University of Asia Pacific
Department of Basic Sciences and Humanities
Semester Final Examination, Spring 2022
Program: B. Sc. Engineering (Civil)
2nd year 2nd semester

Course Title: Principles of Economics | Course Code: ECN 201 | Credit: 2.00
Time: 2 Hours | Total Marks: 100

There are **six** Questions. Answer any **four** of them.

1. $P = 150 - 2Q$
$P = 50 + Q$

a) Calculate the equilibrium price and quantity. **5**

b) Find out the consumer surplus, producer surplus and total surplus from the given equations. **10**

c) Explain the impact of tax on equilibrium price and quantity with the help of appropriate graph. **10**

2. $P = 500 - 5Q$
$C = 100 + 10\ Q^2$

a) Calculate the equilibrium price and quantity in case of perfect competition market. **10**

b) Explain the characteristics of perfect competition and monopoly market. **15**

3. a) Explain trade diversification and its importance. Suggest some policies in case of Bangladesh. **15**

b) Explain different instruments of trade policy. **10**

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

b) Write down the properties of Indifference Curve and explain them. **10**

5. a) Explain GDP and GNP. Describe the differences between GDP and GNP. **10**

b) Describe full employment. Explain different types of unemployment. **15**

6. a) Explain Gravity Model and the reasons behind its exceptions. **15**

b) Explain Absolute Advantage and Comparative Advantage Theory. **10**

University of Asia Pacific
Department of Basic Sciences and Humanities
Final Examination, Spring-2022
Program: B.Sc. Engineering (CE)

Course Title: Mathematics IV | Credit Hour: 3 | Course Code: MTH 203
Time: 3 hours | Full Marks: 150

There are **Eight** Questions. Answer any **Six**. All questions are equal value. Part marks are shown in the Margin.

1. **(a)** Find the Laplace Transformation of the following function **12**

(i) $f(t) = 3t\sin 4t + 7\cos 4t$

(ii) $f(t) = 4t^2 e^{3t}$

(iii) $f(t) = (t+5)^2$

(b) Sketch and find the Laplace transform of the following function, where **13**

$$f(t) = \begin{cases} 0, & 0 < t < 3 \\ 2, & t > 3 \end{cases}$$

2. **(a)** Find the Laplace transformation of $t^2 u(t-5)$. **10**

(b) Let $f(t) = 4t,\ 0 < t < 5$ is a periodic function of period 5. Then find the Laplace transformation of the above function. **15**

3. **(a)** Find the Inverse Laplace Transformation of the following function **10**

(i) $\mathcal{L}^{-1}\left\{\frac{5}{(s+12)^3}\right\}$

(ii) $\mathcal{L}^{-1}\left\{\frac{3s-6}{(s-2)^2+16}\right\}$

(b) Evaluate $\mathcal{L}^{-1}\left\{\frac{2s+7}{(s+3)(s^2+5)}\right\}$ using partial fraction. **15**

4. **(a)** Apply Laplace transform to solve the following ordinary differential equation **10**

$$\dot{y}(t) = 8 - t, y(0) = 0.$$

(b) A resistance R in series with inductance L is connected with e.m.f $E(t) = t$.The current $i(t)$ is given by $L\frac{di}{dt} + Ri = t;\quad i(0) = 0$. Use Laplace transform to find the current $i(t)$. **15**

5. **(a)** Determine whether the following functions are even, odd or neither. **5**

(i) $f(x) = 4x^3 - x$, (ii) $f(x) = \tan 2x$,

(b) Find the Fourier coefficients and then Fourier series of the function of $f(x) = 2x^2$ in the interval $-3 \leq x \leq 3$. **20**

6. **(a)** Solve the homogeneous differential equation $(x^2 + y^2)dx + 2xydy = 0$ **13**

(b) Solve Linear differential equation $(x^3 - x)\frac{dy}{dx} - (3x^2 - 1)y = x^5 - 2x^3 + x$ **12**

7. **(a)** Solve the homogeneous differential equation by substitution method $(x + y)^2 \frac{dy}{dx} = a^2$ **15**

(b) Solve the homogeneous differential equation $x(x^2 + y^2 - a^2)dx + y(x^2 - y^2 - b^2)dy = 0$ **10**

8. Use the Fourier transformation to solve the following boundary value problem **25**

$\frac{\partial U}{\partial t} = 3\frac{\partial^2 U}{\partial x^2}$ with $U(0,t) = U(\pi,t) = 0$ and $U(x,0) = 2x$, where $t > 0$ and $0 < x < \pi$.

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2022
Program: B. Sc. Engineering (Civil)

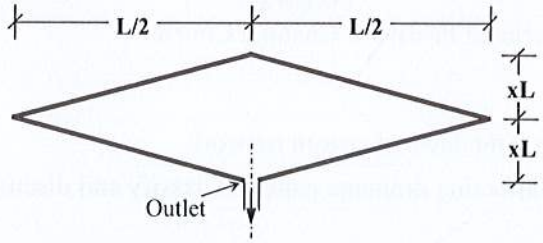
Course # : CE-203 | Course Title: Engineering Geology & Geomorphology
Full Marks: 120 | Credit Hours: 3.0 | Time: 3.0 hours

Answer to all questions

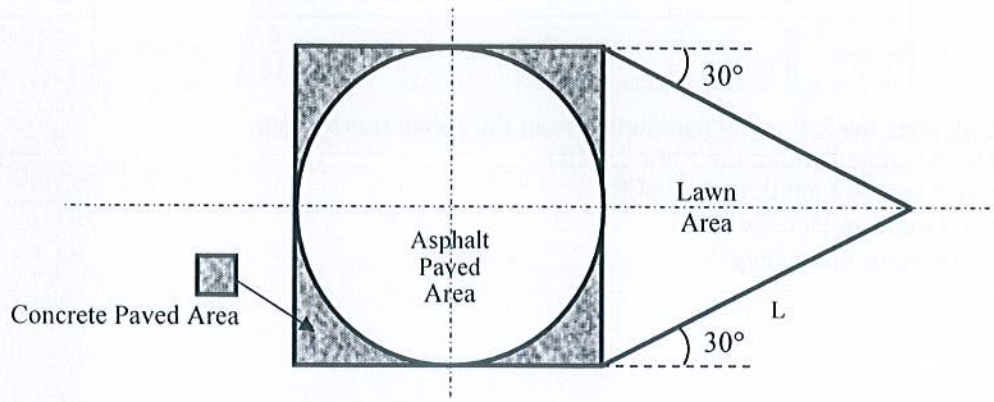
1. (a) Draw a schematic diagram of the rock cycle and discuss (with at least two examples of each) about sedimentary and metamorphic rocks according to the cycle. 12
   (b) Discuss, in brief, any one type of physical weathering process. 3
   (c) Classify geomorphic processes based on origin. Write down the names of major geomorphic agents. 5

2. (a) What is diastraphism? Draw neat sketch of a typical fold geometry showing its major features. 5
   (b) Classify fault and discuss briefly (with neat sketches) any one type of fault according to the direction of movement and net slip. 6
   (c) What is liquefaction? Discuss, in brief, your understanding of the basic mechanism of liquefaction with its aftermath. 9

3. (a) With the aid of sketch show different routes of runoff. 4
   (b) Distinguish among precipitation, infiltration and percolation with the aid of sketches. 6
   (c) 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

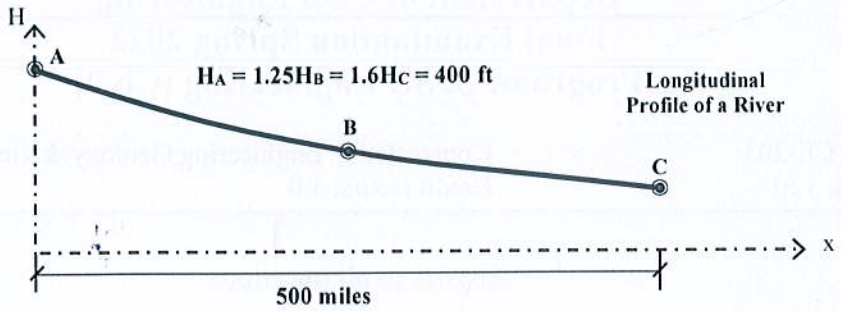


4. (a) Calculated Peak runoff (Q_p) for the conditions of the following facility is 2.244 ft^3/s. Calculate L (L is in meter). Consider intensity of rainfall for the whole area 1.05 in/hr and coefficient of runoff for concrete, asphalt and lawn areas 0.85, 0.75 and 0.20, respectively. 10



(b) Prove that $H = ae^{-bx}$; where symbols carry their usual meanings. 5

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



5. (a) Prove that $\tau = \gamma_w R_H s$; where symbols carry their usual meanings. 6

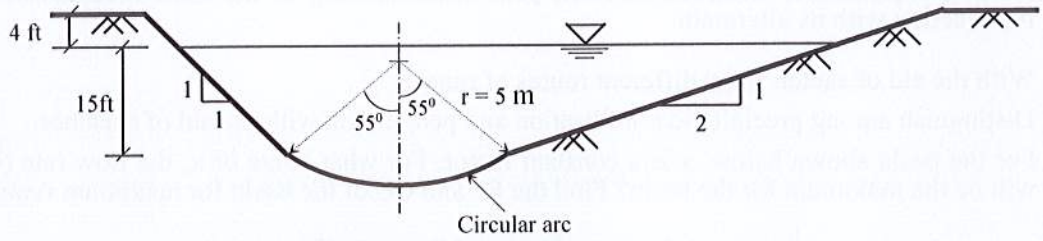
(b) For a stream having triangular x-section and T <<<<< D, prove that $\tau \propto T$ 4

where

τ = tractive pressure along the stream T = Top width of stream

D = depth of stream

(c) Cross-sectional profile of a channel is shown below. The gradient of the channel bed is 3.33×10^{-3}. Calculate the tractive pressure in psf, psi and pascal along the channel. 10



X-Sectional Profile of Channel Course

6. (a) With sketches, discuss the laws of stream network. 5

(b) Mention the factors affecting drainage pattern. Classify and discuss, in brief with sketches, any two. 8

(c) The number and stream ranks of a catchment area of 1,125 square miles are calculated and the results of the survey are summarized in the table below. 7

Steam Rank	No. of Streams	Average Length (mile)
1	22	1.3
2	7	2.2
3	3	6.9
4	1	18.2

Calculate the following parameters from the above survey data:

(i) Average Bifurcation Ratio (ABR)

(ii) Average Length Ratio (ALR)

(iii) Drainage Density (DD)

(iv) Stream Frequency

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2022
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. Assume any reasonable value for missing data)

1. In a typical rectangular channel, critical depth for the flow of water is given by the equation

$$f(x) = 1 - \frac{\alpha Q^2(6+4h)}{g[(6+2h)h]^3}$$

Where $\alpha = 1$, Q=14 m^3/s and g=9.81 m/s^2. Now, use regula falsi method to find the critical depth between the interval h=0.625 to h=1.25. Perform 5 iterations. Also show relative percent error for each iteration. **[10]**

2. Analyze the data provided in the following table, and determine the velocity (v) when time (t) is 20s. Use Lagrange interpoliating polynomial formula.

Time, t (s)	0	10	25	40	50
Velocity,v (m/s)	0	2.5	4	6.8	7

[10]

3. Solve the following system of equations using Gauss Elimination method.

$$x + y + z = 2$$

$$x + 2y + 3z = 5$$

$$2x + 3y + 4z = 11$$ **[10]**

4. For the cantilever beam, calculate the upward reaction force (for **half** of the span starting from the left) using the following equation: $y = 3x^2 + 2e^x + 5$ Where, x is the distance from the left. Use the following methods:

a) Using Simpson's rule with 6 panels. **[10]**

b) Gauss Quadrature with 4 points or n=4. Also state which one gives more accurate result. **[12]**

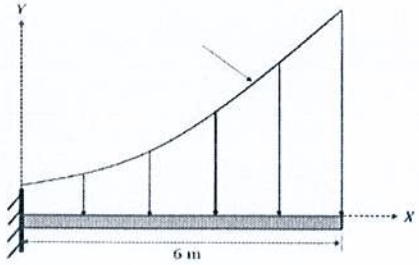


Fig. 1.

Table 1: Gauss points and weight factors for integration

n	x_i	w_i
4	$x_1 = +0.8611363116$	0.3478548451
	$x_2 = +0.3399810436$	0.6521451549
	$x_3 = -0.3399810436$	0.6521451549
	$x_4 = -0.8611363116$	0.3478548451

5. Compare two methods of initial value problem by solving the following differential equation to get y(3).

$$0.4y + \frac{dy}{dx} = 3e^{-x}; \text{ where } y(0)=5$$

a) Use Euler's method with a step size of h=0.5. **[10]**

b) Use fourth order Runge-Kutta method with a step size of h=1.5. **[12]**

c) Compare the results to state which one is the more efficient method. **[3]**

6. Use C++ coding language to write a program that will display the n terms of even natural number and their sum. **[8]**

7. Imagine that, Doctor Strange wants to build a program which will analyze alternate futures and display how many ways Thanos can be stopped from wiping away half of the world population. And Thanos can only be stopped if Iron Man dies in the future. Suppose, the death of Iron Man is indicated by the existence of prime number.

Now, create a program that will take n number of alternate future as input and for each scenario of Iron Man's death, the program will display "The humanity can be saved".

Note: A positive integer (except 0 and 1) that is only divisible by 1 and itself is known as prime number. For example: 13 is a prime number because it is only divisible by 1 and 13; but, 15 is not prime number because it is divisible by 1, 3, 5 and 15. **[15]**

Department of Civil Engineering
Final Examination Spring 2022 (Set 1)
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 two digits of Registration #]

1. Calculate the equivalent polar moments of inertia (J_{eq}) for the cross-sections shown in Figs. 1(a)~(c) by centerline dimensions [Given: $x = (1 + 0.01R_0)'$, Wall thickness = 0.10′].

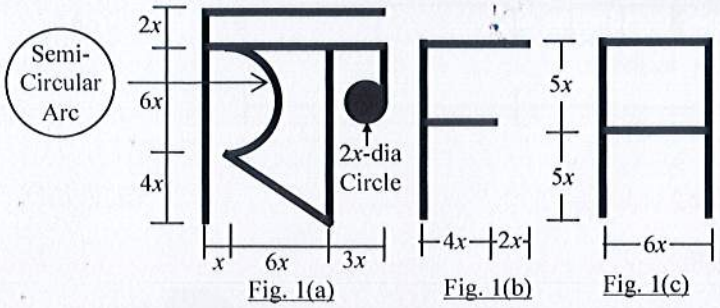


Fig. 1(a) Fig. 1(b) Fig. 1(c)

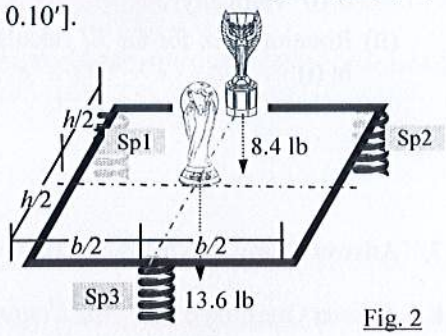


Fig. 2

2. Fig. 2 shows the World Cup Trophy (weighing 13.6 lb) and Jules Rimet Trophy (weighing 8.4 lb) supported by three identical springs (Sp 1, 2, 3).
Given $b = h = (10 + 0.1R_0)$ ft, and the spring-deflections are not to exceed 1″, determine
(i) The required stiffness of the springs
(ii) Coil diameter of springs [Given: Shear modulus = 12000 ksi, mean radius = 3″, number of coils = 5]
(iii) Maximum shear stress of the springs of dimensions found in (i) and (ii), when loaded as shown.

3. Fig. 3(a) shows Ronaldo surging up to head a ball, while Fig. 3(b) shows a possible model of the force on skull and Fig. 3(c) shows a simplified model of the neck cross-section.
Assume $Q = (2 + 0.01R_0)$ kips to calculate maximum combined normal stress acting on neck section.

Fig. 3(a)

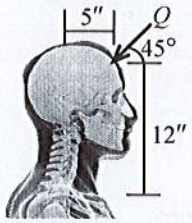
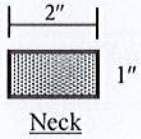


Fig. 3(b)



Neck

Cross-Section
Fig. 3(c)

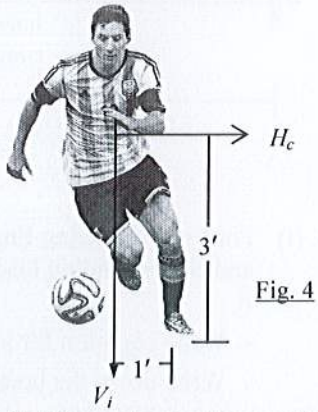


Fig. 4

4. Fig. 4 shows Messi in action, supporting the entire body-weight on his left leg whose cross-section can be approximated by a 0.5″-dia solid circle. The leg supports a vertical force V_i (= 2W, where weight W = 150 lb, at eccentricity 1′) and horizontal (centrifugal) force $H_c = 0.5W$, at height 3′.

Calculate the normal stress σ_{yy}, Shear Stress τ_{xy} and principal stress on his leg.

5. Fig. 5(a) shows a foul committed on Neymar, while Fig. 5(b) shows the impact force from the kick on his spinal cord (a simply supported beam) and Fig. 5(c) shows the approximate cross-section of spinal cord.

Calculate the required yield strength Y of the bone if Neymar is to survive a force $F = (3 + 0.01R_0)$ kip on spinal cord, using the yield criteria of (i) Rankine, (ii) Von Mises.

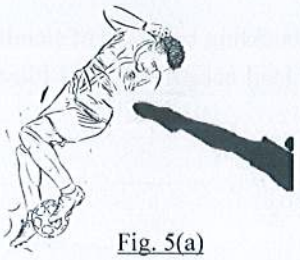


Fig. 5(a)

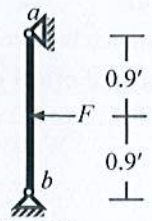
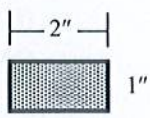


Fig. 5(b)



Spinal Cord

Cross-Section
Fig. 5(c)

6. Fig. 6 shows Maradona [weighing $W_1 = (140 + R_0/2)$ lb] dribbling the ball past a diving goalkeeper [weighing $w_0 = (30 + 0.1R_0)$ lb/ft] on the beam *abcd*.

Use *Singularity Functions* to calculate

(i) The value of *EI* to make *b* deflect 0.10″ vertically

(ii) Rotation at *a*, for the *EI* calculated in (i).

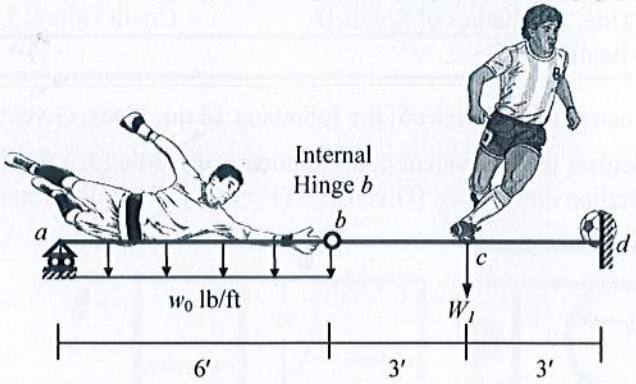


Fig. 6

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

8. Answer Question 6 using the *Conjugate Beam Method*.

9. Fig. 7(a) shows Pele holding three Jules Rimet world cup trophies he won for Brazil, while Fig. 7(b) is a simplified model of his hands holding the trophies.

Given $L_0 = (1 + 0.01R_0)$ ft and $W_1 = W_2 = W_3 = 8.4$ lb, calculate

(i) The value of *EI* to make *b* deflect 1-inch vertically

(ii) Rotation at *c* (right), for the value of *EI* calculated in (i).

Fig. 7(a)

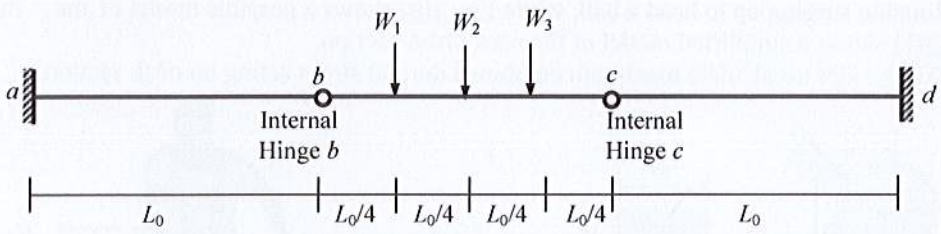


Fig. 7(b)

10. (i) For Fig. 8 showing Embappe celebrating with the World Cup trophy and corresponding loads shown on a beam of length $L_1 = (3 + 0.1R_0)$ ft

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

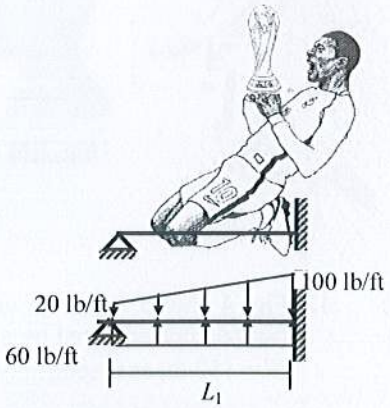


Fig. 8

(ii) Explain the

(a) Difference between buckling behavior of slender columns with and without initial imperfection.

(b) Combined effect of load eccentricity and Plastic Moment (M_p) on buckling behavior of slender columns.

11. Fig. 9(a) shows the maximum axial forces on the cross bar (beam) and side post (columns) of a football goal post [made of steel, with cross-sections shown in Fig. 9(b)] hit by a ball applying force P.

    The ± options are chosen to incorporate any direction of force.

    Calculate the required diameter (d) to avoid buckling of the columns, using

    (i) Alignment chart (for k)

    (ii) Salama's (2014) equations

    to calculate effective length factor k

    [Given: Modulus of elasticity $E = 30000$ ksi].

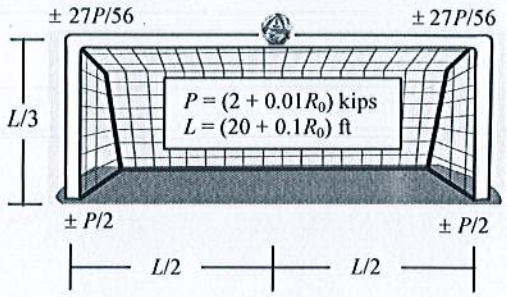


Fig. 9(a)

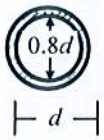


Fig. 9(b)

12. Fig. 10 shows the maximum bending moments on the cross bar (beam) and side post (columns) of a football goal post loaded as described in Question 11.

    The ± options are chosen to incorporate any direction of the force.

    Calculate the Moment Magnification Factor (MMF) and maximum bending moments for the beam, using

    (i) AISC Equation

    (ii) Exact Equation for concentrated midspan force on a simple beam.

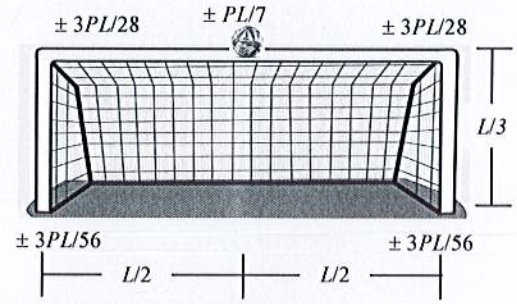


Fig. 10

13. The goal post described in Question 11 and 12 is modified with two internal hinges at two ends of the cross bar (beam). The diameter (d) of the cross-section is also fixed at $d = (1 + 0.01R_0)''$.

    Use the AISC-ASD method to calculate the allowable force P for the modified cross-bar (beam).

14. For the side posts (columns) modified as described in Question 13 [i.e. assumed a cantilever column of length = $L/3$ and diameter $d = (1 + 0.01R_0)''$], calculate the allowable force P for the member if it is constructed of a nonlinear material with stress-strain relationship $\sigma = f_y\,[1 - \text{Cos}(500\varepsilon)]$, where σ is compressive stress (ksi) and ε is strain; given $f_y = (60 + 0.1R_0)$ ksi.

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2022
Program: B.Sc. Engineering (Civil)

Course Title: Fluid Mechanics **Credit Hour: 03** **Course Code: CE 221**
Time: 3 hours **Full Marks: 100**

There are 4 questions with 25 marks for each. Please answer them accordingly.
[Assume reasonable data if and when needed]

1.	**a)**	What is viscous sub-layer? How do we define hydraulically smooth and rough surface in fluid mechanics?	**5**
	b)	What are the different types of minor head losses in pipe flow? Please define and express mathematically.	**10**
	c)	Briefly define and mathematically express Reynolds and Froude Numbers with similarity analysis.	**10**
2.	**a)**	Derive the General Energy Equation for an incompressible fluid.	**10**
	b)	Derive the Darcy-Weisbach equation for a circular pipe.	**15**
3	**a)**	A pipeline with a pump leads to a nozzle as shown in **Figure 1**. Find the flow rate when pump at B develops a head of 25m. Assume that the head loss in pipe 1 and pipe 2 can be expressed by $\mathbf{h_{L1} = 5V_1^2/2g}$ and $\mathbf{h_{L2} = 15V_2^2/2g}$, respectively. Draw the hydraulic grade and energy line accordingly.	**10**
	b)	The water passage is 3m wide, normal to the given **Figure 2**. Determine the horizontal forces acting on the shaded structure. Assume the flow is ideal.	**5**
	c)	In **Figure 3**, the pipes 1, 2 and 3 are 300m of 30 cm diameter, 150m of 15 cm diameter and 250m of 25cm diameter, respectively. All of these are commercial steel pipes which flow the water in 15 degree Celsius. If h = 12m, find the flow rate from A to B using (a) Equivalent Velocity Method and (b) Equivalent Length Method	**10**
4	**(a)**	Find out the most reasonable flow distribution within the pipe network given in **Figure 4**. Assume convenient n values for simple analysis.	**15**
	(c)	A 6cm diameter water jet with a velocity of 36m/s impinges on one of a series of blade of the Pelton Wheel. The blade and wheel are moving at a velocity of 18m/s. β = 150 and relative velocity, $V_2 = 0.9V_1$ due to friction loss. Compute (a) the force exerted by the water on the vane and (b) loss of power due to friction.	**10**

Figure 1

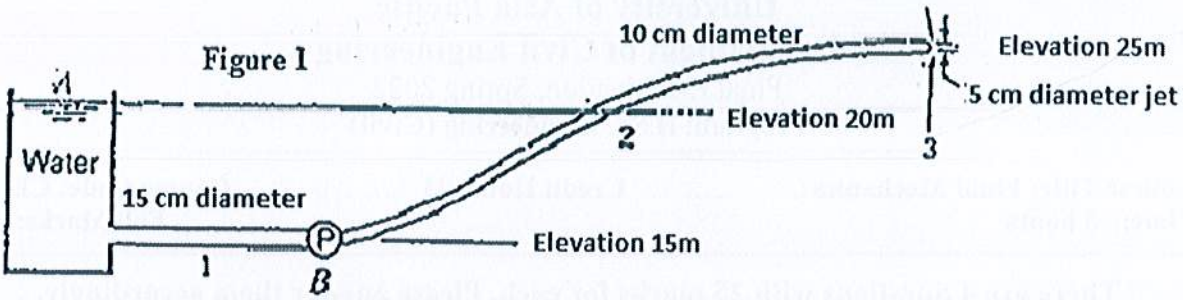


Figure 2

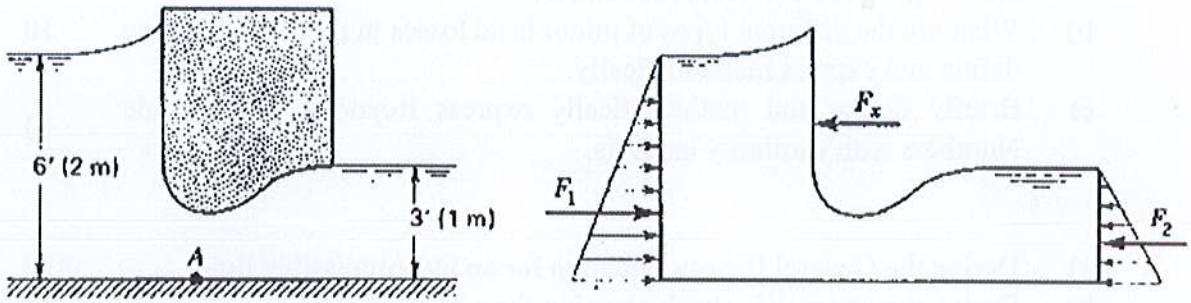
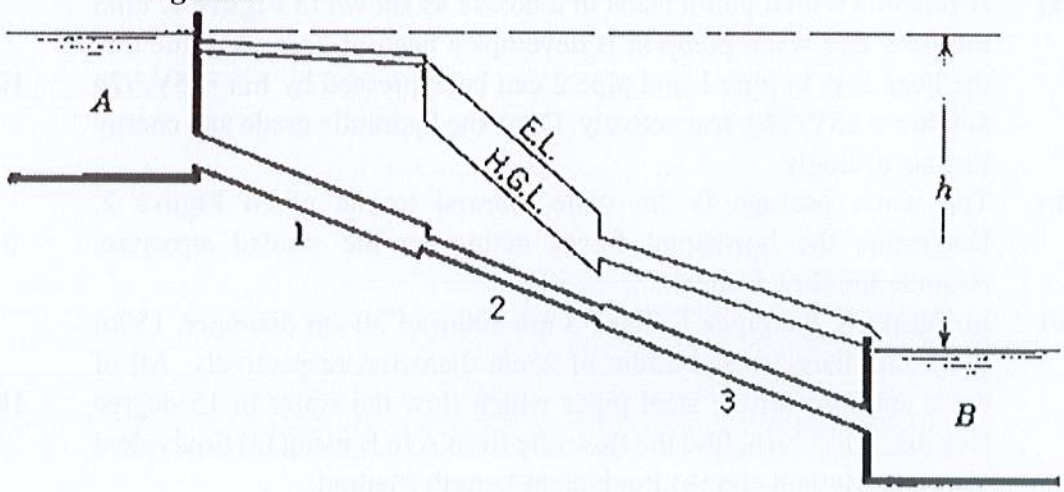


Figure 3



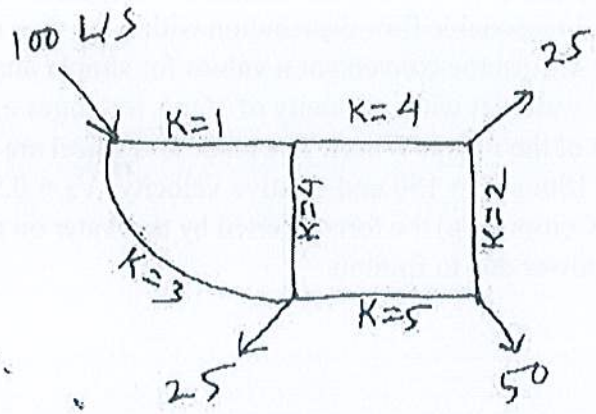


Figure 4

Supplementary Information

Pipe Type	e or k (mm)
Drawn tubing, brass, lead, glass, centrifugally Spun cement, bituminous lining	0.0015
Commercial steel or wrought iron	0.046
Welded-steel pipe	0.046
Asphalt-dipped cast iron	0.12
Galvanized iron	0.15