

End-Term Examination, April – 2024

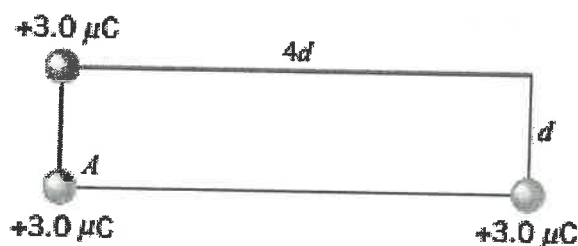
Programme	: B.Tech.	Year/Semester	: 1 st / 2 nd
Course Name	: Applied Physics	Course Code	: AS1108
Time	: 2:30 Hours	Maximum Marks	: 30

Important Notes:

- The candidates, before starting to write the solutions, should check the question paper for any discrepancies and also ensure that they have delivered the question paper with the correct course code.
- All symbols, unless stated, have their usual meaning in the context of the course.
- If any additional data is required, *assume suitably and state clearly*.

Q. No.	Question	Marks/ CO(s)
Q 1.	A particle moves along the x axis. Its position varies with time according to the expression $x = 5 - 4t + t^2$, where x is in meters and t is in seconds. Determine the displacement of the particle in the time intervals $t = 0$ s to $t = 3$ s and $t = 1$ s to $t = 3$ s.	2+2 AS1108.1
Q 2.	Consider a recent scenario where Iran has launched a missile targeting Israel. Let's assume the Iranian missile is traveling through a specific point in space at a fixed altitude of 2000 meters. To intercept this missile, Israel launches a counter-missile from a point directly below the Iran's missile from the ground at a speed of 200 m/s. (i) What angle should the Israeli missile be fired at to successfully intercept the target in space, and (ii) What will be its velocity at the point of impact?	2+2 AS1108.1 AS1108.2
Q 3.	A bicyclist is traveling at night, and a generator mounted on the bike powers a headlight. A small rubber wheel on the shaft of the generator presses against the bike tire and turns the coil of the generator at an angular speed that is 50 times as great as the angular speed of the tire itself. The tire has a radius of 0.2 m. The coil consists of 100 turns, has an area of $2.5 \times 10^{-3} \text{ m}^2$, and rotates in a 0.10 T magnetic field. When the peak emf being generated is 6.0 V, what is the linear speed of the bike?	4 AS1108.3

- Q 4. In the rectangle as shown in the drawing, Determine the charge (magnitude and algebraic sign) must be placed at the empty corner. 2+2
- AS1108.3
- (i) to make the net force on the charge at corner A point along the vertical direction.
- (ii) to make the net force on the charge at corner A point along the horizontal direction.



- Q 5. What is Planck's hypothesis/ assumption? How it helped in understanding quantum behavior of particles? Explain by considering the following applications: 1+2+2
- AS1108.4
- (i) Radiation spectrum, and (ii) Compton scattering

- Q 6. (i) What is Heisenberg uncertainty principle? Explain in brief. 1+2+2
- (ii) Calculate the de Broglie wavelength of an electron and photon with a kinetic energy of 150 eV? Comment on the results. AS1108.4

Take $h = 6.63 \times 10^{-34} \text{ J.s}$

Mass of electron: $m_e = 9.1 \times 10^{-31} \text{ kg}$

Mass of photon: $m_p \sim 0 \text{ (zero) kg}$

- Q 7. It is found in a photoelectric-effect experiment with light of a certain frequency that a reverse potential difference of 1.25 V is required to reduce the current to zero. Find: (a) the maximum kinetic energy, and (b) the maximum speed of the emitted photoelectrons. 2+2
- AS1108.4
- AS1108.5

Take $1\text{eV} = 1.6 \times 10^{-19} \text{ J}$

Mass of photoelectron: $m = 9.1 \times 10^{-31} \text{ kg}$