KATHMANDU UNIVERSITY
End Semester Examination [C]
January, 2018

Marks scored:

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

Course : PHYS 102
Semester: II

Exam Roll No.:

Time: 30 mins.

F.M. : 15

Registration No.:

Date JAN 1 2 2018

SECTION "A"
[15 Q.×1=15 marks]

Choose and tick the most appropriate answer.

1. If the curl of a vector function is zero, then the vector function can be expressed as
   [a] the divergence of some other vector function.
   [b] the curl of some other vector function.
   [c] the gradient of other vector function.
   [d] the gradient of a scalar function.

2. The electrostatic potential energy of configuration of three charges +e,+e and -2e placed at three corners A, B and C of a equilateral triangle of side r is
   [a] $\frac{1}{4\pi\varepsilon_o}\frac{e^2}{r}$ [b] $\frac{1}{4\pi\varepsilon_o}\frac{2e^2}{r}$ [c] $-\frac{1}{4\pi\varepsilon_o}\frac{3e^2}{r}$ [d] $-\frac{1}{4\pi\varepsilon_o}\frac{5e^2}{r}$

3. Which one of the following relation is the correct?
   [a] $\int_v(\nabla\times\vec{A})d\tau=\int_s\vec{A}\cdot\vec{ds}$ [b] $\oint_v(\nabla\cdot\vec{A})d\tau=\int_s\vec{A}\cdot\vec{ds}$
   [c] $\int_v(\nabla\cdot\vec{A})d\tau=\oint_s\vec{A}\cdot\vec{ds}$ [d] $\oint_v(\nabla\cdot\vec{A})d\tau=\int_s\vec{A}\times\vec{ds}$

4. The ratio of electric field at any point at a perpendicular bisector of the short dipole to the electric field at any point along the dipole is
   [a] 1 [b]1/2 [c] 2 [d] 4

5. The source of electric displacement ($\vec{D}$) is
   [a] free charge only [b] bound charge only
   [c] changing electric field [d] both free and bound charge only

6. For steady current $\nabla\times\vec{B}$ is equal to
   [a] 0 [b] $\mu_o\vec{J}$ [c] $\mu_o\nabla\cdot\vec{J}$ [d] $\varepsilon_o\frac{\partial\vec{E}}{\partial t}$

7. If the magnetic dipole of dipole moment $\vec{m}$ is placed in the uniform magnetic field, then the energy stored in the dipole is
   [a] $-\vec{m}\times\vec{B}$ [b] $-\vec{m}.\vec{B}\cos\theta$ [c] $-\vec{m}.\vec{B}$ [d] $-\vec{m}.\vec{B}\sin\theta$

8. Following are some formulae written in their usual symbols. Choose incorrect one.
   [a] $\nabla\times\vec{H}=\vec{J}_f$ [b] $\nabla\times\vec{M}=\vec{J}_b$ [c] $\vec{B}=\mu_o(\vec{H}+\vec{M})$ [d] $\vec{K}_b=\vec{M}\cdot\hat{n}$

9. The expression of energy density (u) for a long solenoid (of radius R, current I and n turns per unit length) is

[a] $\frac{1}{2}\mu_o^2 n^2 I^2$ [b] $\frac{1}{2}\mu_o n^2 I^2$ [c] $\frac{1}{2\mu_o} n^2 I^2$ [d] $\mu_o^2 n^2 I^2$

10. In the region of free space where there is no charge or current, the curl of curl of Faraday's induced electric field $\vec{E}$ is

[a] $\varepsilon_o \mu_o \frac{\partial^2 \vec{E}}{\partial t^2}$ [b] $\mu_o \frac{\partial^2 \vec{E}}{\partial t^2}$ [c] $\varepsilon_o \frac{\partial^2 \vec{E}}{\partial t^2}$ [d] $\frac{1}{\varepsilon_o \mu_o} \frac{\partial^2 \vec{E}}{\partial t^2}$

11. Cyclotron frequency is independent of .....of charged particle.

12. When the electrons make transitions from n = 3 to n = 1, the X-rays produced are called.....

13. The magnetization left on a ferromagnetic material after the removal of magnetizing field once the saturation has been reached is called .....

14. In the nuclear reaction , the missing term is a .....

15. The time required for one half of the radioactive substance to disintegrate is called.....

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

SECTION "B"
[5 Q.×3=15 marks]

1. Define divergence and curl of a vector function. Show that the vector function $\vec{A} = \hat{i}yz + \hat{j}zx + \hat{k}xy$ can be written both as the gradient of scalar and curl of vector.

2. If $\vec{B}$ is uniform, show that $\vec{A} = -\frac{1}{2}\left(\vec{r} \times \vec{B}\right)$, where $\vec{r}$ is a vector from the origin to the point in question.

OR

A primitive model for an atom consists of a point nucleus ($+q$) surrounded by a uniformly charged spherical cloud ($-q$) of radius 'a'. Calculate the atomic polarizability of such an atom.

3. What do you mean by magnetization? Establish the relation between three magnetic vectors $\vec{B}, \vec{H}$ and $\vec{M}$.

4. What is nuclear reactor? With well labeled diagram explain the working principle of nuclear reactor.

OR

The half-life of radon is 3.8days. After how many days will only 1/20 of radon sample be left over?

5. What is motional emf? Show that the emf generated in a loop moving in static magnetic field is equal to rate of change of flux through it.

SECTION "C"
[5 Q.×5=25 marks]

6. Find the electric field a distance z above the centre of flat circular disc of radius R which carries a uniform surface charge σ. What does your formula becomes when $R \to \infty$? Also check the case $z >> R$.

OR

A spherical cavity of radius R is made inside a uniformly polarized dielectric medium. Calculate the electric field at the center of spherical cavity due to the bound charges on the cavity surface and hence obtain the Clasius-Mossotti equation.

7. Discuss the Langevin's theory of diamagnetism and hence derive an expression for the magnetic susceptibility of diamagnetic material.

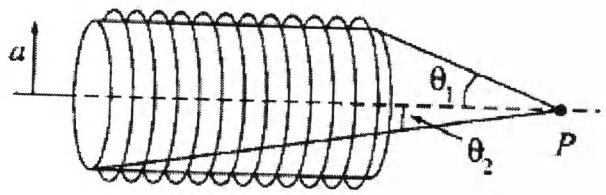
8. Define self-inductance? Obtain an expression for energy stored in magnetic field and hence show that magnetic energy density in space is equal to $\frac{1}{2\mu_o} B^2$.

OR

What do you mean by Raman effect? Give the quantum mechanical explanation of it. Write three characteristics of Raman effect.

9. State and prove Poynting theorem.

10. Find the magnetic field at a point P on the axis of a tightly wound solenoid consisting n turns per unit length wrapped a cylindrical tube of radius a, carrying steady current I. Express your answer in terms of θ_1 and θ_2. Consider the turns to be essentially circular. What is the field on the axis of infinite solenoid (infinite in both directions)?



OR

Find the electric potential inside and outside the uniformly charged spherical shell of radius R, which carries uniform surface charge σ.