

End-Term Examination: May 2025

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.
- Use of scientific calculator is allowed.
- If any additional data is required, *assume suitably and state clearly*.

Q. No.	Question	Marks/ CO(s)
Q 1.	Suppose that Indian Army deploys a tactical drone to destroy a temporary infrastructure used in the training in Pakistan-occupied Kashmir (PoK). The drone hovers at 100 meters altitude and releases a fragmenting explosive payload of 1 kg in free fall. Answer the following:	2+3+3+2 AS1108.1
	i. Calculate the time to reach the ground and the impact velocity of the payload just before the explosion.	AS1108.2
	ii. Plot the displacement-time ($y-t$) and velocity-time ($v-t$) graphs for the fall.	
	iii. If the payload explodes on impact into two equal masses, one rebounds vertically at 10 m/s and the other remains embedded in the debris, use conservation of momentum to calculate the velocity of the second fragment after the explosion.	
	iv. Find out whether the temporary infrastructure will get destroyed or not if it can bear a force upto 5 kN and explosion took place in 10 ms (milli-seconds).	
OR		
	Assume that ISRO's Mars rover, with a mass of 300 kg, is climbing a 15° slope on Mars at constant speed. It experiences a 100 N resistive force due to lose soil. Gravitational acceleration on Mars is 3.71 m/s ² . Answer the followings:	3+2+2+3 AS1108.1
	i. Draw a Free-Body Diagram (FBD) of the rover on the slope.	AS1108.2
	ii. Calculate component of gravitational force down the slope and normal force on the rover from the Martian surface.	
	iii. Determine the motor force needed to maintain the constant speed on the uphill.	
	iv. If the motors stop, how long will it take for the rover to slide 5 meters back down the slope?	
Q 2.	I. Using Bohr's hydrogen spectrum model, calculate the following:	3+2
	i. Energy of electron in first orbit of a hydrogen atom.	AS1108.4
	ii. Radius of the first orbit of a hydrogen atom.	

You may use the following formulas and constant values:

Potential energy: $E = \frac{1}{2}mV^2 - \frac{e^2}{4\pi\epsilon_0 r} = -\frac{me^4}{8\epsilon_0^2 h^2 n^2}$; Force balance: $\frac{mV^2}{r} = \frac{e^2}{4\pi\epsilon_0 r^2}$

Planck's constant $h = 6.63 \times 10^{-34}$ J/s; Mass of electron $m = 9.11 \times 10^{-31}$ kg

Speed of light $C = 3 \times 10^8$ m/s; Charge on electron $e = 1.6 \times 10^{-19}$ C; 1 eV = 1.6 × 10⁻¹⁹ J

Permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12}$ m⁻³kg⁻¹s⁴A²

- Q 2.** II. Ultraviolet light of wavelength 280 nm is incident on a lithium cathode in a photoelectric effect experiment. The work function of lithium is given as $\phi = 2.5$ eV. Calculate the following: 3+2
AS1108.4
- i. Maximum kinetic energy of emitted photoelectrons.
 - ii. Stopping potential to halt the fastest photoelectrons.
- Q 3.** I. A conducting rod slides down between two frictionless vertical copper tracks at a constant speed of 4.0 m/s perpendicular to a 0.50-T magnetic field. The resistance of the rod and tracks is negligible. The rod always maintains electrical contact with the tracks and has a length of 1.3 m. A 0.75- resistor is attached between the tops of the tracks. 2.5
AS1108.2
- (a) What is the mass of the rod?
 - (b) Find the change in the gravitational potential energy that occurs in a time of 0.20 s.
 - (c) Find the electrical energy dissipated in the resistor in 0.20 s
- II. The electric field between the square plates (10 cm $\times$ 20 cm) of a capacitor increases from 100 V/m to 300 V/m in 0.01 ms. 2.5
AS1108.3
- (a) Calculate the displacement current between the square plates.
 - (b) Calculate magnetic field at 40 cm from the center of the plates in a direction perpendicular to the electric field between the plates.
- Q 4.** I. A long, straight wire carries a current of I_1 8.0 A. As given Fig. I, a circular loop of wire lies immediately to the right of the straight wire. The loop has a radius of $R = 0.030$ m and carries a current of $I_2 = 2.0$ A. Assuming that the thickness of each wire is negligible, find the magnitude and direction of the net magnetic field at the centre C of the loop. 2.5
AS1108.2

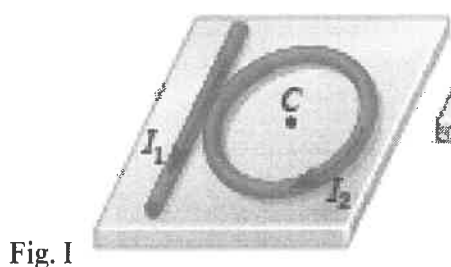


Fig. I

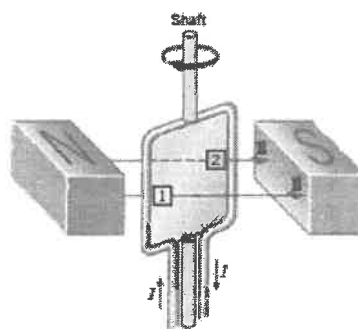


Fig. II

- II. Two coils have the same number of circular turns and carry the same current. Each rotates in a magnetic field as in given Fig. II. Coil 1 has a radius of 5.0 cm and rotates in a 0.18-T field. Coil 2 rotates in a 0.42-T field. Each coil experiences the same maximum torque. What is the radius (in cm) of coil 2? 2.5
AS1108.2