National University of Computer & Emerging Sciences, Karachi
Spring-2024 CS Department
MID – I Exam
September 24, 2024, 11:00 AM– 12:00 PM

Course Code: NS (1001)	Course Name: Applied Physics
Instructor Names: Dr. M. Adeel , Mr. Ishtiaq , Mr. Javaid Qureshi , Ms. Rabia Tabassum , Mr. M. Rahim	
Student Roll No:	Section :

Instructions:

- Attempt all questions.
- Return the question paper with your answer sheet.
- Read each question completely before answering it. There are **3 questions and 2 pages.**
- All the answers must be solved according to the sequence given in the question paper.

Time: 60 minutes. **Max Marks: 30 points**

Question 1: Vectors CLO - 1 [10]

(a) The Figure-1 shows 4 vectors with magnitude given by A = 75, B=59, C =25, D = 91. Their directions are indicated on Figure-1 (i) Write C and B in unit vector notation (ii) Find the magnitude and direction of vector A -2.1D. [4]

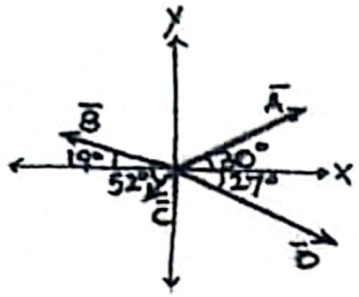

Fig-1

(b) Find the angle between two vectors of equal magnitude such that the dot product of the two vectors is equal to half the square of the magnitude of one of the vectors [2]

(c) What is the cross-product of two vectors in three-dimensional space? How does it relate to the area of the parallelogram formed by the vectors? For the vector $\vec{A} = -1\hat{i}+6\hat{j}+3\hat{k}$ and $B = -4\hat{i}+2\hat{j}-1\hat{k}$. Find the area of the parallelogram formed by A and B. [2+2]

Question 2: Linear Motion (1D motion) CLO2 [10]

(a) The acceleration of a bus is given by $a(t) = bt$ where, $b = 1.2\ m/s^3$ (i) if the bus's velocity at time $t = 1$ s is 5 m/s what is its velocity at time $t = 5$ s? (ii) If the bus's position at time $t = 1$ s is 6 m, what is its position at time $t = 10$ s? (iii) Sketch acceleration-time graph, velocity-time

graph and position-time graph of the bus. (for t = 0 , 2, 4, 6, 8, 10) [2+2+2]

(b) In each of the situations below, indicate the direction of both the velocity and acceleration vectors at the time in question (Draw vectors only).
(i) An elevator is at rest and then starts moving upward (Figure-2). Consider the time just after it starts moving.
(ii) A car is coasting (engine off) up a hill (Figure-3). Consider the time just before it reach its highest point. [2]

Fig-2

Fig-3

(c) Is it possible for an object (i) to be slowing down while its acceleration is increasing in magnitude (ii) to be speeding up while its acceleration is decreasing? In each case, explain your reasoning. [2]

Question 3: Projectile Motions (2D motion) CLO3 [10]

(a) In a projectile motion:
(i) Which velocity component retains its initial value throughout the flight and why? (ii) At what point in the path of a projectile is the speed a minimum? Show this point by drawing a projectile path. (iii) Show that for a projectile motion the maximum range covered is equal to four times of its maximum height attained. (iv) Why is a launch angle of 45° considered optimal for achieving the maximum range in a vacuum? [1+1+2+1]

(b) The position r of a particle moving in an xy plane is given

$$\vec{r} = (2.00t^3 - 5.00t)\hat{i} + (6.00 - 7.00t^2)\hat{j}$$

with r in meters and t in seconds. In unit-vector notation, calculate (i) r, (ii) v , and (iii) a for $t = 3$ s. [3]

(c) A centripetal-acceleration addict rides in uniform circular motion with radius r = 5.00 m. At one instant his acceleration is

$$\vec{a} = (6.00\ m/s^2)\hat{i} + (-4.00\ m/s^2)\hat{j}.$$

At that instant, what are the values of (i) $v \cdot a$ and (ii) $r \times a$? [2]

Good Luck ☺