

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
Program: B. Sc. in Civil Engineering

Course Title: Fluid Mechanics (OBE)
 Time: 3 hours

Credit Hour: 3.00

Course Code: CE 221
 Full Marks: 100

Please answer all questions.

[Assume reasonable data if and when required]

- QUESTION 1 [10 MARKS]**
1. a) Define hydraulic radius. Find hydraulic radius for a circular pipe. 5
 - b) Define stream function. State the condition for flow lines to satisfy continuity equation. 5
- QUESTION 2 [15 MARKS]**
2. Derive the Darcy-Weisbach equation for a circular pipe flow. 15
- QUESTION 3 [30 MARKS]**
3. a) In a 2-dimensional flow field, $u = 2y$ and $v = -x$. Derive general expression for velocity and acceleration. 10
 - b) Water flows from reservoir 1 to 2 through a 6-inch diameter, 500-ft length pipe, as shown in **Figure:1**. Assume initial friction factor, $f=0.037$ and roughness, $\epsilon = 0.003$ ft for the pipe. Calculate major and minor losses. Find the flow rate. Given $k_{entrance}=0.5$, $k_{exit}=1$, $k=0.20$ (90-degree elbow), $k_{globe valve}=10$, $k_b=0.45$. 10
 - c) Determine flow in each pipe as shown in **Figure:2** using **Hardy-Cross** method. Give 2 trials. 10
- QUESTION 4 [5 MARKS]**
4. Define kinetic energy head and potential energy head. 5
- QUESTION 5 [10 MARKS]**
5. Derive Bernoulli's energy equation 10
- QUESTION 6 [30 MARKS]**
6. a) Find the hydrostatic force acting on the 4-feet wide gate which is resisting sea water on the left side only as shown in the **Figure:3**. 10
 - b) Flow occurs over a spillway having an upstream depth of 5 ft and downstream depth of 1 ft. Find the horizontal force on the spillway per unit width. 10
 - c) A jet of water flowing freely in the atmosphere is deflected by a 90° curved vane as shown in **Figure:4**. The water jet has diameter of 2 inch, initial and final velocity 25 ft/s. Find the force on the **vane** by the water jet. Draw the free body diagram. 10

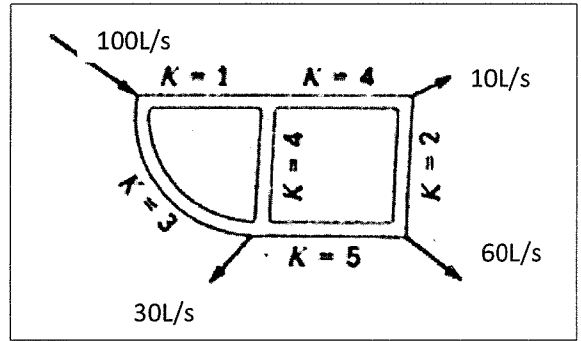
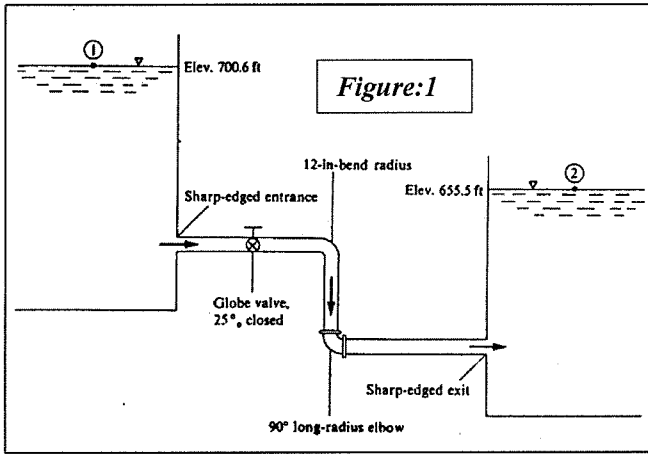


Figure:2

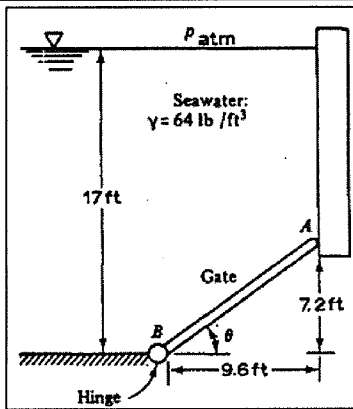


Figure:3

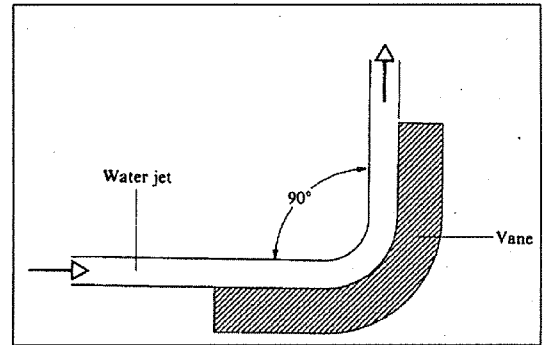
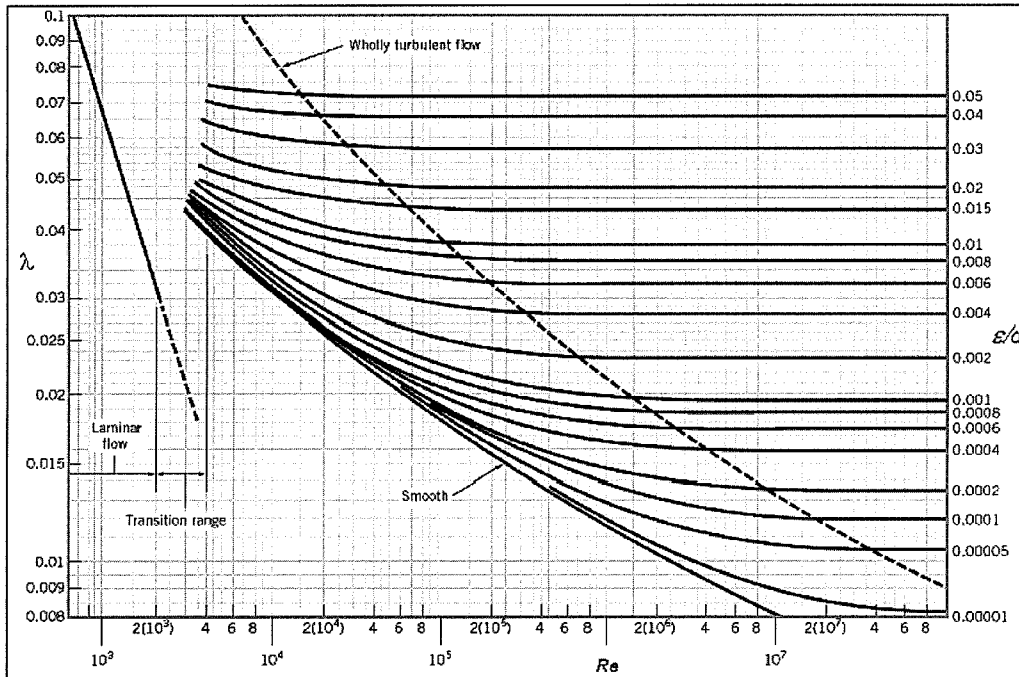


Figure:4



Moody diagram

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
Program: B.Sc. in Civil Engineering
2nd Year 2nd Semester

Course Title: Applied Mathematics for Engineers
 Time: 3 hours

Credit Hour: 3.00

Course Code: MTH 203
 Full Marks: 150

Answer all the questions

QUESTION 1 [20 MARKS]

Determine the deformation for an overburden load on a rail track on soil shown in **Fig 1**.

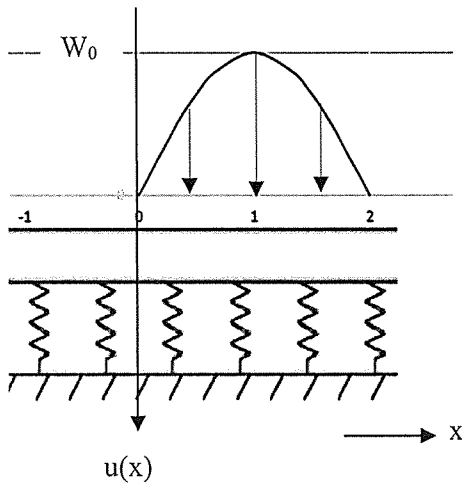


Fig. 1

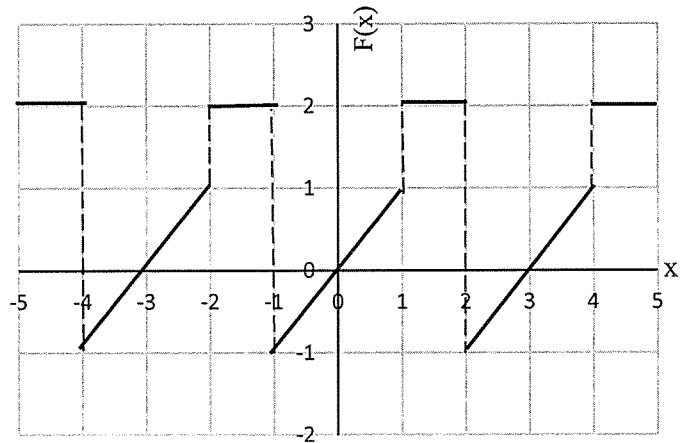


Fig. 2

QUESTION 2 [12 MARKS]

Determine the coefficient b_n of the Fourier Series for the function shown in **Fig 2**.

QUESTION 3 [18 MARKS]

Find the followings-

a. $F \left\{ 3 \frac{d}{dx} (e^{-9x^2}) \right\}$ (10)

b. $F^{-1} \left\{ \frac{2}{\omega^2 + 6\omega + 25} \right\}$ (8)

QUESTION 4 [15 MARKS]

Solve the following differential equations using Laplace transformation.

$$\frac{dX}{dt} = 4X + Y \quad \text{and} \quad \frac{dY}{dt} = -X + 2Y \quad \text{when } X(0) = 5 \text{ and } Y(0) = -1$$

QUESTION 5 [10 MARKS]

Determine $L\{F(t)\}$ using Unit Step Function.

$$F(t) = \begin{cases} -4 & 0 < t < 5 \\ e^{2t} & t > 5 \end{cases}$$

QUESTION 6 [25 MARKS]

Find the followings-

a. $L^{-1} \left\{ \frac{s}{(s^2-1)^2} \right\}$ (10)

b. $\int_0^{\infty} e^t \cos^3(2t) dt$ (10)

c. $L\{F(4t)\}$ if $L\{F(t)\} = \frac{s^3}{(s+2)(s^2+1)}$ (5)

QUESTION 7 [15 MARKS]

Solve the partial differential equation $(x + z - y)q + (y - x)p = -z$ and find the equation of surface satisfying $z=1$ & lying on $x^2 = 1 - y^2$.

QUESTION 8 [25 MARKS]

Obtain the general solution of the partial differential equations

a. $(D^2 - DD')z = \sin x \cos 2y$ (10)

b. $(D^3 - 2D^2D')z = 2e^{2x} + 3x^2y + \sin 2x + \cos 3y$ (15)

QUESTION 9 [10 MARKS]

Find the complete integral of non-linear partial differential equation

$$q^2 - pz + 1 = 0.$$

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
Program: B.Sc. in Civil Engineering
2nd Year 2nd Semester

Course Title: Engineering Geology and Geomorphology
 Time: 3 hours

Course Code: CE 203
 Full Marks: 100

Answer all the questions

QUESTION 1 [2 MARKS]

Mention the characteristics of drainage basin affecting runoff.

QUESTION 2 [8 MARKS]

Using rational method, calculate the peak runoff (Q_p) for the catchment area as shown in **Figure 1**.

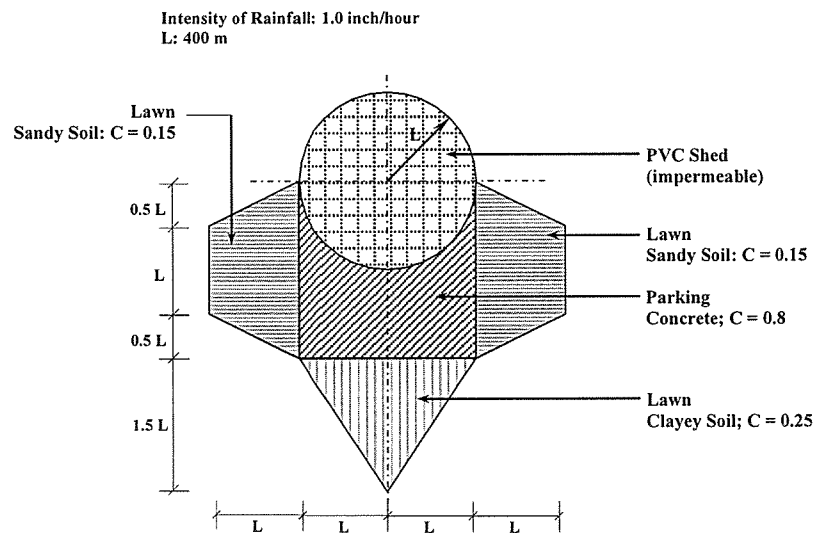


Figure 1

QUESTION 3 [2 MARKS]

Define Capacity and Competence of a river.

QUESTION 4 [8 MARKS]

Cross-sectional profile of a channel, shown in **Figure 2**. The gradient of the channel bed is 7.67×10^{-4} . Calculate the tractive pressure along the channel.

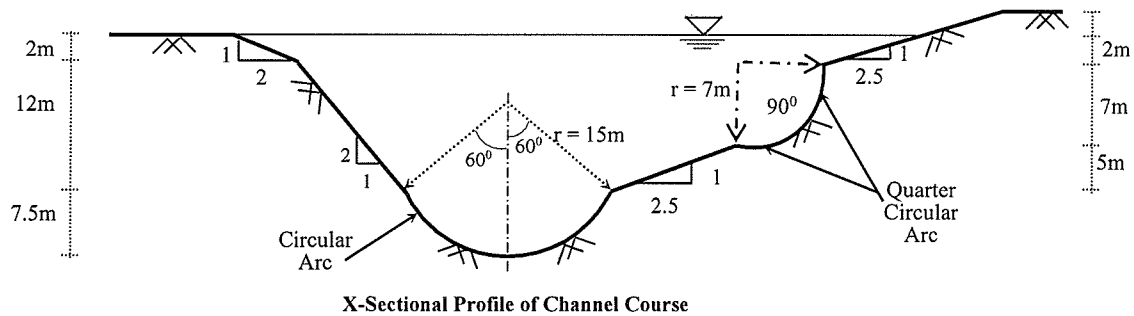


Figure 2

QUESTION 5 [2 MARKS]

Define “graded stream”.

QUESTION 6 [8 MARKS]

Calculate Stream Frequency (SF) of a catchment area (having DD = 0.0340744 km/km²) from the information provided in the table below.

Stream Rank	No. of Streams (N _s)	BR	ABR	Mean Length (L _m , km)	LR	ALR
1	---	2.143	2.492	---	3.0	2.5
2	---			---		
3	3	---		---		
4	---	---		200	2.5	

QUESTION 7 [5 MARKS]

Consider two sections of a river. Hydraulic radiuses for sections 1 and 2 are 300 feet and 200 feet, respectively. Gradients are 0.002 and 0.003 for sections 1 and 2, respectively. Considering unit weight of water to be constant, compare erosional tendency at these two sections of the river.

QUESTION 8 [15 MARKS]

Describe the following drainage patterns with appropriate diagrams-

- a. Trellis
- b. Dendritic
- c. Annular

QUESTION 9 [5 MARKS]

Discuss the importance of the seismic hazard map of Bangladesh updated in BNBC-2020.

QUESTION 10 [10 MARKS]

Explain how rocks are transformed from one type to another with the help of a neat sketch.

QUESTION 11 [5 MARKS]

Discuss briefly the agents of metamorphism.

QUESTION 12 [15 MARKS]

Discuss in depth the three processes of V-shaped valley formation.

QUESTION 13 [5 MARKS]

Compare between earthquake magnitude and earthquake intensity scale.

QUESTION 14 [10 MARKS]

Explain how crystalline structure influence the physical properties of minerals. Also, discuss how you will identify mineral in a natural setting.

Department of Civil Engineering
Final Examination Fall 2024
Program: B. Sc. Engineering (Civil)

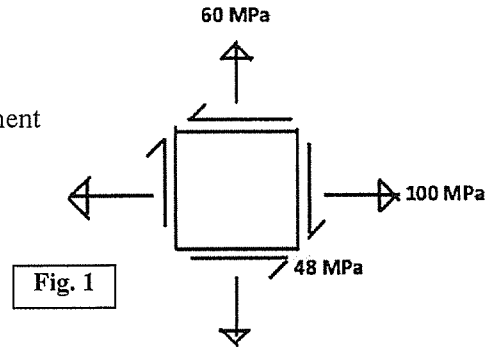
Course Title: Mechanics of Solids II
 Time: 3 hours

Credit Hours: 3.0

Course Code: CE 213
 Full Marks: 100 (= 10 × 10)

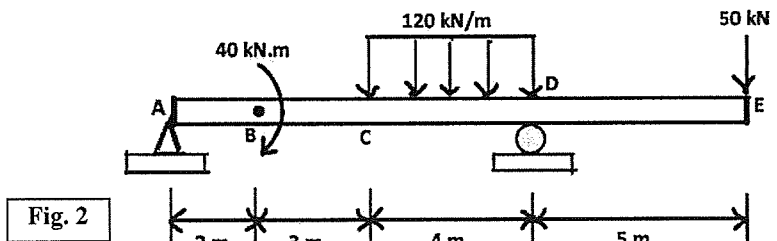
PART A (Answer any 5 (Five) of the following 6 Questions)

1. For state of plane stress shown in Fig. 1, calculate
- Principal planes and the principal stresses.
 - Plane of maximum shear and corresponding stresses.
 - Stress components on element obtained by rotating given element counterclockwise through 30 degrees
 (Show the element on **Mohr's Circle**).



2. A beam with an overhang is subjected to a combined loading, as shown in Fig. 2.

Using the method of **singularity function**, determine the slope at support A and the deflection at B.

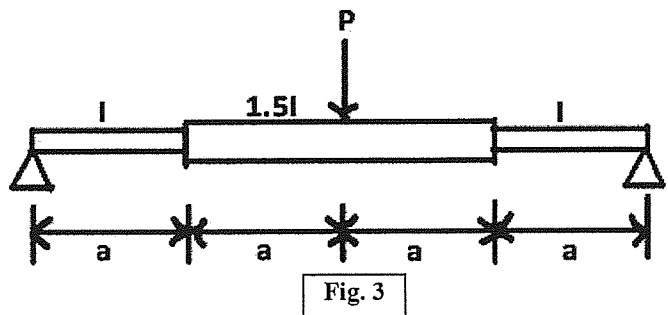


3. (a) The middle half of the beam shown in Fig. 3 has a moment of inertia 1.5 times that of the rest of the beam.

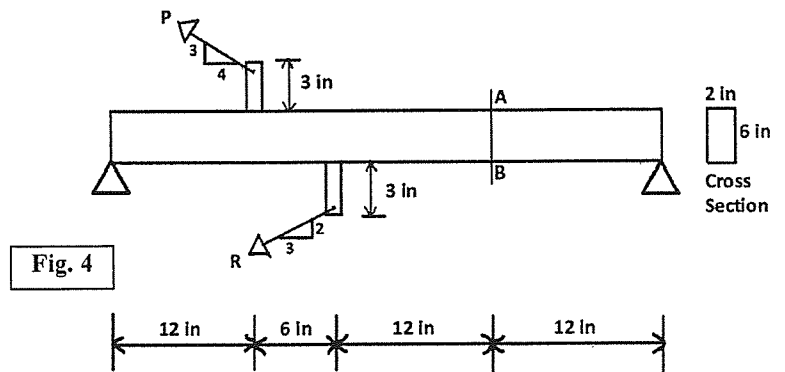
Determine the midspan deflection by using **area-moment theorem**.

- (b) Replace the concentrated load in Fig. 3 by a uniformly distributed load of intensity w_0 acting over the middle half of the beam.

Determine the maximum deflection by using **area-moment theorem**.



4. Compute the stresses at A and B on the link loaded as shown in Fig. 4 if $P = 9000$ lb and $R = 3000$ lb.



5. As shown in **Fig. 5**, a homogeneous 50-kg rigid block is suspended by the three springs whose lower ends were originally at the same level.

Each **steel** spring has 24 turns of 10-mm-diameter on a mean diameter of 100 mm, and $G = 83 \text{ GPa}$.

The **bronze** spring has 48 turns of 20-mm-diameter wire on a mean diameter of 150 mm, and $G = 42 \text{ GPa}$.

Compute the maximum shearing stress in each spring.

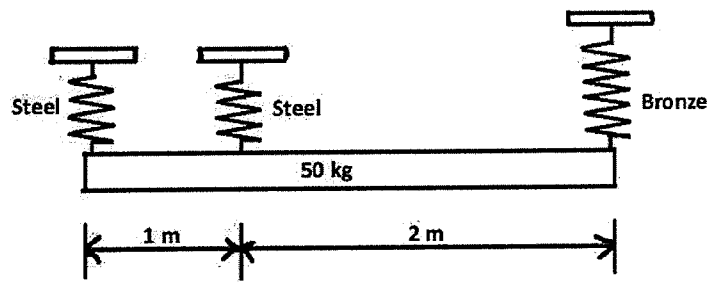


Fig. 5

6. The fixed-ended beam AB carries a concentrated load P , as shown in **Fig. 6**.

Use **area-moment** theorems to determine the fixed-end moments at **A** and **B**

[Given: EI is constant].

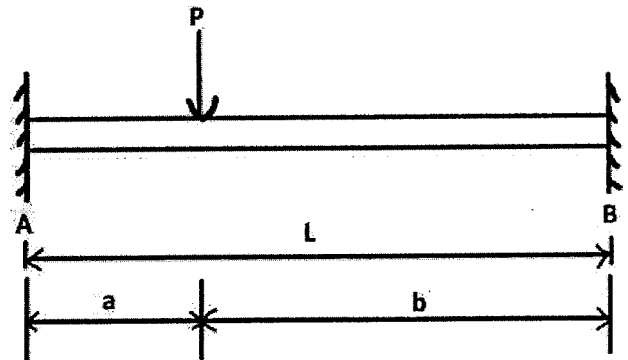


Fig. 6

PART B (Answer any 5 (Five) of the following 7 Questions)

[Given: $R_0 =$ Last three digits of Registration #]

7. **Fig. 7(a)** shows the severely damaged entrance of Al-Aqsa University in Gaza, while **Fig. 7(b)** shows its schematic view $aa_1bb_1cc_1$. If it has circular columns of length $L (= 40 + 0.1R_0)$ ft, diameter $D (= L/20)$ and modulus of elasticity $E = (2000 + 5R_0)$ ksi, calculate the
- Distributed Load w_{max} k/ft required to cause buckling of simply-supported column aa_1
 - Initial imperfection (v_{i0}) of column aa_1 , if transverse deflection $v_{max} = L/20$, when $w = 0.5w_{max}$
 - Load Eccentricity (e) of column aa_1 , if transverse deflection $v_{max} = L/20$, when $w = 0.5w_{max}$.

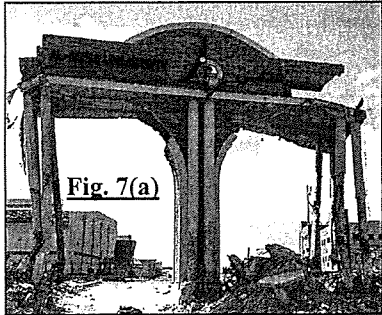
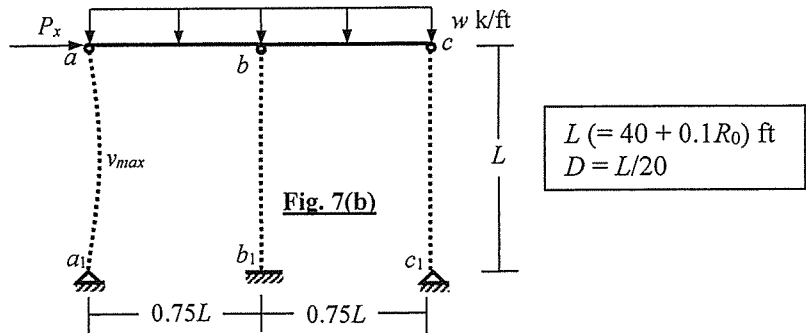


Fig. 7(a)



- Calculate the allowable force P for the for column cc_1 described in **Question 7 [Fig. 7(b)]**, if it is constructed of a nonlinear material with stress-strain relationship $\sigma = (50 + 0.2R_0) (\epsilon)^{0.5}$, where σ is compressive stress (ksi) and ϵ is strain.
 - Calculate the plastic moment M_p of the column section if it buckles at the force P [calculated in (i)] applied at an eccentricity $e = L/500$.
- Use the AISC-ASD method to calculate the
 - Allowable force (P_{ait}) for Column bb_1 and
 - Corresponding load (w k/ft) on Beam abc described in **Question 7 [Fig. 7(b)]**

[Given: $f_y = (4 + 0.01R_0)$ ksi, $E = (2000 + 5R_0)$ ksi.]
- For the simply-supported beam ab shown in **Fig. 7(b)** (described in **Question 7**), calculate the
 - Critical buckling load P_{cr}
 - Maximum Bending Moment (using exact formula and AISC formula for MMF) if subjected to uniformly distributed load $w = (1 + 0.1R_0)$ k/ft and axial force $P_x = 0.5P_{cr}$.
 - Maximum Bending Moment (using exact formula) if the entire uniformly distributed load is replaced by an equivalent force concentrated at its midspan.

11. **Fig. 8(a)** shows a damaged multi-storied building in Gaza, while **Fig. 8(b)** shows its schematic diagram and **Fig. 8(c)** the column and beam section. Use the *Alignment Charts for Effective Length Factors k* to calculate the
- Buckling force of Column BB_0 if effective length factor $k_{BB_0} = 1.5$, and length of beams AB, BC
 - Effective length factors of Column AA_0 and Beam AB [Using Salama (2014)]
- [Given: $H_1 = (20 + 0.05R_0)$ ft, $E = (2000 + 5R_0)$ ksi].

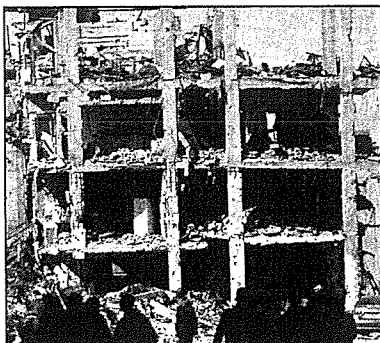


Fig. 8(a)

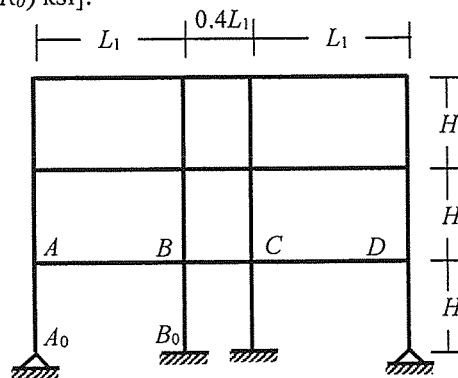


Fig. 8(b)

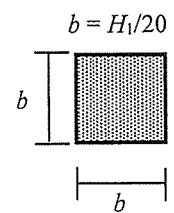


Fig. 8(c)

12. **Fig. 9(a)** shows a damaged multi-storied building in Ukraine, while **Fig. 9(b)** shows the schematic diagram of the top-floor beam ABC (with cantilever extensions) subjected to uniformly distributed torsional moments $t_{AB} = (1 + 0.01R_0)$ k-ft/ft and $t_{BC} = 2t_{AB}$.

Calculate the maximum torsional shear stress and torsional rotation of the beam
 [Given: Length $L = (20 + 0.1R_0)$ ft] and beam section is a $(1' \times 2')$ rectangle].

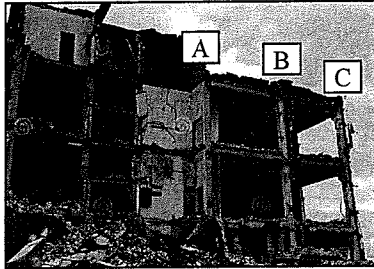


Fig. 9(a)

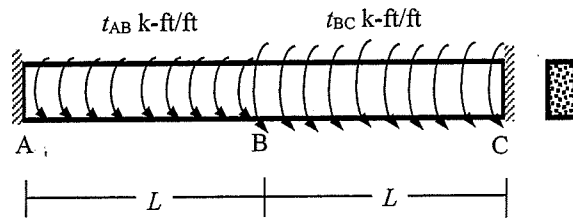


Fig. 9(b)

13. Calculate the equivalent polar moment of inertia (J_{eq}) for cross-sections shown in **Fig. 10(a)** and **Fig. 10(b)** by centerline dimensions

[Given: Wall thickness = $(0.1 + 0.001R_0)'$].

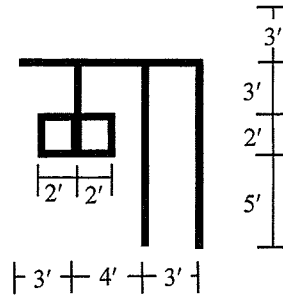


Fig. 10(a)

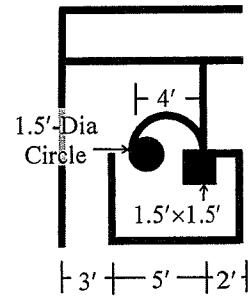


Fig. 10(b)

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
Program: B.Sc. in Civil Engineering
2nd Year 2nd Semester

Course Title: Numerical Analysis and Computer Programming (OBE)

Course Code: CE 205

Time: 3 hours

Credit Hour: 3.00

Full Marks: 100

Answer all the questions

QUESTION 1 [15 MARKS]

In Hydrology lab, an experiment named “Flow through a Venturi Meter” is done to collect Discharge vs Time data provided in the following table. Determine the discharge (Q) when time (t)= 8.5 sec using **Gregory Newton Backward Difference Interpolation Method**.

Time, t (s)	0	2	4	6	8	10
Discharge Q (m ³ /s)	0	5	7	8	9	11

QUESTION 2 [30 MARKS]

In Solid Mechanics lab, an equation, $y = x^2 + 3e^x + \sin x$ is found to determine the reaction force of a cantilever beam. Calculate the reaction force y by **integrating** $I = \int_0^6 (x^2 + 3e^x + \sin x) dx$

- Using Trapezoidal Rule where n=6 [10]
- Using Simpson’s Rule where n=5 [10]
- Using Gauss Quadrature where n=1 [5]
- Make a table of comparison of the obtained results from (a), (b), and (c) with Analytical Solution [5]

QUESTION 3 [30 MARKS]

Following is a differential equation which is found in Geotechnical lab in UAP while performing an experiment.

$$\frac{d^2y}{dx^2} - (x^2 - 10x + 25)y = 0 \quad \text{where } y(0)=1, y(2)=3$$

- Solve the boundary value problem by **Finite Difference Method** [Use step size h=0.5] [15]

b. Solve the equations obtained from (a) by **Gauss Seidel Method**. If not possible, then use **Matrix Inversion Method**

[15]

QUESTION 4 [10 MARKS]

Write a program using **MATLAB** to solve the equations obtained from **Question 3** by **Matrix Inversion Method**

QUESTION 5 [15 MARKS]

A rod subjected to an axial load yielded the following data up to rupture. Stress-strain values are given below

Strain	0	0.05	0.10	0.15	0.2	0.25
Stress (k/in ²)	0	25	40	50	65	55

a. Write a program using **MATLAB** to plot fitted Stress-Strain curve (Use 100 segments, blue color dashed line).

[10]

b. Write a program using **MATLAB** to determine the area under the curve using **Trapezoidal** method

[5]

Relevant Formulae:

$$\int_{-1}^1 f(p) dp = f\left(\frac{-1}{\sqrt{3}}\right) + f\left(\frac{1}{\sqrt{3}}\right)$$

$$\frac{d^2y}{dx^2} = \frac{Y_{n+1} - 2Y_n + Y_{n-1}}{h^2}$$

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
Program: B.Sc. in Civil Engineering
2nd Year 2nd Semester

Course Title: Engineering Economics

Course Code: ECN 201

Time: 3 hours

Credit Hour: 3.00

Full Marks: 150

There are **eight** questions. Answer any **six** including **Q1, Q2, Q3** and **Q4**.

QUESTION 1 [25 MARKS]

- a. What is meant by a production function? Using the data given in **Table 1**, calculate the average product (AP) and marginal product (MP). Plot the AP and MP curves on the same graph. [15]

Table 1

Units of labor input	0	1	2	3	4	5
Total product (TP)	0	29	55	79	99	115

- b. Illustrate the law of diminishing marginal returns using the data given in **Table 1**. [10]

QUESTION 2 [25 MARKS]

- a. Clarify the concepts of 'short-run' and 'long-run' in the theory of production with examples. [10]
- b. Calculate the Total Variable Cost (TVC), Average Fixed Cost (AFC), Average Variable Cost (AVC), Average Cost (AC) and Marginal Cost (MC) from the data given in **Table 2**. Draw these curves on the same graph. [15]

Table 2

Quantity (unit)	1	2	3	4	5	6
Total Fixed Cost (TFC)	55	55	55	55	55	55
Total Cost (TC)	85	95	100	110	130	175

QUESTION 3 [25 MARKS]

Define inflation and its types. Explain the causes and effects of inflation in your own words. [25]

QUESTION 4 [25 MARKS]

- a. Distinguish between ‘nominal GDP’ and ‘real GDP’ with examples. [10]
- b. What is the Consumer Price Index (CPI)? From the following **Table 3** calculate the rate of inflation. [15]

Table 3

Category	Price index for each category		
	Weight	Base Year 2022	Year 2024
Food and beverages	0.25	500	550
Housing	0.45	6000	7500
Entertainment	0.05	300	375
Education	0.15	800	1000
Others	0.1	1200	1300
	1.00		

QUESTION 5 [25 MARKS]

- a. Illustrate the circular flow of income and expenditures in an open economy. [10]
- b. What are the major macroeconomic goals? Discuss any two methods of measuring national income. [15]

QUESTION 6 [25 MARKS]

- a. What is money? Describe the functions of money. [10]
- b. What is fiscal policy? Illustrate the effects of fiscal policy on different areas of an economy. [15]

QUESTION 7 [25 MARKS]

- a. Make a hypothetical investment demand schedule and construct the investment demand curve. [10]
- b. What are the differences between saving and investment? Discuss the determinants of investment. [15]

QUESTION 8 [25 MARKS]

Write short notes on any THREE of the following. [25]

- a) Economic growth and development
b) NPV and IRR
c) Different types of productivity
d) Canons of taxation.