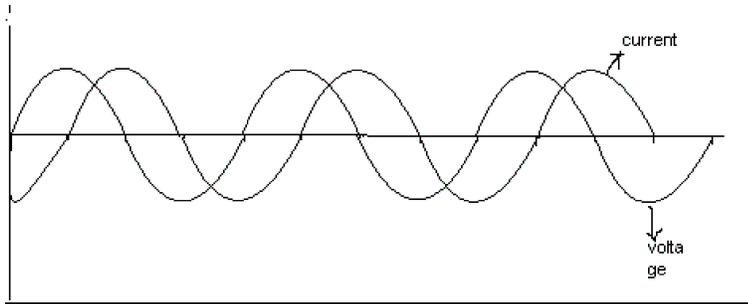


## Alternating current

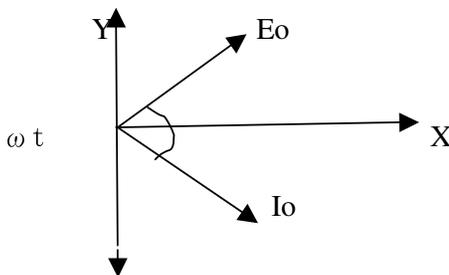
1. a) In a series LCR circuit voltage across an inductor, a capacitor, and a resistor are 30v, 30v, and 60v respectively. What is phase difference between the applied voltage and current in the circuit



b) The figure shows the variation of V & I Vs wt for a circuit element connected to AC mains. Name the circuit element and phase relation between current and voltage. (11/2)

c) Explain the principle on which the metal detector is used at airport for security reason works.

2. In a tuner circuit of radio receivers an electrical circuit is familiar to you is used.
- Identify the circuit.
  - Deduce an expression for impedance of that circuit.
  - Explain the phenomenon which enables above circuit to select a particular frequency from a number of frequency.
  - Low cost radio sometime receives more than one station at a time.
3. What may be the problem associated with the tuner circuit of the radio? (1+2+2+1)  
The reactance of an inductor is 20 ohm
- What does it mean? (1 mark)
  - What will be its reactance if frequency of AC is doubled? (1 mark)
  - What will be its reactance when connected in DC circuit? (1 mark)
4. An inductor, capacitor, and resistor are connected in series to an A.C. source  $V = V_0 \sin \omega t$ .
- Draw a circuit diagram of LCR series circuit. (1 mark)
  - Draw the phasor diagram and find the expression for impedance (1 mark)
5. The phasor diagram of an AC circuit is given below. (a) What type of AC circuit gives this phasor diagram? Draw the diagram of the circuit. (1)

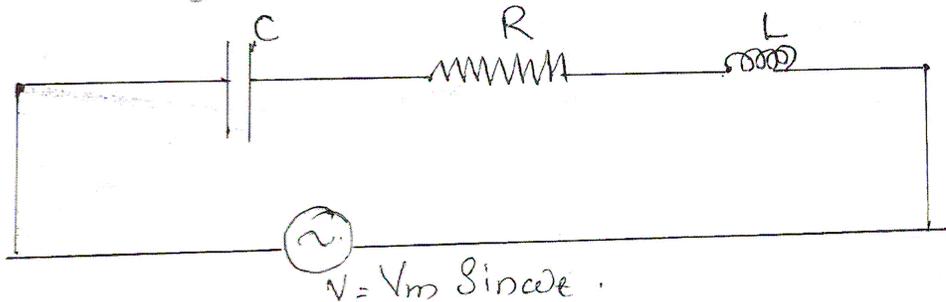


- What is the power through the given circuit? (1)
  - On the basis of power name the current flowing through the circuit? Explain. (2)
  - A capacitor is serially connected to the above circuit. Then at what condition maximum current flowing through it? Explain. (2) Total score: 6
6. Consider an AC flowing an inductor of inductance L
- Is there any ohmic resistance offered by the inductance Score: 1/2
  - What is the resistance offered by the inductor called and what is its expression. Score: 1
  - What is the power consumption in the circuit. Score: 1/2
7. In an AC circuit the current and voltage are not in phase always. The pd across inductor and capacitor are in

oppositedirections. Measure the pd in each element of an LCR circuit.

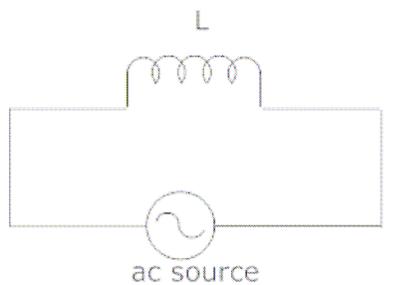
- (a) What is the relation between rms voltages across the three elements of an LCR circuit?
  - (b) Deduce the relation between the current and the applied e.mf with regard to magnitude and phase angle using vector diagrams.
  - (c) Define power factor of a circuit.
  - (d) Find the average power consumed in a circuit having a resistance of 25 ohm in series with an inductance of 50 milli henry in series with an AC of 50Hz, and peak voltage 220 volt. What is the total power and the power across each element in the circuit? [2+2+1+2=7]
8. In a tuner circuit of radio receives an electrical circuit is familiar to you.
- (a) Identify the circuit (1)
  - (b) Deduce an expression for impedance of the circuit (2)
9. An inductor and capacitor are connected in series to an AC source  $V = V_0 \sin \omega t$ .
- (a) Draw a circuit diagram of LC series circuit with applied AC voltage. 1
  - (b) Find the expression for impedance of LC series circuit using phasor diagram. 2
  - (c) Obtain the condition for resonance in the given circuit. 2
- 10.1) A train is running on meter gauge at a speed of 36km/hr. What will be the emf generated between the railway lines, if the vertical component of the earthfield  $4 \times 10^{-5} T$ ? (2)
- 2) An inductor, Capacitor and resistor are connected in series to an AC source.
- a) Draw a circuit diagram of LCR series circuit with the applied AC Voltage. (1)
  - b) Find the expression for impedance of the LCR circuit using Vector diagram. (2)
  - c) Draw the Phasor diagram corresponding to the condition  $X_L > X_C$ . (1)
  - d) Define Quality factor in an LCR circuit. (1)

An LCR circuit is given below



- a. If  $Q$  is the charge on the capacitor and  $I$  is the current. Write Kirchoff's loop rule equation at time  $t$ . (1½)
- 11.
- b. Obtain the expression for impedance of the above circuit (2)
  - c. The given circuit becomes a resonance circuit at 60Hz. Then its impedance is  $8 \Omega$  ~~When~~ <sup>When</sup> the frequency of the applied voltage is changed to 80Hz, impedance becomes  $10 \Omega$ . Find the values of  $L$  and  $C$ . (3½)
12. In a tuner circuit of radio receives an electrical circuit is familiar is your.
- a) Identify the device (1)
  - b) Deduce an expression for impedance of the circuit (2)

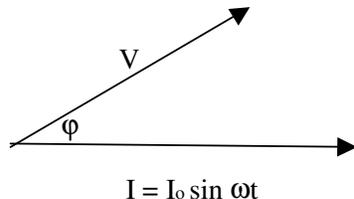
13.



- a) Show that in the above circuit voltage leads the current by  $\pi/2$ . (2)  
 b) Draw the phasor diagram showing the voltage current relation. (1½)  
 c) Obtain the resonant frequency of a series LCR circuit with  $L=2\text{H}$ ,  $C=32\mu\text{F}$  and  $R=10\ \Omega$  (1½)  
 14. a) Derive an expression for the impedance offered by an LCR circuit  
 b) What is the condition for maximum current in LCR circuit 2+2  
 15. (a) **What is the inductive reactance of a solenoid carrying dc? (1)**  
 (b) **Obtain the phase relation between current and voltage when ac flowing through a capacitor?(2)½**  
 (c) **What is the power factor of LCR circuit at resonance? (1)**  
 (d) **A bulb is connected in series with an ideal inductor. How the bulb glows if AC or DC. Is connected to the circuit?(1½)**  
 16. An inductor, capacitor and resistor are connected in series to an ac source  $v=v_0 \sin \omega t$   
 a. Draw a circuit diagram of the circuit. 1/2  
 b. LCR circuit behaves like a resistor only circuit. Is it possible. Why? 1  
 c. find the energy associated with an LCR circuit. 2½

17. Find the power in an L-C- R circuit  $X_L = X_C$

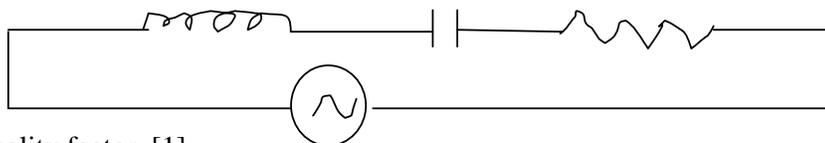
18. Write down the equation for Voltage from Phasor diagram



19. AC generator is a device used to produce emf.  
 a.) Which principle is used in AC generator? [score ½]  
 b.) What is the maximum value of emf generator? [score ½]  
 c.) Obtain the expression for emf ? [score 2]

20. The essential part of a radio receiver is LCR circuits  
 (a) Obtain an expression for current in such a circuit  
 (b) How Q – factor and resonant frequency relates?  
 (c) What is the power factor in such a circuit (2+1+2=5)

21.



- (a) Define quality factor. [1]  
 (b) Draw the phasor diagram for the above circuit. [1]  
 (c) What is impedance triangle? [1]  
 22a) In an A.C. circuit the voltages across inductor, capacitor and resistor are 30 V, 30 V and 60 V respectively. What is the phase difference between current and voltage across each element?  
 b) Show that the average power consumed by an a.c. circuit with capacitor only is zero. 1½

- c) If the current in the circuit is 3 A, and the frequency of A.C. is 50 Hz, Calculate  
 i) value of inductance , capacitance and resistance 1 ½  
 ii) frequency at which power factor of the circuit is unity. 1 (4)

- 23.(a) Represent a series LCR circuit to which ac voltage is applied.  
 (b) Give the impedance of the circuit.  
 (c) When do you think it will attain resonance.?[1+1+1]

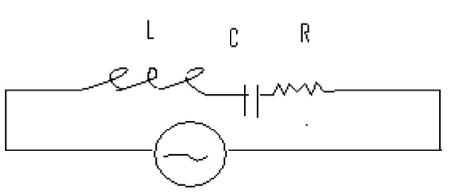
24 A resistance R, Capacitance C and inductance L are connected in series to an a.c source.

- (a) Draw the circuit diagram and show that the average power in the circuit is,  $\langle P \rangle = E I \cos \phi$

where  $\Phi$  is the phase angle.

- (b) What is the impedance of the circuit at resonance?  
 (c) What is the value of current at resonant frequency? (4)  
 25. In an ac circuit current is zero, when voltage is high.  
 a) Identify the circuit. (1)  
 b) Obtain the expression for current in the circuit. (3)

26.



- a) For the given circuit, derive the expression for current in the circuit.  
 b) Find the value of impedance at resonance.  
 c) Give the expression for resonant frequency. (3+1+1)  
 27. A sinusoidal voltage of peak value 283 Vand frequency 50 Hz is applied to a series LCR circuit in which  $R=3 \text{ Ohm}$ ,  $L=25.48\text{mH}$  and  $C=796 \text{ microfarad}$ . Find impedance of the circuit.  
 b. phase difference between voltage across the source and the current.  
 c. Power dissipated in the circuit.  
 d. power factor. (score 2+1+1+1)

**In a phasor diagram alternating voltages and currents are presented by rotating vectors along with the phase angle between them.**

28.  
 a) Draw the phasor diagram for an L-R circuit. (2)  
 b) Draw impedance triangle for L-C-R circuit (1)  
 c) Find power factor of an LCR circuit from the impedance triangle. (1)

28. Ramu peddles a stationary bicycle, the pedals of which are attached to a 100 turn coil of area  $0.10 \text{ sq.m}$ . The coil rotates at half a revolution in one second & it is placed in a uniform  $\mathbf{B}$  of  $0.01\text{T}$   $\perp$  to the axis of rotation of the coil. What is the maximum voltage generated in the coil?

29. Consider a series LCR circuit

- (a) Instantaneous emf of an AC circuit  $E = 200 \sin 314t$  . Find the frequency of AC.  
 (b) With the help of a phasor diagram find the phase difference between V and I in a series LCR circuit.  
 ( 1 + 2 )

30. A series LCR circuit exhibits the phenomenon called Resonance'

- (a) Using phasor diagram for a series LCR circuit , obtain an expression for current?  
 (b) What is meant by Resonance in LCR circuit?  
 © Give a practical application of resonance in LCR circuit? (Score 6)