STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.

(For candidates admitted during the academic year 2004-05 & thereafter)

SUBJECT CODE : **PH/MC/EM54**

B.Sc. DEGREE EXAMINATION NOVEMBER 2007
BRANCH III - PHYSICS
FIFTH SEMESTER

REG. No._____

COURSE : **MAJOR – CORE**
PAPER   : **ELECTRICITY AND MAGNETISM**
TIME   : **30 MINS.**   MAX. MARKS : **30**
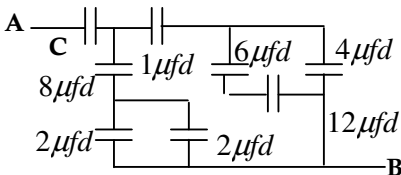
SECTION – A

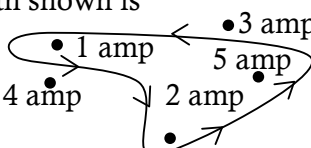**TO BE ANSWERED IN THE QUESTION PAPER ITSELF**

ANSWER ALL QUESTIONS: (30 x 1 = 30)

I   CHOOSE THE CORRECT ANSWERS:

1.   The spacing of electric field lines indicates
       a) the magnitude and direction of the field
       b) the direction of the field
       c) the magnitude of the field

2.   The flux through a closed spherical surface of radius 'a' in a uniform electric field E is
       a) $4\pi a^2 E$ b) $\pi a^2 E$ c) zero

3.   If the equivalent capacitance between A and B is 1 μ fd as shown in the figure, then the value of C is
       a) 32/9 μ fd
       b) 32/23 μ fd
       c) 9/32 μ fd

4.   The work done in carrying a charge 'q' once round a circle of radius 'r' with a charge 'Q' at the centre is
       a) $\dfrac{qQ}{4\pi\varepsilon_0 r}$ b) $\dfrac{qQ}{4\pi\varepsilon_0}\dfrac{1}{2\pi r}$ c) zero

5.   The net charge inside a polarized dielectric is
       a) positive   b) zero   c) negative

6.   The path of a charge in a transverse electric field is a
       a) straight line   b) parabola   c) circle

7.   The magnetic field outside an infinite solenoid
       a) is zero   b) is infinity   c) has a finite value

8. The magnetic field B in terms of the vector potential A is equal to
   a) $\nabla \cdot \mathbf{A}$ b) $\nabla \times \mathbf{A}$ c) $\nabla\ \mathbf{A}$

9. The value $\oint \mathbf{B.ds}$ for the path shown is

   a) $-8\pi \times 10^{-7}\,Tm$

   b) $8\pi \times 10^{-7}\,Tm$

   c) $32\pi \times 10^{-7}\,Tm$

10. An electric current exists in a long wire. At a distance of 2m from the wire the magnetic field is $0.2wb/m^2$. Then the field at a point 4m from the wire is
    a) $0.4wb/m^2$ b) $0.1wb/m^2$ c) $0.05wb/m^2$

11. The force on a magnetic dipole in a magnetic field is
    a) $(\nabla \cdot \mathbf{p})\mathbf{B}$ b) $(\mathbf{p.B})\nabla$ c) $(\mathbf{p.}\ \nabla)\mathbf{B}$

12. If S be the boundary surface between two magnetic media of permeabilities μ_1 and μ_2 and magnetic fields $\mathbf{B_1}$ and $\mathbf{B_2}$.
    a) The normal component of **B** is continuous
    b) The tangential component of **B** is continuous
    c) $\mathbf{B_1} = \mathbf{B_2}$
    across the interface.

13. When the magnetization of a material is uniform, then
    a) only J_b is effective
    b) only λ_b is effective
    c) both J_b and λ_b are effective
    where J_b and λ_b are volume and surface bound current densities respectively.

14. An LCR circuit is executing resonant forced oscillations under an external emf $E=E_0 sinpt$. The work done by the external emf is equal to the
    a) Maximum energy of the electric field
    b) Maximum energy of the magnetic field
    c) Heat produced in R.

15. A and B are two galvanometers that require a current of 4×10^{-3} mA and 2×10^{-3} mA respectively to produce unit deflection. Then
    a) A is more sensitive than B
    b) B is more sensitive than A
    c) both are equally sensitive.

II   FILL IN THE BLANKS:

16. The equi potential surfaces near a point charge are _____.

17. If the voltage across a capacitor is doubled the energy stored changes by a factor of _____.

18.   Ampere's law in terms of magnetizing field intensity is _____.

19.   The permeability of a medium is the ratio of _____.

20.   The growth and decay of current in L-R circuit is _____.

III   STATE WHETHER TRUE OR FALSE:

21.   A point in space can have a non zero potential even when the electric field in the space is zero.

22.   Gauss' law inside a dielectric is $\nabla . \mathbf{E} = \rho / \varepsilon_0$

23.   A magnetic field cannot change the kinetic energy of a moving charge.

24.   The magnetic field produced by a circular coil of wire of single turn carrying a current i amp at the centre is doubled when it is bent to give a double loop with the same current.

25.   The magnetic susceptibility of free space is zero.

IV   ANSWER BRIEFLY:

26.   What are linear dielectrics?

27.   State Biot and Savart law.

28.   What is the physical significance of (i) div B=0 (ii) curlB $\neq$ 0?

29.   Distinguish between bound currents and free currents.

30.   Define current sensitivity and charge sensitivity of a ballistic galvanometer.

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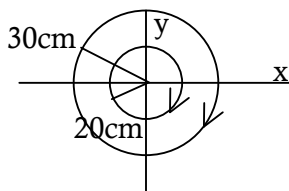
B.Sc. DEGREE EXAMINATION NOVEMBER 2007
BRANCH III - PHYSICS
FIFTH SEMESTER

COURSE   :   **MAJOR – CORE**
PAPER   :   **ELECTRICITY AND MAGNETISM**
TIME   :   **2 ½ HOURS**   MAX. MARKS : **70**

SECTION – B

ANSWER ANY FIVE QUESTIONS: (5 x 5 = 25)

1.   The space between the conductors of a long coaxial cable used to transmit TV signals has an inner radius a=0.15mm and an outer radius b=2.1mm. What is the capacitance/unit length of this cable?

2.   Two oppositely charged parallel plates have an area of $1m^2$ and are separated by 0.01m. The potential difference between the plates is 100V. Find (a) the field between the plates and (b) the magnitude of the charge on a plate.

3.   Earth's magnetic field is 5×10^{-5}T. A cable is 10m above the ground. Calculate the current in the cable so that it may produce a neutral point with earth's magnetic field on the surface of the earth just below it.

4.   A straight horizontal segment of copper wire carries a current i=28amp. What is the magnitude and direction of the magnetic field needed to 'float' the wire? Linear mass density of the wire =46.6gm/m.

5.   The magnetic susceptibility of gold is -3.6×10^{-5}. What is its relative permeability? Calculate the magnetization **M** and the magnetic intensity **H** in a sample of gold when the magnetic induction **B** is 0.08 Tesla.

6.   Two concentric circular loops, radii 20cm and 30cm in the xy plane each carry a clockwise current of 7amp. as shown in the figure.
a) Find the net magnetic moment of the system.
b) If the current in the outer loop is reversed, what would be its resultant magnetic moments?

7.	A solenoid having a resistance of 5ohms and self inductance of 4H is connected to a battery of emf 10V and negligible resistance. After how long will the current in it rise to 1 amp?

SECTION – C

ANSWER ANY THREE QUESTIONS:			(3 x 15 = 45)

8.	a) State and prove Gauss' law in Electrostatics.
	b) Use the law to find the field due to a line charge.

9.	a) Find an expression for the capacity per unit length of two coaxial cylinders placed in air. What is the effect of introducing a dielectric between them.
	b) Show that when two capacitors are joined in parallel, the system has four times the capacity of that obtained when they are joined in series.

10.	a) What is solenoid?
	b) Derive expression for the magnetic field due to a long solenoid.

11.	a) State Gauss' law and Ampere's circuital law in magnetism.
	b) Use these to establish the boundary conditions for **B** and **H** across an interface.

12.	Describe with necessary theory an experiment to determine
	a) the current sensitivity and
	b) the charge sensitivity
	of a ballistic galvanometer.

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