

Level : B.E./B.Sc./B. Pharm./B. Tech.  
Year : I

Course : PHYS 102  
Semester : II

Exam Roll No. :

Time : 30 mins.

F.M. : 15

Registration No.:

Date : 3

SECTION "A"  
[15Q × 1 = 15 marks]

Choose and tick the most appropriate answer. The symbols, unless mentioned otherwise, have their usual meanings.

- A ring of radius  $R$  carries a uniformly distributed total charge  $q$ . The ring lies on  $xy$ -plane with center at origin. The electric field on  $z$ -axis due to the ring charge will be maximum at a distance

[a]  $\frac{1}{2}R$  above the center of the ring.      [b]  $\sqrt{2}R$  above the center of the ring.  
[c]  $\frac{1}{\sqrt{2}}R$  above the center of the ring      [d]  $2R$  above the center of the ring.
- $a$  and  $b$  are the distances of two points  $P_1$  and  $P_2$  respectively, from the center of a spherical shell of radius  $R$  which carries a uniform surface charge density  $\sigma$ . Point  $P_1$  lies outside and  $P_2$  inside of the sphere. The amount of work done to move a point charge  $Q$  from  $P_1$  to  $P_2$  is

[a]  $\frac{QR^2\sigma}{\epsilon_0} \left( \frac{1}{R} - \frac{1}{a} \right)$     [b]  $\frac{QR^2\sigma}{\epsilon_0} \left( \frac{1}{b} - \frac{1}{R} \right)$     [c]  $\frac{QR^2\sigma}{\epsilon_0} \left( \frac{1}{b} - \frac{1}{a} \right)$     [d] zero
- A short dipole of dipole moment  $\vec{p}$  is placed at a distance  $r$  from the center of another short dipole of same dipole moment. Both the dipoles point along same radial direction. The potential energy of the dipole-dipole system is

[a]  $\frac{p^2}{4\pi\epsilon_0 r^3}$       [b]  $-\frac{p^2}{2\pi\epsilon_0 r^3}$       [c]  $-\frac{p^2}{4\pi\epsilon_0 r^3}$       [d]  $\frac{p^2}{2\pi\epsilon_0 r^3}$
- The frequency of revolution of a charge particle entering normally into a uniform magnetic field is

[a] independent on charge of the particle.  
[b] independent on the mass of the particle.  
[c] independent on the value of the magnetic field.  
[d] independent on the radius of the circular path traced by the particle.
- The diamagnetic susceptibility is

[a] always positive and very large.  
[b] independent of the absolute temperature.  
[c] directly proportional to the absolute temperature.  
[d] inversely proportional to the absolute temperature.

6. Which one of the following equations is not associated to the Faraday's law of induction?

[a]  $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$       [b]  $\vec{E} = -\frac{\partial \vec{A}}{\partial t}$       [c]  $\mathcal{E} = -\frac{d\phi}{dt}$       [d]  $\vec{J}_d = \epsilon_0 \frac{\partial \vec{E}}{\partial t}$

7. Poynting vector is defined as energy per unit  
 [a] area transported by the electromagnetic field.  
 [b] volume transported by the electromagnetic field.  
 [c] time, per unit area transported by the electromagnetic field.  
 [d] time, per unit volume transported by the electromagnetic field.

8. If  $H_{c_1}$  and  $H_{c_2}$  are the critical field of a superconductor at temperatures  $T$  and  $2T$  respectively, then the critical temperature of the superconductor is

[a]  $\frac{2H_{c_1}}{H_{c_2}} T$       [b]  $\left( \frac{4H_{c_1} - H_{c_2}}{H_{c_1} - H_{c_2}} \right)^{\frac{1}{2}} T$   
 [c]  $\frac{4H_{c_1} - H_{c_2}}{H_{c_1} - H_{c_2}} T$       [d]  $\left( \frac{4H_{c_1} - H_{c_2}}{H_{c_1} - H_{c_2}} \right)^2 T$

9. The magnitude binding energy of a nucleus determines  
 [a] its scattering strength.      [b] its number of neutrons and protons.  
 [c] its stability against disintegration.      [d] its reaction strength with another nucleon.
10. In nuclear reactor, the neutron reflectors are used  
 [a] to reflect the radiation emitted from the reactor.  
 [b] to increase the flux of neutrons inside the reactor.  
 [c] to decrease the flux of neutrons inside the reactor.  
 [d] to control the unnecessary neutrons entering into the reactor.

Fill the following blanks with appropriate answers.

11. If  $\vec{r}$  is the position vector, then divergence of unit vector  $\hat{r}$  will be \_\_\_\_\_
12. The dielectric constant of methanol is 33. When  $33 \mu C$  of free charge is inserted into the unit volume of the methanol, then total charge in the system is \_\_\_\_\_
13. The magnetic vector potential of a current carrying coil is  $\vec{A} = \frac{1}{2} \mu_0 n I (-z\hat{j} + y\hat{k})$ . The magnetic field of the coil is \_\_\_\_\_
14. The unit of magnetization is \_\_\_\_\_
15. The half-life of radon is 3.8 days. The time taken to decay 60% of radon is \_\_\_\_\_

KATHMANDU UNIVERSITY  
End Semester Examination  
August/September, 2017

Level : B.E./B.Sc./B. Pharm./B. Tech.  
Year : I  
Time : 2 hrs. 30 mins.

3  
Course : PHYS 102  
Semester : II  
F. M. : 40

SECTION "B"

[5Q × 3 = 15 marks]

1. Define divergence of a vector. Obtain the divergence of a vector in Cartesian coordinate.

OR

Find the electric field a distance  $z$  above the mid-point of a straight line segment of length  $2L$ , which carries uniform line charge  $\lambda$ .

2. Derive the expressions for torque and energy of an electric dipole of dipole moment  $\vec{p}$  placed in a uniform electric field  $\vec{E}$

3. What do you mean by surface and volume current densities? Derive the continuity equation of charge flow.

OR

What is hysteresis loss? Show that hysteresis loss is equal to the area of B-H curve in one complete magnetization.

4. Define mutual inductance and self-inductance. Derive the Neumann formula for mutual inductance and hence give the statement of reciprocity theorem.

5. What do you mean by threshold energy in nuclear reaction? Derive an expression for this energy.

OR

Explain the working principle of G. M. counter with schematic diagram. Also draw a G. M. plateau.

SECTION "C"

[5Q × 5 = 25 marks]

6. Obtain an expression of electric potential from the relation  $\vec{E} = -\nabla V$  and using the result find the electric potential inside and outside of spherical shell of radius  $R$  carrying a uniformly distributed surface charge density  $\sigma$ .

OR

Find the electrostatic energy stored in a solid sphere of radius  $R$  which carries a uniformly distributed volume charge  $\rho$ .

7. Find the electric field at the center of a cavity sphere in a uniformly polarized medium and hence obtain the Clausius-Mossotti relation.

8. If  $\vec{B}$  is uniform, show that  $\vec{A}(\vec{r}) = -\frac{1}{2}(\vec{r} \times \vec{B})$ , where  $\vec{r}$  be the position vector from origin to a point of concern. Using this result, check that  $\nabla \cdot \vec{A} = 0$  and  $\nabla \times \vec{A} = \vec{B}$ .

OR

What is bound current? Show that  $\vec{K}_b = \vec{M} \times \hat{n}$  and  $\vec{J}_b = \nabla \times \vec{M}$ , where the symbols carry their usual meanings.

9. Explain the Raman Effect with schematic diagram of experimental setup. Give the quantum mechanical explanation of Raman spectra with energy level diagram.
10. Show that the energy density stored in a magnetic field  $\vec{B}$  is equal to  $\frac{1}{2\mu_0} B^2$  .

OR

Explain, how Maxwell corrected the Ampere's law for electromagnetic induction. Establish the Maxwell's equations in the presence of material medium.