RAMAKRISHNA MISSION VIDYAMANDIRA
(Residential Autonomous College under University of Calcutta)
THIRD YEAR
B.A./B.SC. FIFTH SEMESTER (July – December), 2012
Mid-Semester Examination, September 2012

Date : 13/09/2012

Time : 2 pm – 3 pm

PHYSICS (Honours)
Paper : VI

Full Marks : 25

Answer five questions taking at least one from each group.

Group -A

1. a) Distinguish between $\vec{E}$ and $\vec{D}$. A parallel plate capacitor is filled with linear dielectric of dielectric constant ε and carries a charge Q, Find $\vec{D}$.

b) Find an expression of energy when capacitor of capacitance C is charged from Q = 0 to 3C and force between the plates in above capacitor. 3+2

2. a) Consider long straight wire carrying current I. Show that $\vec{\nabla} \times \vec{B} = \mu_o \vec{J}$. Prove that for steady current $\vec{\nabla} \cdot \vec{J} = 0$.

b) An infinite metal sheet lying in X-Y plane carries a surface current $j_s = j_o \hat{y}$. Find the magnetic field in region above and below the sheet. $y\hat{y}$ is unit vector along Y. 3+2

3. a) An electromagnetic wave of frequency ω is propagating along z-axis where the amplitudes of electric field and magnetic field are same. Write E and H for this wave and find the relation between ω and wave vector k.

b) Write the Maxwell's equations and show that electric field in free space satisfies the wave equation. 3+2

Group -B

4. Describe the function of a time base generator in a CRO.

Discuss how a CRO may be used to measure the phase difference between two ac signals and the frequency of an ac signal. 2+3

5. Define amplitude modulation. Obtain an expression for an amplitude modulated wave. Find out the frequency components present in AM wave. 1+2+2

6. Define modulation index in AM wave. The total power content of an AM wave is 4.72 kW and the index of modulation is 0.6. Find the power of the carrier and side bands. What is SSB transmission ? 1+3+1

Group -C

7. a) An amplifier has a voltage gain of 200 without feedback. The gain is reduced to 20 when a negative feedback is applied. Determine the value of feed-back-factor. 2

b) An amplifier has a mid frequency gain of 100 and bandwidth 50 kHz. A negative feedback is applied with feed-back-factor 0.04 in this amplifier. Find the bandwidth of the amplifier with feedback. 3

8. a) Draw a block diagram of a feed back amplifier. 1

b) Find the relation between closed and open loop gain in above amplifier 3

c) Give only one major advantage of using negative feedback. 1

9. Find an expression of short circuit current gain of a n-p-n transistor and command on which factors the high frequency response of a transistor depends. 4+1

10. a) Find an expression for low frequency voltage gain in a common emitter transistor amplifier, with an input capacitor and emitter short circuited to ground.
Explain, what will be the modification of its voltage gain if an emitter resistance and a bypass capacitor is present in the amplifier circuit. 4+1