MAGNETIC EFFECT OF CURRENT AND MAGNETISM

1 MARKS QUESTION

1. A moving electron enters a uniform and perpendicular magnetic field. Inside the magnetic field, the electron travels along: (a) a straight line. (b) a parabola (c) a circle (d) a hyperbola

2. What is the function of shunt in an ammeter?

3. Arrange the three types of magnetic materials in decreasing order of the magnetic susceptibility.

4. State the SI unit of magnetic dipole moment.

5. A metallic wire carrying a current is kept in a uniform magnetic field, at different angles. At what angle, is the force acting on it maximum?

6. Explain the term Hysteresis.

7. When would a moving charged particle travel undeviated in a uniform magnetic field?

8. Which of the two; an ammeter or a voltmeter, has a greater resistance?

9. When a charged particle is projected perpendicular to a uniform magnetic field, it describes a circular path in which:
   (A) Its speed remains constant.
   (B) Its velocity remains constant.
   (C) Its momentum remains constant.
   (D) Its kinetic energy increases.

10. The Biot-Savat’s law in vector form is:
    
    (a) \( \mathbf{d}\mathbf{B} = \frac{\mu_{0} (r \times \mathbf{I} \times \mathbf{r})}{4\pi r^3} \)
    
    (b) \( \mathbf{d}\mathbf{B} = \frac{\mu_{0} (r \times \mathbf{I} \times \mathbf{r})}{4\pi r^2} \)
    
    (c) \( \mathbf{d}\mathbf{B} = \frac{\mu_{0} (r \times \mathbf{I})}{4\pi r^3} \)
    
    (d) \( \mathbf{d}\mathbf{B} = \frac{\mu_{0} (r \times \mathbf{I})}{4\pi r^2} \)

11. A moving coil galvanometer can be converted into a voltmeter by connecting:
    
    (A) A low resistance in series with its coil
    
    (B) A low resistance in parallel with its coil
    
    (C) A high resistance in parallel with its coil
    
    (D) A high resistance in series with its coil

12. Arrange the three types of magnetic materials, i.e. paramagnetic, diamagnetic and ferromagnetic materials, in decreasing order of their magnetic susceptibility.

13. Two substances A and B have their relative permeability slightly greater and slightly less than 1 respectively. What do you conclude about A and B as far as their magnetic materials are concerned?
14 When does a moving charged particle not experience any force while moving through a uniform magnetic field?

15 Define curie temperature.

16 What is the value of magnetic field around a current carrying torroid?

17 If magnetic susceptibility of a certain magnetic material is 0.0001, find its relative permeability.

18 Calculate magnetic flux density of the magnetic field at the center of a circular coil of 50 turns, having radius of 0.5m and carrying a current of 5A.

**2 marks question**

19 A long straight wire is bent as shown in *Figure* below. Find the resultant magnetic field “B” at the centre C of the circular path of radius 2 cm if a current I of 5 A is passed through the wire as shown:

20 A galvanometer with a resistance of 75 ohm produces a full scale deflection with a current of 5 mA. How can this galvanometer be converted into an ammeter which has a range of 0-5A?

21 Explain the meaning of the statement:
   “Angle of dip at a certain place on earth is 60°.”

22 If the horizontal component of earth’s magnetic field at this place is $3 \times 10^{-5}$ T, calculate the earth’s total magnetic field at that place.

23 What is meant by a paramagnetic substance? State Curie’s law.

24 What is the value of magnetic susceptibility of Aluminum if its relative permeability is 1.000022?

25 A moving coil galvanometer has a coil of resistance 59 ohm. It shows a full scale deflection for a current of 50mA. How will you convert it in to an ammeter having a range of 0 to 3A?
26 PQ is a long straight conductor carrying a current of 3A as shown in figure below. An electron moves with a velocity of $2 \times 10^7$ m/s parallel to it. Find the force acting on the electron.

27 The horizontal component of earth’s magnetic field at a place is $\frac{1}{\sqrt{3}}$ times the vertical component. Determine the angle of dip at that place.

28 Write an expression of magnetic flux density $B$ at a point in end-on position or axial position of a magnetic dipole. (Derivation not required)

29 In Moving coil galvanometer. What is meant by radial magnetic field.

30 At a certain temperature, a ferromagnetic material becomes paramagnetic. What is this temperature called?

31 Find magnetic flux density at a point on the axis of a long solenoid having 5000 turns/m when it is carrying a current of 2 A.

32 State how magnetic susceptibility is different for the three types of magnetic materials, i.e. diamagnetic, paramagnetic and ferromagnetic materials.

33 Name three elements of the earth’s magnetic field which help in defining earth’s magnetic field completely.

3 marks question

34 (i) Two infinitely long current carrying conductor X and Y are kept parallel to each other, 24 cm apart in vacuum. They carry currents of 5 A and 7 A respectively, in the same direction as shown in figure below. Find the position of a neutral point, i.e. a point where resultant magnetic flux density is zero. (Ignore earth’s magnetic field)
(ii) If the current through Y is reverse in direction will neutral point lie between X and Y, to the left of X or to the right of Y?

35 Figure below shows two very long conductors PQ and RS kept parallel to each other in vacuum at a distance of 20cm. They carry currents of 5A and 15A, respectively, in the same direction, as shown. Find the resultant magnetic flux density \( B \) at a point M which lies exactly midway between PQ and RS.

36 Using Ampere’s circuital law or Biot and Savart law, show that magnetic flux density \( B \) at a point P at a perpendicular distance \( a \) from a long current carrying conductor is given by:

\[
B = \frac{\mu_0 \, 2I}{4\pi \, a}
\]

(Statement of laws- not required)

37 How much force per unit length acts on a long current carrying conductor X due to a current flowing through another similar conductor Y, kept parallel to it in vacuum? Use this equation to define an Ampere, the fundamental unit of current.

38 Using Ampere’s Circuital Law and with the help of a labelled diagram, show that magnetic flux density ‘B’ at a center of a circular current carrying coil is given by:

\[
B = \frac{\mu_0 \, 2\pi I}{4\pi \, a}
\]

, where the terms have their usual meaning.
EMI & AC

1 Marks Question

1. What is meant by ‘Wattless’ current?
2. What is meant by the term band width of an LCR circuit?
3. Why is soft iron preferred to steel in making the core of a transformer?
4. Write the expression for the Lorentz force $F$ in vector form.
5. A coil has a self inductance of 0.05H. Find magnitude of the emf induced in it when the current flowing through it is changing at the rate 100 A/s.
6. In a series LCR circuit, what is the phase difference between $V_L$ and $V_C$ where $V_L$ is the potential difference across the inductor and $V_C$ is the potential difference across the capacitor?
7. What is meant by meant by quality factor of LCR circuit?
8. Alternating current flowing through a certain electrical device leads over the potential difference across it by 90°. State whether this device is a resistor, capacitor or an inductor.
9. At resonance, what is the relation between impedance of a series LCR circuit and its resistance $R$?
10. An a.c. generator generates an emf ‘E’ where $E=314\sin(50\pi t)$ volt. Calculate the frequency of the emf $E$.
11. Figure below shows a graph of emf ‘e’ generated by an ac generator verses time ‘t’.

$$Y$$

What is the frequency of the emf?

12. An ideal inductor does not consume any power even though both $V$ and $I$ are non zero. Explain in Brief.
13. What is an ideal transformer.
14. Which one of the following graphs in figure 2 represents variation of reactance ‘$X_C$’ of a capacitor with frequency ‘$f$’ of an ac supply:
15. The loss of power in a transformer can be reduced by:
   (A) Increasing the number of turns in primary.
   (B) Increasing ac voltage applied to primary.
   (C) Using solid core made of steel.
   (D) Using a laminated core of soft iron.

2 marks question

16. Variation of alternating current ‘I’ with time ‘t’ is shown in graph below:

What is the RMS value of alternating current?

17. What is the turns ratio i.e. transformer ratio, \( N_s : N_p \), in an ideal transformer which increases ac voltage from 220V and 33000V?

18. An emf of 2V is induced in coil when current in it is changed from 0A to 10A in 0.40 sec. Find the coefficient of self inductance of the coil.

19. A 0.4 m long straight conductor is moved in a magnetic field of induction 0.9 Wb m\(^{-2}\) with a velocity of 7 m s\(^{-1}\). Calculate the maximum emf induced in the conductor.

20. An a.c voltage of 200 V is applied on primary and 1400 V is obtained in secondary. Find the ratio of current of secondary to primary of the transformer.

21. Draw a labelled graph showing variation of impedance of a series LCR circuit with frequency of the a.c. supply.
22. In an ideal transformer, an output of 66kV is required when an input voltage of 220V is available. If the primary has 300 turns, how many turns should the secondary have?

23. In a series LCR circuit, obtain an expression for the resonant frequency.

24. Briefly explain the following terms:
   (i) Self Induction
   (ii) Mutual Induction

3 marks question

25. Define self inductance. Obtain the expression for the self inductance of a solenoid, explaining steps with the help of a diagram. In an LCR circuit with all components connected in series, the emf and current flowing in the circuit are given by the following equations:
   \( E = 200 \sin(314t + \pi/6) \) volt, \( I = 5 \sin 314t \) ampere.
   Obtain:
   (i) The peak values of current and emf.
   (ii) The frequency of the ac source.
   (iii) The phase difference between current and emf.

26. With the help of a neatly drawn labelled diagram, prove that the magnitude of motional emf \( e \) is given by \( e = Blv \), where \( l \) is the length of a metallic rod and \( v \) is the velocity with which it is pulled in a transverse magnetic field \( B \).

27. Plot a labelled graph showing variation in impedance \( Z \) of a series LCR circuit with frequency \( f \) of alternating emf applied to it. What is the minimum value of this impedance?

28. Explain an a.c. circuit contain only capacitor?

29. AB and CD are two parallel conductors kept 1 m apart and connected by a resistance \( R \) of 6 ohm, as shown in figure below. They are placed in a magnetic field \( B = 3 \times 10^{-2} \) T which is perpendicular to the plane of the conductors and directed into the paper. A wire MN is placed over AB and CD and then made to slide with a velocity 2 m/s. (Neglect the resistance of AB, CD and MN.)
30. What are four different types of energy losses in a transformer? State how to reduce/minimize any one of them.

31. A 50µF capacitor, a 30 ohm resistor and a 0.7H inductor are connected in series to an ac supply which generates an emf ‘e’ given $e=300\sin(200t)$ volt. Calculate peak value of the current flowing through the circuit.

32. A metallic rod CD rests on a thick metallic wire PQRS with arms PQ and RS parallel to each other, at a distance $l=40cm$, as shown in figure. A uniform magnetic field $B=0.1T$ acts perpendicular to the plane of this paper pointing inwards (i.e away from the reader). The rod is now made to slide towards right, with a constant velocity of $v=5\ m/s$.

(i) How much emf is induced between the two ends of the rod CD?
(ii) What is the direction in which the induced current flows?

33. An a.c. source of frequency 50 Hz is connected to a 69 mH inductor and a bulb. The bulb glows with some brightness. Calculate the capacitance of the capacitor to be connected in series with the circuit, so that the bulb glows with maximum brightness.

34. A coil having self-inductance of 0.7H and resistance of 165 ohm is connected to an a.c. source of 275 V, 50 Hz. Calculate:

(i) Reactance of the coil
(ii) Impedance of the coil
35. Figure below shows a series RCL circuit connected to an ac source which generates an alternating emf of frequency 50 Hz. The readings of the voltmeter \( V_1 \) and \( V_2 \) are 80V and 60 V respectively.

Find:
(1) The current in the circuit.
(2) The capacitance \( C \) of the capacitor.

4 marks Question

36. Obtain the relation \( I = I_0 \sin(\omega t + \pi/2) \) and \( X_C = 1/C\omega \) for a pure capacitor across which an ac emf \( e = E_0 \sin \omega t \) is applied. Draw the phasor diagram showing emf \( E \), current \( I \) and their phase difference \( \phi \).

37. Figure below shows a capacitor \( C \), an inductor \( L \) and a resistor \( R \), connected in series to an a.c. supply of 220 V.

Calculate:
(i) The resonant frequency of the given CLR circuit.
(ii) Current flowing through the circuit.
(iii) Average power consumed by the circuit.
38. An alternating emf of 110V is applied to circuit containing a resistance R of 80 ohm and an inductor L in series. The current is found to lag behind the supply voltage by an angle \( \Phi = tan^{-1} \left( \frac{3}{4} \right) \). Find the:

(I) Inductive reactance
(II) Impedance of the circuit
(III) Current flowing in the circuit
(IV) If the inductor has a coefficient of self inductance of 0.1H, what is frequency of applied emf?

39. In the circuit shown in figure below, calculate phase difference between the current and the supply voltage:

![Circuit Diagram](image)

\[ E = 300 \sin(500t) \]

40. An 8 H inductor, a 2 \( \mu \)F capacitor and a 100 \( \Omega \) resistor are connected in series to an A.C. supply of 220 V and 50 Hz. Calculate:

(i) Impedance of the circuit
(ii) Current flowing through the circuit
(iii) Phase difference between the current and supply voltage
(iv) Average power consumed by the circuit.

41. An A.C. generator generating an emf „E“ given by ( ) is connected to a 44 \( \Omega \) resistor. Calculate:

(i) rms value of A.C. flowing through the resistor.
(ii) Frequency of the current
(iii) Mean value of emf generated by the generator in time interval 0.06s to 0.08s.
WORKSHEET-3

ELECTRONIC DEVICES & DIGITAL CIRCUIT

1 marks question

1. Draw circuit diagrams to illustrate forward biasing and reverse biasing of a diode.
2. Write the truth table of AND gate?
3. What is rectification?
4. What is meant by doing?
5. Draw the truth table of OR gate.
6. Show the variation of voltage with time, for a digital signal.
7. What is the use of Zener diode?
8. Draw the truth table of a NOR gate.
9. State one important use of a Zener diode.
10. Draw a labelled graph of voltage verses time for a signal voltage used in digital circuits.
11. How can an n type semiconductor be obtained from a pure crystal of germanium?
12. What is the symbol of a NOT gate?
13. State one use Zener diode.
14. How can a p type semiconductor be obtained from a pure crystal of silicon?
15. Why is a NAND gate called as universal gate?
16. What is LED?
17. What is the difference between analog signal and digital signal?

2 marks question

18. What is meant by the terms: (i) a full wave rectifier, (ii) An amplifier.
20. Using several NAND gates, how can you obtain an AND gate? Draw a labeled diagram in support of your answer.
21. Using several NAND gates, how can you obtain an OR gate? Draw a labeled diagram in support of your answer.
22. Write the truth table of the following circuit. Name the gate represented by this circuit.
23. Show how an OR gate can be obtained using NOR gates.

24. What is the symbol of a NOR gate? Write its truth table.

25. With reference to a semiconductor diode, define the terms ‘depletion region’ and ‘potential barrier’. How will the width of depletion region change during reverse biasing?

26. For a common emitter transistor amplifier, the audio signal voltage across the collector resistance (rc) of 2 kΩ is 2 V. If the current amplification factor (β) of the transistor is 100, calculate the input signal voltage (VBE) and base current (IB) for base resistance of 1 kΩ.

27. Prepare a table for the combination of gates shown in figure below:

28. The following combination of gates acts as a logic gate. With the help of a truth table, find out which logic gate the combination represents.

3 marks question

29. With reference to the semiconductor diode, what is meant by:
   (i) Forward bias
   (ii) Reverse bias
   (iii) Depletion region.

30. For a transistor in a common emitter mode, draw labelled graph to show:
   (1) Input characteristic curve
   (2) Output characteristic curve
   (3) Transfer characteristic curve
   (Circuit diagram of the arrangement is not required.)
31. The characteristic curve of a silicon diode is shown in Figure below:

![Characteristic curve of a silicon diode](image)

Calculate the resistance of the diode at:
(1) I= 15 mA and  
(2) V= -10 V

32. Draw a labelled diagram of a common emitter amplifier. What is the phase angle between the input and output voltages?

33. Draw a labelled diagram of a full wave rectifier. Show how output voltage varies with time, if input voltage is a sinusoidal voltage.

34. Show by drawing labeled diagrams, the nature of output voltages in case of:
   (i) A half wave rectifier.  
   (ii) A full wave rectifier.  
   (iii) An Amplifier (CE configuration) 

   Circuit diagrams of these devices are not required.

35. Identify the logic gate whose truth table is given below and draw its symbol:

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36. Draw a labeled energy band diagram for a solid which is an insulator. What is the main difference between this diagram and that of a semiconductor?

37. Show how you will obtain an AND gate using only NOR gates. Draw the truth table for this arrangement of gates.
38. Figure below shows the circuit of an electronic device:

(i) Which electronic device: a rectifier or an amplifier does above circuit represents?
(ii) State where the input voltage is applied and where the output voltage is available.
(iii) Compare the output voltage of this circuit with its input voltage.

39. Draw a circuit diagram for the common emitter transistor amplifier. What is meant by phase reversal?

5 marks question

40. Draw labelled diagrams to illustrate:
   (i) energy bands of a conductor, semiconductor and insulator.
   (ii) $n_{pn}$ and $p_{np}$ transistors.
   (iii) Transistor as an amplifier (common emitter).
COMMUNICATION SYSTEM

1 Marks Question

1. What are the three basic units of a communication system?

2. Identify the parts X and Y in the following block diagram of a generalized communication system?

3. Draw the waveform of two types of signals used in communication systems?

4. What is meant by modulation?

5. What is meant by bandwidth of information signal?

6. Name the two types of modulations in analog communication.

7. Which characteristic of modulated carrier wave varies in amplitude modulation?

8. Which characteristic of modulated carrier wave varies in frequency modulation?

9. With respect to the communication system what do you understand by Transducer.

10. What is space communication?

11. With respect to the communication system what do you understand by Noise.

12. What is basic difference between analog and digital communication system.

13. With respect to the communication system what do you understand by Transmitter.

14. What is ground wave propagation?

15. With respect to the communication system what do you understand by Receiver.

16. Why do we need a higher bandwidth for transmission of music compare to that for commercial telephone communication system?

17. With respect to the communication system what do you understand by Communication channel.
20. Name an appropriate communication channel need to send a signal of 100 kHz over a distance of 8 km.

21. With respect to the communication system what do you understand by Attenuation.

22. What is the range of audio frequencies?

23. With respect to the communication system what do you understand by Range.

24. Name the different layers of earth’s atmosphere.

25. With respect to the communication system what do you understand by Repeater.

26. From which layer of atmosphere, radio waves are reflected back.

27. With respect to the communication system what do you understand by Antenna.


29. Why ground wave communication is not suitable for high frequency.

30. What is sky wave propagation?

31. Why sky waves are not used in transmission of television signals?

32. Define the term critical frequency in relation to skywave propagation of EM waves.

33. What mode of communication is employed for transmission of TV signals?

34. What is range of frequencies used for satellite communication?

35. Define modulation index.

36. What is importance of modulation index?

37. What is demodulation?

38. What is demodulator?

2 MARKS QUESTION

39. Derive an expression for covering range of TV transmission tower.
40. State two factors by which the range of transmission of TV signals by a TV tower can be increased.

41. Greater the height of TV transmitting antenna greater its range. Explain.

42. Explain the function of repeater in communication system.

43. Write any two factors which justify the need for the modulating signal.

44. The audio signal cannot be transmitted directly into space.

45. Draw a labelled circuit diagram for producing amplitude modulated wave.

46. What is the carrier wave? Why high frequency carrier wave is employed for transmission?

47. Draw the general shape of the resulting amplitude modulated wave. Also draw the corresponding carrier wave that is to be modulated by modulating signal.

48. A carrier wave \( c(t) = E_c \sin \omega_c t \) is amplitude modulated by a modulating signal \( m(t) = E_m \sin \omega_m t \). The maximum and minimum amplitude are found to be 16 volt and 4 volt respectively. Calculate modulation index.

49. Mention any two disadvantages of frequency modulation.

50. Write any two advantages of amplitude modulation over frequency modulation.

51. A 600 Hz modulating voltage fed into FM generator produces a frequency deviation of 3.36 kHz. Find the modulation index.

52. Draw a labelled circuit diagram for the detection of AM wave.

53. Give two merits of communication satellites.

54. A message signal of frequency 10 kHz and peak voltage of 10 volts is used to modulate a carrier of frequency 1 MHz and peak voltage of 20 volts. Determine modulation index.

55. Write an expression for the critical frequency in terms of the maximum electron density of the ionosphere.

56. A transmitting antenna at the top of a tower has a height 32 m and the height of the receiving antenna is 50 m. What is the maximum distance
between them for satisfactory communication in LOS mode? Given radius of earth \(6.4 \times 10^6\) m. What does the term LOS communication mean? Name the types of waves that are used for this communication.

57. A carrier wave of peak voltage 12V is used to transmit a message signal. What should be the peak voltage of the modulating signal in order to have a modulation index of 75%?

58. What does the term LOS communication mean? Name the types of waves that are used for this communication.

59. Calculate the length of dipole antenna required for carrier wave of frequency 600MHz.

60. A radio can tune to any station in the 3.6 MHz to 12 MHz high frequency band. Compute the corresponding wavelength band.

61. A FAX message is to be sent from Bhopal to Singapore via a geostationary satellite. Calculate the minimum time delay between the dispatch and its being received. (Given; Height of geostationary satellite above the earth =36000km).