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EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE – 2012/2013

SECOND SEMESTER (PROPER/REPEAT)

(AUGUST/SEPTEMBER 2015)

PH 104 AC THEORY

Time: 01 hour

Answer ALL Questions

1.

(a) A series circuit consists of a capacitor C, resistor R and a battery of e.m.f E. The capacitor is initially uncharged. Show that after a time t the capacitor carries a charge Q is given by,

$$Q = Q_0\left[1 - exp^{\left(-\frac{t}{CR}\right)}\right]$$

where Q_0 is the final charge of the capacitor.

(b) A 20 μF capacitor is connected in series with a 1 MΩ resistor and a 100 V battery. Calculate,

i. the initial charging rate;

ii. the charging rate when the capacitor is charged to one-fourth of the final charge and

iii. the time constant of the circuit.

Illustrate the variation of charge versus charging time for various time constants.

2.

(a) Derive an expression for the alternating current in an LCR series circuit. Hence, explain resonance in the circuit and obtain an expression for resonance frequency in terms of L and C.

(b) A series LCR circuit has L= 200 mH, C= 1.25 μF and R= 400 Ω. The circuit is connected to an AC source with r.m.s voltage 250 V and frequency 500 Hz. Calculate,

i. the reactance of inductor;

ii. the reactance of capacitor;

iii. the total impedance and

iv. the r.m.s current through the circuit

Suppose if the frequency of the AC source can be varied, then find,

v. the resonance frequency;

vi. the impedance of the circuit at resonance and

vii. the r.m.s potential difference across each circuit component at resonance.