RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. FIFTH SEMESTER EXAMINATION, DECEMBER 2012

THIRD YEAR

Date : 21/12/2012 **PHYSICS (Honours)**

Time : 11 am – 1 pm Paper : VI Full Marks : 50

[Use separate Answer Book for each group]

Group – A

(*Answer **any two** questions*)

1. a) Assuming that there is no accumulation of free charge, write Maxwell's equations in a conductor. 2

   b) Derive the energy balance equation $\frac{\partial u}{\partial t}+\vec{\nabla}.\vec{S}=-\vec{E}.\vec{J}$ where symbols have their usual meanings. Show that $\vec{S}$ represents the energy flow/area. 4

   c) An alternating current ($I=I_0 \sin\omega t$) is flowing through a long straight wire. Find the direction of $\vec{E},\vec{B}$ and $\vec{S}$ and show that the electromagnetic energy flowing into wire is the Joule's heat. 4

2. a) A plane electromagnetic wave is incident normally on a metal of electrical conductivity σ. Show that the electromagnetic wave is damped inside the conductor and find the expression of skin depth. 4

   b) Show that in conducting medium the dielectric constant is complex. Discuss why a good metal has high reflective property. 4

   c) The power density of solar radiation reaching earth is $1\times10^3 W/m^2$. Find the r.m.s. value of $\vec{B}$ 2

3. a) State the laws to which Maxwell's equations are related. 2

   b) Give Ampere's law of magnetomotive force. What is the defect of this law? How is it modified by incorporating the concept of displacement current? 4

   c) Show that the time average of the energy density in the case of a monochromatic plane wave in free space is shared equally between electric and magnetic fields. 4

Group-B

(*Answer **any three** questions*)

4. a) Draw the circuit diagram of a small signal single-stage low-frequency transistor amplifier in the CE-mode with proper biasing. Obtain expressions for current gain, input resistance and voltage gain. 8

   b) Discuss the high-frequency effects in a transistor. 2

5. a) With the help of a block diagram, explain the working principle of a feedback amplifier. Derive an expression for voltage gain with negative feedback. 5

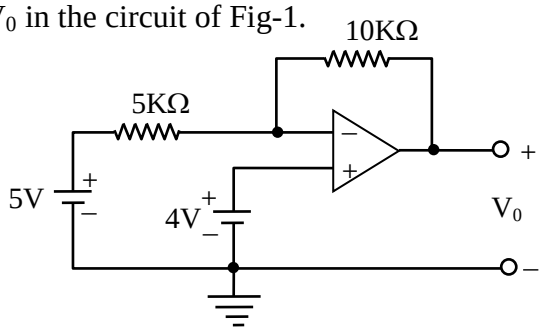
   b) Draw the circuit diagram of an emitter follower and explain the nature of feedback in this circuit. 3

   c) An amplifier has a voltage gain of -100. The feedback ratio is -0.04. Find the voltage gain with feedback and the output voltage of the feedback amplifier for an input voltage of 25 mV. 2

6. a) What are Barkhausen criteria? Draw the circuit diagram of a Wien-bridge oscillator and explain its action. Derive the frequency of oscillation. 5

   b) Draw the circuit diagram of an inverting amplifier using an OP AMP. Discuss the existence of a virtual ground at the input of the proper amplifier. 3

   c) Calculate the voltage V_0 in the circuit of Fig-1. 2



7 a) Distinguish between a combinational circuit and a sequential circuit. 2

b) What is an RS flip-Flop? Give its logic symbols and the truth table. Show how the basic RS flip-flop can be obtained using NAND gates only. 5

c) What is RAM? Explain the operation of a 1-bit RAM. 3

8. a) Obtain an expression for an amplitude modulated wave. Define amplitude modulation index. 2+1

b) The maximum and minimum value of amplitudes of a modulated wave are 1.6V and 0.4V. Find out the index of modulation. 2

c) Draw the circuit diagram of a linear diode detector. Obtain an expression for amplitude frequency output of the detector. 2+3