2-2

University of Asia Pacific
Department of Basic Sciences and Humanities
Final Examination, Spring 2023
Program: B.Sc. in Civil Engineering

Course Title: Principles of Economics		Course Code: ECN 201
Time: 2 hours	Credit Hour: 2.00	Full Marks: 100

There are **six** questions. Answer any **four including Q-1 and Q-2**. All questions are of equal value. Figures in the right margin indicate marks.

1. a) $U = X_1^2 X_2^2$. Price of X_1 is 4 tk, price of X_2 is 8 tk and income is 100 tk. Calculate the optimal value of X_1, X_2 and maximum utility. **15**

   b) Explain the properties of indifference curve. **10**

2. $P = 100 - 5Q$

   $C = 10 + 4Q^2$

   a) Calculate equilibrium price and quantity in case of perfect competition market. **15**

   b) Explain different methods of calculating GDP. **10**

3. Explain the characteristics of perfect competition market. **25**

OR

4. Explain the characteristics of monopoly market. **25**

5. Explain different types of price elasticity of demand with the help of appropriate graph. **25**

OR

6. Explain different types of price elasticity of supply with the help of appropriate graph. **25**

University of Asia Pacific
Department of Basic Sciences & Humanities
Final Examination, Spring 2023
Program: B.Sc. in Civil Engineering

Course Title: Mathematics-IV — Course Code: MTH 203

Time: 3.00 Hours — Credit Hour: 3.00 — Full Marks: 150

There are **eight (8) questions**. Answer **six (6) including Q1, Q2, Q3 and Q4**. Figures given in the right margin indicate the marks of the respective questions.

1. a. State first shifting property. Evaluate $\mathcal{L}\{t \sin at\}$ and $\mathcal{L}\{t \cos at\}$ by using the first shifting property. **15**

   b. Evaluate $\mathcal{L}\{\frac{\cos 3t - \cos 5t}{t}\}$. **10**

2. a. A linear time-invariant continuous system is in zero state. Its response $y(t)$ is described by the DE $\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 6y = \frac{df}{dt} + f(t)$. Derive the transfer function of the system. If the input is given by $f(t) = e^{-t}$, find the total response of the system. **20**

   b. Evaluate $\mathcal{L}\{\sinh at\}$ by using the change of scale property. **5**

3. a. Solve $x^2\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} - 4y = x^4$. **15**

   b. Solve $(D^2 + 4D + 3)y = e^{-3x}$. **10**

4. a. Identify and solve $\frac{dx}{dy} - xy = x^2y^3$. **15**

   b. Solve the equation $(D^3 - 3D^2 + 4D - 2)y = 0$. **10**

5. a. Evaluate the Fourier Series for the function **15**

$$f(x) = \begin{cases} -\pi; & -\pi < x < 0 \\ x; & 0 < x < \pi \end{cases}.$$

b. Find the Fourier sine transform of $e^{-x}; x \geq 0$. **10**

OR

6. a. Evaluate the Fourier Series for the function **15**

$$f(x) = \begin{cases} 0; & -\pi \leq x \leq 0 \\ 1; & 0 \leq x \leq \pi \end{cases}.$$

b. Show that $\int_0^\infty \frac{\cos ux}{u^2+1} du = \frac{\pi}{2} e^{-x}\ ; x > 0$. **10**

7. a. Obtain the Fourier sine and cosine transform of the function **15**

$f(x) = 2x$ on the interval $(0, 4)$.

b. Find the Fourier Series of the function **10**

$f(x) = x^2$ on the interval $(-\pi, \pi)$.

OR

8. a. Obtain the Fourier Transform of $f(x) = \begin{cases} 1 - x^2; & |x| < 1 \\ 0; & |x| > 1 \end{cases}$. **15**

b. Express $f(x) = x$ as a half-range sine series on the interval $(0, 2)$. **10**

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2023
Program: B. Sc. Engineering (Civil)

Course # : CE-203 Course Title: Engineering Geology & Geomorphology
Full Marks: 120 Credit Hours: 3.0 Time: 3.0 hours

Answer to all questions

1. (a) Draw a schematic diagram of the rock cycle and discuss (with at least two examples of each) about sedimentary rock according to the cycle. 10

(b) Distinguish between physical and chemical weathering processes. Discuss, in brief, any one type of physical weathering process. 3+2 = 5

2. (a) Classify fold and discuss (in short) basin and dome with neat sketches. 1 + 5 =6

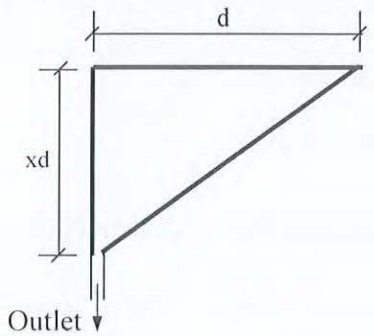
(b) Classify fault and compare normal and reverse fault. 2 + 5 =7

(c) What is liquefaction? Discuss, in brief, your understanding of the basic mechanism of liquefaction with its aftermath. 11

3. Briefly discuss, mention or draw sketches of, as asked, the following topics: 4 X 4 = 16

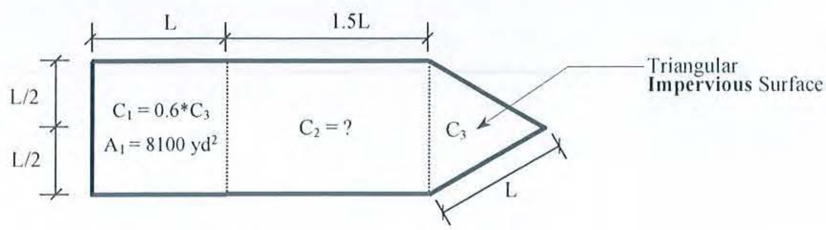
(i) Principal zones of earth (names only) with a schematic diagram showing the thicknesses of different parts of lithosphere/geosphere
(ii) Routes of runoff with sketch
(iii) Horton's Laws of stream network
(iv) Classification of earthquake waves with short notes

4. (a) For the basin shown below, x is a constant factor. For what value of x, the flow rate (Q) will be the maximum for the basin? Find the FF and CC of the basin for maximum runoff. 10



(b) Discuss, in short, Rational Method and its assumptions. 5

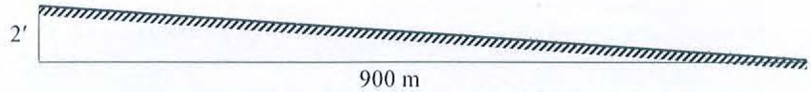
(c) For the drainage area as shown below, calculate co-efficient of runoff (C_2) for Q_p = 11.3 ft^3/min and I =0.05 inch/hour. 10



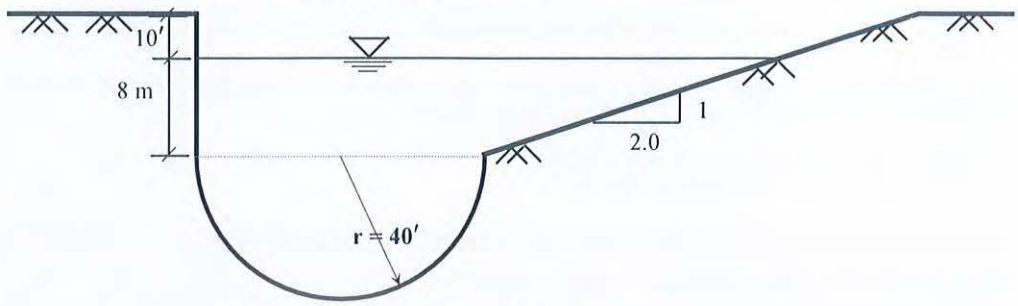
5. (a) What are the major causes of river erosion? Mention three hydraulic actions responsible for river erosion. 3

(b) Prove that $d \propto v^2$; where symbols carry their usual meanings. 5

(c) The longitudinal and cross-sectional profiles of a channel are shown below. Calculate the tractive pressure in kPa along the channel. 7

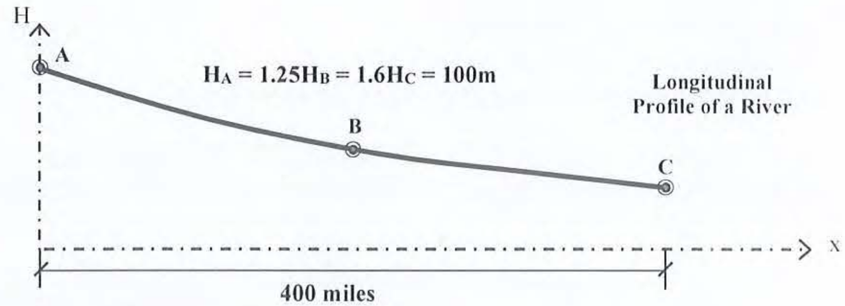


(Longitudinal Profile of Channel Course)



(X-Sectional Profile of Channel Course)

(d) From the following figure, calculate the horizontal distance between locations B and C. 5



6. (a) Discuss, briefly, suspended load and bed load. 4

(b) Discuss, in brief, the ways valleys are deepened. 4

(c) Mention different types of drainage pattern and discuss, in brief with sketches, any one type of drainage pattern. 5

(d) The number and stream ranks of a catchment area having a stream frequency (SF) of $0.033/mi^2$ are calculated and the results of the survey are summarized in the table below. 7

Steam Rank	No. of Streams	Average Length (km)
1	22	1.2
2	7	2.1
3	3	7.1
4	---	17.9

Calculate the following parameters from the above survey data:

(i) Average Bifurcation Ratio (ABR)

(ii) Average Length Ratio (ALR)

(iii) Drainage Density (DD)

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2023
Program: B.Sc. Engineering (Civil)

Course Title: Numerical Analysis and Computer Programming | Course Code: CE 205
Time: 3 hour | Credit Hour: 3.00 | Full Marks: 100

(Answer ALL the questions)

Part A

1. In environmental engineering, the equation used to calculate the oxygen demand remaining L_t (mg/L) in a river stream after time t is expressed by

$$L_t = L_0(1-e^{-kt})$$

Where, ultimate oxygen demand L_0= 250 mg/L, reaction rate constant k= 0.18/day, t=time. Now, use the **Regula Falsi** method to calculate the time required for the oxygen demand remaining in the river stream to drop to the level of 100mg/L. Assume that your solution lies between t=1 day and t=3 day. Perform 4 iterations. [10]

2. For the data provided in the following table, determine the velocity v (m/s) when time t is 18 s. Use **Forward Difference Interpolation** formula.

Time, t (s)	5	10	15	20	25
Velocity v (m/s)	1.3	2.5	4	6.8	8

[10]

3. In a geotechnical lab, the following test results are obtained through a direct shear test.

Time (min)	0.5	1	1.5	2
Shear force (lb)	11.62	12.8	14.21	16.1

a) Determine the equation of a **straight line** of the form y=a+bx using the tabular data. [10]

b) Determine the equation of a **parabola** of the form $y=a+bx+cx^2$ using the tabular data. [10]

c) If the analytical result requires the shear force at 1.3 seconds to be 13.6 lbs, which equation is more appropriate to predict the trendline? [2.5]

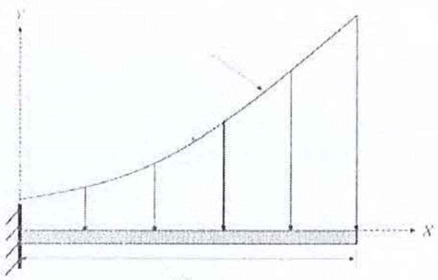
4. Solve the differential equation $\frac{dy}{dx} - y^2 = x$ using Fourth Order Runge Kutta method to get y(0.4). Assume initial value y(0)=1 and step size h=0.2. [10]

5. For the cantilever beam, calculate the upward reaction force (for the **middle-third** of the span) using the following equation: $y = x^2 + 3e^x + 5$, where, x is the distance from the left and y is the reaction (shown in Fig. 1). Use the following methods:

a) **Trapezoidal** rule with 6 panels. [10]

b) **Gauss Quadrature** with 3 points or n=3. [10]

c) Compare the results to state which one gives a more accurate result. [2.5]



18m

Fig. 1

Table 1: Gauss points and weight factors for integration.

n	x_i	w_i
3	X_1= +0.77459	0.55556
	X_2= 0	0.88889
	X_3= -0.77459	0.55556

Part B

6. The bending moment M at any point x along a beam can be expressed as:

$$M(x)= x^3-2x^2-19x+20$$

You have to determine the position x where the bending moment is exactly zero. This point is critical for the stability and design of the structure.

Create a C++ program to solve the equation M(x)=0 using either the Bisection method or the Regula Falsi method.

Consider the beam length to be in the range [0, 4] meters, and precision up to 0.001 meters is acceptable. Your program should output the position x where the bending moment is zero. [12]

7. Create a C++ code to calculate the determinant of the following matrix.

$$A = \begin{bmatrix} 2 & 6 & 0 \\ -3 & 8 & -5 \\ 0 & 5 & 10 \end{bmatrix}$$

[13]

Department of Civil Engineering
Final Examination Spring 2023
Program: B. Sc. Engineering (Civil)

Course Title: Mechanics of Solids II | Credit Hours: 3.0 | Course Code: CE 213
Time: 3 hours | Full Marks: 100 (= 10 × 10)

[Answer **any 10 (ten)** of the following 14 questions. Given: R_0 = Last three digits of Registration #]

1. Calculate the equivalent polar moment of inertia (J_{eq}) for the cross-section shown in Fig. 1 by centerline dimensions [Given: Wall thickness = $(0.1 + 0.001R_0)'$].

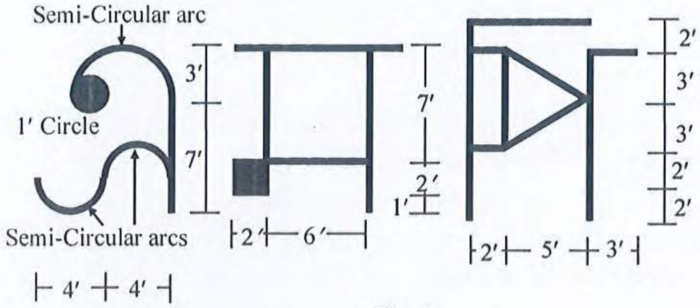


Fig. 1


Fig. 2(a)

2. Fig. 2(a) shows a tiger being bottle-fed by caretaker, while Fig. 2(b) is a schematic view of forces acting on the bottle ABC (whose cross-sections A and B~C are also shown).
   At the top peripheral point of section A
   (i) Calculate the normal stress and shear stress
   (ii) Show the stresses in Mohr's circle of stresses
   [Given: Load $w_y = (1 + 0.01R_0)$ lb/″, $F_x = (10 + 0.1R_0)$ lb, Length $L_{AB} = (4 + 0.02R_0)''$, $L_{BC} = 1.5L_{AB}$].

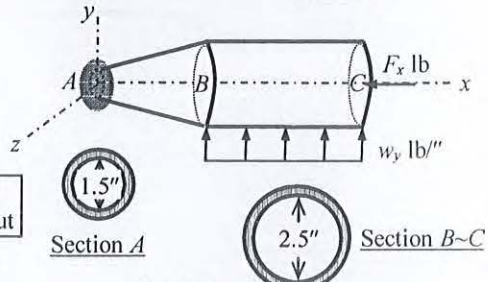


Fig. 2(b)

3. Fig. 3 shows distributed torque $w_x = (1 + 0.01R_0)$ lb/″acting on the bottle ABC described in Question 2 and Fig. 2(b). Calculate the
   (i) Maximum torsional shear stress at section A
   (ii) Torsional rotation at C.

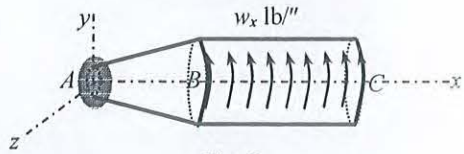


Fig. 3

4.

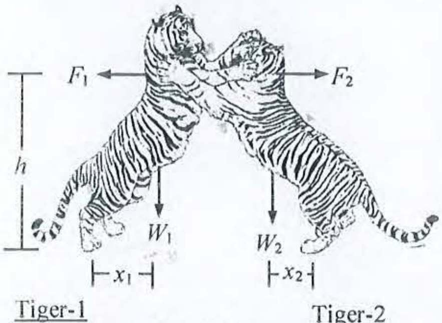
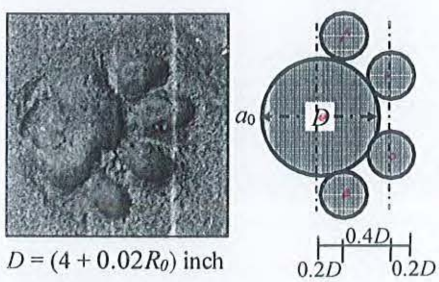


Fig. 4(a)



$D = (4 + 0.02R_0)$ inch

Fig. 4(b)

Fig. 4(a) shows Tiger-1 and Tiger-2 fighting, being subjected to their weights $W_1 = (500 + R_0)$ lb, $W_2 = 0.9W_1$ lb at distances $x_1 = (1 + 0.01R_0)$ft, $x_2 = 0.9x_1$ and forces $F_1 = 0.2W_2$, $F_2 = 0.2W_1$ at height $h = 3$ ft.

Fig. 4(b) shows their actual foot-print, as well as its simplified picture.

Calculate the combined normal stress at point 'a_0' of the foot of Tiger-1.

5. The back leg-bone of Tiger-2 (loaded as described in Question 4) is a solid circular section of 3″-dia (shown in Fig. 5). Calculate the
   (i) Maximum normal stress and shear stress at the center of section
   (ii) Principal stresses (σ_1, σ_2)
   (iii) Yield Strength (Y) required to avoid its yielding (according to Von Mises and St. Venant yield criteria, if $\nu = 0.30$).

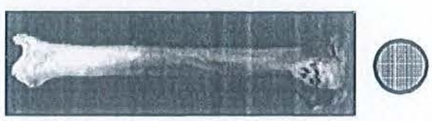


Fig. 5

6. Fig. 6 shows a tiger running over the beam *dream* to catch a prey at point *m*, while the Cricket World Cup trophy is at point *d*.

   Given: $W_0 = 25$ lb,
   $W_1 = (400 + R_0)$ lb and $W_2 = W_1/3$

   Use *Singularity Functions* to calculate
   (i) The value of EI to make d deflect 0.10″ vertically (upward)
   (ii) Rotation at d, for the EI calculated in (i).

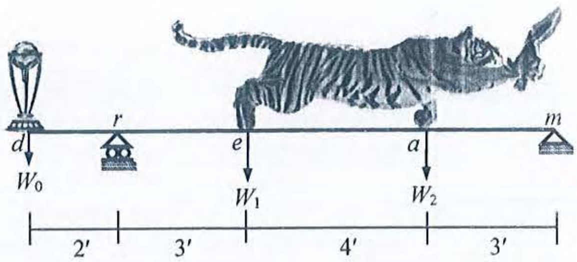


Fig. 6

7. Answer Question 6 using the *Moment-Area Theorems.*

8. Fig. 7(a) shows a beam represented by a man BCb sleeping on a tiger, while Fig. 7(b) represents its schematic view showing the loads (given w_0 and unknown w_1) working.

   If slope (θ_B) of the beam at end $B = 0$, use *Singularity Functions* to calculate the deflection (v_B) at B [Given: $L_{BC} = (3.5 + 0.01R_0)$ ft, $L_{Cb} = L_{BC}/3$, $EI_{BCb} = (2.5 + 0.01R_0) \times 10^3$ lb-ft^2].

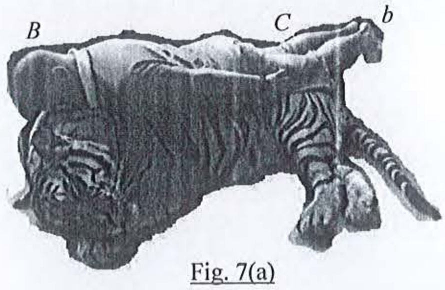


Fig. 7(a)

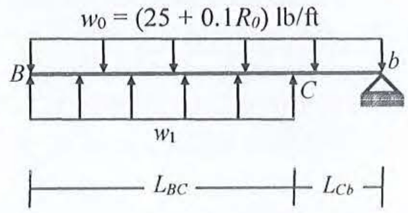


Fig. 7(b)

9. Answer Question 8 using the *Moment-Area Theorems.*

10. (i) For the tiger-skeleton shown in Fig. 8(a), and carrying loads shown in Fig. 8(b) [Given: $w_c = (1 + 0.01R_0)$ lb, $w_d = (1 + 0.01R_0)$ lb/″].

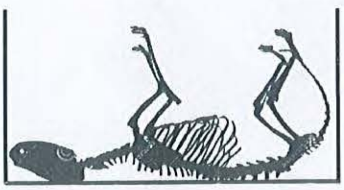


Fig. 8(a)

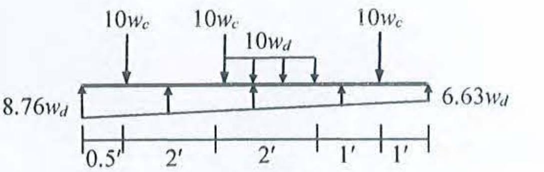


Fig. 8(b)

   * Write down the equation for load *w(x)* using singularity functions.
   * Write down the boundary conditions.
   * Determine whether the beam is statically determinate or indeterminate.
   * Draw the qualitative deflected shape of the beam under the given loads.

   (ii) (a) Explain the effect of Load Eccentricity (e) on the buckling behavior of slender columns.
   (b) Use Salama (2014) to calculate the effective length factor (k) of a hinged-fixed ended column.

11. Fig. 9(a) shows cricket fans carrying the Bangladesh flag, which is represented schematically by the simplified flag-beam (of width $b = 40'$ and thickness $t = 0.10''$) in Fig. 9(b).

Given: $L = (4 + 0.02R_0)$ ft, calculate buckling loads and draw buckling shapes of the flag-beam, considering [Fig. 9(c)] it to be a

(i) Simply supported beam (AA_1~CC_1) of span L

(ii) Continuous beam (AA_1~BB_1~CC_1) of span ($L/2 + L/2$) hinged at BB_1

(iii) Continuous beam (AA_1~BB_1~CC_1) of span ($L/2 + L/2$) fixed at BB_1.

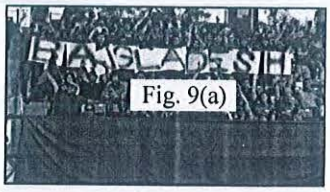


Fig. 9(a)

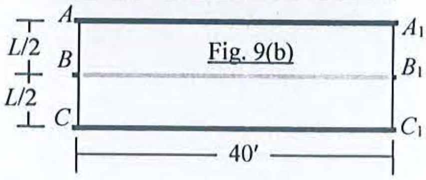


Fig. 9(b)

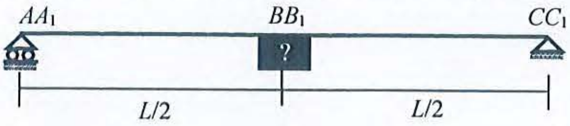


Fig. 9(c)

12. Fig. 10 shows two tigers [each weighing $W_0 = (500 + R_0)$ lb] holding out posters on simply supported beams SA and AH to signal 'TIMED OUT'.

Both beams are subjected to axial force $P_0 = 0.5P_{cr}$, where P_{cr} is their critical buckling force.

Calculate the maximum bending moments for both beamsSA and AH,

(i) Using the Exact Moment Magnification Factors (MMF), (ii) Using the MMF-AISC

[Given: $L = (30 + 0.1R_0)$ ft, $EI = (30 + 0.1R_0) \times 10^3$ lb-ft^2].

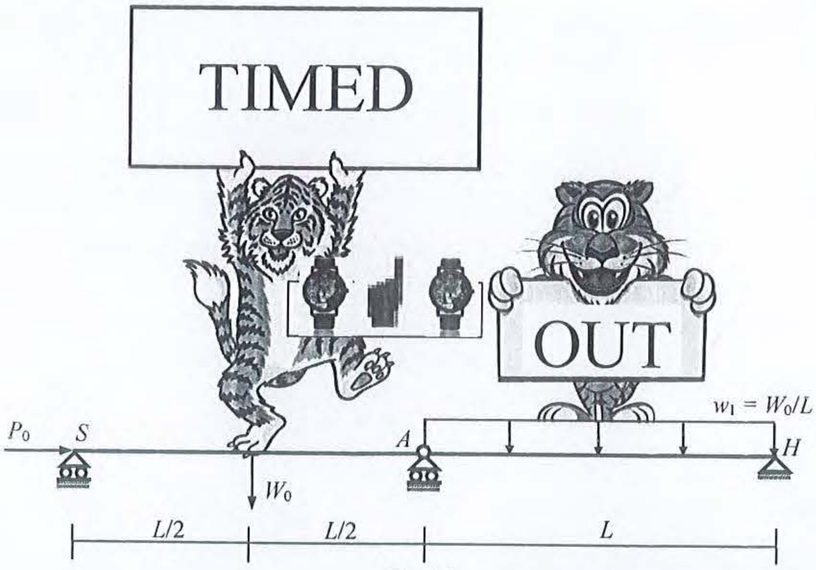


Fig. 10

Fig. 11

13. Fig. 11 shows a tiger [weighing $W_0 = (500 + R_0)$ lb] holding the Champions Trophy (weighing W_C) to be held in the year 2025. The forces W_0 and W_C cause compressive force (P_A) on its right leg A.

Its leg-bone is a 3″-dia circle and made of a material with stress-strain relationship

$\sigma = (20 + 0.1R_0)\,(\varepsilon)^{0.5}$, where σ is the compressive stress (ksi) and ε is strain.

Calculate the

(i) Allowable compressive force (P_A) on the leg A and

(ii) Corresponding weight (W_C) of the Champions Trophy [Given: $L_1 = (3 + 0.01R_0)$ ft].

14. For the loading shown in Fig. 11 and described in Question 13, use the AISC-ASD method [for $f_y = (3 + 0.01R_0)$ ksi and $E = 1000f_y$] to calculate the

(i) Allowable compressive force (P_A) on leg A of the tiger and

(ii) Corresponding weight (W_C) of the Champions Trophy.

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2023
Program: B.Sc. in Civil Engineering

Course Title: Fluid Mechanics		Course Code: CE 221
Time: 3 hour	Credit Hour: 3.00	Full Marks: 100

There are 4 questions with 25 marks for each. Please answer them accordingly.
[Necessary figures are given in the opposite page, assume reasonable data if and when required]

1. a) Define hydraulic radius for conduits. State and mathematically express subsonic, supersonic and hypersonic flow? [5]

   b) Define energy correction factor and mathematical ly express it. State the limitations of Bernoulli's energy equation. [10]

   c) Define transitional flow. Discuss different type of similarities in fluid mechanics. [10]

2. a) State and derive Bernoulli's energy equation for incompressible fluid. [10]

   b) Derive the Darcy-Weisbach equation for a circular pipe [15]

3. a) Two cisterns are connected by cast iron pipes in **Figure: 1.** Neglecting minor losses, compute flow rate in each pipe for water. Friction factor for pipe a is 0.020, for pipe b is 0.032 and for pipe c is 0.024. [10]

   b) The 12-cm pipe is connected to a 10-cm pipe by a reducer in **Figure: 2**. Oil of s.g.=0.85 flows through 12-cm pipe with a pressure of 80 kN/m^2 and velocity of 10m/s. Flow rate through the pipes are $30m^3/s$. Find the force exerted by the oil on the reducer. Neglect head losses. [Hint: the flow is not discharged in the atmosphere] [8]

   c) In a two-dimensional flow field u=2x and v=y. Find velocity and acceleration for point (1,2). [7]

4. a) Find the suitable diameter for the new wrought iron pipe in **Figure: 3** required to carry water from the reservoir to the small tank. Let, pipes of diameter 6, 8 and 12 inches are available in the market. Use the Moody diagram attached in your question paper. [10]

   b) Calculate the horizontal thrust on the sluice gate by water in **Figure: 4**. Gate's width is 1m. [8]

   c) Water flows from reservoir A to a turbine, then to small tank at B in **Figure: 5**. Head loss from A to 1 is $6v^2/2g$ and from point 2 to B is $0.5v^2/2g$, where v is velocity in the pipe. The flow rate through the pipe is 30 ft^3/s and diameter is 24-inch. Compute the power of the turbine. [7]

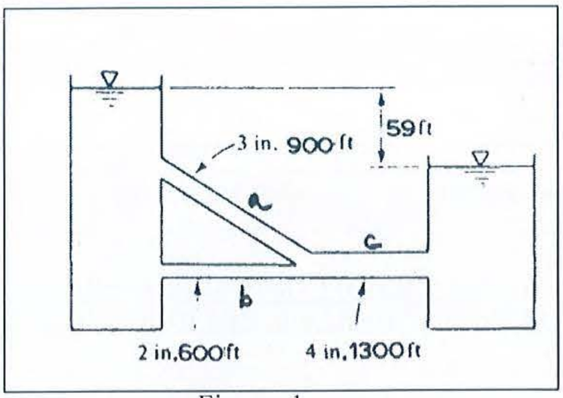


Figure: 1

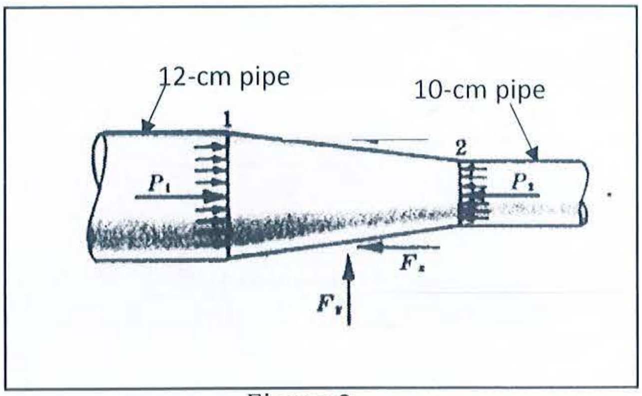


Figure: 2

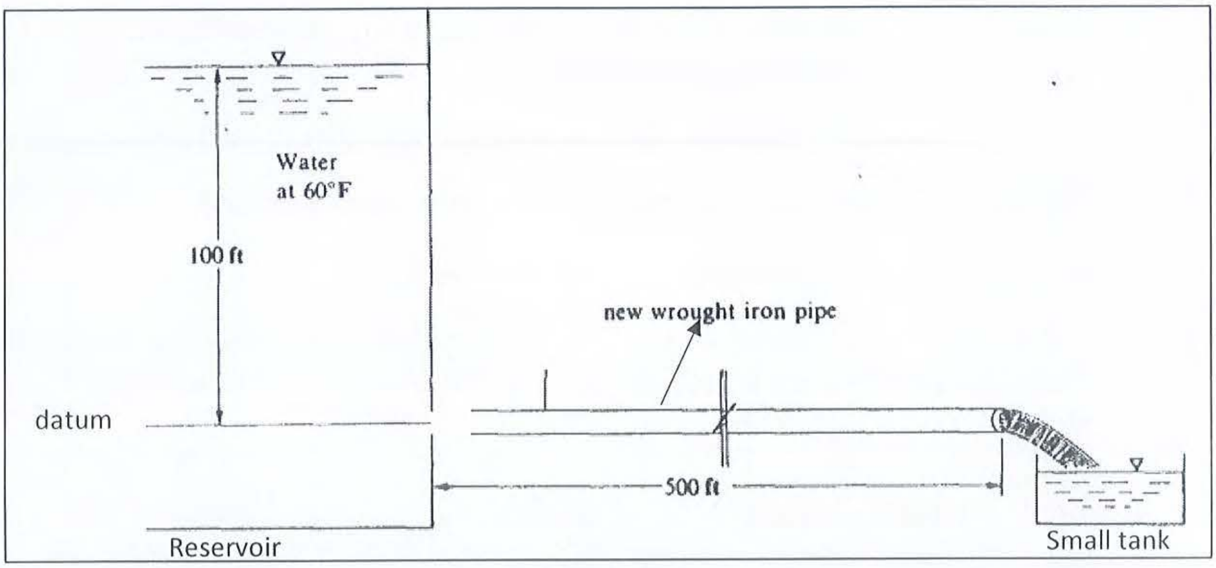


Figure: 3

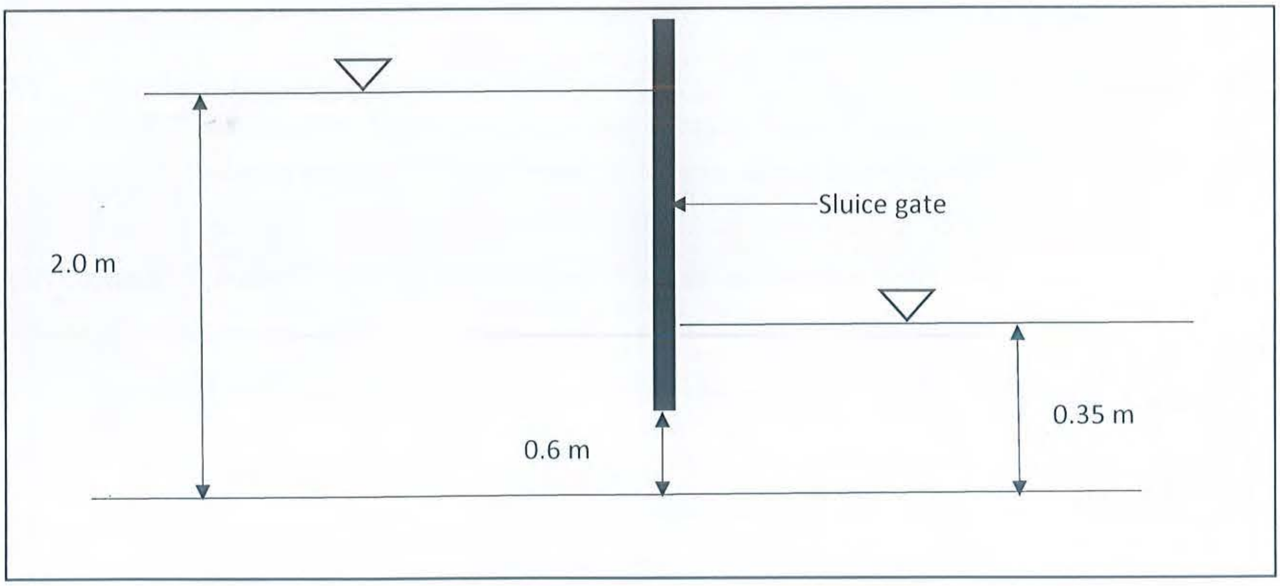


Figure: 4

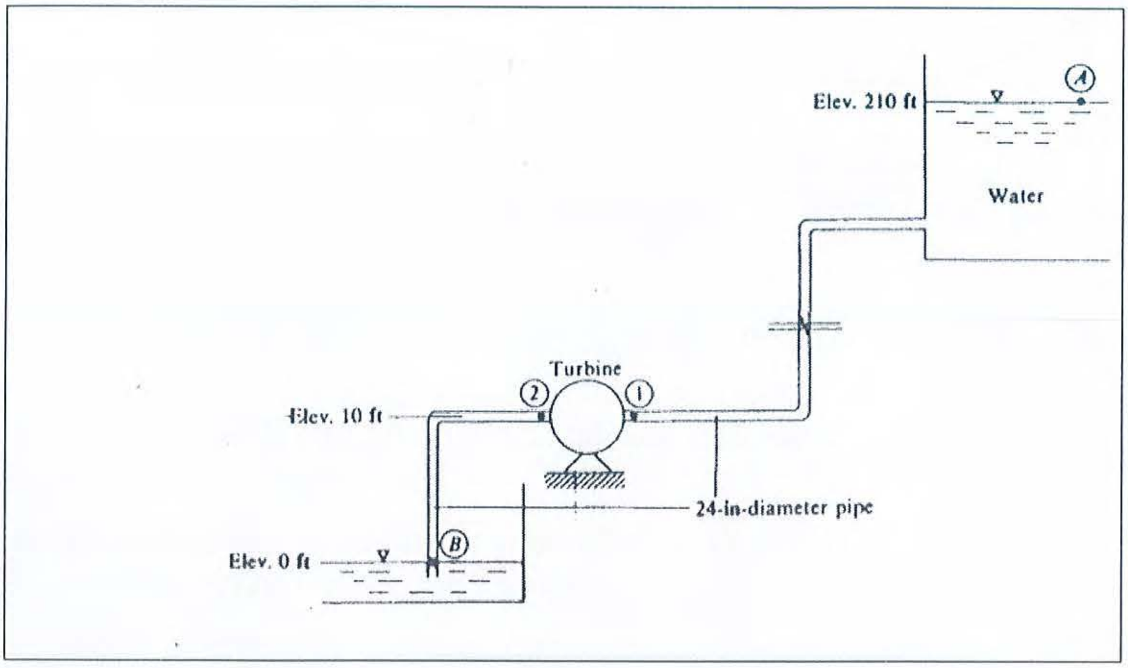
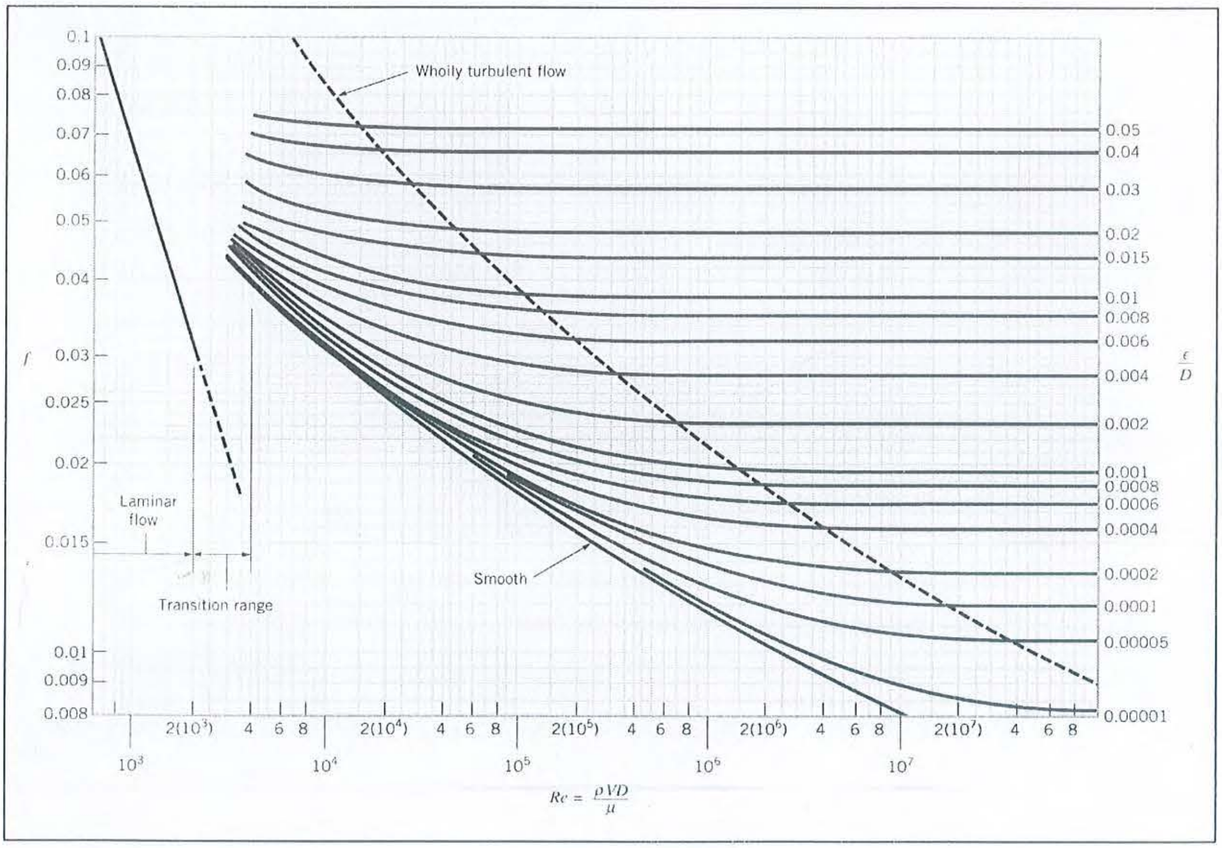


Figure: 5



Moody Diagram