UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE	:	LKB30903
COURSE TITLE	:	COMPUTATIONAL ANALYSIS FOR OFFSHORE ENGINEERING
PROGRAMME NAME	:	BACHELOR OF ENGINEERING TECHNOLOGY (OFFSHORE) WITH HONOURS
DATE	:	26 JANUARY 2026
TIME	:	2:00PM - 5:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of ONE sections.
4. Section A consist of five questions. Answer FOUR (4) questions only.
5. Please write your answer on the answer booklet provided.
6. Please answer all questions in English only.
7. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

THERE ARE 12 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 100 marks)

Answer FOUR (4) questions.

Please use the answer booklet provided.

Question 1

The development of oil or gas reserves in productive oil or gas fields or the operation for recovering or extracting such reserves fall under production activities. Specific activities include drilling projects, facilities engineering, and other construction projects. Closure activities commence once all reserves have been effectively extracted. These activities include plugging and abandoning fields and project reevaluation. There are different modes of transportation for moving oil and gas products shows in Figure 1. These include pipeline and pipeline networks, rails and trucks for land transportation, and barge and tankers for maritime transportation. Notable examples of midstream players are pipeline transport companies, trucking and hauling companies, shipping companies, and terminal developers and operators, among others. The analysis from this processes can be analysed by using numerical computational analysis.

Refer Below - Figure1 : Upstream Midstream Downstream Activities .

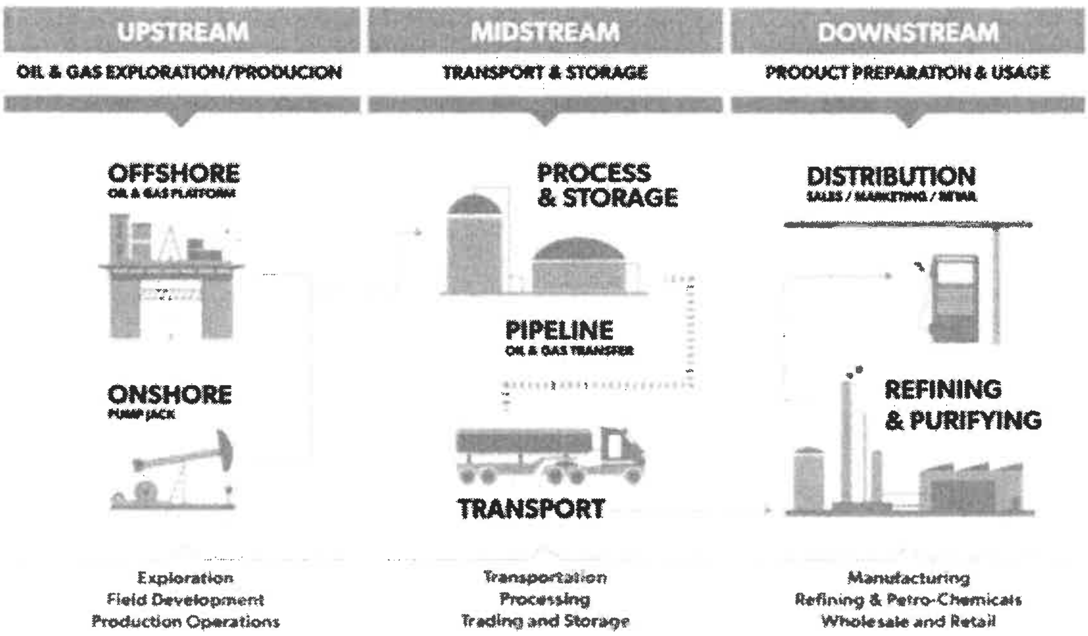

Figure 1: Upstream Midstream Downstream Activities

(a) Describe steps involve in solving a non-linear equation using Bisection method (include error approximation).

(5 marks)

(b) Determine the lowest positive roots of equation $f(x) = x^3 - 0.5x^2 + 4x - 2$ by using graphical method (plot in graph paper).

(10 marks)

(c) Then compare your answer by using Bisection method with initial guesses of a = 0 and b = 1

(5 marks)

(d) Another process also need to use Gauss Elimination method. Determine the missing code in M Script file for linear equation below.

$$\begin{array}{rrrcr} x_1 & +x_2 & -x_3 & = & -3 \\ 6x_1 & +2x_2 & +x_3 & = & 2 \\ -3x_1 & +4x_2 & +x_3 & = & 1 \end{array}$$

```
a = [__________
    __________
    __________];
[m,n]=size(a);
for j=1:m-1
   for z=2:m
      if a(j,j)==0
         t=a(j,:);a(j,:)=a(z,:);
         a(z,:)=t;
      end
   end
   for i=j+1:m
      a(i,:)=a(i,:)-a(j,:)*(a(i,j)/a(j,j));
   end
end
x=zeros(1,m);
for s=m:-1:1
   c=0;
   for k=2:m
      c=c+a(s,k)*x(k);
   end
   x(s)=(a(s,n)-c)/a(s,s);
end
disp('________________:');
a
x'
```

(5 marks)

Question 2

A permanent mooring must remain secure for long periods while unattended, occasionally under adverse conditions. For peace of mind, it should be the right size for the job. The size of your mooring should depend on the conditions under which the boat is moored, such as the amount of fetch for waves to build up and whether your mooring is for light duty, such as overnight use in fair weather, or designed to ride out a hurricane. The two preferred designs for mooring buoys are a traditional buoy with hardware or a buoy with a tube through the center. Both offer reliable flotation and will last for several seasons, depending upon the salinity of the water. Obviously, freshwater applications will extend the useful life of any mooring system.

Refer Below - Figure2 : The Mooring Buoy Chain for Anchor .

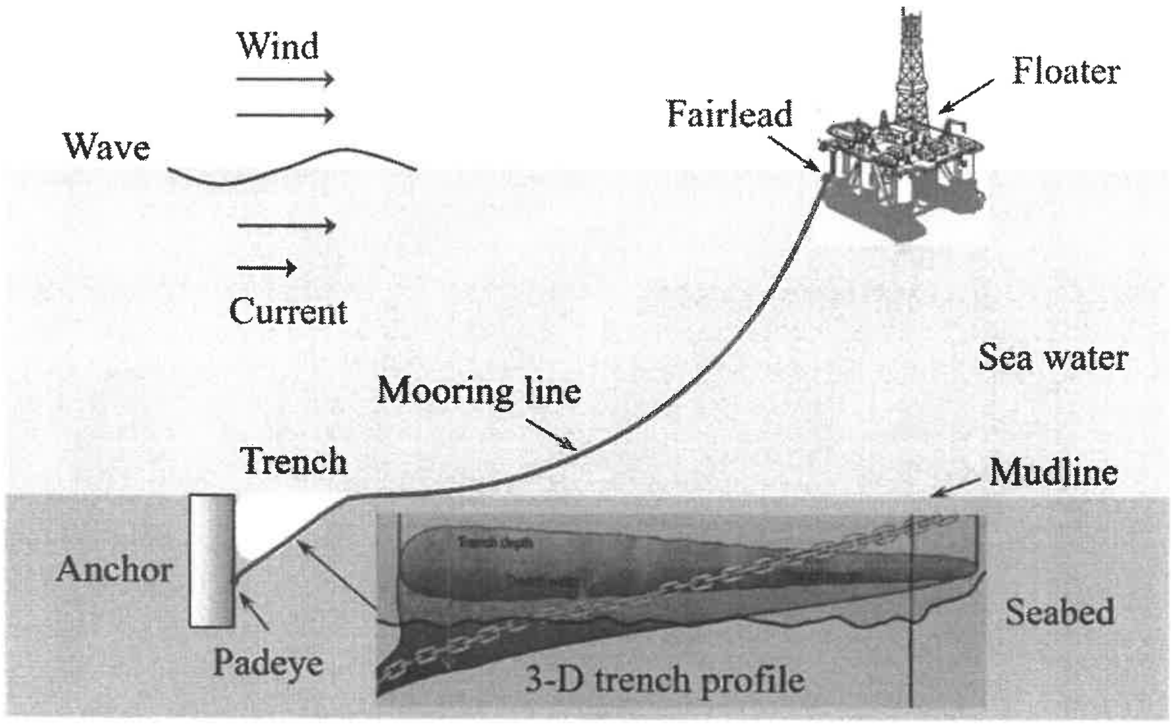

Figure 2: The Mooring Buoy Chain for Anchor

(a) Determine for all the forces (roots) and reaction for the cable by using graphical method. The forces can be transformed in non-linear equation as roots of equation,

$$f(x) = 5x^3 - 5x^2 + 6x - 2$$

(10 marks)

(b) Solve the linear system below using Gauss-Seidel Iteration method. Calculate up to 3rd iteration.

$$\begin{array}{lllll} x_1 & + & x_2 & -x_3 & = -3 \\ 6x_1 & + & 2x_2 & +2x_3 & = 2 \\ -3x_1 & + & 4x_2 + & +7x_3 & = 1 \end{array}$$

(8 marks)

(c) Determine the missing code in M Script file from (a) Newton Raphson method.

```
%The Newton Raphson Method
clc;
close all;
clear all;
%syms x;
x=__:_____:___;
f(x)=_________________________________;
g=diff(f); %The Derivative of the Function
n=input('_____________________________:');
epsilon = 1*10^-(n+1)
x0 = input('____________________________:');
for i=1:100
        f0=vpa(subs(f,x,x0)); %Calculating the value of function at x0
         f0_der=vpa(subs(g,x,x0)); %Calculating the value of function derivative at x0
        y=x0-f0/f0_der; % The Formula
err=abs(y-x0);
if err
break
end
x0=y;
end
y = y - rem(y,10^-n); %Displaying up to required decimal places
fprintf('The Root is : %f \n',y);
fprintf('No. of Iterations : %d\n',i);
```

(7 marks)

Question 3

A jacket is a welded tubular space frame with three or more near vertical tubular chord legs with a bracing system between the legs. The jacket provides support for the foundation piles, conductors, risers, and other appurtenances. A jacket foundation includes leg piles which are inserted through the legs and connected to the legs either at the top, by welding or mechanical means, or along the length of the legs, by grouting. The data has been taken during installation of the platform.

Refer Below - Figure3 : Jacket Pile through Jacket Leg .

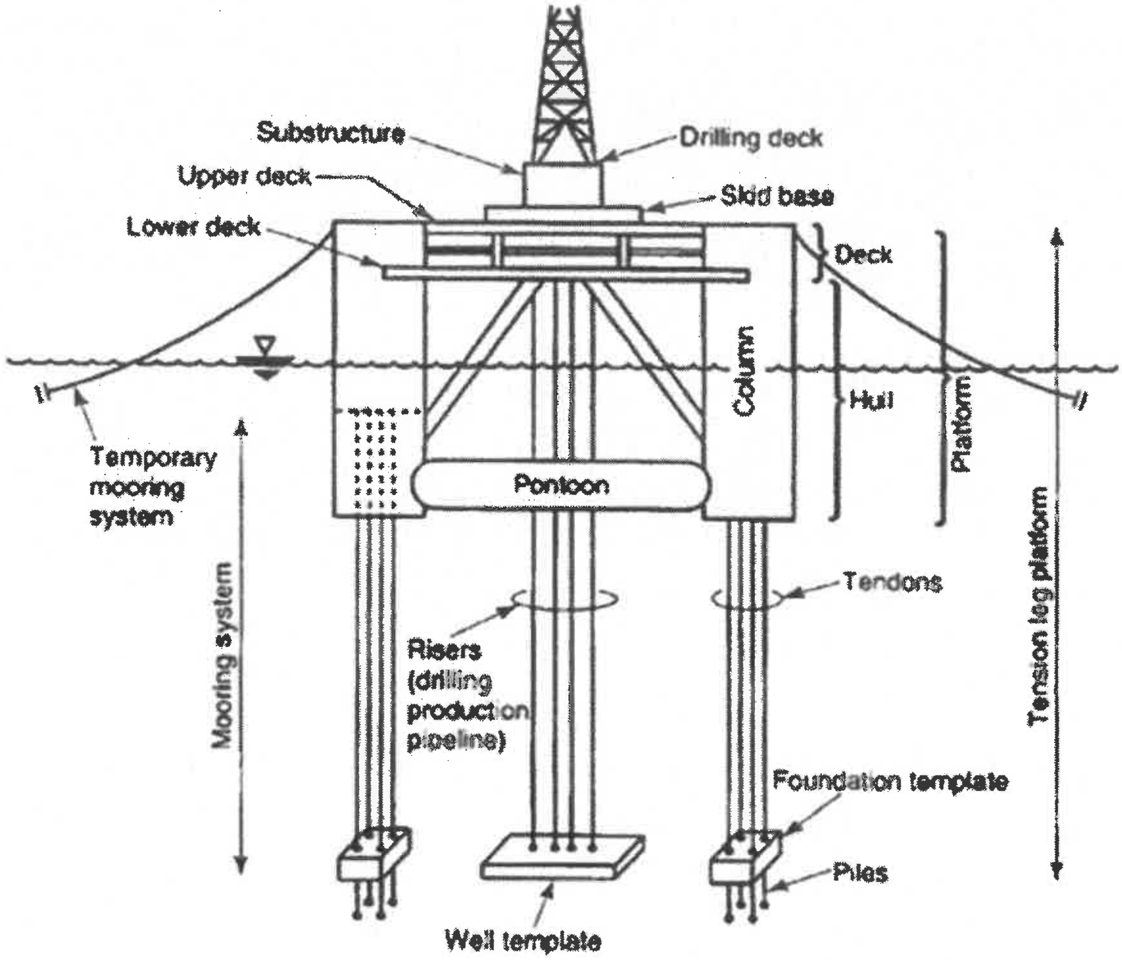

Figure 3: Jacket Pile through Jacket Leg

(a) From the Table, the data has been taken from a concrete pile composition during seabed auto filling self-pile. Use the best numerical method (for this type of problem) to determine P(x) from the first order Lagrange polynomial until third order Lagrange polynomial.

Refer Below - Table1 : Lagrange polynomial Concrete Pile .

(15 marks)

Table 1: Lagrange polynomial Concrete Pile

x	1	2	3	5	7	8
f(x)	3	6	19	99	291	444

(b) Use the polynomial in (a) to analyse the value of $f_3(4)$

(10 marks)

Question 4

One of the most important issues that offshore structures face is corrosion. Corrosion is a major factor affecting the longevity, protection, and long-term viability of buildings and structures. Corrosion-induced failure can result in severe safety incidents as well as financial losses. The characteristics of materials and structures in the marine environments deteriorate over time as a result of various parameters eroding at the same time. These parameters such as; dissolved oxygen, temperature, salinity, pH, seawater speed, and other variables. Corrosion progresses more quickly in an offensive setting. Seawater hastens the rate of corrosion due to its high electrolyte levels. The high salt content in this environment contributes additional ions to the water, which in turn increases the charge imbalance discussed above. In order to analyse all these chemical elements, engineer need to apply numerical differentiation methods.

Refer Below - Figure4 : Corrosion Processes .

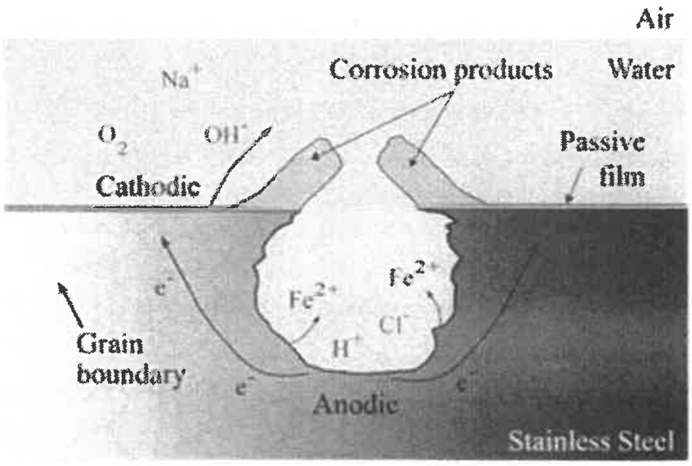

Figure 4: Corrosion Processes

(a) The following data shows the data corrosion rate (y) versus months (x). Data need to generate cubic interpolating polynomial below

$$f_3(x) = a_0x^0 + a_1x^1 + a_2x^2 + a_3x^3$$

x	2	3	4	5	6	7
f(x)	0.5	0.3333	0.25	0.2	0.1667	0.1429

Then analyse the month it is took for the corrosion rate at $f_3(x) = 0.23$

(15 marks)

(b) Plot the graph for the graphical method $f_3(x) = 0.943 - 0.3261833x + 0.04911x^2 - 0.00271667x^3$

(10 marks)

Question 5

In the design of structures, engineers are always faced with the task of carrying out interpolations as supported by various codes of practice. These interpolations are often encountered when we are carrying out wind load analysis, designing our columns, designing our two-way slabs, etc.

Refer Below - Figure5 : Compression Bending Moment .

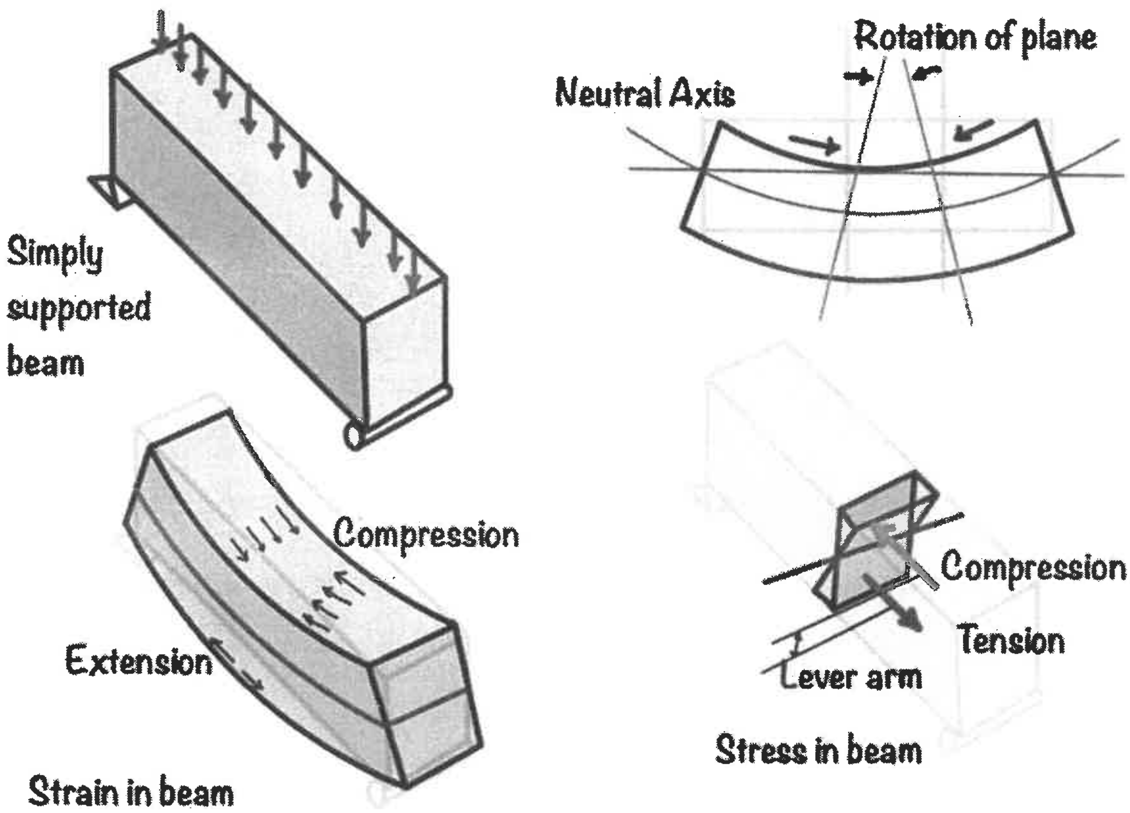

Figure 5: Compression Bending Moment

(a) Plot the graph for function $f(x) = \dfrac{1}{(1 + 25x^2)}$ with the interval from x = -1 to 1.

(10 marks)

(b) Generate and plot the fourth-order Lagrange interpolating polynomial graph using values corresponding to x = -1, 0.5, 0, 0.5, and 1.

(15 marks)

END OF EXAMINATION PAPER