Indian Institute of Technology

Date..... Time **2 hours**..Full Marks...**60**..... No. of Students:...**4**.....
Mid-**Spring** Semester **2009-10** Dept **Geology and Geophysics** Subject No **EX40008**...
1st year M. Sc. (Geophysics) Subject name **Time varying field and EM methods**

Instruction: Answer all the questions.

1. Write short answer of the following questions. (20)
   i) Based on EM induction phenomenon, which electromagnetic method uses the highest frequency? Write its frequency range.
   ii) Write the phase difference between the induced current and secondary field. Does frequency of the Secondary field changes with respect to the Primary field after EM induction in the earth.
   iii) What are the limitations of Fixed vertical loop EM survey?
   iv) Over which type of conductor EM field is nearly circularly polarized? What will be the ratio of real to imaginary components of resultant field for a good conductor?
   v) What will be the amplitude of EM wave after traveling 50 m depth in a homogeneous medium when the skin depth in the medium is 25 m?
   vi) What is the similarity between electrical and EM methods?
   vii) Draw a comparative diagram of the dip angle profile over a vertical and dipping conductor? Show the dip direction of conductor on the diagram.
   viii) What will be the velocity of EM wave when it travels in the earth subsurface?
   ix) Which EM method has the deepest depth of exploration? Write the source of primary field for this method.
   x) How does VLF method overcome the limitation of AFMAG method?

2. Discus basic principle of VLF method? Which quantity is measured in VLF- magnetic field mode measurement? Mention the limitations of this method. (8)

3. Prove elliptical polarization of the resultant field in EM prospecting. Mathematically show that phase difference between induced emf and induced current will be 0 degree for a poor conductor. (8)

4. Draw a compensating network diagram and show mathematically how the cancel the primary field at receiver station. If there is any limitation of your compensating network, then mention it. (8)

5. Solve the diffusion equation over homogeneous half-space for a vertically downward travelling sinusoidal EM wave. Show that both amplitude and phase will change as wave travels downward. (8)

6. Prove that:

$$\nabla^2 \vec{E} = \mu\sigma \frac{\partial \vec{E}}{\partial t} + \mu\varepsilon \frac{\partial^2 \vec{E}}{\partial^2 t} \qquad (8)$$

S.P. Sharma