



UNIVERSITY OF THE PUNJAB

Second Semester 2011

Examination: B.S. 4 Years Programme

Roll No. _____

PAPER: Electricity & Magnetism (IT)
Course Code: IT-12399

TIME ALLOWED: 2hrs. & 30 mins.
MAX. MARKS: 60

Attempt this Paper on Separate Answer Sheet Provided.

SECTION II

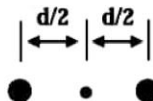
Question no. 2: Answer the following questions. (10x3=30)

1. Differentiate between reversible and irreversible process by giving examples.
2. What do you know about thermodynamics and its states?
3. State zeroth law in terms of temperature.
4. Differentiate between an isothermal and an adiabatic process by giving examples.
5. What is Quantization of charge?
6. Derive the relationship between the current density and the drift speed of a conductor of length L.
7. If resistors are connected in series in a circuit what is the effect on the voltage and current?
8. Can you prove (detect) a magnetic field with the help of a static electric charge? Justify your answer.
9. What is the change in potential energy of a charge moving in close path?
10. Compare Faraday's Law and Lenz's Law.

SECTION III

Question no. 3: (7+4+4=15)

- (a) Using the Gauss' Law find the electric field due to a line charges.
- (b) Prove that for an adiabatic process, $PV = \text{Constant}$.
- (c) Charges $+q$ and $-2q$ are fixed at distance d apart. Find Electric field at the point B due to charge $+q$ and $-2q$.



Question no. 4: (10+5=15)

- (d) State and explain Ampere's Law and find the magnetic field due to a solenoid by using Ampere's Law.
- (e) Calculate the potential energy of a system with $r_{12}=r_{13}=r_{23}=d=12\text{cm}$ and $q_1=+q$, $q_2=-4q$ and $q_3=+2q$.



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MAX. MARKS: 60

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SECTION II

Question no. 2: Answer the following questions. (10x3=30)

- Water is heated on a stove. Rank the entropy changes of the water as temperature rise (i) from 20°C to 30°C (ii) 30°C to 35°C (iii) 80°C to 80°C. Greatest first.
- What do you know about second law of thermodynamics?
- State Boyle's law and derive the general gas equation.
- What are electric charges, electric field and electric potential?
- Distinguish between potential difference and the difference of potential energy?
- The potential energy of a dipole placed in an external electric field is given by $U = -\mathbf{p} \cdot \mathbf{E}$ discuss the angles at which potential energy is maximum and minimum.
- A positive point charge q is located at the center of a hollow metal sphere. What charges appear on the outer surface of the sphere? Justify your answer.
- Write properties of electric field lines.
- Is magnetic force a conservative force? Give answer with proper reason.
- Define electromagnetism and differentiate between magnetism and electromagnetism.

SECTION III

Question no. 3: (10+5=15)

- Using the Gauss' Law find the electric field due to,
 - An infinite sheet of charges.
 - A spherical shell of charges
- Charges $+q$ and $-q$ are fixed a distance d apart. Find the net Electric field at the point in between the two charges $+q$ and $-q$. where $d=2\text{cm}$ and $q=5\mu\text{C}$.

Question no. 4: (10+5=15)

- Find the expression of magnetic force,
 - On a single moving charged particle.
 - On a current carrying wire.
- A solenoid 95.6cm long has a radius of 1.90cm, a winding of 1230 turns, and carries a current of 3.58A. Calculate the strength of the magnetic field inside the solenoid. ($\mu_0 = 4\pi \times 10^{-7} \text{ T m/A}$)



UNIVERSITY OF THE PUNJAB

Second Semester 2013

Examination: B.S. 4 Years Programme

Roll No. _____

PAPER: Electricity & Magnetism (IT)
Course Code: IT-12399 / PHY-122

TIME ALLOWED: 2hrs. & 30 mins.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet Provided.

SECTION II

Question no. 2: Answer the following questions briefly. (10x2=20)

- 1) Is there exist any process for which entropy decreases or change in entropy is zero? Explain briefly.
- 2) What is Carnot engine? Which processes are involved in Carnot cycle?
- 3) Define thermodynamics. What is thermal engine?
- 4) Show that Gauss' law is equivalent to Coulomb's law
- 5) What is field? Find the expression of electric field due to collection of point charges.
- 6) State and briefly explain Ohm's law.
- 7) What is capacitance? How energy stored in a capacitor varies with capacitor?
- 8) What is work done if a charge of magnitude q' moves one equipotential surface having potential V_1 to another equipotential surface having potential V_2 ? Also find the value of work done q' moves to the same equipotential surface.
- 9) State and briefly explain Biot Savart law.
- 10) Discuss the effect of dielectric medium on the electric flux with the help of Gauss' law dielectrics.

SECTION III

Question no. 3: (5+5+5)

- (A) State Coulomb's law and explain the experiment performed by Coulomb to find the expression of electric force.
- (B) Also write vector form of Coulomb's law and show that electric forced obey Newton's third law.
- (C) Calculate the electric dipole moment of an electron and proton 4.5nm apart.

Question no. 4: (10+5)

- (A) By using Ampere's law calculate the magnetic field of
 - (1) Straight current carrying wire
 - (2) Solenoid
- (B) A solenoid has a length $L = 1.23\text{m}$ and an inner diameter $D = 3.55\text{cm}$. It has five layers of windings of 800 turns each and carries $i = 4.7\text{A}$. What is the magnitude field at its center? What is the magnetic field outside the solenoid?



UNIVERSITY OF THE PUNJAB

Second Semester 2014

Examination: B.S. 4 Years Programme

Roll No. _____

PAPER: Electricity & Magnetism (IT)
Course Code: PHY-122 / IT-12399

TIME ALLOWED: 2hrs. & 30 mins.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet Provided.

SECTION II Subjective Part

Question no. 2: Write short answers of the following questions. (10x3=30)

1. Briefly explain kinetic theory of gases and ideal gas.
2. State Boyle's law. Also describe isothermal process.
3. Consider four object A, B, C and D. It is found that A and B are in thermal equilibrium. It is also found that C and D are in thermal equilibrium. However A and C are not in thermal equilibrium. What can conclude about thermal equilibrium of B and D?
4. Write any two properties of electric field lines.
5. Two identical, small, conducting spheres are separated by a distance of 1m. The spheres originally have the same positive charges, and the force between them is F_0 . One half of the charge on one sphere is then moved to the other sphere. What is the force between the spheres now?
6. Show that Gauss' law is equivalent to Coulomb's law.
7. Four 18ohms resistors are connected in parallel across a 27V battery. What is the current through the battery?
8. What do you know about electric potential and electric potential energy?
9. How torque is produced in a current carrying loop placed in an electric field?
10. How can we find the direction of induced current with the help of Lenz's law?

Question no. 3: (6+4=10)

- a) State and discuss second law of thermodynamics. How can you explain second law in terms of entropy?
- b) The turbine in a steam power plant takes steam from a boiler at 520°C and exhausts it to a condenser at 100°C. What is the maximum possible efficiency of the turbine?

Question no. 4: (6+4=10)

- a) State Gauss's law. Find the electric field due to an infinite sheet of charges.
- b) A cube with 1.4m edges is oriented in a region of uniform electric field $E = (-4 \text{ N/C}) \hat{j}$. Find the flux through the cube.

Question no. 5: (6+4=10)

- a) Explain the Ampere's Law. Find the magnetic field due to a solenoid by using Ampere's Law.
- b) A uniform electric field is perpendicular to a uniform magnetic field. A proton moving with a velocity v_p perpendicular to both fields experiences no net force. An electron moving with a velocity v_e also experiences no net force, which means combination of electric and magnetic field is zero. Show that the ratio of proton's kinetic energy to that of electron is m_p/m_e .



UNIVERSITY OF THE PUNJAB

Second Semester 2015

Examination: B.S. 4 Years Programme

Roll No.

PAPER: Electricity & Magnetism (IT)
Course Code: PHY-122 /

TIME ALLOWED: 2 hrs. & 30 mins.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

SECTION II Subjective Part

Question no.2: Write short answers of the following questions. (10×2=20)

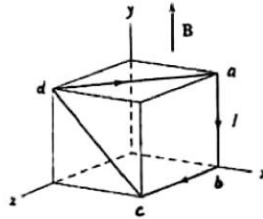
1. State the zeroth law of thermodynamics.
2. Is it possible to construct a heat engine that will not expel heat into atmosphere? Why?
3. What is a Carnot engine? Which processes are involved in Carnot cycle?
4. What is irreversible process? Give an example of irreversible process.
5. Compare Isothermal Expansion and Adiabatic Expansion.
6. A proton moves perpendicularly to a uniform magnetic field B with velocity 1.0×10^7 m/s and experiences an acceleration of 2.0×10^{13} m/s² in the $+x$ direction when its velocity is in the $+z$ direction. Determine the magnitude and direction of the field. Mass of proton is 1.67×10^{-27} kg and charge of proton is 1.6×10^{-19} C.
7. Show the mechanism of insulator in an electric field with the help of diagrams.
8. What are capacitors? Briefly explain.
9. What should be the orientation of a current carrying coil in a magnetic field so that the torque acting upon the coil is,
a) maximum b) minimum
10. State Faraday's law. How can we find the direction of induced current with the help of Lenz's law?

Question no.3: (5+5+5=15)

- a) State Coulomb's law. Also write its vector form.
- b) Using Gauss's law, find the electric field due to spherical shell of charges.
- c) A uniform charged conducting sphere of 1.22m radius has a surface charge density of $8.13 \mu\text{C}/\text{m}^2$.
 - i. Find the charge on sphere.
 - ii. What is the total electric flux leaving the surface of sphere?
 - iii. Calculate the electric field at the surface of the sphere.

Question no.4: (10+5=15)

- a) Explain the Ampere's Law. Find the magnetic field due to a straight wire at its internal and external points by using Ampere's Law.
- b) In the figure, the cube is 40.0 cm on each edge. Four straight segments of wire— ab , bc , cd , and da —form a closed loop that carries a current $I = 5.00$ A, in the direction shown. A uniform magnetic field of magnitude $B = 0.020$ T is in the positive y direction.



- (1) Determine the magnitude and direction of the magnetic force on segment ab .
- (2) Determine the magnitude and direction of the magnetic force on segment bc .



UNIVERSITY OF THE PUNJAB

Second Semester 2016

Examination: B.S. 4 Years Programme

Roll No.

PAPER: Electricity & Magnetism (IT)
Course Code: PHY-122 / IT-12399

TIME ALLOWED: 2 hrs. & 30 mins.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

SECTION II Subjective Part

Question no.2: Write short answers of the following questions.

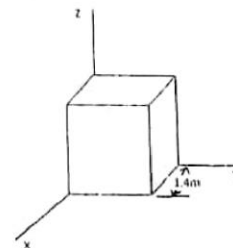
(10×2=20)

1. State the second law of thermodynamics.
2. What is Entropy and what are its characteristics?
3. A Carnot engine has the same efficiency (i) between 100 K and 500 K and (ii) between T K and 900 K. Calculate the temperature T of the sink.
4. Explain Cyclic Process with example.
5. Compare Isothermal Expansion and Adiabatic Expansion.
6. State Coulomb's law. Also write its vector form.
7. A point charge is placed at the center of a spherical Gaussian surface. Is flux changed if the sphere is replaced with by a cube of same volume? Justify your answer.
8. A point charge is moving in a magnetic field at right angle to the field lines. Does any force act on it?
9. A straight wire of length 1m has a current of 10 A in it. Calculate the magnetic field that exerts a force of 1.6×10^{-12} N on the current carrying wire. Take $\theta = 23^\circ$.
10. State Faraday's law of electromagnetic induction.

Question no.3:

(5+5+5=15)

- a) Find the expression of ΔU electric potential energy and ΔV electric potential for charges $+q_1$ and $+q_2$.
- b) Using Gauss's law, find the electric field due to a uniform line of charges.
- c) A cube with 1.4 m edges is oriented in a region of uniform electric field as shown in figure. Find the electric flux through the right face of the cube if the electric field is given by $\mathbf{E} = (6\text{N/C}) \mathbf{j}$. Also calculate the total flux through the cube.



Question no.4:

(10+5=15)

- a) Find the magnetic field due to a single moving charge. Also find the magnetic field of a current carrying wire.
- b) A straight conductor of length 1.5 m experiences a maximum force of 2.0 N when placed in a uniform magnetic field. The magnetic induction of the field is 1.3 T. Calculate the value of the current in the conductor.



UNIVERSITY OF THE PUNJAB

Second Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. 0191025

PAPER: Electricity & Magnetism (IT)
Course Code: PHY-122 / IT-12399

TIME ALLOWED: 2 hrs. & 30 mins.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

SECTION II
Subjective Part

Question no.2: Write short answers of the following questions. (10×2=20)

1. State and briefly explain the first law of thermodynamics.
2. What is heat capacity? Differentiate between C_p and C_v .
3. An ideal heat engine operates between two temperatures 600 K and 900 K. What is the efficiency of the engine?
4. What is internal energy of an ideal gas? Explain briefly.
5. What is an electric dipole? Sketch the electric field around an electric dipole.
6. A parallel-plate air capacitor of capacitance of 100 pF has a charge of magnitude $0.1 \mu\text{C}$ on each plate. The plates are 0.5 mm apart. What is the potential difference between the plates?
7. A point charge of $+3.12 \times 10^{-6} \text{C}$ is 12.3 cm distant from a second point charge of $-1.48 \times 10^{-6} \text{C}$. Calculate the magnitude of the force on each charge.
8. What is Lorentz Force? Find the expression of velocity of the moving particle at which the Lorentz force on particle is equal to zero and particle moves straight in the region of uniform electric and magnetic fields.
9. What is magnetism and electromagnetism? Explain briefly.
10. State Lenz's law of electromagnetic induction.

Question no.3: (5+5+5=15)

- a) State Coulomb's law. Sketch torsion balance and explain how it was used to find the electrostatic forces between charged particles. Also write its vector form.
- b) Find the capacitance of parallel plate capacitor in terms of area of plate 'A' and separation between plates 'd' where electric field due to infinite sheet of charges is $\sigma/2\epsilon_0$.
- c) Consider a point charge $q_1 = +2.2 \mu\text{C}$ at the origin and a second point charge $q_2 = +1.2 \mu\text{C}$ at a distance L along x axis, where $L = 15 \text{cm}$. At what point P along the x axis is the electric field zero?

Question no.4: (8+7=15)

- a) Find the magnetic field due to a current carrying wire and a solenoid by using Ampere's Law.
- b) Two parallel wires are 10.0 cm apart, and each carries a current of 10.0 A. If the currents are in the same direction, find the force per unit length exerted by one of the wires on the other. Are the wires attracted or repelled? Repeat the problem with the currents in opposite directions.



UNIVERSITY OF THE PUNJAB

Second Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. 024016

PAPER: Electricity & Magnetism (IT)
Course Code: PHY-122 / IT-12399 Part - II

TIME ALLOWED: 2 Hrs. & 45 Mints.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

Question no.2: Write short answers of the following questions.

(10×2=20)

1. What is the significance of entropy? Describe briefly.
2. In a system undergoing adiabatic compression, what are the values of internal energy and heat if work done on the system is 500 J?
3. How many laws of thermodynamics are there? Give statements.
4. State and explain Ohm's law.
5. Sketch the electric field lines due to a uniform line of charges, uniform shell of charges and two opposite charges (dipole).
6. An electric bulb draws a current of 0.43 A for 18 minutes. Calculate the amount of electric charge that flows through the circuit.
7. In what sense are electricity and magnetism related? Explain briefly.
8. What is capacitance? Discuss the dependence of capacitance on q , ΔV and geometry.
9. Describe two main ways to generate electricity by electromagnetic induction.
10. State Lenz's law. Briefly explain.

Question no.3:

(6+6+3=15)

- a) Explain the phenomena of an insulator and a conductor in an electric field with the help of diagrams.
- b) State and explain Ampere's law. Give its any two applications (e.g. by finding the magnetic field of wire, solenoid etc).
- c) A Carnot engine has the same efficiency (i) between 200 K and 600 K and (ii) between T K and 850 K. Calculate the temperature T of the sink.

Question no.4:

(10+5=15)

- a) Find the magnetic force on a single static charge, single moving charge and a current carrying wire.
- b) The electric field at point P is zero. Find the unknown charge Q?





UNIVERSITY OF THE PUNJAB

B.S. 4 Years Program / Second Semester – 2021

Paper: Electricity & Magnetism (IT)

Course Code: PHY-122 / IT-12399 Part – II

Time: 2 Hrs. 45 Min. Marks: 50

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

Q.2. Answer the following short questions:

(10x2=20)

- (i). For an ideal gas in an isothermal process, there is no change in internal energy. Suppose gas does work W during such a process. How much is energy transferred by heat?
- (ii). An ideal gas expands at constant pressure. Does heat flow into or out of gas? If heat flows into gas, justify your answer. If heat flows out of gas, give a proof.
- (iii). Can a heat pump have a coefficient of performance less than unity?
- (iv). Suppose two different objects have same amount of heat. Can you say that their temperature is same?
- (v). Two point charges of unknown magnitude and sign are placed a distance d apart. Is it possible for any arrangement of two point charges to find two points at which $E = 0$, if so under what conditions?
- (vi). Can there be a potential difference between the two conductors that carry the like charges of the same magnitude?
- (vii). Two capacitors are identical. They can be connected in series or in parallel. If we want the smallest equivalent capacitance for the combination, do you connect them in series?
- (viii). What is angle between direction of flow of current and external magnetic field to have magnetic force of maximum value?
- (ix). In Faraday's law of induction, does the induced emf depend on the resistance of the circuit? If so, how?
- (x). Wires that carry equal and opposite currents are often twisted together to reduce their magnetic effect at distant points. Why is this effective?

Answer the following questions:

(3x10=30)

- Question no.3:** (a)-What is meant by thermal expansion? Explain with an example. Prove that coefficients of linear and volume expansions are related by equation $\beta = 3\alpha$. 06 + 04
(b)-Show that efficiency of a reversible ideal heat engine is related to co-efficient of performance of reversible refrigerator obtained by running the engine backward by relation:

$$e = \frac{1}{k + 1}$$

Question no.4: (a)-Define Gauss's law. Prove it by using integration technique for n point charges. 05 + 05

(b)-A proton orbits with a speed $v = 294 \text{ km/s}$ just outside a charged sphere of radius 1.13 cm . Find the charge on the sphere.

Question no.5: (a)-Apply Ampere's law to find magnetic field due to current in a solenoid.

(b)-Prove that if magnetic induction is not a function of time, then

05 + 05

$$\text{curl } \vec{B} = \mu_0 \vec{j}$$