

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. Engg.(CSE) 1st Year EVEN Semester 2016
Course: PHY 1221 (Applied Electricity and Magnetism)
Time: 3 Hrs. Full Marks: 52.5
[N.B. Answer SIX questions taking at least THREE from each part.]

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Dept. of Computer Science & Engg.
University of Rajshahi

Part A

- 1.a) State superposition principle for electric charges. 1
- b) Derive an expressions for the electric field at a point on the axial line due to an electric dipole. 4.75
- c) An electric dipole of moment 2×10^{-8} cm is placed in a uniform field intensity $1.5 \times 10^5 \text{ NC}^{-1}$ (i) What maximum torque does the field exert on the dipole? (ii) How much work is done on turning the dipole end to end? 3
- 2.a) State and prove Gauss's law in electrostatics. 5
- b) Charge is distributed uniformly over the surface of a sphere. Use Gauss's law to find the electric field at the points (i) Outside of the sphere (ii) On the surface of the sphere 3.75
- 3.a) Define capacitor. Classify the capacitors. Write down the major uses of capacitor. 1+1+1
- b) Derive an expression for the energy stored by a charged capacitor. 3
- c) The parallel plates of an air-filled capacitor are 1 cm apart. What will be the area A of each plate if capacitance is to be $0.25 \mu\text{F}$? 2.75
- 4.a) Establish the relation between current density and electron drift velocity. 3.5
- b) Deduce the condition for the balance of a Wheatstone's bridge. 3.5
- c) Write short note about Superconductor. 1.75

Part B

- 5.a) State and prove Ampere's law. Apply it to calculate the magnetic field due to a solenoid. 3+3
- b) Define self-inductance and mutual inductance. 2.75
- 6.a) Describe a moving coil galvanometer. Explain how current can be measured with it. 4
- b) What are the differences between ballistic and deadbeat galvanometer? 2
- c) Prove that the charge sensitivity of a B.G. is $2\pi/T$ times the current sensitivity. 2.75
- 7.a) Briefly describe about Seebeck and Peltier effects. 4
- b) Write down the laws of addition of thermal electromotive forces. 4.75
- 8.a) A series circuit containing an inductor L and a resistor R is connected to a battery. Obtain the expression for the rate of decay of current. 4.75
- b) An e.m.f. 10V is applied to a circuit having a resistance of 10Ω and in inductance of 0.5H. Find the time required by the current to attain 63.2% of its final value. What is the time constant of the circuit? 4

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. Engg. Part-I Even Semester Exam - 2015
Course: PHY1221 (Applied Electricity and Magnetism)
Full Marks: 52.5 Time: 3 Hours

(Answer any 6 questions not taking more than 3 from each Part)

Part A

- | | |
|---|------|
| 1.(a) Define an electric dipole and its moment. | 1 |
| (b) Find the electric field \vec{E} at a point P due to a dipole at a distance r from the midpoint of the dipole. | 5 |
| (c) A water molecule in its vapour state has an electric dipole moment $6.2 \times 10^{-30} \text{ cm}$. What is the electric field \vec{E} at a distance r of 1.1 nm from the molecule on the dipole axis? | 2.75 |
| 2.(a) What is electric flux? | 2 |
| (b) Obtain Coulomb's law from Gauss's law. | 3.50 |
| (c) A point charge of $1.8 \mu\text{C}$ is at the centre of a spherical Gaussian surface of radius 55 cm. What is the net flux through the surface? | 3.25 |
| 3.(a) Calculate the total enclosed charge q for a parallel plate capacitor with dielectric using Gauss's law. | 5 |
| (b) A parallel plate capacitor of plate area 11.5 cm^2 and plate separation 1.24 cm. A potential difference 85.5 V is applied between the plates. The battery is then disconnected, and a dielectric slab of thickness 0.78 cm and dielectric constant 2.61 is placed between the plates. What is the capacitance with the slab in place? | 3.75 |
| 4.(a) What is the current density and drift velocity of the charge carrier? | 2 |
| (b) Establish the relationship between the current density and drift velocity. | 4 |
| (c) What is the drift velocity of the conduction electrons in a copper wire of diameter 0.5 mm and length 20 m, when it is connected across the battery of 1.5V and the internal resistance 1.25Ω .
(Here $\rho = 8.96 \times 10^3 \text{ kg/m}^3$, $n = 8.49 \times 10^{28} \text{ m}^{-3}$) | 2.75 |

Part B

- | | |
|--|------|
| 5.(a) State and explain Faraday's law of induction. Deduce its differential form. | 3.75 |
| (b) Find the mutual inductance of two co-axial coils. | 5 |
| 6.(a) What do you mean by thermal emf? | 2 |
| (b) What is Thomson effect? | 3 |
| (c) Find an expression of the thermo-electric power. | 3.75 |
| 7.(a) Find expression for the growth and decay of charges of a capacitor through resistor with constant emf. | 3.75 |
| (b) What is the time constant in an RC circuit? Show that the time constant has the unit of time. | 2 |
| (c) In an RC circuit $R = 0.4 \times 10^6 \text{ ohm}$ and $C = 2.5 \times 10^6 \text{ F}$, in what time will the charge in the capacitor decay one fourth of its initial value? | 3 |
| 8.(a) An alternating emf is applied to a circuit consisting an inductor, capacitor and resistor in series. Obtain the expression for the current and impedance. | 5.75 |
| (b) A circuit consists of a non-inductive resistance of 50Ω , an inductance of 0.3H and a resistance of 2Ω and a capacitor of $40\mu\text{F}$ in series and is supplied with 200 volts at 50 Hz. Find the impedance and the current in the circuit. | 3 |

University of Rajshahi
Department of Computer Science & Engineering
1st Year Second Semester Examination 2014
Course: PHY 1221 (Applied Electricity and Magnetism)
Full Marks: 52.5 Duration: 3 (Three) Hours

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Answer 06(Six) questions taking any 03(Three) questions from each part

Part-A

1. a) State and prove Gauss's law in electrostatics. 5
b) Charge is distributed uniformly over the surface of a sphere. Use Gauss's law to find the electric field at the points 3.75
 - i. Outside the sphere
 - ii. On the surface of the sphere
2. a) Define capacitance and capacitor. 2
b) Deduce the relation $C = \frac{\epsilon_0 A}{d}$ for a parallel plate capacitor, where the symbols have their usual significance. 4.75
c) The parallel plate of an air-filled capacitor are 1cm apart. What must be the area A of each plate if capacitance is to be 0.25 μ F? 2
3. a) Derive an expression for the energy stored by a charged capacitor. 4.75
b) The capacitance of a parallel plate capacitor is 400pF and its plate are separated by 2mm of air. 2
 - i. What will be the energy when it is charged to 1500 volts? 2
 - ii. What will be the potential difference with the same charge if the plate separation is doubled? 2
4. a) State and explain Kirchhoff's law in an electrical network. 4
b) Deduce the condition for the balance of a Wheatstone's bridge. 4.75

Part-B

5. a) State Ampere's law. Derive an expression for magnetizing force, B due to a current carrying long straight conductor. 2+2
b) Calculate the magnetizing force and flux density at a distance of 1 cm from a long straight circular conductor in air carrying a current of 100A. Draw a curve showing the variation of B from the conductor surface outwards if its diameter is 1mm. 4.75
6. a) Describe a moving coil galvanometer. Explain how current can be measured with it. 3+2
b) What are the differences between ballistic and deadbeat galvanometer? 1
c) In a ballistic galvanometer 2 μ A gives a steady deflection of 1 division. The time of free oscillation is 8s and damping is negligible. What quantity of electricity is measured by a kick of 1 division? 2.75
7. a) A series circuit containing an inductor L and a resistor R is connected to a battery. Obtain the expression for the rate of decay of current. 4.75
b) An e.m.f. 10v is applied to a circuit having a resistance of 10 Ω and an inductance of 0.5H. find the time required by the current to attain 63.2% of its final value. What is the time constant of the circuit? 4
8. a) Define reactance and impedance of an AC circuit. 2
b) Analyze a series LCR circuit and explain the phenomenon of resonance. 3+1
c) Find the resonance frequency of an LCR series circuit for L=10mH, C=0.02 μ F and r=20 Ω . 2.75

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University of Rajshahi
Department of Computer Science and Engineering

B.Sc. (Engg.) Examination-2013, Year-I, Semester-II

Course: PHY-1221 (Applied Electricity and Magnetism)

Full Marks-52.5 Time: 3 hours

[N.B. Answer any six questions taking THREE from each of the groups]

Part-A

1. a) Derive an expression for the electric field at any point due to an electric dipole. 5
b) Find the potential energy of an electric dipole placed in a uniform external electric field. 3.75
2. a) Define dielectric constant and energy density. 2
b) Find the expression for the capacitance of a parallel plate capacitor without dielectric. 3.75
c) Show that $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$. 3
3. a) Derive an expression for the conductivity of metals based on free electron theory of conductivity. 5
b) A metal rod of length 25cm has resistance $7.5 \times 10^{-6} \Omega$. The diameter of the rod is 0.40 cm. Calculate the resistivity of the metal. 3.75
4. a) Define current density. Establish the relation between current density and electron drift velocity. 5
b) One end of an Al wire of diameter 2.5 mm is welded to one end of a Cu wire of diameter 1.8 mm. The composite wire carries a steady current of 1.3 A. What is the current density in each wire? 3.75

Part-B

5. a) State and explain Faraday's law of induction. Deduce its differential form. 3.75
b) Find the mutual inductance of two co-axial coils. 5
6. a) Write down the laws of intermediate metal and intermediate temperature. 5
b) Describe Thomson effect. 3.75
7. a) Find expressions for the growth of charges of a capacitor through a resistor with constant emf. 5
b) In an RC circuit $R = 0.4 \times 10^6 \Omega$ and $C = 2.5 \times 10^{-6} F$, in what time will the charge in the capacitor decay one fourth of its initial value? 3.75
8. Write short note on (any TWO): 8.75
 - a) Seebeck effect
 - b) Peltier effect
 - c) Reactance
 - d) Resonance

University of Rajshahi
 Department of Computer Science and Engineering
 B.Sc. Engg.(CSE) 1st Year Even Semester 2012
 Course: PHY 1221 (Applied Electricity and Magnetism)
 Time: 4 Hrs. Full Marks: 52.5

[N.B. Answer SIX questions taking at least THREE from each part.]

Part A

- 1.a) State Gauss's law in electrostatics. 1.75
- b) Find an expression for the magnitude of the electric field E at a distance r in front of a sheet having surface charge density σ . 4
- c) The nucleus of a uranium atom has a radius R of 6.8×10^{-15} m. What is the magnitude of the electric field at its surface? 3
- 2.a) Define polarization. 2
- b) Prove the relation for the capacitance of a parallel plate capacitor $C = \frac{\epsilon_0 A}{d - t + t/k}$ of plate area A separated by a distance d with dielectric slab of thickness ' t ' and constant ' k ' in between plates. 3.75
- c) Derive an expression for the energy stored in a capacitor. 3
- 3.a) Define resistance, resistivity and conductivity. 2.75
- b) What do you mean by a superconductor? 3
- c) A Cu wire of diameter 1.8 mm carries a steady current of 2.54 A. What is the current density in the Cu wire? 3
- 4.a) State and Explain Kirchhoff's laws in a network and apply them to find an expression for the current through the galvanometer in an unbalanced Wheatstone bridge. 2+3
- b) How can you use this bridge to determine an unknown resistance? 2
- c) The current in a simple series circuit is 5 A. When an additional resistance of 2 ohm is inserted, the current drops to 4 A. What was the resistance of the original circuit? 1.75

Part B

- 5.a) State and prove Ampere's law. Apply it to calculate the magnetic field due to a solenoid. 3+3
- b) Explain and find motional emf. 2.75
- 6.a) Explain Seebeck and Peltier effects. 4
- b) What is neutral temperature and temperature of inversion? 2
- c) Calculate the maximum emf in an Fe-Pb thermocouple, the cold junction of which is kept at 0°C. 2.75
Given $a = 13.8 \mu V/^\circ C$; $b = -0.015 \mu V/^\circ C^2$
- 7.a) Derive expressions for the growth and decay of current in a circuit having inductance and resistance with constant emf. 3+3
- b) An emf 10 volts is applied to a circuit having a resistance of 10 ohm and an inductance of 0.5 henry. Find the time required by the current to attain 63.2% of its initial value. What is the time constant of the circuit? 2.75
- 8.a) Define reactance and impedance of an ac circuit. 2
- b) An alternating emf $E = E_0 \sin \omega t$ is applied to a circuit containing a capacitor C and a resistor R . Find the current at any instant. 4
- c) Explain Resonance in LCR ac series circuit. 2.75

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. Engg.(CSE) 1st Year 2nd Semester 2011
Course: PHY 1221 (Applied Electricity and Magnetism)
Time: 4 Hrs. Full Marks: 52.5
[N.B. Answer SIX questions taking at least THREE from each part.]

Part A

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|--|------|
| 1.a) Define an electric dipole and its moment. | 1 |
| b) Find the electric field \vec{E} at a point P due to a dipole at a distance r from the midpoint of the dipole. | 5 |
| c) A water molecule in its vapour state has an electric dipole moment 6.2×10^{-30} cm. What is the electric field \vec{E} at a distance r of 1.1 nm from the molecule on the dipole axis? | 2.75 |
| 2.a) What is the role of dielectric constant in a capacitor. | 1.75 |
| b) Explain susceptibility and electric polarization. Show that $\vec{D} = \epsilon_0 \vec{E} + \rho$. | 3+4 |
| 3.a) Define current density and conductivity. | 2 |
| b) Establish the relation between current density and electron drift velocity. | 3 |
| c) One end of an Al wire of diameter 2.5 mm is welded to one end of Cu wire of diameter 1.8 mm. The composite wire carries a steady current of 1.3A. What is the current density in each wire? | 3.75 |
| 4.a) Describe Kirchhoff's laws in a network. | 3 |
| b) Deduce the condition of balance of Wheatstone's bridge. | 5.75 |

Part B

- | | |
|---|------|
| 5.a) State and explain Faraday's law of induction. | 1.75 |
| b) Show that the mutual inductances are complementary. | 2 |
| c) Find the co-efficient of coupling. | 2 |
| d) A 0.5 m long solenoid has 1500 turns and area of cross section 0.0075 m^2 . A second coil of 500 turns is closely wound on the central part of the solenoid. Calculate mutual inductances between two coils. | 3 |
| 6.a) Explain Peltier and Thomson effects. | 3 |
| b) How the Peltier effect differs from Joule heating effect? | 3 |
| c) The emf in a Fe-Pb thermocouple, the cold junction of which is kept at 0°C is given by $E=18t-0.015t^2$. Find the neutral temperature and Peltier co-efficient at 27°C . | 2.75 |
| 7.a) Find expression for the growth and decay of charges of a capacitor through a resistor with constant emf. | 3.75 |
| b) What is the time constant in an RC circuit? Show that the time constant has the unit of time. | 2 |
| c) In an RC circuit $R=0.4 \times 10^6 \text{ ohm}$ and $C=2.5 \times 10^6 \text{ F}$, in what time will the charge in the capacitor decay one fourth of its initial value? | 3 |
| 8.a) Find the mean value and rms value of an alternating current. | 3 |
| b) Obtain the circuit equation for LR ac series circuit and solve it for the current i. | 3.75 |
| c) Define reactance and impedance of the above circuit. Show graphically the variation of reactance with frequency. | 2 |