenance workers were killed during a welding operation.
- \_\_\_\_\_ 9. Maintenance workers were killed when they tried to clean out plastics from a waste tank.
- \_\_\_\_\_ 10. Slow decomposition took place releasing large amount of gas and increasing the internal pressure inside of a waste storage tank.
- \_\_\_\_\_ 11. Liquid reached a height of 98 ft before noon and overflowed around 1 pm into the relief line and up a blow-down drum.
- \_\_\_\_\_ 12. This accident led to the creation of the Chemical Safety Board to monitor accidents and submit proposal for safety regulations in the US.

**IV. FIRE PREVENTION TRAINING (35 points)**

1. Name 4 basic ways to prevent a fire in home and office. **(4 points)**

2. Name 4 ways of extinguishing a fire. **(4 points)**

3. Name 5 common causes of fire. **(5 points)**

4. Name 5 ways of preparation for fire. **(5 points)**

5. When trying to put out a fire, list 3 circumstances (situations) in which you should run from a fire? **(3 points)**
  
6. Before you escape from a fire, what 4 things must you do or thinking about? **(4 points)**
  
7. From the Fire Training hosted by the Hat Yai Fire Department, discuss ALL the different scenarios presented and ways of handling them (for example: gas tank leak with and without regulator). Make sure you mention all the **training techniques** that you were taught. **(10 points)**

## V. INDUSTRIAL ACCIDENTS (28 points)

Read the following articles below and answer the following questions?

### 1. Article 1: (20 Points)

## Thailand oil spill: Tourists abandon blackened Koh Samet beach

By **Andrew Stevens**, CNN  
August 1, 2013 -- Updated 1102 GMT (1902 HKT)

**Koh Samet, Thailand (CNN)** -- A picture postcard beach on one of Thailand's most popular tourist islands is now the focus of frantic efforts to staunch a tide of oil sweeping ashore. Where pleasure seekers would normally relax on pristine white sand, sandwiched between two lush green headlands, now white-coated cleanup crew smeared with crude suck oil from the shallow waters.

Gobbets of oil lie along the beach, a thin sheen covers much of the wet sand and oil-drenched booms lie like giant black snakes along the shoreline. The sea is a rust red color and the odor of fuel hangs heavy in the air. Not even a brisk onshore wind can keep the smell away.



For the past four days crude has been washing up here and cleanup crews have been dealing with it the best way they can -- pumping it into holding tanks, containing it with booms, even mopping it up with absorbent pads.

Ao Prao beach on the island of Koh Samet is the main impact zone of the 50,000 liters of oil (around 13,200 gallons) spilled during a faulty transfer operation between a tanker and a seabed pipeline on Saturday.

About 600 soldiers, volunteers and workers from PTT Global Chemical, the partially state-owned oil giant that has claimed responsibility for the spill, are involved in the cleanup. A PTT spokesman says that 70% of the oil has been dealt with. The remaining crude will be "90% clear by Friday or Sunday at the latest."

Local fisherman say they've caught fewer fish over the last few days, but it's too early to estimate the damage to fish stocks.

There are no signs of affected marine or bird life at Ao Prao. The focus is now switching to how this happened. A PTT spokesman told CNN that the leak on Saturday happened as a tanker was



transferring crude to an undersea pipe. A giant flexible rubber hose used to transport the oil began to leak. The hose is replaced every two years. This one had been in operation for just one year. It's being sent to the manufacturer, Goodyear, for further tests.

PTT is also defending accusations that it has underplayed the amount of oil that leaked. According to academics at two universities, satellite pictures of the spill, and the amount of dispersants used suggests it could have been twice as big -- 100,000 liters or about 26,000 gallons. PTT says it is "confident" of its own calculations.

The Thai energy ministry has promised the results of an investigation within seven days. Meanwhile the cleanup continues. It's a race against time. Every day, the pictures of the spill are flashed around the world increases the likelihood that tourists -- so important to this country's economy -- will go elsewhere for their fun in the sun.

1.1 What possibly caused the accident? **(2 points)**

1.2 At the time of the article, how many days had the oil leaked? Which date did it begin leaking? What beach was affected by the accident? **(3 points)**

1.3 According to PTT's estimate, how much oil was spilled into the Gulf of Thailand off of Koh Samet? Which groups of people were involved in the cleanup operation? **(3 points)**

1.4 What are the clean-up methods mentioned in this article? **(3 points)**

1.5 As mentioned by this article, what is the major impact of this oil spill on Koh Samet? **(3 points)**

1.6 List 3 ways to prevent such an accident from occurring in the future.  
**(6 points)**

2. From the videos of the accidents that you and your classmates posted in Facebook, describe the CAUSES and of the accident and HOW TO PREVENT it.  
**(8 points)**

<b>Accident</b>	<b>Causes (4)</b>	<b>Preventions (4)</b>
<b>Fukushima Nuclear Power Plant Explosion</b>	<ul style="list-style-type: none"><li>- Earthquake</li><li>- Tsunami</li><li>- Power Outage</li><li>- Cooling water cut</li><li>- Runaway Reaction</li><li>- Explosion</li></ul>	<ol style="list-style-type: none"><li>1. Additional emergency cooling system</li><li>2. Automatic shutdown</li><li>3. Construction design</li><li>4. Study possible dangers</li></ol>

## VI. DISCUSSIONS (30 points)

1. Using the attached diagram of a typical R&D facility layout (Fig.1), write where the following should be located: the service vehicles, the parking space for the employees and visitors, the office area, the workshops, store area, low hazards materials, high hazards materials, laboratory, control equipment, high hazard experimental area, and restricted area. **(10 points)**

**Use the attached diagram.**

2. Draw a layout of a Petroleum Refinery. List of the safety equipment, assembly point, entrances and exits, office area, labs, operating area, etc. that you think is best for a safe operating environment. **(20 points)**

**BONUS: (6 Points)**

**1. From the movie Armageddon, why was oil drilling team sent into space? (2 points)**

**2. What is N'Bright's favorite superhero from Justice League? (2 points)**

- (a) Superman
- (b) The Flash
- (c) Batman
- (d) Green Lantern

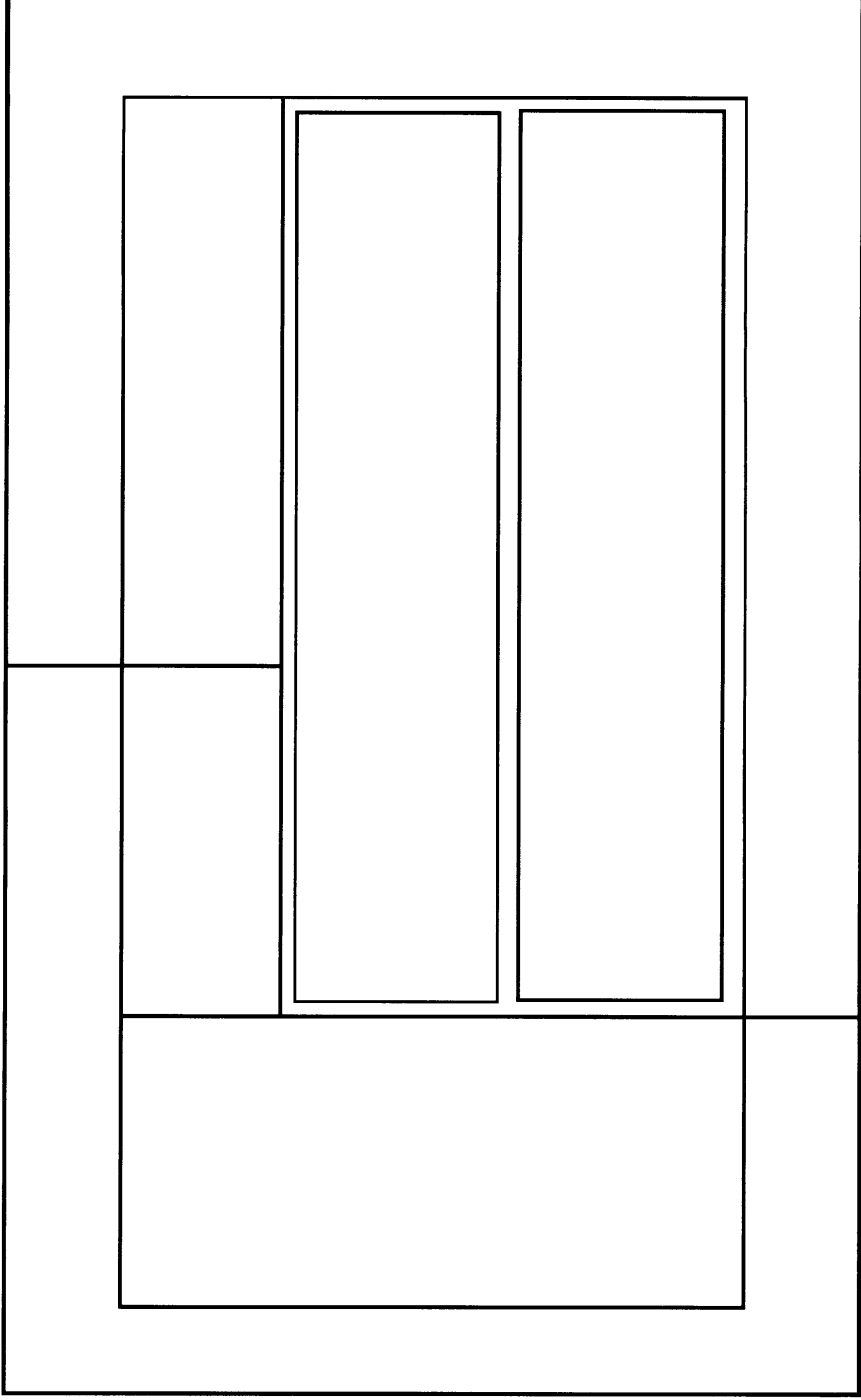
**3. From the picture below, which 2 boys are my sons? (2 points)**



**Good Luck!**

# Designing R&D Facilities

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**Fig. 1: Typical R&D facility layout**