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University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2021
Program: B.Sc. Engineering (Civil)

Course Title: Principles of Economics — Course Code: ECN 201
Time: Two hours — Credit Hour: Two — Full Marks: 50

(Answer any five of the following questions.)

1. Illustrate the calculation of elasticities with an example. 10

2. What are long run and short run production adjustments? Write with examples. 10

3. (a) Show the relationship between average cost (AC) and marginal cost (MC) drawing the graph of cost curves. 5
(b) What is least-cost rule? Explain. 5

4. (a) Describe the functions of money. 3
(b) Would money ever be used as a store of value? Why or why not? Explain. 7

5. (a) Describe short run Philips curve with the diagram. 8
(b) What is non-accelerating inflation rate of unemployment (NAIRU)? 2

6. (a)

Units of Labor input	Total Product	Marginal Product
0	0	
1	2000	
2	3000	
3	3,500	
4	3,800	
5	3,900	

The table shows the total product that can be produced by different inputs of labor when other inputs (capital, land etc.) and state of technical knowledge are unchanged. Calculate marginal product from the table. 3

(b) A firm's engineers have calculated that the desired output level of 9 units could be produced with two possible options. In both cases energy (E) costs \$2 per unit, while labor (L) costs \$5 per hour. Under option 1, the input mix is $E = 10$ and $L = 2$. Option 2 has $E = 4$ and $L = 5$. Which is the preferred (least-cost) option? 2

(c) Draw the curves and show cost-push inflation with brief illustration. 5

University of Asia Pacific
Department of Basic Sciences & Humanities
Final Examination, Fall 2021
Program: B.Sc. in Civil Engineering

Course Title: Mathematics-IV
Credit: 3.00

Time: 3.00 Hour

Course Code: MTH 203
Full Marks: 150

There are **Eight (8)** questions. Answer any **Six (6)**. All questions are of equal values, indicated in the right margin

1. (a) Solve the exact differential equation: $(x^3 + y^3)\,dx + 3xy^2\,dy = 0$ **12**

   (b) Solve the non exact differential equation: $\left(y + \frac{1}{3}y^3 + \frac{1}{2}x^2\right)dx + \frac{1}{4}(x + xy^2)dy = 0$ **13**

2. (a) Solve the linear differential equation: $(x^3 - x)\frac{dy}{dx} - (3x^2 - 1)y = x^5 - 2x^3 + x$ **12**

   (b) Solve the Bernoulli's equation: $\frac{dy}{dx} + \frac{1}{x} = \frac{e^y}{x^2}$ **13**

3. (a) Solve the followings: **10**

   (i) $25\frac{d^2y}{dx^2} - 40\frac{dy}{dx} + 16 = 0$

   (ii) $\frac{d^4y}{dx^4} - \frac{d^3y}{dx^3} - \frac{dy}{dx} + 1 = 0$

   (b) Solve the Bernoulli's equation: $\frac{dy}{dx} + x\sin 2y = x^3\cos^2 y$ **15**

4. (a) Solve the following differential equations by constant co – efficients: **25**

   (i) $(D^3 - D^2 - 6D)y = 0$

   (ii) $(D^3 - 4D^2 - 3D + 18)y = 0$

   (iii) $(D^4 - a^4)y = 0$

5. (a) Solve DE $f''(t) + f(t) = \sin 3t, f(0) = 0, f'(0) = 0$ by applying Laplace Transform and Inverse Laplace Transform. 13

(b) Find the inverse Laplace Transform of $\frac{2s^2 - 4}{(s-3)(s+1)(s-2)}$ by applying Heaviside's expansion formula. 12

6. (a) Find the inverse Laplace Transform of: (i) $\left(\frac{s}{s^2 + 4s + 13}\right)$ (ii) $\left(\frac{5s - 10}{9s^2 - 16}\right)$ 10

(b) Find the Laplace Transform of: (i) $\frac{1}{t}(e^{-t} \sin t)$ (ii) $(t^4)^m$ 10

(c) Find the Laplace transform of periodic function e^t of period 2π. 5

7. (a) Obtain the Fourier series for $f(x) = e^{-x}$ in the interval $-\pi < x < \pi$. 15

(b) Express $f(x) = 3x$ as a half range sine series in the interval $0 < x < 5$. 10

8. Solve the following boundary value problem by the method of Separation of variables: 25

$$\frac{\partial U}{\partial t} = 2\frac{\partial^2 U}{\partial x^2}, U(0,t) = 0, U(\pi, t) = 0, U(x,0) = 3\sin 2x + 2\sin 3x$$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2021
Program: B. Sc. Engineering (Civil)

Course # : CE-203 | Course Title: Engineering Geology & Geomorphology
Full Marks: 120 | Time: 3 hours

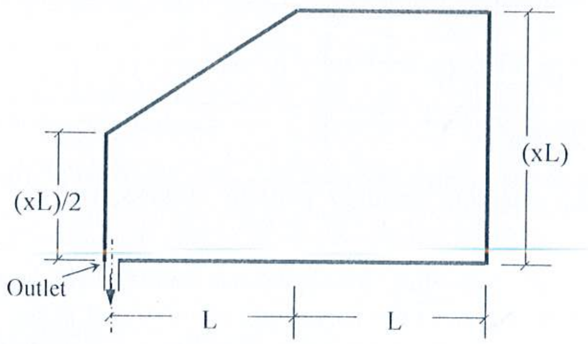
Answer to all questions

1. (a) Discuss Sedimentary rock. Giving examples distinguish between igneous and metamorphic rocks. 11
   (b) Show two examples of metamorphic rocks that are generated from sedimentary rocks due to metamorphism. 3
   (c) Distinguish between weathering and erosion. Mention a few major physical and chemical weathering processes. 6

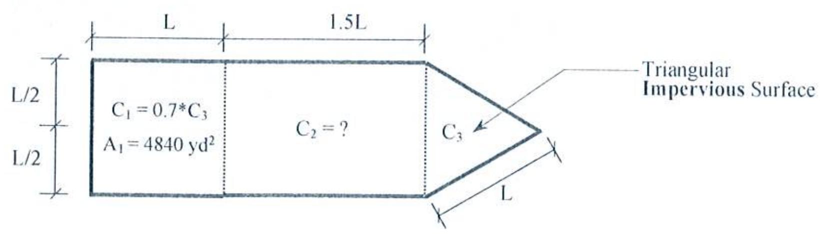
2. (a) What is fold. With the aid of neat sketches, discuss in short, any two types of folds. 8
   (b) Classify (mention names only) faults according to net slip and direction of movement. 3
   (c) Draw neat sketches of Horst and Graben. 4

3. (a) Classify (mention names only) folds and discuss any two types showing neat sketches. 7
   (b) Discuss liquefaction phenomenon in the light of its mechanism and aftermaths. 10
   (c) Discuss, in short, S-wave. 3

4. (a) Mention a few factors affecting runoff. No description is required. 5
   (b) For the following basin, x is a constant factor. For what value of x, the flow rate (Q) will be the maximum for the basin? Find the FF of the basin for maximum runoff. 10

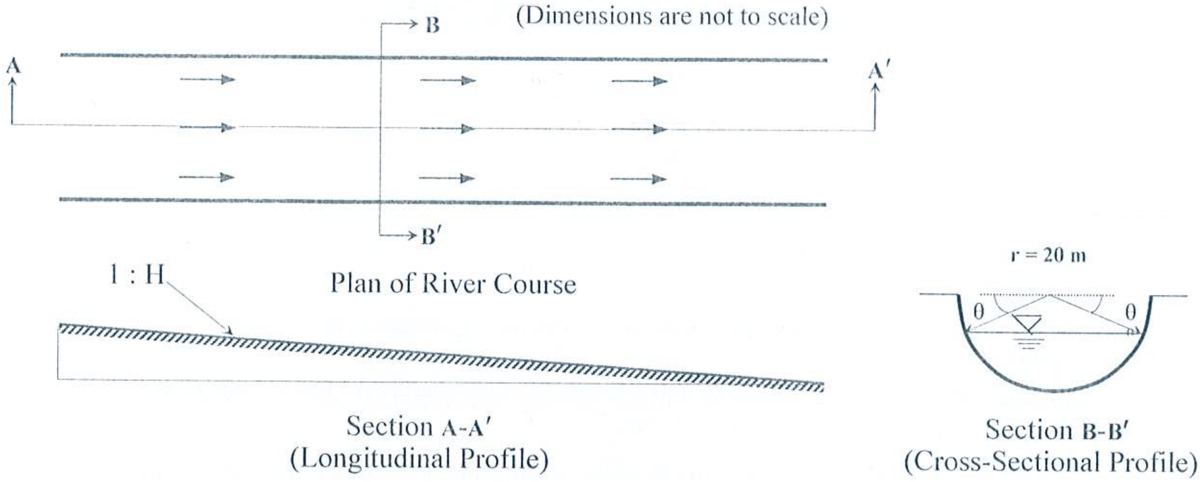


   (c) For the drainage area as shown below, calculate co-efficient of runoff (C_2) for $Q_p = 0.361$ ft^3/s and I =0.25 inch/hour. 10



5. (a) What are the major causes of river erosion? Mention three hydraulic actions responsible for river erosion 3
   (b) Prove that $d \alpha v^2$; where symbols carry their usual meanings. 6
   (c) Velocity of flow of one river (R-1) is four times the velocity of flow of another river (R-2). Derive a correlation between the two rivers in terms of their ability of transporting maximum size of sediments. 3

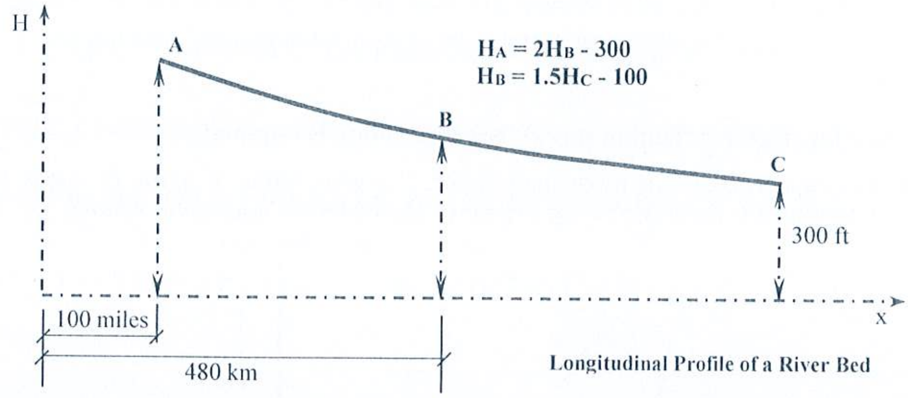
(d) Consider the following river having the longitudinal and cross-sectional profiles as follows. Calculate H if traction pressure is 10.24 psf. 8



Section A-A′
(Longitudinal Profile)

Section B-B′
(Cross-Sectional Profile)

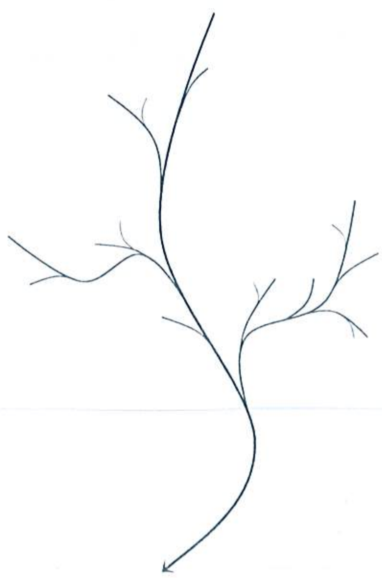
6. (a) Using the figure shown below, calculate the horizontal distance between B and C. 5



Longitudinal Profile of a River Bed

(b) Mention the factors affecting drainage pattern. Discuss, in brief, the ways valleys are deepened. 5

(c) Rank the streams of the following drainage basin having a total catchment area of 5,000 square kilometer. The results of the survey are summarized in the table below. Calculate the following parameters: (i) Average Bifurcation Ratio (ii) Average Length Ratio & (iii) Stream Frequency 10



Steam Rank	Average Length (km)
1	7.0
2	18.9
3	44.8
4	99.9

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2021
Program: B.Sc. Engineering (Civil)

Course Title: Numerical Methods and Computer Programming — Course Code: CE 205

Time: 3 hours — Credit Hour: 3.0 — Full Marks: 120

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1. In environmental engineering, the following equation can be used to compute the oxygen level c (in mg/L) in a river downstream from a sewage discharge [7]

$$c = 10 - 20(e^{-0.15x} - e^{-0.5x})$$

Where x is the distance downstream in kilometers. Use the bisection method. As an initial guess, assume that your solution lies within x = 0 and x = 5 km. Calculate the distance downstream where the Oxygen level falls to a reading of 5 mg/L. Take 4 significant digits after the decimal. Perform 6 iterations.

2. Calculate the saturation-growth-rate equation, $y = a\frac{x}{b+x}$ for the given data: [12]

x	3	5	7	9	11	15	18
y	7	11	15	19	22	31	38

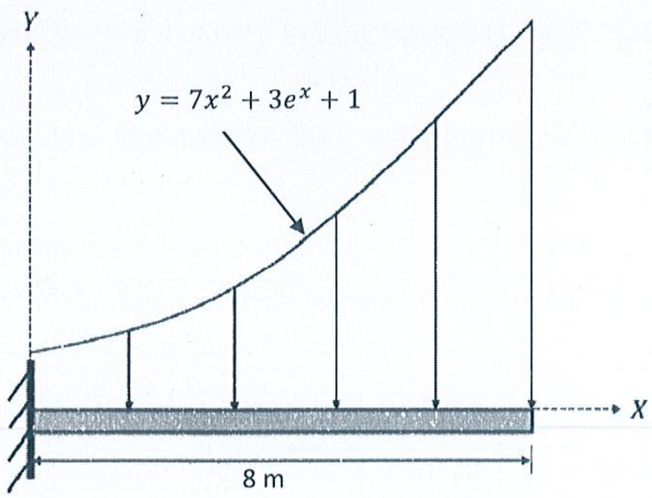
3. For the cantilever beam, calculate the upward reaction force using the following equation:

$$y = 7x^2 + 3e^x + 1$$

Where, x is the distance from the left. Use the following methods:

(a) Simpson's Rule with 6 panels [8]

(b) Gauss Quadrature method with 4 points. [12]



Weighing Co-efficient (W_k) and associated points (x_k) for the Gauss Quadrature		
n	x_k	W_k
4	0 ± 0.5385 ± 0.9062	0.5689 0.4786 0.2369

4. Use zero to 4th order Taylor series expansion to predict $f(3.5)$ for $f(x) = lnx$ using a base point at $x = 1$. Compute the true percent relative error for each approximation. [10]

5. The following table provides x(degree) and corresponding Sinx values. Compute $\text{Sin}24^0$ using Gregory-Newton Interpolation. [15]

x(degree)	0	10	20	30	40
Sinx	0.00000	0.17365	0.34202	0.50000	0.64279

6. Solve the following boundary value problem by the Finite Difference method with step length 0.5 [12]

$$5\frac{d^2y}{dx^2} - 8y + 11 = 0$$

Given that, $y(0) = 1, y(2) = 4$

7. Apply Gauss Elimination method to solve the following system of equations: [10]

$$10x + 6y - 4z = 5$$
$$4y - 5z + 3x = 8$$
$$-8x + z + 3y = 6$$

8. Derive the equation of the polynomial passing through (1, 1), (2,5), (4,9) and (6, 11). [10]

9. Write a program code to find the value for $x = 3$ using the data points in question 8. [12]

10. Write a program code to calculate n from the equation $Q = 10H^n$ using the data shown in the Table for the discharge (Q) through a hydraulic structure for different values of head (H). [12]

H (ft)	1.3	2.2	2.8	4.2
Q (cft/sec)	11	20	33	42

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2021
Program: B. Sc. Engineering (Civil)

Course Title: Mechanics of Solids II | Course Code: CE 213
Time: 3 Hours | Credit Hour : 3.0 | Full Marks: 10 × 10

ANSWER ALL QUESTIONS. Any missing data can be assumed reasonably.

1. Calculatethe equivalent polar moments of inertia (J_{eq}) for any three cross-sections shown in ***Fig.1(a)*** to ***Fig.1(d)*** by centerline dimensions [Given: Wall thickness = 0.10" throughout].

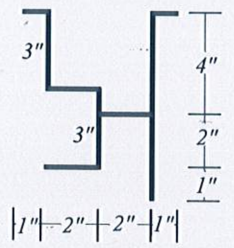


Fig.1(a)

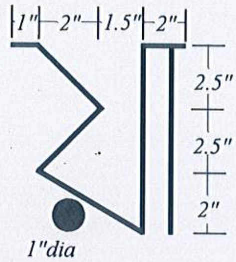


Fig.1(b)

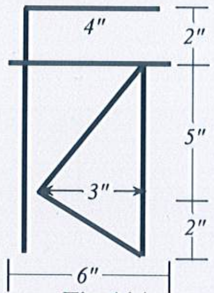


Fig.1(c)

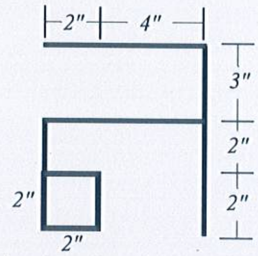


Fig.1(d)

2. For the structure loaded as shown in ***Fig.2***,
   (i) Calculate the normal stress at center of cross section **B**
   (ii) Draw Mohr's circle of stresses.

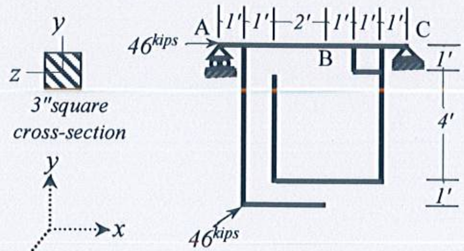


Fig. 2

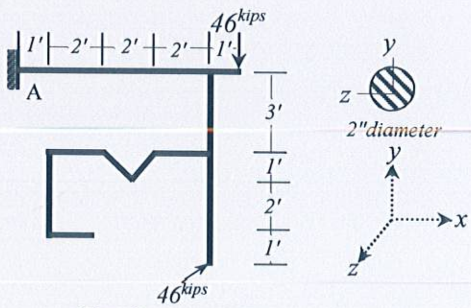


Fig. 3

3. Calculate maximum compound shear stress on the cross-section at **A** of the structure loaded as shown in ***Fig. 3***, including Direct Shear and Torsional Shear.

4. For the beam loaded as shown in ***Fig. 4***, determine $\theta_{D(+)}$, $\theta_{D(-)}$ and Δ_D using Moment area theorem [Given: $EI = 46000\ k\text{-}ft^2$].

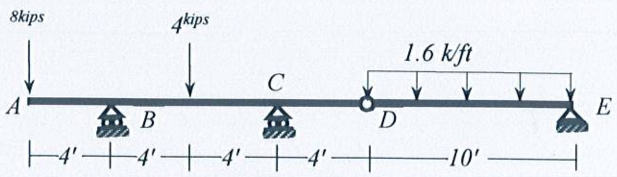


Fig. 4

5. Solve Question No. 4 using Singularity Functions.

6. Solve Question No. 4 using Conjugate Beam Method.

7. Draw (i) qualitative defected shape and (ii) bending moment diagram for the structure shown in ***Fig. 5***.

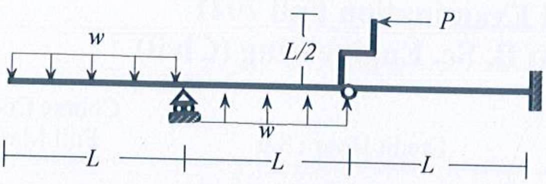


Fig.5

8. Calculate the buckling load in column **AB** (unbraced) and **BC** (braced), for the structure shown in ***Fig.6*** [Given: $E = 4{,}000$ *ksi*].

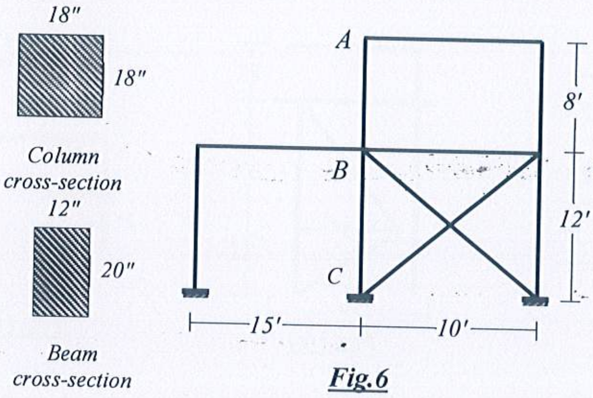


Fig.6

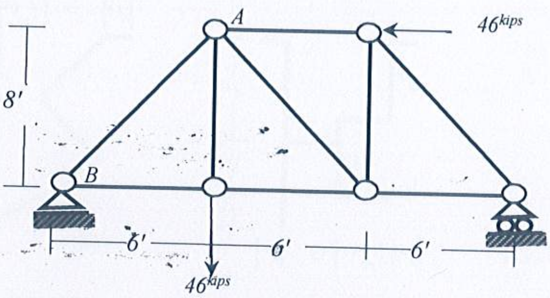


Fig. 7

9. A truss system shown in ***Fig.7*** is made of a nonlinear material with stress-strain relationship given by $\sigma = 460(\varepsilon)^{0.46}$ where **σ** is the stress (ksi) and is **ε** the strain.
Calculate the critical buckling load for the truss member **AB**
[Given: Cross sectional area of the truss member = $0.902\ in^2$].

10. Check adequacy of the truss member **AB** ($L\ 2\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{16}$, A= 0.902 in², r_z = 0.495 in) for axial compression using the AISC-ASD Method, if it is loaded as shown in ***Fig.7***
[Given: f_y = 60 ksi (A36) and E = 29,000 ksi].

List of Useful Formulae for CE 213

* Torsional Rotation $\phi_B - \phi_A = \int(T/J_{eq}G)\,dx$, and $= (TL/J_{eq}G)$, if T, J_{eq} and G are constants

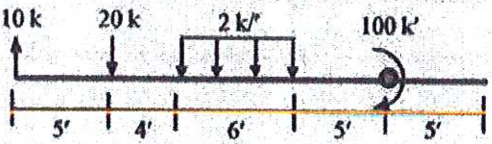
Section	Torsional Shear Stress	J_{eq}
Circular	$\tau = Tc/J$	$\pi d^4/32$
Thin-walled	$\tau = T/(2Ⓐ\,t)$	$4Ⓐ^2/(\int ds/t)$
Rectangular	$\tau = T/(\alpha bt^2)$	βbt^3

b/t	1.0	1.5	2.0	3.0	6.0	10.0	∞
α	0.208	0.231	0.246	0.267	0.299	0.312	0.333
β	0.141	0.196	0.229	0.263	0.299	0.312	0.333

* Biaxial Bending Stress: $\sigma_x(z, y) = M_z\, y/I_z + M_y\, z/I_y$
* Combined Axial Stress and Biaxial Bending Stress: $\sigma_z(x,y) = -P/A - M_x\, y/I_x - M_y\, x/I_y$
* Corner points of the kern of a Rectangular Area are (b/6, 0), (0, h/6), (–b/6, 0), (0, –h/6)
* Maximum shear stress on a Helical spring: $\tau_{max} = \tau_{direct} + \tau_{torsion} = P/A + Tr/J = P/A\,(1 + 2R/r)$
* Stiffness of a Helical spring is $k = Gd^4/(64R^3N)$

* $\sigma_{xx}' = (\sigma_{xx} + \sigma_{yy})/2 + \{(\sigma_{xx} - \sigma_{yy})/2\}\cos 2\theta + (\tau_{xy})\sin 2\theta = (\sigma_{xx} + \sigma_{yy})/2 + \sqrt{[\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2]}\cos(2\theta-\alpha)$
  $\tau_{xy}' = -\{(\sigma_{xx} - \sigma_{yy})/2\}\sin 2\theta + (\tau_{xy})\cos 2\theta = \tau_{xy}' = -\sqrt{[\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2]}\sin(2\theta-\alpha)$
  where $\tan\alpha = 2\tau_{xy}/(\sigma_{xx} - \sigma_{yy})$
* $\sigma_{xx(max)} = (\sigma_{xx} + \sigma_{yy})/2 + \sqrt{[\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2]}$; when $\theta = \alpha/2,\ \alpha/2 + 180°$
  $\sigma_{xx(min)} = (\sigma_{xx} + \sigma_{yy})/2 - \sqrt{[\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2]}$; when $\theta = \alpha/2 \pm 90°$
* $\tau_{xy(max)} = \sqrt{[\{(\sigma_{xx}-\sigma_{yy})/2\}^2 + (\tau_{xy})^2]}$; when $\theta = \alpha/2 - 45°,\ \alpha/2 + 135°$
  $\tau_{xy(min)} = -\sqrt{[\{(\sigma_{xx}-\sigma_{yy})/2\}^2 + (\tau_{xy})^2]}$; when $\theta = \alpha/2 + 45°,\ \alpha/2 - 135°$
* Mohr's Circle: Center (a, 0) = $[(\sigma_{xx} + \sigma_{yy})/2,\ 0]$ and radius $R = \sqrt{[\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2]}$
* For Yielding to take place
  - Maximum Normal Stress Theory (Rankine): $|\sigma_1| \geq Y$, or $|\sigma_2| \geq Y$.
  - Maximum Normal Strain Theory (St. Venant): $|\sigma_1 - \nu\sigma_2| \geq Y$, or $|\sigma_2 - \nu\sigma_1| \geq Y$.
  - Maximum Shear Stress Theory (Tresca): $|\sigma_1 - \sigma_2| \geq Y$, $|\sigma_1| \geq Y$, or $|\sigma_2| \geq Y$
  - Maximum Distortion-Engrgy Theory (Von Mises): $\sigma_1^2 + \sigma_2^2 - \sigma_1\sigma_2 \geq Y^2$

* $M(x) = EI\,\kappa \cong EI\, d^2v/dx^2$
* $w(x) \cong EI\, d^4v/dx^4$, $V(x) = \int w(x)\,dx \cong EI\, d^3v/dx^3$, $M(x) = \int V(x)\,dx \cong EI\, d^2v/dx^2$
  $S(x) = \int M(x)\,dx \cong EI\, dv/dx \cong EI\,\theta(x)$, $D(x) = \int S(x)\,dx \cong EI\, v(x)$
* Singularity Functions for Common Loadings



$w(x) = 10\langle x-0\rangle^{-1} - 20\langle x-5\rangle^{-1} - 2\langle x-9\rangle^0 + 2\langle x-15\rangle^0 + 100\langle x-20\rangle^{-2} + C_0\langle x-20\rangle^{-3}$.

* First Moment-Area Theorem: $\theta_B - \theta_A = \int (M/EI)\,dx$
* Second Moment-Area Theorem: $(x_B - x_A)\,\theta_B - v_B + v_A = \int x\,(M/EI)\,dx$
* Conjugate Beam Method

Original Beam	Free End	Fixed End	Hinge/Roller End	Internal Support	Internal Hinge
Conjugate Beam	Fixed End	Free End	Hinge/Roller End	Internal Hinge	Internal Support

* Euler Buckling Load: $P_{cr} = \pi^2 EI_{min}/(kL)^2$
* Effect of Initial Imperfection: $v(x) = v_{0i}/[1-P/P_{cr}]\sin(\pi x/L) \Rightarrow v(L/2) = v_{0i}/[1-P/P_{cr}]$
* Effect of Load Eccentricity: $\lambda^2 = P/EI \Rightarrow v(L/2) = e\,[\sec \lambda L/2 - 1] = e\,[\sec\{(\pi/2)\sqrt{(P/P_{cr})}\}-1]$
* Effect of Material Nonlinearity: $P_{cr} = \pi^2 E_t I/L^2 \Rightarrow \sigma_{cr} = \pi^2 E_t/\eta^2$
* Eccentric Loading with Elasto-plastic Material:
  $v(L/2) = e\,[\sec\{(\pi/2)\sqrt{(P/P_{cr})}\}-1]$ for the elastic range; and
  $v(L/2) = M_p/P - e$, for the plastic range
* k = 1.0 for Hinge-Hinged Beam, 0.7 for Hinge-Fixed Beam, 0.5 for Fixed-Fixed Beam, 2.0 for Cantilever Beam
* In general, k can be obtained from ψ_A and ψ_B for braced and unbraced frames
  Using approximate formulae (Salama, 2014)
  For braced frame, $k \cong \{3\,\psi_A\psi_B + 1.4\,(\psi_A + \psi_B) + 0.64\}/\{3\psi_A\,\psi_B + 2.0\,(\psi_A + \psi_B) + 1.28\}$
  For unbraced frame, $k \cong \sqrt{[\{1.6\,\psi_A\psi_B + 4.0\,(\psi_A + \psi_B) + 7.5\}/(\psi_A + \psi_B + 7.5)]}$
* AISC-ASD Method, $\eta = L_e/r_{min}$, and $\eta_c = \pi\sqrt{(2E/f_y)}$
  If $\eta \leq \eta_c$, $\sigma_{all} = f_y\,[1-0.5\,(\eta/\eta_c)^2]/FS$, where $FS = [5/3 + 3/8\,(\eta/\eta_c) - 1/8\,(\eta/\eta_c)^3]$
  If $\eta > \eta_c$, $\sigma_{all} = (\pi^2 E/\eta^2)/FS$, where FS = Factor of safety = 23/12 = 1.92
* Moment magnification factor for a Simply Supported Beam
  For concentrated load at midspan of = $[\tan(\lambda L/2)/(\lambda L/2)]$, subjected to end moments only = $[\sec(\lambda L/2)]$
  Under UDL = $2\,[\sec(\lambda L/2)-1]/(\lambda L/2)^2$, according to AISC code = $1/(1-P/P_{cr})$

University of Asia Pacific
Department of Civil Engineering
Midterm Examination Fall – 2021
Program: B.Sc. Engineering (Civil)

Course Title: Fluid Mechanics **Credit Hour: 03** **Course Code: CE 221**
Time: 3 hours **Full Marks: 120**

There are 4 questions with 30 marks for each. Please answer them accordingly.
[Assume reasonable data if and when needed]

1.	**a)**	Briefly discuss and classify laminar and turbulent flow with examples Or with Reynold's experiment.	**10**
	b)	Explain hydraulic grade and energy lines and why true position of energy line is unknown?	**10**
	c)	Briefly discuss and mathematically express Reynolds and Froude Numbers.	**10**
2.	**a)**	Express Bernoulli's theorem with its components and derive the Theorem using Newton's Law.	**10**
	b)	Describe how changes in absolute and relative velocity are equal for the case of forces on moving vane?	**10**
	c)	Derive an expression for drag force exerted on a moving sphere through a viscous liquid using dimensional analysis.	**10**
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 $\mathbf{h_{L_1} = 5V_1^2/2g}$ and $\mathbf{h_{L_2} = 15V_2^2/2g}$, respectively. Draw the hydraulic grade and energy line for the pipe system.	**12**
	b)	The water passage is 3m wide, normal to the given **Figure 2**. Determine the horizontal forces acting on the shaded structure. Assume ideal flow.	**6**
	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 welded-steel pipes which flow the water in 15 degree Celsius. If h = 10m, find the flow rate from A to B using (a) Equivalent Velocity Method and (b) Equivalent Length Method	**12**
4	**(a)**	What are the advantages and practical use/ application of impulse momentum transfer? And why momentum correction factor is needed in momentum transfer calculation?	**6**
	(b)	What are the four different types of head losses in pipe flow? Analyze and express mathematically.	**12**
	(c)	Write the Darcy Weisbach, Hagen-Poisulle and Hazen–Willams formulas and their advantages in fluid mechanics problems.	**12**

Figure 1

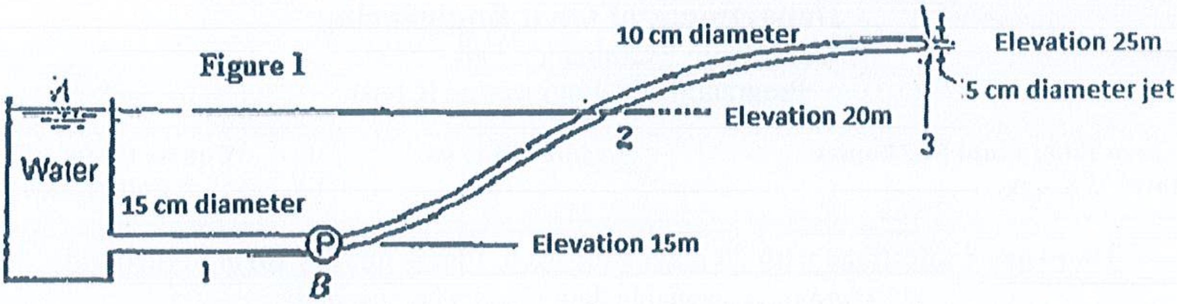


Figure 2

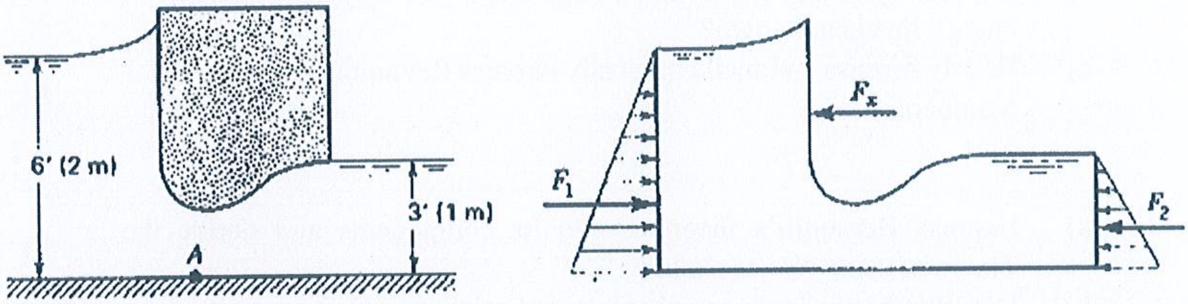
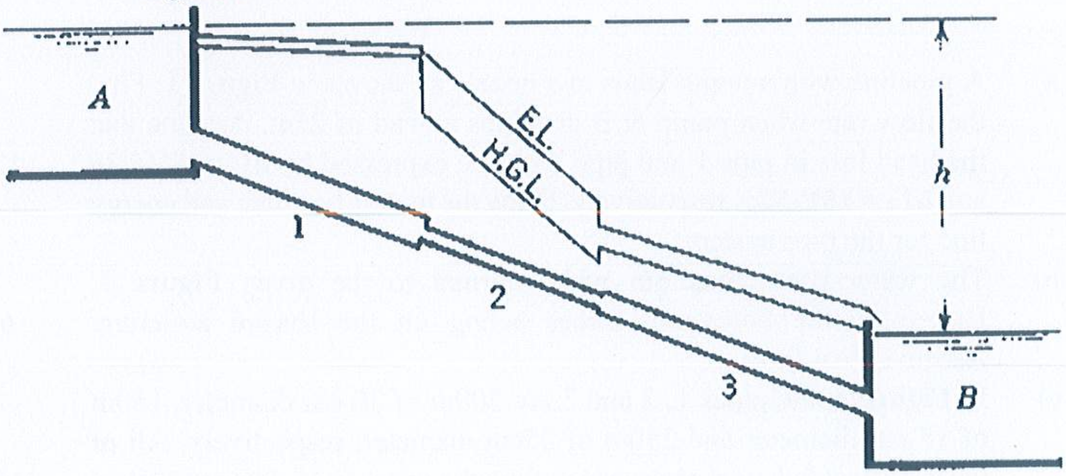


Figure 3



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