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

Course Title: Principles of Economics — Course Code: ECN 201
Time: 1 hour — Credit Hour: 2.00 — Full Marks: 40

There are **three** Questions. Answer any **two including Q-1**. All questions are of equal value. Figures in the right margin indicate marks.

1. $P = 100 - 2Q$

$P = 10 + Q$

a) Calculate consumer surplus, producer surplus and total surplus from the given equations. **10**

b) Explain the impact of change in input price on equilibrium price and quantity. **10**

2. a) Describe different types of price elasticity of supply with the help of diagrams. **10**

b) When demand is price inelastic, a price increase decreases total revenue. – True / False **10**

OR

3. a) Describe different types of price elasticity of demand with the help of diagrams. **10**

b) When demand is price elastic, a price increase decreases total revenue. – True / False **10**

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

Course Title: Mathematics-IV		Course Code: MTH 203
Time: 1.00 Hour	Credit: 3.00	Full Marks: 60

There are **four (4) questions**. Answer **three (3) including Q1 and Q2**. Figures given in the right margin indicate the marks of the respective questions.

1. a. Obtain the associated differential equations of the equation $y = A\cos ax + B\sin ax$, where A and B are arbitrary constants and a is a fixed number. **10**

   b. Obtain the differential equation of all circles passing through the origin and having their centres on the x axis. **10**

2. a. Identify and solve the equation $x^2(y+1)dx + y^2(x-1)dy = 0$. **10**

   b. Verify whether the differential equation is exact or not. Also, solve the equation $(y^2 - 2xy + 6x)dx - (x^2 - 2xy + 2)dy = 0$. **10**

3. a. Solve the equation $x^2\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} - 4y = x^4$. **10**

   b. Solve the equation $(D^2 - 3D + 2)y = \sin 3x$. **10**

OR

4. a. Identify and solve the equation $\frac{d^3y}{dx^3} + 6\frac{d^2y}{dx^2} + 25y = 0$. **10**

   b. Solve the equation $(D^3 - 2D^2 - 5D + 6)y = (e^{2x} + 3)^2$. **10**

University of Asia Pacific
Department of Civil Engineering
Mid Semester Examination Spring 2023 (Set 2)

Course #: CE 213 — Course Title: Mechanics of Solids II

Full Marks: 40 (= 4 × 10) — Time: 1 hour

Given R_0 = Last three digits of Registration #

1. Calculate equivalent polar moment of inertia (J_{eq}) of the cross-section shown in Fig. 1 by centerline dimensions

   [Given: $x = (1 + 0.01R_0)$ ft
   Wall thickness = 0.10 ft throughout].

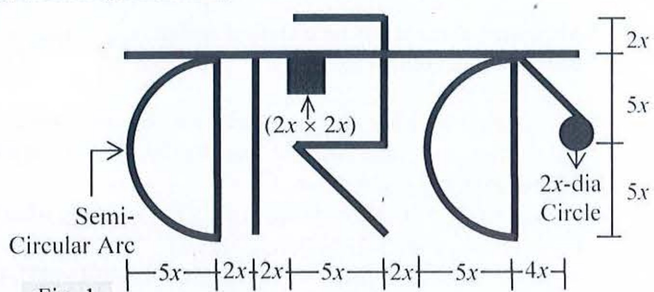


Fig. 1

2.

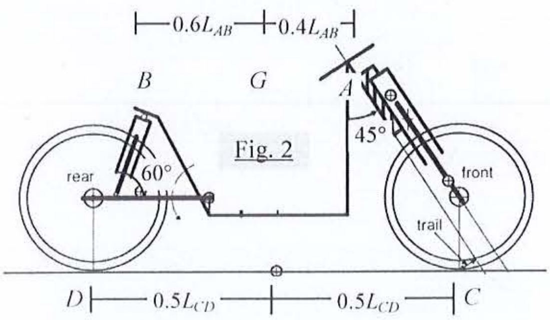


Fig. 2 shows a motorbike with helical Spring-pairs A and B at a distance $L_{AB} = (1 + 0.01R_0)^{m}$, supporting a weight W_0 $(= 500 + 5R_0)^{N}$ at the center of gravity G.

All springs have shear modulus = 80 GPa, coil diameter = 3^{mm}, mean diameter = 50^{mm}, number of coils = 6.

(i) For each Spring B, calculate the
  (a) Force, (b) Deformation.

(ii) Draw Mohr's circle of stresses for the coil of Spring B.

3. Fig. 2 shows front wheel C and rear wheel D of a motorbike at a distance $L_{CD} = (2 + 0.02R_0)^{m}$, supporting weight W_T $(= 2000 + 20R_0)^{N}$ at the center of gravity G.

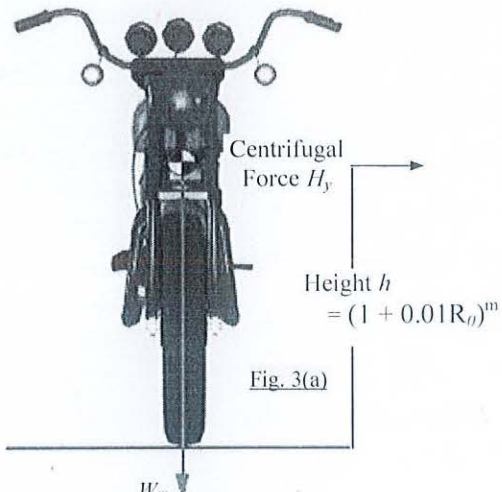
   Fig. 3(a) shows the front view of a moving motorbike, being subjected to centrifugal force H_x (in addition to weight W_T).

   Fig. 3(b) shows the contact surface area of both tyres, as well as the center of gravity G (where W_T works), inertia force H_x $(= 0.5W_T)$ and centrifugal force H_y, acting at height $h = (1 + 0.1R_0)^{m}$.

   Given: $b_0 = 300^{mm}$ and $t_0 = 150^{mm}$, calculate the

   (i) Centrifugal force H_y required to overturn the bike

   (ii) Maximum combined normal stress on the contact area of tyres.



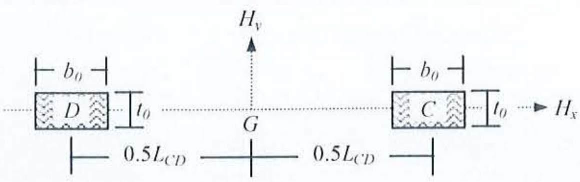


Fig. 3(b)

4. Fig. 4(a) shows impact force (P) on the head of a motorcyclist, Fig. 4(b) shows impact force (Q) reduced by protective helmet while Fig. 4(c) shows a simplified model of the neck cross-section.

   If $P = (5 + 0.05R_0)$ kips, calculate the

   (i) Principal Stresses (σ_1 and σ_2) acting at the center of the neck cross-section.

   (ii) Yield Strength (Y) required to avoid yielding, according to Tresca yield criterion

   (iii) Yield Strength required to avoid yielding, according to St. Venant ($\nu = 0.30$), for force $Q = P/10$.

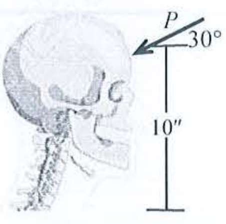


Fig. 4(a)

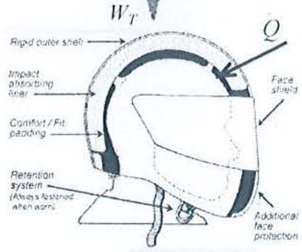
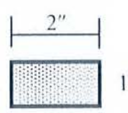


Fig. 4(b)



Cross-Section
Fig. 4(c)

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}
Solid Circular	$\tau = Tc/J$	$\pi d^4/32$
Thin-walled	$\tau = T/(2A\,t)$	$4A^2/(\int ds/t)$
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

* Normal Stress (along x-axis) due to Biaxial Bending (about y- and z-axis): $\sigma_x(y, z) = M_z\, y/I_z + M_y\, z/I_y$
* Normal Stress (along x-axis) due to Combined Axial Force (along x-axis) and Biaxial Bending (about y- and z-axis): $\sigma_x(y, z) = P/A + M_z\, y/I_z + M_y\, z/I_y$
* 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 of Stresses: Center (a, 0) = $[(\sigma_{xx} + \sigma_{yy})/2, 0]$ and radius $R = \sqrt{[\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2]}$

* To avoid Yielding
  - Maximum Normal Stress Theory (Rankine): $|\sigma_1| < Y$ and $|\sigma_2| < Y$.
  - Maximum Normal Strain Theory (St. Venant): $|\sigma_1 - \nu\sigma_2| < Y$ and $|\sigma_2 - \nu\sigma_1| < Y$.
  - Maximum Shear Stress Theory (Tresca): $|\sigma_1 - \sigma_2| < Y$ and $|\sigma_1| < Y$ and $|\sigma_2| < Y$
  - Maximum Distortion-Energy Theory (Von Mises): $(\sigma_1^2 + \sigma_2^2 - \sigma_1\sigma_2) < Y^2$

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

Course Title: Numerical Analysis and Computer Programming | Course Code: CE 205
Time: 1 hour | Credit Hour: 3.00 | Full Marks: 40

(Answer all of the questions. Assume any reasonable value for missing data.)

Part A

1. The volume of a regular octagonal prism is expressed by the equation.

$$V = 2\,(1+\sqrt{2})\,a^2 h$$

Where, volume 'V'= $60m^3$ and height 'h'=3m. Solve the equation for base edge 'a' between the interval [1.5,2.5] using Regula Falsi method, which is correct upto 3 decimal places. **[10]**

2. Solve the following equations using Gauss Jordan Elimination method.

$$x+3y+z = 10$$
$$x-2y-z = -6$$
$$2x+y+2z = 10$$

[10]

3. Imagine, a construction company has developed a model which determines the C: FA: CA ratio for concrete mixture to be used in a day. On a certain day, the ratio needs to be determined by the following system of linear equations:

$$27FA + 6CA - C = 85$$
$$FA + CA + 54C = 110$$
$$6FA + 15\,CA + 2C = 72$$

Now, determine the C: FA: CA ratio using Gauss Seidel method. **[10]**

Part B

1. Imagine you are designing a road pavement, and you need to assess the impact of wheel loads on the pavement's structural integrity. You need to write a C++ program to calculate the impact factor for the pavement based on the wheel loads. The impact factor (IF) for a wheel load is calculated as follows: IF = (Load / Spacing) * (Tire Pressure / 1000)
Where: Load is the magnitude of the wheel load (in kg). Spacing is the spacing between wheels (in meters). Tire Pressure is the tire pressure (in kPa).

Write a C++ program that takes as input: The number of wheel loads; For each wheel load, the program should take the magnitude (in kg), tire pressure (in kPa), and spacing between wheels (in meters); A specified value beyond which pavement integrity will be impacted.

The program should then calculate and display the impact factor for each wheel load. Sum the impact factors and determine if pavement integrity is impacted when the total impact factor exceeds a specified value. **[6]**

2. Write a C++ program that allows environmental engineering students to input the AQI value and displays the corresponding AQI category.

The program should:
Display a menu of AQI categories: Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, Very Unhealthy, and Hazardous.
Allow the user to input AQI of their area to determine the category.

Use a switch statement to determine and display the AQI category based on the entered AQI value.

AQI Categories:
Good: 0-50
Moderate: 51-100
Unhealthy for Sensitive Groups: 101-150
Unhealthy: 151-200
Very Unhealthy: 201-300
Hazardous: 301 and above [4]

University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination Spring 2023
Program: B.Sc. in Civil Engineering

Course Title: Fluid Mechanics | Course Code: CE 221

Time: 1 hour | Credit Hour: 3.00 | Full Marks: 50

Answer all the Questions. Assume any reasonable value(s) if missing.
Necessary figures are given in the opposite page

1. Define and provide mathematical expression for the following fluid properties: [10]

   i) kinematic viscosity, **ii)** surface tension, **iii)** bulk modulus of elasticity, **iv)** specific volume, **v)** capillary effect

2. Define and briefly explain different flow type for following criterion: [10]

   i) time, **ii)** density, **iii)** space **iv)** velocity distribution and Reynold's number, **v)** velocity components,

3. Derive the mathematical expression for equation of continuity for steady and unsteady flow (Draw necessary figure) [6]

4. Two parallel plates are filled with fluid of s.g.= 0.8 and dynamic viscosity 0.7 poise. Plates are 10cm apart and one plate is moving at 1m/s while the other is stationary (**Figure 1**). Velocity distribution of the flow is: $v=100-k(10-y)^2$. Find **i)** velocity gradient, **ii)** shear stress at boundary [8]

5. Calculate the resultant force on triangular gate ABC in **figure:2** and locate its center of pressure. It is located 10cm below from water table and its height is 40cm and width is 60cm. [8]

6. A flow velocity profile is given, $u=-x$, $v=y$, $w=0$ find out whether, the flow is **a)** steady or unsteady? **b)** 1D/2D/3D=? **c)** does it satisfy continuity? **d)** find the equation of streamline. [8]

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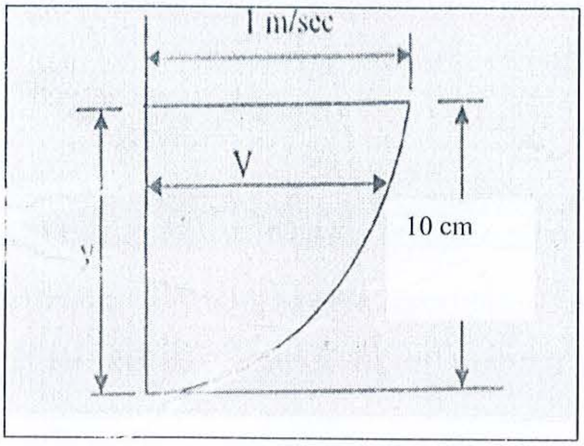


Figure: 1

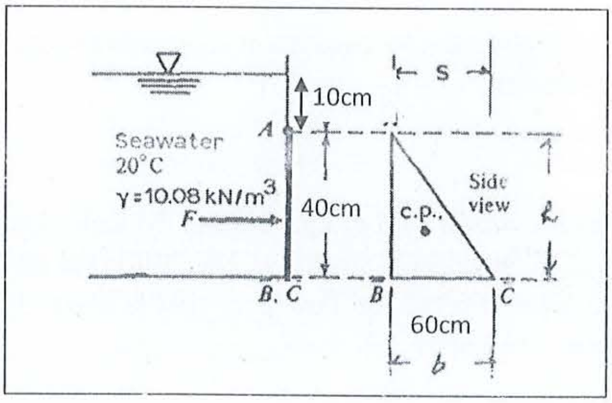


Figure: 2

University of Asia Pacific
Department of Civil Engineering
Midterm Examination Spring 2023

Course # : CE 203	Course Title: Engineering Geology & Geomorphology
Full Marks: 40	Time: 1 hour

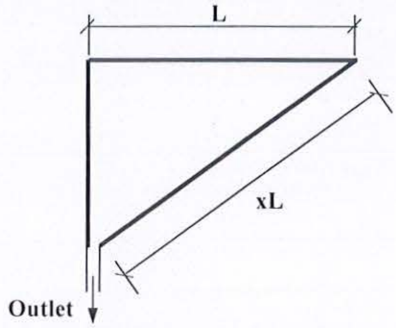
Answer to all the questions

1(a). Draw a schematic diagram of the rock cycle and provide two examples of each type of rock. 4

1(b). Distinguish between physical and chemical weathering processes. Also distinguish between weathering and erosion. 3+3=6

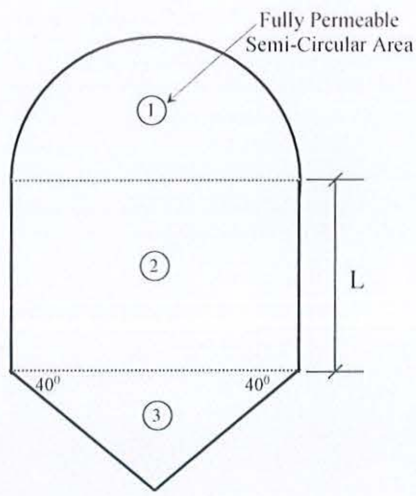
2(a). Mention the basin factors (no description required) affecting runoff. 2

2(b). In the following basin determine the value of x for which flow rate (Q) or runoff will be the maximum. Also find the FF and CC of the basin for maximum runoff. 8



3(a). Mention two assumptions of rational formula. 2

3(b). For the following figure and information calculate intensity of rainfall in mm/hr. 8
$A_1 = 2.0$ Acre (1Acre =4840 d^2); $L = 70$ yd; $C_2 = 0.2$; $C_3 = 0.7$; $Q_p = 63.7$ yd^3/hr



4(a). With the aid of a neat sketch show different parts of a typical fold geometry. 3

4(b). Classify fold (mention names only). Draw a neat sketch of oblique fault. 3

4(c). Sketch and mention few major features of any two types of drainage pattern. 4