University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
1st Year 2nd Semester

Course Title: Chemistry | Course Code: CHEM 111

Time: 3 hours | Credit Hour: 3.00 | Full Marks: 150

There are eight questions. Answer **any six** including **QUESTION 1, QUESTION 2, QUESTION 3** and **QUESTION 4.**

QUESTION 1 [25 MARKS]

a. Discuss the physical significance of the four quantum numbers used to describe all the attributes of an electron. [10]

b. Explain how the quantum mechanical model of atom accounts for the Zeeman effect. [10]

c. Calculate the velocity of an electron having a de Broglie wavelength of 0.25 nm. [Planck's constant, $h = 6.626 \times 10^{-34}$ J·s; mass of an electron, $m_e = 9.11 \times 10^{-28}$ g] [05]

QUESTION 2 [25 MARKS]

a. Consider the following reactions: (i) $M \rightarrow N$ & (ii) $P \rightarrow Q$. [15]

Reaction (i) follows zero-order kinetics, while reaction (ii) follows second-order kinetics. Show that the half-life of reaction (i) is proportional to the initial concentration of M, whereas the half-life of reaction (ii) is inversely proportional to the initial concentration of P.

b. 40% of a first-order reaction is completed in 42 seconds. Calculate the time required for 60% of the reaction to be completed. [10]

QUESTION 3 [25 MARKS]

a. Draw the Born-Haber cycle for the formation of a MgO crystal lattice and calculate the lattice enthalpy of the crystal lattice from the following enthalpy changes: [15]

(i) $Mg(s) + \frac{1}{2}O_2(g)$	$\longrightarrow MgO(s)$	$\Delta H = -602$ kJ/mol
(ii) $Mg(s)$	$\longrightarrow Mg(g)$	$\Delta H = +136$ kJ/mol
(iii) $Mg(g)$	$\longrightarrow Mg^{2+}(g) + 2e$	$\Delta H = +2188$ kJ/mol
(iv) $O_2(g)$	$\longrightarrow 2O(g)$	$\Delta H = +498$ kJ/mol
(v) $O(g) + 2e$	$\longrightarrow O^{2-}(g)$	$\Delta H = +656$ kJ/mol

b. With reference to Le Chatelier's principle and Van't Hoff's equation, explain how a decrease in temperarure affects the equilibrium for an endothermic reaction. [10]

QUESTION 4 [25 MARKS]

a. Explain the concept of chemical equilibrium with the help of (i) a rate vs time plot and (ii) a concentration vs time plot. [10]

b. Establish a relationship between the equilibrium constants K_p and K_c for the following reaction: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$. Calculate the temperature at which the numerical values of K_p and K_c will be equal for this reaction. [Molar gas constant, $R = 0.0821\ L \cdot atm \cdot mol^{-1} \cdot K^{-1}$] [15]

QUESTION 5 [25 MARKS]

a. With chemical reasoning, discuss how galvanizing prevents the rusting of iron. [10]

b. Explain how a magnesium rod can act as a sacrificial anode to provide cathodic protection to a buried iron pipe. [08]

c. A magnesium (Mg) rod is connected to an iron pipe with a metallic wire to prevent the pipe from corrosion. If a steady current of 5 mA flows in the galvanic cell between magnesium and iron, calculate the total mass of magnesium that will be consumed in protecting the iron pipe for 30 years. Assume the current remains constant throughout this period. [Molar mass of Mg = 24 g/mol; Faraday's constant, F = 96,485 C] [07]

OR

QUESTION 6 [25 MARKS]

a. Briefly discuss the process of eutrophication. [10]

b. If both Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are determined for a water sample, explain which value is expected to be higher and why. [08]

c. A 100 mL pond water sample was analyzed for its Dissolved Oxygen (DO) using the Winkler's titration method. It required 7.5 mL of 0.02 N sodium thiosulfate solution to titrate the liberated iodine. Calculate the DO of the water sample in mg/L. [Molar mass of O_2 = 32 g/mol] [07]

QUESTION 7 [25 MARKS

a. Explain how paints and varnishes vary in their compositions, properties, and applications. [10]

b. Discuss the differences between thermoplastic and thermosetting polymers in terms of their structures and thermal behaviour. [15]

OR

QUESTION 8 [25 MARKS]

a. Explain how a non-ideal solution deviates from the ideal behavior exhibited by an ideal solution. [10]

b. Discuss the differences between lyophilic and lyophobic sols in terms of their properties and interaction with the dispersion medium. [15]

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Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
1st Year 2nd Semester

Course Title: Physics II | Course Code: PHY 103
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 150

Answer all the questions

QUESTION 1 [25 MARKS]

a. Define electric field. Derive an equation for the integral form of Gauss's law. [3+12]

b. Draw a hypothetical cylinder of radius R immersed in a uniform field E, the cylinder axis being parallel to the field. Determine the Φ_E for the closed surface. [10]

OR

a. Define inductance. Derive an equation for the inductance of a solenoid. [3+12]

b. A long solenoid has 400 turns and is 4 cm in length. It carries a current of 3 amp; its diameter is 3.0 cm. At its center, we place a 100-turn, close-packed coil of diameter 2.0 cm. This coil is arranged so that B at the center of the solenoid is parallel to the axis. The current in the solenoid is reduced to zero and then raised to 3 amp in the other direction at a steady rate over a period of 0.05 sec. Calculate the induced emf that appears in the coil while the current changes. [10]

QUESTION 2 [25 MARKS]

a. Describe an experiment by which the photo-electric effect is studied. Describe Einstein's interpretation on the three major features that cannot be explained in terms of the wave theory of light. [3+12]

b. Determine the threshold wavelength for a Cesium surface whose work function is 2.1 eV. [10]

OR

a. Describe X-ray diffraction. Derive the Bragg's law for X-ray scattering from a crystal lattice. [3+12]

b. A set of lattice planes reflects X-rays of wavelength 1.54 Å of a glancing angle of 11.1°. Deduce the possible spacing for this set of planes. [10]

QUESTION 3 [25 MARKS]

a. Define frame of reference. Using inverse Lorentz transformation equations, show that the interval of time observed in a moving frame of reference is less than in a stationary frame of reference and is given by the equation [3+12]

$$t = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

where, v is the velocity of the moving frame of reference and c is the velocity of light.

b. The mean life of a π meson is 2.2 μs. Calculate the mean life of a meson moving with a velocity of 0.998 c. [10]

QUESTION 4 [25 MARKS]

a. Define packing fraction. Show that the atomic packing fraction of face-centered cubic (FCC) structure is 0.74. [3+12]

b. Show that the atomic packing fraction of simple cubic (SC) structure is 0.52. [10]

QUESTION 5 [25 MARKS]

a. Define Miller indices. The intercepts along the three axes a, b and c are given below. Determine the Miller indices and draw the respective planes. [3+12]

(i) $\infty, 1, 1$
(ii) $1, \infty, \infty$

b. Calculate the packing efficiency and density of NaCl from the following data: [10]

Radius of Na ion = 0.98 Å, radius of Cl ion = 1.81 Å
Atomic mass of Na = 22.99 amu, atomic mass of Cl = 35.45 amu.

QUESTION 6 [25 MARKS]

a. Discuss on the followings: Light year, Hubble's law and red shift, laws of planetary orbits. [15]

b. Write short notes on neutron star and quasar. [10]

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
1st Year 2nd Semester

Course Title: English Composition and Communication | Course Code: HSS 103

Time: 3 hours | Credit: 3.00 | Full Marks: 50

QUESTION 1 [5 MARKS]

Fill in the blanks with appropriate words.

[5]

a) We found a lost cat near our home. We don't know _____ (who's/whose) cat it is.
b) The orange juice has _____ (passed/past) its sell-by date.
c) The contractor recommended _____ (sealing/ceiling) the deck to protect it from damage.
d) There are _____ (less/fewer) students in the class today due to the school trip.
e) The hikers prepared for the challenging _____ (ascent/assent) of Mount Kilimanjaro.
f) We spent the_____ (hole/whole) week at the beach.
g) Have you decided to join the school _____ (quire/choir)?
h) Your hair looks different today. Did you _____ (dye/die) it by any chance
i) The lawyers would _____ (advise/advice) the client to keep quiet.
j) She was _____ (quiet/quite) surprised by her birthday present.

QUESTION 2 [5 MARKS]

The following is a paragraph containing 10 grammatical errors (5 capitalization-related errors, 5 punctuation-related errors). Rewrite the text correctly and underline your changes.

[5]

Phil is an author living in london, England. Being an author of horror novels he spends a lot of his time writing His favourite author is stephen King. Phil's last 3 books were best-sellers in the following countries Spain, Germany and France. The name of his latest book is called the Haunting in Salem. The main character of this book is inspired by his uncle Ryan who lives near the Appala mountains. Phil loved visiting there during his childhood in fact he wanted to move there.

QUESTION 3 [10 MARKS]

Fill in the blanks using the correct form of the words in brackets.

[10]

The (a) _____ (globe) spread of English over the last few decades is (b) _____ (remark). In various countries English has (c) _____ (office) status. 90% of all(d) _____ (inform) in the world's electronic retrieval systems is stored in English. The (e) _____ (necessary) to learn English is rising (f) _____ (rapid) in this era. Computer-mediated communication is closing the gap between (g) _____ (speak) and written English. It encourages (h) _____ (tolerate) for (i) _____ diversity, and has resulted in Internet English replacing the (j) _____ (author) of language institutes and practices.

QUESTION 4 [10 MARKS]

Transform the sentences as instructed.

[10]

a. Despite the thunderstorm having intensified, the people remain safe due to timely warning. (*Transform into Complex Sentence*)

b. In the event of rain, the wedding ceremony will move to the barn. (*Transform into Complex sentence*)

c. As Keiko has a calculus test on Friday, she needs to study.. (*Transform into Simple sentence*)

d. On account of gaining experience at her last job, Maisha was able to land another job very easily . (*Transform into Complex sentence*)

e. It was not only difficult but also time consuming to solve. *(Transform into a compound sentence)*

f. If you don't exercise regularly, you will be in poor health. *(Transform into a simple sentence)*

g. Besides being a researcher, Rafa is a data analyst. (*Transform into compound sentence*)

h. Mimi is working on the project and volunteering at the animal shelter as well. *(Transform into a complex sentence)*

i. Although it was very difficult and time consuming to solve, we had a lot of fun. *(Transform into a compound sentence)*

j. Marina was very clever and didn't believe the scammers. *(Transform into a simple sentence)*

QUESTION 5 [10 MARKS]

Write an event report on the 'Annual Civil Engineering Student Conference' held on 23 October, 2025. Describe the objectives, key activities, and notable speakers of the event. Highlight how this experience relates to your studies and future career as well.

[10]

QUESTION 6 [10 MARKS]

Write an essay within 450 - 500 words

[10]

Does Technology Negatively Affect Children's Development?

Or,

Should All University Students Take Part-time Jobs?

GOOD LUCK!

University of Asia Pacific
Department of Civil Engineering
Semester Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
1st Year 2nd Semester

Course Title: Mathematics II | Course Code: MTH 103
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 150

Answer all the questions.

QUESTION 1 [25 MARKS]

a. Find the equation of the plane which is passing through $(1,1,2)$ and is perpendicular to two planes $2x - 2x - 4z - 6 = 0$, $3x + y + 6z - 4 = 0$. [10]

b. Find the equation of the plane which is passing through (2,3,1), (1,1,3), (2,2,3). Also find the perpendicular distance from the point (5,6,7) to this plane. [15]

QUESTION 2 [25 MARKS]

a. Find the two tangent planes to the sphere $x^2 + y^2 + z^2 - 4x + 2y - 4 = 0$ which is parallel to the plane $2x - y + 2z = 0$. [10]

b. Find the value of k for which the plane $kx + 2y + 2z + 1 = 0$ cuts the sphere $7x^2 + 7y^2 + 7z^2 - 14x + 21y + 7z + 6 = 0$. [15]

QUESTION 3 [25 MARKS]

a. If $\bar{a} = \hat{\imath} + 3\hat{\jmath} - 2\hat{k}$, $\bar{b} = 4\hat{\imath} - 2\hat{\jmath} + 4\hat{k}$, $\bar{c} = \hat{\imath} + 3\hat{\jmath} + 2\hat{k}$ [15]

i. Show that for vector triple product $[\bar{a}, \bar{c}, \bar{b}] \neq [\bar{b}, \bar{c}, \bar{a}]$.
ii. find projection of $\bar{a}$ on $\bar{a} \times \bar{b}$.

b. Find the value of m for which the vectors represented by $\bar{a} = m\hat{\imath} - 2\hat{\jmath} - 3\hat{k}$, $\bar{b} = 2\hat{\imath} + \hat{\jmath} - \hat{k}$, $\bar{c} = \hat{\imath} + 3\hat{\jmath} - 2\hat{k}$ are coplanar. [10]

OR

a. If $\bar{a} = -\hat{\imath} + j + 2\hat{k}$, $\bar{b} = 2\hat{\imath} + \hat{\jmath} - \hat{k}$, $\bar{c} = \hat{\imath} + 2\hat{\jmath} - 2\hat{k}$ [15]

i. Find the unit vector of vector triple product $[\bar{a}, \bar{c}, \bar{b}]$.
ii. Show that for scalar triple product $[\bar{a}, \bar{c}, \bar{b}] = [\bar{b}, \bar{c}, \bar{a}]$.

b. Find the volume of the parallelepiped whose edges are represented by [10]

$\bar{a} = 7\hat{\imath} - 2\hat{\jmath} + 3\hat{k}$, $\bar{b} = 2\hat{\imath} + 3\hat{\jmath} - \hat{k}$, $\bar{c} = 8\hat{\imath} - 3\hat{\jmath} - 2\hat{k}$.

QUESTION 4 [25 MARKS]

a. A particle moves so that its position vector is given by $\bar{r} = cos\omega t\hat{\imath} + sin\omega t\hat{\jmath}$; where ω is constant. Show that [15]

i. The velocity $\bar{v}$ of the particle is perpendicular to $\bar{r}$.
ii. $\bar{r} \times \bar{v} = a\ constant\ vector.$
iii. The acceleration $\bar{a}$ is directed toward the origin and has magnitude proportional to the distance from the origin.

b. A particle moves along the curve $x = 2t^4,\ y = 5t^3 - t^4,\ z = 8t^3 - 5$, where t is the time. Find the component of tangent vector at time $t = \frac{1}{2}$ in the direction $2\hat{\imath} - \hat{\jmath} + 2\hat{k}$. [10]

QUESTION 5 [25 MARKS]

a. Define curl. Suppose stress in a concrete footing is modeled as [15]

$$\vec{\sigma} = (x + 2y + az)\hat{\imath} + (2x - 3y - z)\hat{\jmath} + (4x - y + 2z)\hat{k}\ .$$

Check if the stress field is suitable for the concrete footing. If not, for which value of a it will be suitable.

b. Find the directional derivative of $\varphi = 4e^{2x-y+z}$ at the point $(1,1,-1)$ in the direction toward the point $(-3,5,6)$. Comment on the result. [10]

OR

a. Define divergence and gradient. Find $\vec{\nabla}\varphi$ if i. $\varphi = lnr$ ii. $\varphi = \frac{1}{r}$. [15]

b. Show that $\vec{A} = (2x^2 + 8xy^2z)\hat{\imath} + (3x^3y - 3xy)\hat{\jmath} - (4y^2z^2 + 2x^3z)\hat{k}$ is not solenoidal but $\vec{B} = xyz^2\vec{A}$ is not solenoidal. [10]

QUESTION 6 [25 MARKS]

a. A concrete beam under variable stress has a stress vector field is given by [12]

$$\vec{A} = (3x^2y - y^3)\hat{\imath} + (x^3 - 3xy^2)\hat{\jmath} + z^3\hat{k}$$

i. Verify whether the vector field is conservative.
ii. If it is, find the scalar potential function.
iii. Compute the total work done by the stress field along the path from $(0,0,0)$ to $(1,1,2)$.

b. State Gauss's Divergence theorem. Ground water velocity in a soil mass is represented by $\vec{v} = 3x^2\hat{\imath} + 5yz^2\hat{\jmath} + 2y^2\hat{k}$. Here the region V is a cube defined by $1 < x, y, z < 2$. Find the total discharge of water out of the cube. [13]

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
1st Year 2nd Semester

Course Title: Surveying | Course Code: CE 105
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 100

Answer all the questions

QUESTION 1 [24 MARKS]

a. Explain (any five) characteristics of contour lines. [05]

b. Discuss the steps (with figure) to be followed to conduct Electromagnetic Distance Measurement (EDM) Method. [04]

c. Explain Repetition and Reiteration Method with Figure. [3+3]

d. The following grid lines along with the reduced levels are provided in **Figure 1** to draw a contour map for a place. Draw the contour lines with reduced levels 32 m, 33 m, 34 m and 36 m using **Figure 1**. Also, demonstrate your understanding on the contour map. [***Draw the following grid on your answer script and then answer Question No. 1(d)]*** [09]

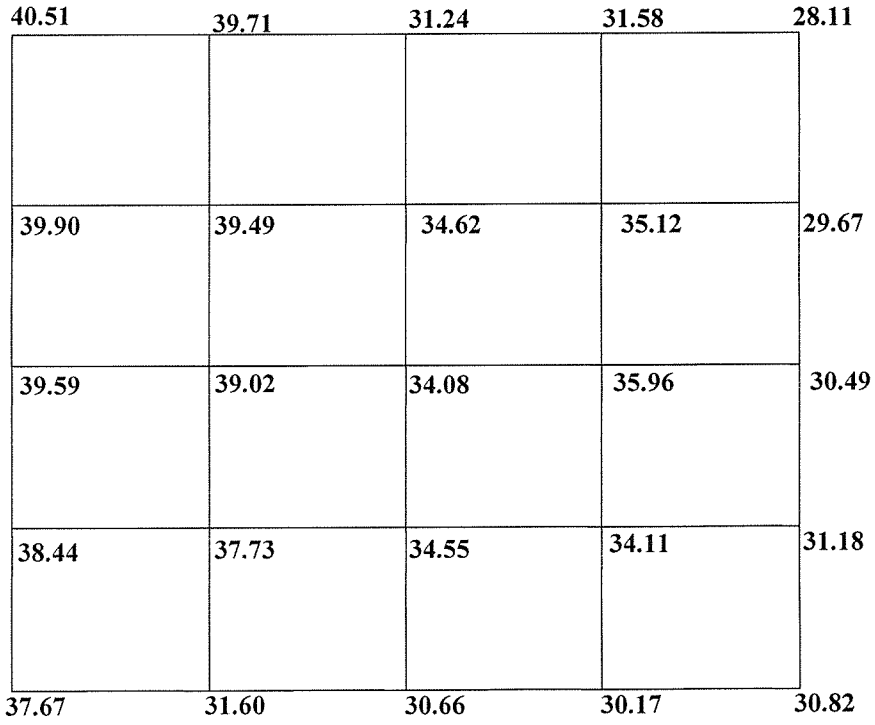

Figure 1

QUESTION 2 [20 MARKS]

In 1966, a close traverse **ABCDA** was conducted at a particular place and magnetic declination was **4°51′ E** at every station. A rail line went through the place. In 2025, the same close traverse **(ABCDA)** was conducted in the same place where magnetic declination was **7°28′ W** at ever station. Contour maps were drawn for the place in 1966 and 2025 to plot the traverse. The magnetic bearing of the lines in the traverse according to 1966 contour map are given in the **Table 1**.

Table 1

Line	Fore Bearing (F.B.)	Back Bearing (B.B.)
AB	63°56′	244°33′
BC	124°11′	304°54′
CD	204°25′	23°46′
DE	283°50′	103°42′
EA	344°06′	163°47′

Calculate the followings in **ABCDA** Traverse:

i. True bearings ***(both F.B. and B.B.)*** of all lines according to the old and new contour maps. [05]

ii. Magnetic bearings ***(both F.B. and B.B.)*** of all lines according to the new contour map. [05]

iii. Corrected Interior Angles using Magnetic Bearings of all lines according to the new contour map. [10]

QUESTION 3 [12 MARKS]

The following observations in **Table 2** were made during a tacheometric survey where staff was held normal to the line of sight. The stadia constants are **98.16** and **0.174**.

[Necessary Formulas are given below.]

Table 2

Inst. station	Height of Instrument	Staff Station	Vertical Angle	Hair Readings	Remarks
A	1.732	BM	-4°58′	0.894, 1.243, 1.582	Reduced Level of BM= 384.143 m
B	1.549	BM	-6°24′	0.903, 1.197, 1.331	
B	1.549	C	-8°51′	0.916, 1.285, 1.774	

Calculate the gradient of the line joining **Station A** and **Station C**.

Necessary Formulas:

$$\mathbf{D = \frac{f}{i} \times S \cos\theta + (f + d) \cos\theta + h \sin\theta}$$

$$D = \frac{f}{i} \times S \cos\theta + (f + d)\cos\theta - h \sin\theta$$

$$V = \frac{f}{i} \times S \sin\theta + (f + d)\sin\theta$$

QUESTION 4 [14 MARKS]

The following observations were obtained while conducting a closed traverse round an obstacle. Compute the missing values in **Table 3**. [14]

Table 3

Line	Length (m)	Bearing
AB	?	79° 51′
BC	?	237° 22′
CD	467.29	109° 07′
DE	506.84	297° 66′
EA	532.81	143° 41′

QUESTION 5 [8 MARKS]

A surveyor intended to set out a circular curve to design a roundabout in a location. To set out the curve, he located a fixed-point **Z** in the ground surface. Two tangents intersect at 7518.36 m from **Z**. The deflection angle, length of long chord and versed sine of the circular curve were 57 °, 7260 m and 800.43 m respectively. The surveyor would follow the **Ordinates from Long Chord Method** to set out the curve.

Calculate the followings:

i. Radius of Curvature [01]

ii. Length of Back Tangent and Forward Tangent. [01]

iii. Length of Circular Curve. [01]

iv. Location of Point of Curve from **Z** point. [01]

v. Location of Point of Tangency from **Z** point. [01]

vi. Ordinates at 605 m interval along the long chord. [03]

QUESTION 6 [14 MARKS]

Levelling was conducted at a construction site and the following Back Sight (B.S.), Intermediate Sight (I.S.) and Fore Sight (F.S.) readings were obtained and shown in **Table 4**. Rise and Fall Method was followed to calculate the Reduced Levels (R.L.) of all stations.

i. Fill up the missing values in **Table 4**. [10]

ii. Calculate the gradient of the line joining the first and last station where the horizontal distance between the first and last station is 119.36 m. [04]

[PLEASE SHOW ALL NECESSARY CALCULATIONS AND CHECKS.]

Table 4

Station	B.S. (m)	I.S. (m)	F.S. (m)	Rise (m)	Fall (m)	R.L. (m)	Remarks
1.	0.927	?				365.380	Bench Mark
2.	1.971		?	?	?	365.081	CP1
3.		0.597		?	?	?	
4.	1.278		?	?	?	366.006	CP2
5.		?		?	?	365.346	
6.		?		0.326		?	
7.	?		?		1.141	?	CP3
8.		2.384		?	?	366.937	
9.		1.498		?	?	?	
10.		?			0.406	?	
11.			?	0.118		?	

QUESTION 7 [8 MARKS]

A client wants to construct two separate buildings—a hospital and a nursing center—on two different plots of land located in an inaccessible mountainous area. **Land 1** is adjacent to a steel factory, with a canal bisecting the land. **Land 2** has a dense vegetation and numerous electric poles with a river crossing through the land. A connecting road is also required to be constructed that links both structures to the main road network. The client requires a comprehensive land survey to support practical site planning.

i. Identify the most effective survey methods to capture land topography and to support infrastructure planning. [04]

ii. Clarify how your proposed survey methods fit with high accuracy on the challenging terrains. [04]