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University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
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. Define heat of neutralization. Explain why the heat of neutralization of a strong acid and a strong base is approximately constant. [10]

b. Show the Born-Haber cycle for the formation of a NaCl crystal lattice and calculate the lattice enthalpy using the following reactions and enthalpy changes. [15]

(i) $Na(s) + \frac{1}{2}Cl_2(g) \longrightarrow NaCl(s)$ $\Delta H = -411$ kJ/mol

(ii) $Na(s) \longrightarrow Na(g)$ $\Delta H = +107$ kJ/mol

(iii) $Na(g) \longrightarrow Na^+(g) + e$ $\Delta H = +502$ kJ/mol

(iv) $\frac{1}{2}Cl_2(g) \longrightarrow Cl(g)$ $\Delta H = +121$ kJ/mol

(v) $Cl(g) + e \longrightarrow Cl^-(g)$ $\Delta H = -355$ kJ/mol

QUESTION 2 [25 MARKS]

a. Consider the following reactions: (i) $A \rightarrow P$ (ii) $X \rightarrow Y$. [15]

Reaction (i) follows first-order kinetics, while reaction (ii) follows second-order kinetics. Show that the half-life of reaction (i) is independent of the initial concentration of A, whereas the half-life of reaction (ii) is dependent on the initial concentration of X.

b. An ancient paper was discovered containing traces of radioactive ink. The radioisotope in the ink decays according to first-order kinetics, with a half-life of 1,200 years. If only 1/8 of the original radioisotope remains today, determine the age of the paper. [10]

QUESTION 3 [25 MARKS]

a. Derive a relationship between the equilibrium constants K_p and K_c for the following reaction: $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$. [10]

b. Consider the following reaction: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$. Explain the effects of changes in temperature and pressure on the equilibrium. [15]

QUESTION 4 [25 MARKS]

a. Define lyophilic and lyophobic sols. Differentiate between their properties. [10]

b. Write short notes on the following: (i) Tyndall Effect (ii) Electric Double Layer. [15]

QUESTION 5 [25 MARKS]

a. Discuss the differences between thermoplastic and thermosetting polymers. [10]

b. Show the mechanism of addition polymerization mentioning all the steps involved. [15]

OR

QUESTION 6 [25 MARKS]

a. Discuss the differences between paints and varnishes. [10]

b. Explain the functions of the various ingredients used in paints. [15]

QUESTION 7 [25 MARKS

a. Define Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). "COD is always higher than BOD"- explain. [10]

b. The initial dissolved oxygen (DO) of a water sample was found to be 9.2 mg/L. The sample was then incubated at 20°C for 5 days. After incubation, the final DO was determined using Winkler's method. If 6.0 mL of 0.025 N sodium thiosulphate was required to titrate 250 mL of the water sample, calculate the Biochemical Oxygen Demand (BOD) of the sample. [Molar mass of oxygen = 32 g/mol] [15]

OR

QUESTION 8 [25 MARKS]

a. Discuss rusting of iron with appropriate chemical reactions. [10]

b. An aluminium rod is used as a sacrificial anode to protect an underground iron tank from corrosion. Verify whether the aluminium rod can serve as the sacrificial anode or not. If the protection system delivers a constant current of 2.5 ampere over a period of 48 hours, calculate the mass of the aluminium rod lost due to the corrosion. [$E^0_{Al^{3+}/Al}$ = -1.66 V; $E^0_{Fe^{2+}/Fe}$ = -0.44 V; Molar mass of aluminium = 26.98 g/mol; Faraday's constant, F= 96,485 C/mol] [15]

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
Program: B.Sc. in Civil Engineering
1st Year 2nd Semester
(Self-Study)

Course Title: Chemistry | Course Code: CHEM 111 (Old)
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. Describe the graphical method for the determination of order of reaction. [10]

b. Hydrolysis of ethyl acetate by NaOH using equal concentration of the reactants was studied by titrating 25 mL of the reaction mixture at different time intervals against standard acid. From the data given below, establish that this is a second order reaction. [15]

t / minutes	0	5	15	25
mL of acid used	16.00	10.24	6.13	4.32

QUESTION 2 [25 MARKS]

a. Define paint failure. Briefly outline different types of paint failure. [15]

b. Explain cathodic protection of a metal. [10]

QUESTION 3 [25 MARKS]

a. Show the relationship between the equilibrium constants K_p and K_c where the reaction is: [10]

$$2SO_2 + O_2 \rightleftharpoons 2SO_3\ (g).$$

b. At 500°C, the reaction between N_2 and H_2 to form NH_3 has a K_c of 6.0×10^{-2}. Calculate the numerical value of K_p for the reaction. [15]

QUESTION 4 [25 MARKS]

a. Discuss heat of formation, heat of combustion, heat of neutralisation and Hess's law of constant heat summation with examples. [12]

b. Calculate ΔH° for the reaction $CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$ given that ΔH_f for CO_2 (g), CO (g) and H_2O (g) are – 393.5, – 111.31 and – 241.80 $kJmol^{-1}$ respectively. [13]

QUESTION 5 [25 MARKS]

a. Discuss how corrosion of iron can be prevented. [10]

b. Discuss rusting of iron with appropriate chemical reactions. [15]

OR

QUESTION 6 [25 MARKS]

a. Discuss the differences between paints and varnishes. [10]

b. Explain the functions of the various ingredients used in paints. [15]

QUESTION 7 [25 MARKS

a. Define half-life of a reaction. Derive the second-order integrated rate equation and show that its half-life is inversely proportional to the initial concentration of the reactant. [10]

b. For a certain first-order reaction, half-life ($t_{1/2}$) is 100 seconds. Calculate the time required for 90% of the reaction to be completed. [15]

OR

QUESTION 8 [25 MARKS]

a. Using the Arrhenius equation, show the calculation of the activation energy (E_a). [10]

b. 50% of a first-order reaction is complete in 23 minutes. Calculate the time required for 90% of the reaction to be completed.. [15]

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
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 [22 MARKS]

a. Explain Reiteration Method with figure.

[04]

b. Describe the use of Sounding Instrument with figure.

[05]

c. Explain the principle and steps to conduct Electromagnetic Distance Measurement (EDM).

[2+4]

d. Draw the contour lines with reduced levels 36 m, 37 m, 38 m and 39 m using **Figure 1**. Also, demonstrate your understanding on the contour shape. [***Draw the following grid on your answer script and then answer Question No. 1(d)]***

[07]

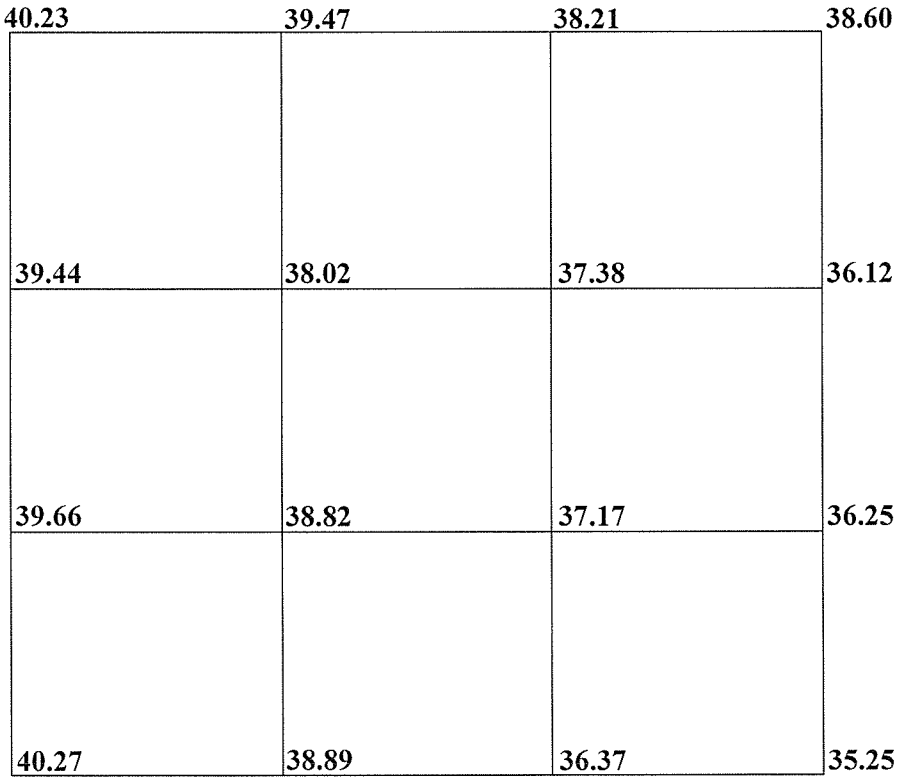

Figure 1

QUESTION 2 [26 MARKS]

In a closed traverse survey, the following Fore Bearings (F.B.) and Back Bearings (B.B.) were recorded in **Table 1** and local attractions were suspected during the observations. [26]

Table 1

Line	Fore Bearing (F.B.)	Back Bearing (B.B.)
AB	60°23′	241°00′
BC	120°38′	301°21′
CD	200°52′	20°13′
DE	280°17′	100°09′
EA	340°33′	160°14′

Calculate the corrected Fore Bearings (F.B.), Back Bearings (B.B.) of all the given lines and corrected interior angles in each station after applying necessary corrections to eliminate local attraction.

QUESTION 3 [16 MARKS]

While conducting levelling, the given staff readings (**in meter**) were obtained as: 2.845, ***2.713***, 2.898, ***3.431***, 3.705, 3.878, 3.878, ***3.964***, 3.842, 4.169, 4.273. The instrument had been moved after second, fourth and eighth readings. Calculate the Reduced Levels of all stations using ***Rise and Fall Method*** if the first reading was taken with a staff held on a bench mark with reduced level ***387.587 m***. [16]

QUESTION 4 [16 MARKS]

The following readings in **Table 2** were obtained while conducting a traverse survey and **Figure 2** was drawn from these readings after completion of it.

i. Calculate Length of closing error. [08]

ii. Calculate Relative error of closure. [02]

iii. Eliminate closing error using Graphical Method. Also draw the modified figure of the traverse. [4+2]

Table 2

Line	Fore Bearing (F.B.)
PQ	57°48′
QR	159°26′
RS	236°56′
SP′	317°13′

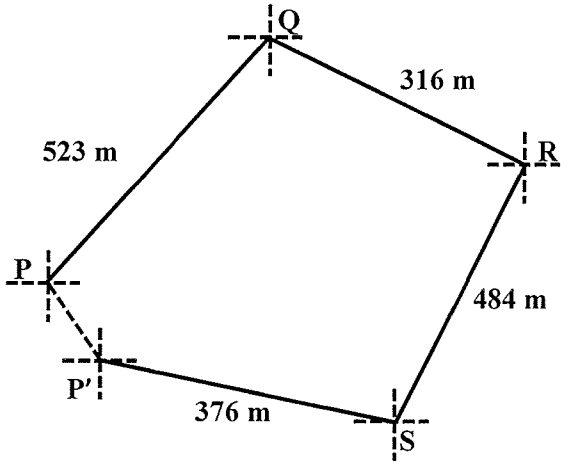

Figure 2

QUESTION 5 [12 MARKS]

The following observations in **Table 3** were made during a tacheometric survey where staff was held normal to the line of sight. The stadia constants are **97.5** and **0.163**. [12]

Table 3

Inst. station	Height of Instrument	Staff Station	Vertical Angle	Hair Readings	Remarks
P	1.052	BM	+6°27′	1.045, 1.327, 1.689	Reduced Level of BM= 297.468 m
P	1.052	Q	-7°43′	0.952, 1.218, 1.470	
Q	1.628	R	-9°51′	0.883, 1.136, 1.743	

Calculate the gradient of the line joining **Station P** and **Station Q**.

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

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

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

QUESTION 6 [8 MARKS]

While setting out a simple curve, two tangents intersect at 1147 m distance from a fixed-point **B**. The deflection angle of the curve is 34° and the radius of curvature is 396 m. Calculate the followings:

i. Length of circular curve. [01]

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

iii. Position of Curve from **B** point. [03]

iv. Position of Tangency from **B** point. [03]

pUniversity of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
Program: B.Sc. in Civil Engineering
1st Year 2nd Semester

Course Title: Engineering Mechanics II | Course Code: CE 103

Time: 3 hours | Credit Hour: 3.00 | Full Marks: 100

Answer all the questions

QUESTION 1 [30 MARKS]

a. Calculate maximum weight of block A in ***Fig. 1*** that can be moved leftward by moving the wedge downward. Applied force Q= 50 kN. Neglect weight of the wedge.
Coefficient of static friction: For both sides of wedge = 0.20;
Between block and horizontal surface = 0.40.

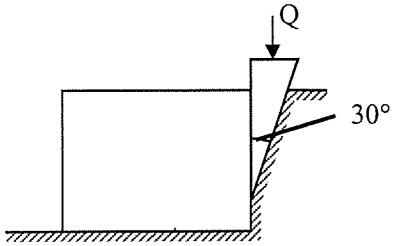

Fig.1

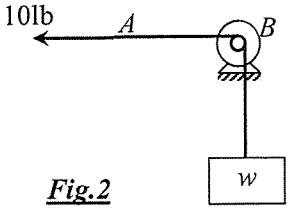

Fig.2

b. In the system shown in ***Fig. 2***, weightless cable *ABC* is wrapped around pulley *B*. Horizontal pull 10 lb holds block C of *w* weight, if cable is wrapped around the pulley *5* times. Calculate the weight of block C for this system. Co-efficient of static friction between pulley and cable is 0.15.

c. Calculate the magnitude of the resultant and direction cosines for the following system of non-coplanar forces: L (300 lb, 4, -2, 7); M (400 lb, -1, 6, -2); N (200 lb, -3, 7, 0).

QUESTION 2 [10 MARKS]

Calculate the mass moment of inertia of the composite body with respect to centroidal Y axis shown in ***Fig 3***.

Given,	A	B	C
Diameter:	4′	2′	4′
Length(thickness):	2′	6′	2′
Unit weight (lb/ft^3):	900	490	900

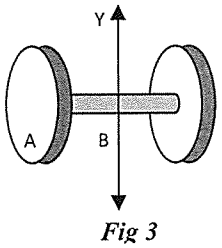

Fig 3

QUESTION 3 [60 MARKS]

a. i) A body starting from rest rotates counter clockwise according to $\alpha = 5t + 4$. Calculate its angular velocity and angular displacement after 3 seconds.

ii) Second hand of an analog clock starts to malfunction at 10:00 am, so that at 11:30 am, the clock displayed 11:23 am. Calculate angular velocity of minute hand and hour hand during this period.

b. A car, shown in ***Fig. 4*** weighing 4.5 kip starts to move downward from rest by its own weight. Brake is applied after the car moves for 5 seconds. The car starts to decelerate in such a manner that it stops at 500 ft away from the point it started to move. Assume the inclined surface is smooth; calculate acceleration after brake was applied. Angle of inclination = 30°.

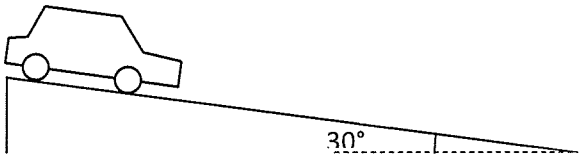

Fig. 4

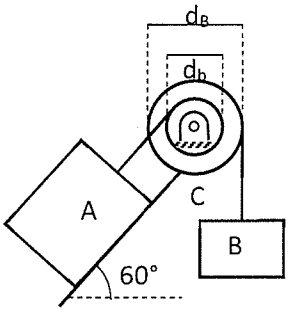

Fig. 5

c. In ***Fig.5***, the bodies A and B weigh W_A= 50 lb, W_B= 20 lb, with pulley diameters d_A= 1 ft and d_B= 2 ft. Rotating part C weighs 75 lb and has a radius of gyration 1.25 ft with respect to its axis. Coefficient of kinetic friction for A is 0.25. If B moves 4 ft from rest, calculate velocity of A and B using work energy principle.

d. A system weighing 6 lb is spinning counterlockwise with respect to point C shown in ***Fig. 6*** Here, AC= BC= DC= 3ft. When force E is applied, the system accelerates. Angular velocity after the force is removed is 1.3 times of initial angular velocity. a) How much work is done by E= 15 lb through a rotation of 60°? The effects of friction are negligible. b) What is the final angular velocity if radius of gyration of the spinning part is 2.5 ft?

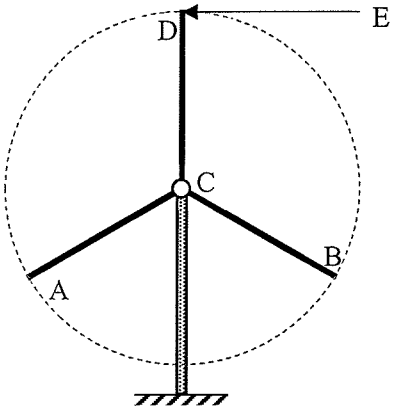

Fig.6

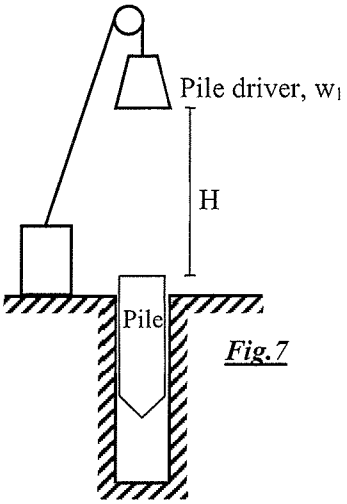

Fig.7

e. A pile-driver of weight, w_1 = 35.5 kip drives a pile of weight, w_2= 7 kip vertically into the ground shown in ***Fig. 7***. The driver falls freely a vertical distance of H = 7 ft before hitting the pile and there is no rebound. Calculate the velocity of driver and pile after impact.

f. For the same system in ***Ques 3(e)*** if w_2= 6 kip and H = 5.5 ft, combined velocity of driver and pile is calculated 16 fps. Calculate acceleration of pile after impact. When will the pile stop into the ground? Given that ground resistance is 250 kip.

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
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

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

QUESTION 1 [25 MARKS]

a. Explain co-efficient coupling. Show that the co-efficient of coupling of two inductors is $K = \frac{M}{\sqrt{L_1 L_2}}$, where the symbols have their usual meaning. [18]

b. Two inductors whose self-inductances are of 75mH and 55mH respectively are connected in parallel aiding. Their mutual inductance is given as 22.5mH. Calculate the total inductance and coefficient of coupling. [07]

QUESTION 2 [25 MARKS]

a. Define inertial and non-inertial frame of reference. Show that Einstein mass-energy equivalence is $E = mc^2$, where the symbols have their usual meaning. [20]

b. A proton is moving at a speed of 0.900 times the velocity of light. Calculate its kinetic energy in joules and MeV. [05]

QUESTION 3 [25 MARKS]

a. Derive an expression of De-Broglie wavelength. Show that the De-Broglie wavelength of electron is $\lambda = \frac{12.26}{\sqrt{V}}$ Å, where the symbols have their usual meaning. [20]

b. X-ray photon of wavelength 0.3 Å is scattered through an angle 45° by a loosely bound electron. Calculate the wavelength of scattered photon. [05]

QUESTION 4 [25 MARKS]

a. Derive the expression of atomic radius of body-centered cubic (bcc) and face-centered cubic (fcc) lattice. [15]

b. Calculate packing fraction of bcc and fcc lattice. [10]

QUESTION 5 [25 MARKS]

a. Explain the experimental study and hence observations of photoelectric effect. [20]

b. The work function for cadmium is 4.08 eV. Calculate the wavelength of radiation incident on cadmium so that the maximum velocity of photoelectrons will be 7.2 $\times 10^5$ m/s. [05]

OR

QUESTION 6 [25 MARKS]

a. Explain the origin of characteristic X-ray spectra and find out the minimum wavelength of characteristic X-ray. [20]

b. Calculate the glancing angle on a cubic crystal rock salt of spacing 1.987 Å corresponding to second order diffraction maximum for the X-rays of wavelength 0.71 Å. [05]

QUESTION 7 [25 MARKS]

a. State and explain the Kepler's law of planetary motion [10]

b. Define escape velocity. Show that the escape velocity from the surface of the earth is 11.2 km/s. [15]

OR

QUESTION 8 [25 MARKS]

a. State and explain Hubble's law. [10]

b. Briefly discuss about Neutron Stars, Supernovae, and Black Holes. [15]

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
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) My mentor gave me _____ (advice/advise) on how to navigate through the challenges.
b) The fog began to _____ (disperse/disburse) as the sun rose higher in the sky.
c) We went to the park, and _____ (than/then) we had ice cream at the nearby café.
d) The singer won the hearts of many fans and became an overnight_____ (idle/idol).
e) The committee gave its unanimous _____ (assent/ascent) to the proposed budget increases
f) There are _____ (less/fewer) people in the bus today due to the rain.
g) The change in policy had little _____ (effect/affect) on most people.
h) _____ (Beside/Besides) him was a large flower vase filled with tulips.
i) Sugar can be harmful for your body if consumed in _____ (access/excess).
j) All the machines in the factory operate on the same general _____ (principal/principle).

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]

Sima lives in Green Rd , Dhaka. Being a talented singer, she spends most of her time covering popular songs. She takes inspiration from singers like taylor swift. She plays three instruments guitar, drums, and piano. Moreover, she goes to dhanmondi for vocal lessons. In spite of her strict schedule she makes time to upload her videos to YouTube. Her teacher, professor Rukaya motivates her to become a better artist. Sima studies in the Department of english at University of Asia Pacific. Despite being a dedicated singer it never prevents her from doing well in her studies in fact, she does great in exams.

QUESTION 3 [10 MARKS]

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

[10]

Since the a) _____ (arrive) of (b) _____ (expense) cell phones in the 90s, new ways of (c) _____ (communicate) have become possible. In 2005, there were 82 million cell phone (d) _____ (use) in Africa, and it's rising (e) _____ (rapid). With the difficult (f) _____(economy) situation in Africa, cell phones became a (g) _____ (necessary). The continent's (h) _____ (rely) on technology has (i) _____ (strength) the economy. The (j) _____ (abate) use of cell phones will improve their lives.

QUESTION 4 [10 MARKS]

Transform the sentences as instructed.

[10]

a. The snowstorm has intensified, yet the roads remain clear due to timely salting. (*Transform into Complex Sentence*)

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

c. The library extended its hours so that they get more visitors. (*Transform into Simple sentence*)

d. Owing to a key player's injury, the match was postponed . (*Transform into Complex sentence*)

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

f. If you exercise regularly, you will be in good health. *(Transform into a simple sentence)*

g. She is a painter and a novelist as well. (*Transform into simple sentence*)

h. Besides using research papers, Lia is using newspaper articles. *(Transform into a complex sentence)*

i. Unless Daniel practices Japanese everyday, he will forget the words. *(Transform into a simple sentence)*

j. Maisha was too clever to believe the scammers. *(Transform into a compound sentence)*

QUESTION 5 [10 MARKS]

Write an event report on the "Civil Fest" organized by your department on 29 April, 2025, highlighting key attractions of the event, student participation, and overall success of the event.

[10]

QUESTION 6 [10 MARKS]

Write an essay within 450 - 500 words

[10]

Public Parks Are Essential for Urban Living

Or,

The Demerits of Social Media Outweigh Its Merits

GOOD LUCK!

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
Program: B.Sc. in Civil Engineering
1st Year 2nd Semester (Self-Study)

Course Title: Co-Ordinate Geometry & Vector Analysis | Course Code: MTH 103
Time: 3.00 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. Find the equation of plane which is passing through (1, 1, 2) and perpendicular to two planes$2x - 2y - 4z - 6 = 0, 3x + y + 6z - 4 = 0$. [15] CO2

b. Find the equation of plane which is passing through (2, 1, 3), (-1, -2, 4), (4, 2, 1). Also find the perpendicular distance from the point (1, 1, -1) to this plane. [10] CO2

QUESTION 2 [25 MARKS]

a. Find the two tangent planes to the sphere $x^2 + y^2 + z^2 - 4x + 2y - 6z + 5 = 0$ which are parallel to the plane $2x + y = 0$. [10] CO3

b. Identify the name of the equation$9x^2 + 4y^2 + 4z^2 + 4x + y + 10z + 1 = 0$. Also find the center and length of semi major axes. [15] CO3

QUESTION 3 [25 MARKS]

If the velocity and displacement of a moving particle are zero at $t = 0$, find velocity and displacement. The acceleration of the particle at any time $t \geq 0$ is given by [25] CO4

$\vec{a} = 12cos2t\,\hat{\imath} - 8sin2t\,\hat{\jmath} + 16t\hat{k}$.

QUESTION 4 [25 MARKS]

If $\vec{A} = (3x^2 + 6y)\,\hat{\imath} - 14yz\,\hat{\jmath} + 20xz^2\,\hat{k}$, evaluate $\oint \vec{A}.d\vec{r}$ from (0, 0, 0) to (2, 2, 2) [25] CO4

along the following paths C:

i. $x = t,\ y = t^2,\ z = t^3$.

ii. the straight lines from (0, 0, 0) to (2, 0, 0) then to (2, 2, 0) then to (2, 2, 2).

QUESTION 5 [25 MARKS]

a. Define Direction cosine. Find the ratio in which XY plane divides the line joining (2, 1, -3) and (1, 3, 2). Also find the coordinates of that point. [15] CO1

b. Write the relation between direction cosine and direction ratio. Find the angle between lines AB and BC. Where A(-11, 8, 4), B(-1, -7, -1) and C(9, -2, 4). [10] CO1

OR

QUESTION 6 [25 MARKS]

a. Find the equation of plane which is passing through (1, 1, 2) and perpendicular to two planes $2x - 2y - 4z - 6 = 0, 3x + y + 6z - 4 = 0$. [15] CO1

b. Find the equation of plane which is parallel to the plane $4x - 4y + 2z - 3 = 0$ and a distance 4 unit from the point (4, 1, -2). [10] CO1

QUESTION 7 [25 MARKS]

Define line, surface and volume integral. Evaluate $\iint \vec{A}.\hat{n}ds$, where [25] CO4

$\vec{A} = 18z\hat{\imath} - 12\hat{\jmath} + 3y\hat{k}$ and S is that part of the plane $2x + 3y + 6z = 12$ which is located in the first octant.

OR

QUESTION 8 [25 MARKS]

a. Define the followings: [15] CO4

Vector, Sense, Position vector, Unit vector, Null vector, Parallel vector, Equal vector, Opposite vector, Co-planer vector, Like vector.

b. Find the volume of the parallelepiped whose edges are given by $\vec{A} = 2\hat{\imath} - 3\hat{\jmath}$, $\vec{B} = \hat{\imath} + \hat{\jmath} - \hat{k}$ and $\vec{C} = 3\hat{\imath} - \hat{k}$. [10] CO4