NATIONAL UNIVERSITY OF COMPUTER AND EMERGING SCIENCES FAST

Fall-2021 CS-Department

Final Exam

08 January, 2022 (09:00 am – 12:00 noon)

Course Code: NS (1001)	Course Name: Applied Physics
Instructor Name / Names: Mr. Adeel , Mr. Javaid Qureshi , Engr. Junaid Rabbani, Engr. Muhammad Ahsan, Engr. Quratulain, Ms. Rabia Tabassum , Mr. Waqar Ahmed	
Student Roll No: K21-4539	Section : J

Instructions:

- Return the question paper with your answer sheet.
- Read each question completely before answering it. There are **9 questions and 2 pages.**
- All the questions must be solved according to the sequence given in the question paper.

Time: 3 hours **Max Marks: 100**

Q1: Vector (Marks 5 , Estimated Time: 10mins)

(a) Find the magnitude of vector C that satisfy the equation

$2\mathbf{A} - 6\mathbf{B} + 3\mathbf{C} = 2j$, where $\mathbf{A} = i - 2k$ and $\mathbf{B} = -j + k/2$ [2]

(b) A person walks 57.0 m at 47.0° north of east, turns and walks 72.0 m at 15.0° south of east. How far and at what angle is the person's final position from his/her initial position. [3]

Q2: Motion in 1D and 2D (Marks 10, Estimated Time: 15mins)

(a) The position of an object moving along an x-axis is given by $x = 3t - 4t^2 + t^3$, where x is in meter and t is in seconds. Find the position of the object at the following values of t: (i) 2 s, (ii) 3 s, (iii) 4 s, (iv) What is the object's displacement between t = 2s and t = 4s? (v) What is the average velocity for the time interval from t = 2s to 4s? [5]

(b) With what speed must a ball be thrown vertically from ground level to rise to a maximum height of 50 m? How long will it be in air? Sketch graphs of y, v, and a, versus t for the ball. On the first two graphs, indicate the time at which 50 m is reached. [5]

Q3: Oscillation (Marks 15, Estimated Time: 25mins)

(a) Determine whether the following quantities can be in the same direction for a simple harmonic oscillator: (i) position and velocity, (ii) velocity and acceleration, (iii) position and acceleration [3]

(b) In an engine, a piston oscillates with simple harmonic motion so that its position varies according to the expression: $x = (5.00\ cm)\cos(2t + \pi/6)$

Where, x is in centimeters and t is in seconds. At t =0, find (i) the position of the piston, (ii) its velocity, and (iii) its acceleration. (iv) find the period and amplitude of the motion. [4]

(c) In a SHM, discuss how kinetic energy "K" and potential energy "U" change with respect to position "x", only with help of graph between energy and position. Does the total energy change if the mass is doubled but the amplitude is not changed? [2]

(d) What happens, if any resistive force is applied on SHM? Suppose "b" is a resistive constant. Discuss the three conditions for the different values of "b". [3]

(e) Amplitude(A), frequency(f), and phase constant (Φ) are the parameter of simple harmonic oscillation. Only draw the waveform (displacement v/s time) for the following conditions: (i) With $\Delta\Phi = 90$ and A and f are same. (ii) With $\Delta f = 1/2$ and A and Φ are same. (iii) With $\Delta A = 2$ and Φ and f are same. [3]

Q4: Wave motion (Marks 15, Estimated Time: 20mins)

(a) Discuss the nature of Water waves. [3]

(b) The equation of a transverse wave on a string is

$y = (2.0\ mm)\sin[(20\ mm^{-1})x - (600\ s^{-1})t]$

Calculate (i) Wave length (ii) Time period (iii) Wave speed (iv) Frequency (v) Wave number [5]

(c) The nature of light wave is transverse but it is not mechanical wave, give the reason. [3]

(d) Two identical sinusoidal waves, moving in the same direction along a stretched string, interfere with each other. The amplitude of each wave is 15mm. Calculate the amplitudes of the resultant waves due to the interference for phase differences 120° and 180°.Give the types of both interferences? [4]

Q5: Newton's Law (Marks 5, Estimated Time: 10mins)

(a) In the Fig-1, a tin of antioxidants ($m_1 = 1.0\ kg$) on a frictionless inclined surface is connected to a tin of corned beef ($m_2 = 2.0\ kg$). The pulley is massless and frictionless. An upward force of magnitude $F = 6.0\ N$ acts on the corned beef tin, which has a downward acceleration of $5.5\ m/s^2$. What are the tension in the connecting cord and the angle β? [5]

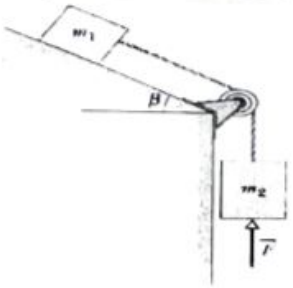

Fig-1

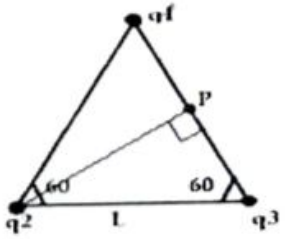

Fig-2

Q6: Electric force(Marks 15, Estimated Time: 25mins)

(a) Three equal point charges are located at the corner of an equilateral triangle of side L as shown in Fig-2. Calculate the resultant electric force on the charge q1? (q1=q2=q3 = +10μC and L = 1.316 m). [8]

(b) What are the differences between Gravitational force and Electric force? [3]

(c) What must be the distance between point charge q1 =26.0 mC and point charge q2 = 47.0 mC for the electrostatic force between them to have a magnitude of 5.70 N? ($k = 9 \times 10^9\ Nm^2/C^2$). Is the force repulsive or attractive? [4]

Q7: Electric field (Marks 15, Estimated Time: 25mins)

(a) Consider Fig-2 (Q6a) and calculate the electric field at point P. [5]

(b) A charged paint is spread in a very thin uniform layer over the surface of a plastic sphere of diameter 12.0 cm, giving it a charge of -49.0 μC. Find the electric field (i) just inside the paint layer; (ii) just outside the paint layer; (iii) 5.00 cm outside the surface of the paint layer. [5]

(c) You want to produce and electric field = (0, 4104 ,0) N/C. (i) where would you place a proton to produce this field at the origin? (ii) Instead of proton, where would you place an electron to produce this field at the origin? [5]

Q8: Gauss's Law (Marks 10, Estimated Time: 20mins)

(a) Show the variations of the electric field for a spherical symmetrical charged distribution and a thin shell with respect to distance with the help of graphs only.(Plot must start from the origin , the surface, and the outside the surface of the both distributions) [2]

(b) A charge q = -3 C is placed at the center of a cube of side lengths L. Find the flux through the whole cube. If the cube is changed into sphere what will happen to the flux? [3]

(c) An infinite line of charge produces a field of 4.52×10^4 N/C at a distance of 1.96m. Calculate the linear charge density. [3]

(d) The total flux through a Gaussian surface is zero. (i) What is the net charge enclosed (ii) Is E = 0 at all point on the surface Give reason. [2]

Q9: Electric Current (Marks 10, Estimated Time: 20mins)

(a) Although current is a scalar quantity, we assign it a direction. Why? [1]

(b) Discuss ohmic and non-ohmic materials. Give the examples of both types of materials with help of graph between current and voltage. [3]

(c) What will be the effect of raising temperature on conductor? Explain by drawing graphs between resistivity and temperature. [2]

(d) For a hypothetical electronic device, the potential difference V in volts, measured across the device, is related to the current "i" in mA by $V = 3.55i^2$. (i) find the resistance when current is 2.4mA. (ii) At what value of the current is the resistance equal to 16 Ω? [4]

Good Luck ☺