BENNETT UNIVERSITY

POSSESSION OF MOBILE IN EXAMINATION IN UFM PRACTICE

Name of Student ---------- Enrolment No. ----------

Department ----------

BENNETT UNIVERSITY, GREATER NOIDA

Mid Term Examination, FALL SEMESTER 2018-19

COURSE CODE: **EPHY203L** MAX. DURATION: **ONE HOURS**

COURSE NAME: **Electrodynamics**

COURSE CREDIT: **3-1-0** MAX. MARKS: **30**

Note:

- This question paper contains **FOUR** questions.
- All the questions are compulsory.
- Marks of each question are indicated next to it.
- Rough work must be carried out at the back of the answer script.
- Do not **derive** an expression **unless explicitly asked** in the question. When the question is "**Write** an expression for ....", the derivation of the same is **NOT** required.
- Please write precisely and neatly. Please make clear diagram wherever required.
- Use of calculator is allowed.

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1. a) Describe specifically the Maxwell's contribution in the Maxwell equations. 3 Marks

   b) Which statement is incorrect expression for $\vec{E}$ and $\vec{B}$ field at the boundary 2 Marks

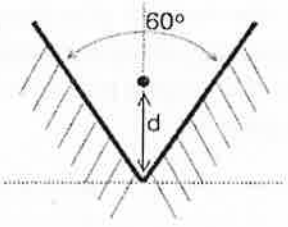
   i. $E^{\perp}_{above} - E^{\perp}_{below} = \frac{\sigma}{\epsilon_0}$

   ii. $E^{||}_{above} - E^{||}_{below} = \frac{\sigma}{\epsilon_0}$

   iii. $B^{\perp}_{above} - B^{\perp}_{below} = 0$

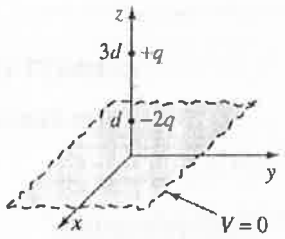
   iv. $B^{||}_{above} - B^{||}_{below} = \mu_0 K$

2. a) Two grounded semi-infinite conducting planes meet at angle of 60° between them as shown below. A charge q is placed at a point midway between these planes at a distance d from their line of intersection.



Obtain the image charges (other than the real charge q) and their locations to satisfy the boundary conditions (Just draw this arrangement). 4 Marks

b) Find the force on charge $+q$ in the following arrangement. Shaded area (in the x-y plane) shown in the figure is grounded 2-d infinite conducting plane. 4 Marks



c) A one-dimensional wire of 5.0 meter is maintained at V = 4.0 volt and one end and V= 0 volt at another end. Obtain the expression for the potential variation within the wire. 2 Marks

3. The general solution of Laplace equation for potential V in spherical polar coordinate system with azimuthal symmetry is given as

$$V(r,\theta) = \sum_{l=0}^{\infty} \left(A_l r^l + \frac{B_l}{r^{l+l}} \right) P_l(cos\theta),$$

where $P_l(x)$ are Legendre polynomials, which can be obtained using Rodrigues formula:

$$P_l(x) = \frac{1}{2^l l!} \frac{d^l}{dx^l} (x^2 - 1)^l.$$

These Legendre polynomials also satisfy following orthonormality condition:

$$\int_{-1}^{1} P_l(x) P_{l'}(x) dx = 0 \quad if\ l' \neq l$$

$$= \frac{2}{2l+1} \quad if\ l' = l$$

a) Specify the conditions on coefficients A_l and B_l for potential *inside* and *outside* the hollow sphere. 2 Marks

b) Now consider a hollow sphere of radius R with the potential on the surface is specified as 6 Marks

$$V_0(\theta) = \frac{k}{2}(1 - \cos\theta).$$

Obtain the potential inside the hollow sphere.

4. a) In the method of images, induced surface charge density on a 2-d grounded infinite conducting plane (lying in the x-y plane) due to point charge q placed at a distance d from the plane (in z-direction) is given as 4 Marks

$$\sigma(x,y) = -\frac{qd}{2\pi(x^2 + y^2 + d^2)^{\frac{3}{2}}}.$$

Obtain the total induced charge on the plane.

b) A thick spherical shell (inner and outer radius a and b, respectively) carries charge density as 3 Marks

$$\rho(r) = \frac{k}{r} \quad (a \leq r \leq b).$$

Find the electric field within the shell. Also find the total charge enclosed within the shell.

.....Paper Ends.....