INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: BACHELOR OF PETROLEUM ENGINEERING

YEAR/SEM: YEAR 3/SEMESTER 2

COURSE CODE: PTE3262

NAME: FACILITIES ENGINEERING

DATE: 2025-04-23

TIME: 2:00-5:00PM

INSTRUCTIONS TO CANDIDATES:

1. Read the instructions very carefully
2. The time allowed for this examination is STRICTLY three hours
3. Read each question carefully before you attempt and allocate your time equally between all the Sections
4. Write clearly and legibly. Illegible handwriting cannot be marked
5. Number the questions you have attempted
6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks
7. Any examination malpractice detected will lead to automatic disqualification.

DO NOT WRITE ANYTHING ON THE QUESTION PAPER

Section A Attempt any TWO Questions (40 Marks)

Question 1:

a) Explain any five (**5**);

(i) advantages of a depleted gas reservoir as a storage facility **(5 marks)**

(ii) problems faced by natural aquifers as a gas storage facility **(5 marks)**

b) (i) State any five (**5**) mitigation techniques for buoyancy in pipelines.

(5 marks)

(ii) Consider a pipeline under design to operate under the following conditions;

Pipeline internal pressure	= 800 psia
Pipeline safety factor	= 0.6
Pipe mean radius	= 2.5 ft
Pipe specified minimum yield stress	= 400 kN/ft^2

Determine the pipe thickness that should be used. **(5 marks)**

Question 2:

a) Explain how the following separator internals work;

(i) Baffle plates **(5 marks)**

(ii) Wave breakers **(5 marks)**

b) (i) State any four factor that guide on the choice of a horizontal separator **(4 marks)**

(ii) Explain the operational problems associated with the separator in **b(i)** above **(6 marks)**

Question 3:

a) Define the following terms;

(i) Retention time **(1 mark)**

(ii) Re-entrainment **(1 mark)**

(iii) Slenderness ratio **(1 mark)**

b) (i) State any four (**4**) operations and processes involved in the treatment of produced fluids **(4 marks)**

(ii) list three (**3**) fundermental factors that the functioning and separation ability of a separator depends on. **(3 marks)**

c) Given;

Gas flow rate at operational conditions	= 3.77 cfs
Gas density at operational conditions	= 3.7 lb/ft^3
Liquid density at operational conditions	= 51.4 lb/ft^3
Vertical separator empherical factor	= 0.21

Determine;

(i) gas velocity based on the total separator area **(3 marks)**

(ii) cross-sectional area (in sq.ft) **(2 marks)**

(iii) Gas capacity at standard conditions (operating pressure = 1000 psia, operating temperature = 60 °F, and the gas deviation factor = 0.31) **(5 marks)**

Question 4:

a) (i) Define the following as applied to pipeline transportation;
â??Right of wayâ?• and â??Special consideration pointsâ?• **(1 mark)**

(ii) State how buoyancy effect in pipelines can be mitigated **(5 marks)**

(iii) List any three (**3**) advantages of gaseous hydrocarbon over oil and coal. **(3 marks)**

b) (i) Explain why storing and/or transporting gaseous hydrocarbon other than liquid is considered as non-practical. **(4 marks)**

(ii) Briefly explain any four (**4**) importance of the knowledge of facilities engineering to a petroleum engineer **(2 marks)**

c) A 2-phase crude settling volume in a separator is 4,500 bbl, if it is being produced at 200mmbbl/day, estimated the retention time. **(5 marks)**

Section B Attempt any THREE Questions (60 Marks)

Question 1:

a) List five (**5**) advantages and five (**5**) disadvantages of using a vertical separator **(10 marks)**

b) Explain the procedures to be followed to size a vertical separator **(10 marks)**

Question 2:

a) (i) What is a separator? List any four (**4**) of its basic functions.**(5 marks)**

(ii) Explain the four (**4**) major specific sections of a separator **(10 marks)**

b) Explain how this hydro-testing is performed in newly completed pipelines.
(5 marks)

Question 3:

a) (i) Explain any five (**5**) safety precautions associated with natural gas pipelines
(10 marks)

b) Pipeline is considered as the best suited mode of transportation. Explain five (**5**) advantages compared to other transportation modes. **(10 marks)**

Question 4:

a) State any five (**5**) factors that affect separation of well head streams
(5 marks)

b) Given the following data, size a 2-phase vertical separator **(15 marks)**

Gas flow rate	= 12 MMscfd at 0.6 API
Liquid flow rate	= 2500 bpd at 40 API
Operation pressure	= 1200 psia
Density of gas	= 3.71 lb/ft3
Density of liquid	= 50.2 lb/ft3
Oil viscosity	= 0.013 cp
Gas compressibility	= 0.84
Liquid drop	= 140 micron
Retention time	= 3 min
Drag coefficient	= 0.851