BITS, PILANI- DUBAI

DUBAI INTERNATIONAL ACADEMIC CITY

Second Semester 20011-2012

COMPREHENSIVE EXAM

Class: I Year **Date:10.6.12**

Course No: PHY C132 **Course title: Physics II**

Time duration: 3 hours **Marks: 80** **Weightage: 40%**

All questions are compulsory

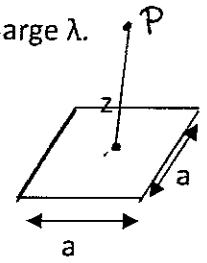
Useful data: $c=3\times10^{8}$ m/s; $\mu_o = 4\pi \times 10^{-7}$ N A^{-2}; $\varepsilon_O = 8.85 \times 10^{-12}$ F.m^{-1}; $h = 6.63 \times 10^{-34}$ J-s

$e = 1.602 \times 10^{-19}$ C; $m_e = 9.1 \times 10^{-31}$ kg ; 1e V= 1.6×10^{-19} J

$$\bar{\nabla}\cdot\bar{V} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 V_r) + \frac{1}{r\sin\theta}\frac{\partial}{\partial\theta}(\sin\theta\, V_\theta) + \frac{1}{r\sin\theta}\frac{\partial V_\phi}{\partial\phi}$$

$$\bar{\nabla}\times\bar{V} = \left[\frac{1}{s}\frac{\partial}{\partial\phi}V_z - \frac{\partial}{\partial z}V_\phi\right]\hat{s} + \left[\frac{\partial}{\partial z}V_s - \frac{\partial}{\partial s}V_z\right]\hat{\phi} + \frac{1}{s}\left[\frac{\partial}{\partial s}(sV_\phi) - \frac{\partial V_s}{\partial\phi}\right]\hat{z}$$

Q1. Find the electric field at a distance 'z' above the center of the square loop (side a) carrying uniform line charge λ. (9)



Q2. A point charge 'q' is embedded at the center of the sphere of linear dielectric material with susceptibility 'χ_e' and radius 'R'. Find the electric displacement, polarization and the bound charge densities ρ_b and σ_b. What is the total charge on the surface? (10)

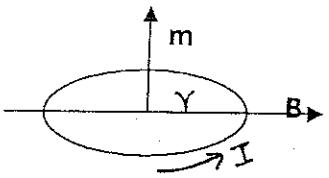
Q3. An infinitely long cylinder of radius 'R' carries magnetization parallel to the axis $\mathbf{M} = 3ks^3\hat{z}$, where 'k' is a constant and 's' is the distance from the axis. (9)

a) Calculate J_b and K_b.

b) Calculate the total bound current.

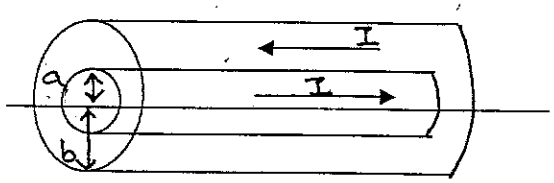
c) Find the magnetic field due to '**M**' for point inside and outside the long cylinder.

Q4. A circular coil 0.05 m in radius with 30 turns of wire , lies in a horizontal plane as shown in the figure. It carries a current of 5.00 amperes in a counterclockwise sense when viewed from above. The coil is in a uniform magnetic field directed to the right , with magnitude 1.2 Tesla. Find the magnitudes of the magnetic moment and the torque on the coil. (9)

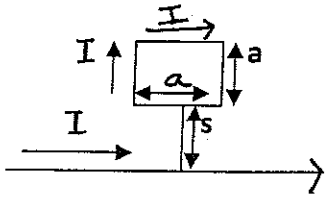


Q5. A square loop of wire , with sides of length 'b', lies in the first quadrant of the xy plane, with one corner at the origin. In this region there is a non-uniform time dependent magnetic field $\mathbf{B}(y,t) = ky^2t^2\hat{z}$ (where 'k') is a constant. Find the e.m.f. induced in the loop. (9)

Q6. A long co-axial cable carries current 'I' which flows down the surface of the inner cylinder of radius 'a', and back along the outer cylinder of radius 'b' as shown in the figure. Find the magnetic energy stored in a section of length 'l'. Hence calculate the self- inductance of the cable.(9)



Q7. Find the force on a square loop placed as shown below, near an infinite straight wire. Both the loop and the wire carry a steady current I (9)



Q8. In an experiment on Compton effect, X-rays of wavelength 10pm are scattered from an electron. (9)

a) Find the wavelength of the X-rays scattered through 45°.
b) Find the maximum kinetic energy of the recoil electron.

Q9. a) If the work function for a metal is 1.85 e V , what would be the stopping potential for light having a wavelength of 410nm? What would be the maximum speed of the emitted photoelectrons at the metal surface?(4)

b) A microscope using photons is employed to locate an electron in an atom to within a distance of 12pm. What is the minimum uncertainty in the momentum of the electron located in this way? (4)

BITS, PILANI- DUBAI

DUBAI INTERNATIONAL ACADEMIC CITY

Second Semester 20011-2012

TEST 2 – Regular (Open book)

Class: I Year **Date:16.05.12**

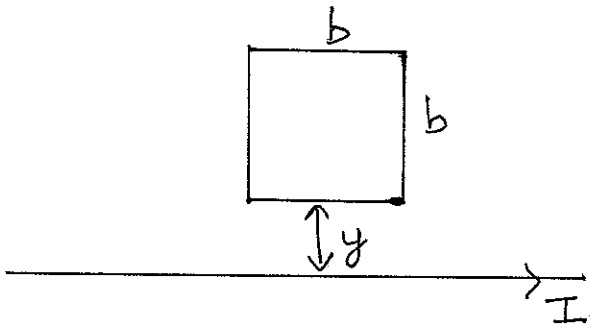
Course No.: PHY C132 **Course title: Physics II**

Time duration: 50 min. **Marks: 40** **Weightage: 20%**

Q1. A square loop lies at a distance 'y' above a long straight wire, which carries a current 'I'.

a) Find the flux of the magnetic field through the loop.
b) The loop is pulled directly away from the wire at a speed 'v'.
What will be the e.m.f. generated and in what direction will the current flow.
c) What happens if the loop is pulled to the right at a speed ' v ', instead of away.

(15)



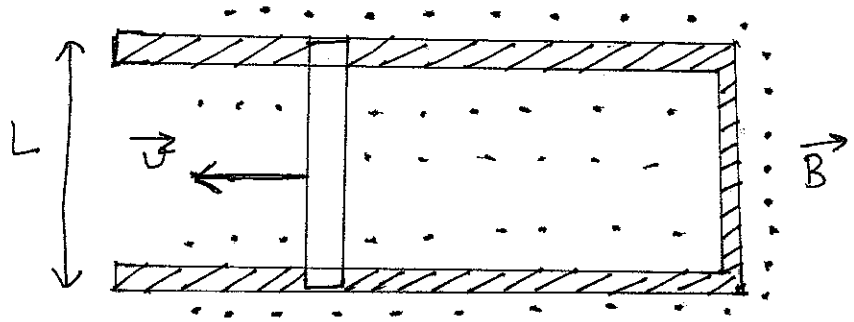
Q2. A) The following figure shows a conducting rod of length 'L' being pulled along horizontal, frictionless, conducting rails at a constant velocity '**v**'. A uniform vertical magnetic field '**B**' fills the region in which the rod moves. Assume that L= 10.8 cm, **v** = 4.86m/s and **B** = 1.18T.

a) Find the induced e.m.f. in the rod.
b) Calculate the current in the conducting loop.

Assume that the resistance of the rod is 415 mΩ and that the resistance of the rails is very small.

c) At what rate does the internal energy of the rod increase .
d) Find the force that must be applied by an external agent to the rod to maintain its motion.
e) At what rate does this force do work on the rod.

(5)



B) If a magnetic field **H**= $3a_x + 2a_y$ A/m exists at a point in free space, calculate the magnetic flux density at that point Given $\mu_o = 4\pi \times 10^{-7}$ H/m. (5)

Q3. An infinitely long cylinder of radius R has a magnetization parallel to the axis.

$$\mathbf{M} = ks^2\hat{z}$$

Where k is a constant and s is the distance from the axis. There is no free current anywhere.

a) Calculate the bound currents $\mathbf{K_b}$ and $\mathbf{J_b}$.
b) Use Ampere's law to find the auxillary field **H** and then obtain **B** inside and outside the cylinder.

(15)

BITS, PILANI- DUBAI

DUBAI INTERNATIONAL ACADEMIC CITY

Second Semester 20011-2012

TEST 1 – Regular (Closed book)

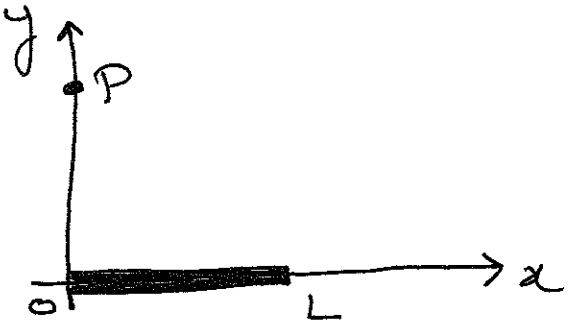
Class: I Year **Date:28.03.12**

Course No.: PHY C132 **Course title: Physics II**

Time duration: 50 min. **Marks: 25** **Weightage: 25%**

Use: $\bar{\nabla}.\bar{v} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 v_r) + \frac{1}{r\sin\theta}\frac{\partial}{\partial\theta}(\sin\theta\, v_\theta) + \frac{1}{r\sin\theta}\frac{\partial v_\phi}{\partial\phi}$

Q1. On a thin rod of length 'L' lying along the x- axis with one end at the origin (x=0), as shown in the figure, there is distributed,a charge per unit length given by $\lambda = kr$, where k is a constant and r is the distance from the origin. Taking the electrostatic potential at infinity to be zero, find V at a point P on the y- axis.(5M)



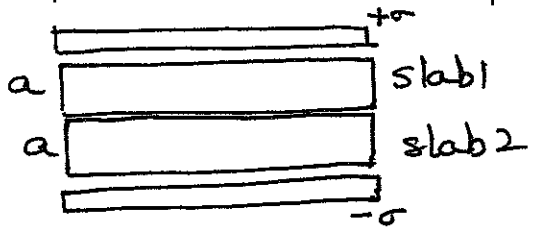
Q2. A sphere of radius R carries a polarization $\mathbf{P(r)} = k\,\mathbf{r}$, where k is a constant and **r** is the vector from the center. (5M)

a) Calculate the bound charges σ_b and ρ_b .
b) Find the field inside and outside the sphere.

Q3 The space between the plates of a parallel plate capacitor (as shown in the figure) is filled with two slabs of linear dielectric material. Each slab has thickness 'a' ,so the total distance

between the two plates is '2a'.Slab 1 has dielectric constant of 2 and slab 2 has dielectric constant of 1.5. The free charge density on the top plate is σ and on the bottom plate is –σ. (5M)

a) Find the electric displacement **D** in each slab.
b) Find the electric field **E** in each slab.
c) Find the polarization **P** in each slab.
d) Find the potential difference between the plates.



Q4. Three spherical cavities of radii a ,b and c are hollowed out from the interior of a conducting sphere of radius 'R'. At the center of each cavity a point charge is placed , call these q_a ,q_b and $-q_c$. (5M)

a) Find the surfaces charges σ_a ,σ_b ,σ_c and σ_R.
b) What is the field outside the conductor.
c) What is the field within each cavity.

Q5. Two charges 25.5n C and 17.2 n C are separated by a distance 14.6cm. Where on the line joining these two charges should a third charge of -19.2n C be placed so that the energy of the system is zero.(5M)

BITS, PILANI – DUBAI

1st Year, SECOND SEMESTER 2011 – 2012

QUIZ - 2

Course Code:	**PHY C132**	Date:	**25.04.2012**
Course Title:	**Physics 2**	Maximum Marks:	**14**
Duration:	**20 minutes**	Weightage:	**7%**

Name _____

ID No: _____ **Program:** _____ **Section** _____

Instruction : ***Answer all the questions.***

Q 1. There will be a force of attraction between two current carrying conductors if the currents are in :

a) Same direction
b) Opposite direction
c) None of these
d) Cannot say

Q 2. Lorentz force equation comprises of :

a) Mechanical and Chemical forces
b) Electric and magnetic forces
c) Both a and b
d) None of these

Q 3. Magnetic dipole moment is a product of:

a) Current and area
b) Area and its direction
c) Current, Area and its direction
d) None of these

Q 4. Ampere's law is analogous to:

a) Lenz's law
b) Coulomb's law
c) Biot -Savart law
d) Faraday's law

Q 5. What can be obtained from magnetic vector potential:

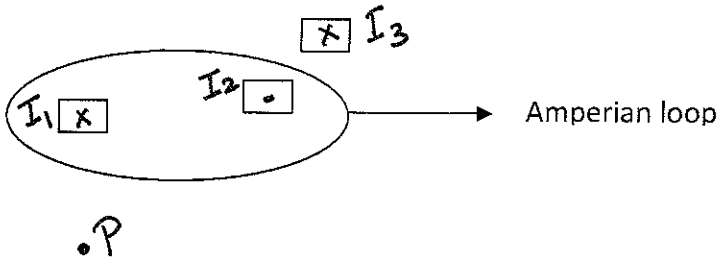
a) $\vec{B}$
b) $\vec{H}$
c) Both a and b
d) None of these

Q 6. Magnetization is defined as:

a) Volume/Dipole moment
b) Dipole moment/Volume
c) Dipole moment X Volume
d) None of these

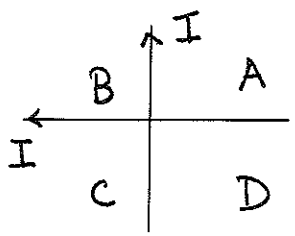
Q 7. The sketch below shows three wires carrying currents I_1 ,I_2 and I_3 with an Amperian loop drawn around I_1 and I_2 . The wires are all perpendicular to the plane of the paper. Which currents produce the magnetic field at a point P.

a) I_3 only
b) I_1 and I_2 only
c) I_1 ,I_2 and I_3
d) None of these



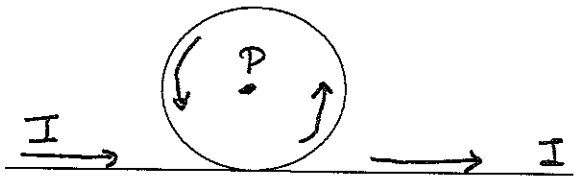
Q 8. Two wires carrying equal currents are perpendicular to each other as shown. The largest magnitude of magnetic field pointing out of the paper is in region:

a) A
b) B
c) C
d) D



Q 9. Write the expression for Biot- Savart Law in terms of volume current density J.

Q 10. Find the magnitude and direction of the magnetic field at a point P generated by the current carrying wire and loop as shown.



Q 11. What is the magnetic field inside a solenoid (n turns per unit length, current I) if it's filled with linear material of susceptibility χ_m .

BITS, PILANI – DUBAI

1st Year, SECOND SEMESTER 2011 – 2012

QUIZ - 1

Course Code:	**PHY C132**	Date:	**7.03.2012**
Course Title:	**Physics 2**	Maximum Marks:	**16**
Duration:	**20 minutes**	Weightage:	**8 %**

Name _____

ID No: _____ **Program:** _____ **Section** _____

Instruction : ***Answer all the questions.***

Q1. Find the gradient of the function $f(x,y,z) = e^x \sin(y)\ln(z)$ and divergence of the vector function

$$\mathbf{v_c} = y^2\hat{x} + (2xy + z^2)\hat{y} + 2yz\,\hat{z}$$

Q2. State the Stoke's theorem.

Q3. A square frame of edge 10cm is placed with its positive normal making an angle of 60° with a uniform electric field of 20V/m. Find the flux of the electric field through the surface bounded by the frame.

Q4. The electric field in a region is radially outward with magnitude E=Ar. Find the charge contained in a sphere of radius 'a' centered at the origin. Take A= 100V/m^2 and a=20.0cm.

Q5. Find the electric field a distance 's ' from an infinitely long straight wire which carries a uniform line charge λ. Use Gauss's law.

Q6. If the flux of the electric field through a closed surface is zero, then what will be the charge inside the surface and what will be the electric field on the surface.

Q7. Two point charges are placed on the y axis as follows: Charge q_1 =-1.5 nC at y= -0.6m and charge q_2 =+3.2 nC at the origin. What is the total force exerted by these two charges on the third charge q_3 =+5.0 n C located at y=-0.4m.

Q8. A closed surface encloses a net charge of -3.6μC .What is the net flux through the surface?