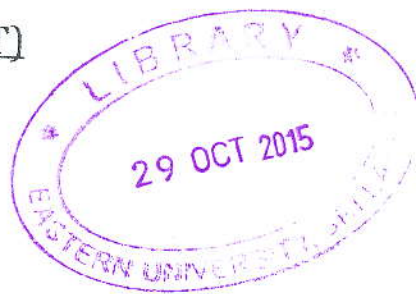


EASTERN UNIVERSITY, SRI LANKA  
FIRST EXAMINATION IN SCIENCE - 2012/2013

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  $20 \mu\text{F}$  capacitor is connected in series with a  $1 \text{ M}\Omega$  resistor and a  $100 \text{ V}$  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  $L = 200 \text{ mH}$ ,  $C = 1.25 \mu\text{F}$  and  $R = 400 \Omega$ . The circuit is connected to an AC source with r.m.s voltage  $250 \text{ V}$  and frequency  $500 \text{ Hz}$ . 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.