

**BITS, PILANI-DUBAI**

Dubai International Academic City, Dubai, U.A.E.

IV Year Chemical Engineering, II Semester 2008-09

**COMPREHENSIVE EXAM**

CHE C413 Process Plant Safety

Maximum Marks: 80

Weightage: 40%

Duration: 3 hr

(Closed Book)

21.05.2009

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1. a) Discuss the basic principles of controlling hazards in process industries. (5 m)  
b) Name the substance which produces health hazards from the following industries.  
(i) paint spraying (ii) rubber industry (2 m)
2. a) What are the disadvantages of disposable mask? (2 m)  
b) Recommend the PPE for the following conditions (4.5 m)  
(i) Light concentration acid fumes (respirators)  
(ii) Oil and paint splashes (eye face protection)  
(iii) Falling welding spatters from above (head protection)
3. a) What are the legal requirements for siting and layout of industries? (3 m)  
b) Mention the distances from industrial sites should be taken into account while sitting up any process industry. (3 m)
4. Discuss the working principles of colorimeter and thermo gravimetric analyzer. (3 + 3 m)
5. a) In which category PETN explosives are classified. Explain its characteristics and its applications. (1 + 4 + 1 m)  
b) Mention the significance of positive oxygen balance in explosives. (2 m)
6. a) Explain how to recognize of pipe line spills. (3 m)  
b) Discuss in detail about design of pipeline and its attachments. (3 m)
7. a) Perform HAZOP study with any 3 guide words for the following condition. A cooling system is provided to remove the excess energy of reaction. The reaction is exothermic.

In the event of cooling function is lost, the temperature of reactor would increase. This would lead to an increase in reaction rate leading to additional energy release. The result could be a runaway reaction with pressures exceeding the bursting pressure of the reactor. The temperature within the reactor is measured and is used to control the cooling water flow rate by a valve. (6 m)

- b) Discuss what went wrong in detail about the Flixborough disaster which should include
- (i) the materials involved (1 m)
  - (ii) root causes (2 m)
  - (iii) what precautions should be considered in future to avoid such incidents (2 m)
8. a) Define flammable gases, flammable liquids and flammable solids. (7.5 m)
- b) Mention the safety parameters involved while designing process equipments (4 m)
- c) Mention the various techniques for evaluating hazards. (4 m)
9. a) Mention the key points should consider for the preparation of onsite and off site emergency plan. (3 + 3 m)
- b) How the safety auditing programmes are classified. (5 m)
10. Four acid trucks were ready to unload in the storage tanks. Three of the trucks were carrying sulfuric acid and one were nitric acid (35 wt %). The nitric acid tank was misdirected and partially unloaded in the sulfuric acid tank. What will happen if above said is followed? (3 m)

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**Test 2**

CHE C413 Process Plant Safety

Maximum Marks: 20

Weightage: 20%

Duration: 50 min

(Open Book)

12.04.2009

**Note: only prescribed txt book is allowed**

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1. What is called deluge system? Explain with an example. (3 m)
2. A plug valve was supplied stating that the valve was made from 304L steel (good resistant to nitric acid). The valve was installed in a nitric acid line and tightly closed. Five hours later the acid was escaping through the valve. State the reason for the above incident and how to prevent in future? (1 + 1 m)
3. A furnace was operated at 540-600°C and a gauge pressure of 900 psi, it was connected with a pipeline fixed by studs with nuts. It was running smoothly for the past 28 years. All of the sudden one day there was a rapid cascade of failures. It was found that a nut is forced onto a stud with a thread of a different pitch. The load was held by only a few threads, the studs failed, and the bonnet separated from the body. Once one stud failed, the load on the others increased, and there was a rapid cascade of failures. What type of a failure it is? (2 m)
4. There was a choke on the exit line from a small tank. To try to clear the choke, the operator held a compressed air hose against the open end of the choked line. The gauge pressure of the compressed air was 7 bars. What will happen if above said is followed to clear the choke? (2 m)
5. How to minimize the internal and external corrosion in the pipelines. (2m)
6. Mention the several ways of preventing explosions formation of static electricity. (3 m)

7. What is PRE? Where it is used? (2 m)
8. Paper and pulp mills use large quantities of water, and the water is usually recycled. Buffer storage is needed, and at one paper mill, it took the form of a 740 m<sup>3</sup> tank. Experience showed that this was insufficient, and another tank of the same size was installed alongside. To simplify installation it was connected in series with the original tank. A week after the new tank was brought into use, welders were completing the handrails on the roof, an explosion occurred in the tank. Explain why the explosion happened? (2 m)
9. On a very hot day, after a tank has been cleaned, a plastic bag was tied over the vent to keep dirt from getting in. When a sudden shower cooled the tank. What would have happened? (2 m)

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**Test 1**

CHE C413 Process Plant Safety

Maximum Marks: 25

Weightage: 25%

Duration: 50 min

(Closed Book)

01.03.2009

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1. Discuss in detail about physical classification of airborne contaminants. (6 m)
  2. Discuss in detail about the test for withstand of safety helmet. (3 m)
  3. Mention the purpose of barrier cream and lead apron. (2 m)
  4. Discuss in detail about various canister color codes. (4.5 m)
  5. What are the essential instructions to be given while training for safe and effective use of any PPE? (2.5 m)
  6. Mention the basic factors should be considered while dealing with EIA. (2 m)
  7. Discuss in detail about the sampling strategies of chemicals at workplace environment? (5 m)

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**Quiz No 3**

CHE C413 Process Plant Safety

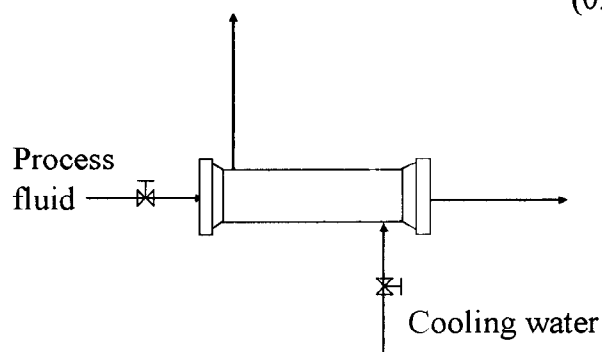
Maximum Marks: 10

Weightage: 5%

Duration: 15 min

(Closed Book)

Using given guide works, complete HAZOP study on shell & tube heat exchanger. (0.5 × 10 = 5 m)



| Guide Word | Deviation                  | Causes                         | Consequences                                  | Action |
|------------|----------------------------|--------------------------------|---|--------|
| Less       | Less flow of cooling water |                                | Temperature of process fluid remains constant |        |
| More       | More cooling flow          | Failure of cooling water valve |   |        |

|                      |  |                                  |  |  |
|----------------------|--|----------------------------------|--|--|
| <b>More of</b>       | <b>More pressure on tube side</b>          |                                  |  | <b>Install high pressure alarm</b>           |
| <b>Contamination</b> | <b>Contamination of process fluid line</b> |                                  |  | <b>Proper maintenance and operator alert</b> |
| <b>Corrosion</b>     | <b>Corrosion of tube</b>                   | <b>Hardness of cooling water</b> |  |  |

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**Quiz No 2**

CHE C413 Process Plant Safety

Maximum Marks: 10

Weightage: 5%

Duration: 15 min

(Closed Book)

1. What is DTA and mention its use? (0.5 + 0.5)

2. Match the various types of the explosives: (1 x 9)

- |                      |                               |
|----------------------|-------------------------------|
| a) Mercury fulminate | a) Plastic explosive          |
| b) Propellants       | b) Single compound explosives |
| c) Gun powder        | c) Nitrocellulose             |
| d) Cylonite          | d) primary explosives         |
| e) Smokeless powder  | e) Low explosives             |
| f) Picric acid       | f) Binary explosives          |
| g) Titronal          | g) Low explosive              |
| h) Amatol            | h) Binary explosives          |
| i) Hand moulded      | i) Single compound explosive  |
|                      | j) Dynamites                  |
|                      | k) Cordite                    |
|                      | l) PETN                       |
|                      | m) DDNP                       |
|                      | n) Plastic explosives         |
|                      | o) None                       |



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**Quiz No 1**

CHE C413 Process Plant Safety

Maximum Marks: 10

Weightage: 5%

Duration: 15 min

(Closed Book)

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1. Mention the various ways of organic solvents by which it can enter through skin absorption mode of entry. (1.5 m)
2. \_\_\_\_\_ constitute solid particles generated by condensation from the gaseous state. (it is one of the airborne contaminant) (1 m)
3. Airborne contaminants such as welding gases and combustion engine exhaust gases are the examples of the \_\_\_\_\_ (1 m)
4. Once the hazard is identified and evaluated, residual hazards may be controlled by the application of \_\_\_\_\_ principles. (1.5 m)
5. In the \_\_\_\_\_ mode of entry, the toxic materials that are readily soluble in body fluids are absorbed in the digestive system. (1 m)
6. The use of personal protective equipments should not be used as an alternative to engineering or other suitable control measures. (T/F) (1m)
7. What is gauntlet? (1 m)
8. What type PPE should be used for oily floors to protect feet? (Material of construction) (2 m)