1. (a) Define the term ‘capacitance’ of a capacitor. Write its S.I. unit. Establish a relation for the total capacitance of ‘n’ capacitors connected in series. 6

OR

Calculate the capacitance of a parallel plate capacitor consisting of two plates of size 15 cm × 15 cm separated by a distance of 2 mm with a medium of dielectric constant 6 between the plates.

(b) Derive a mathematical relation for the magnetic field strength at a point at a distance ‘a’ from a long straight conductor carrying current I. 5

(c) Write two differences between ‘intrinsic semiconductors’ and ‘extrinsic semiconductors’. How is the conductivity of an intrinsic semiconductor affected due to increase in temperature? 4
2. (a) What is a solenoid? Why does a current carrying solenoid behave as a bar magnet? Write an expression for the magnetic field at a point inside a current carrying solenoid.

OR

An electron is projected with a uniform speed of $6 \times 10^4$ ms$^{-1}$ at an angle of 30° to a uniform magnetic field of strength 0.5 Wb m$^{-2}$. Calculate the magnitude of the force acting on the electron.

(b) What is nuclear fusion? Under what conditions does it take place? Why is it not possible to produce commercial energy by this process? Name one example in nature in which energy is produced by this process.

(c) Explain the principle of working of a N-P-N transistor with the help of a circuit diagram. Which of the junctions is (i) forward biased (ii) reverse biased?

3. (a) State Gauss’s theorem in electrostatics. Apply it to establish a relation for the electric field strength at a point outside a charged hollow sphere.
(b) Name any three radio-isotopes and write their specific uses. Write any two precautions used for protecting oneself from radiation hazards.

OR

What is nuclear fission? Explain how energy is produced by this process. Give one example of release of energy by this process for commercial purposes.

(c) What is a P-N Junction Diode? Explain, with the help of a circuit diagram, its use as a full-wave rectifier.

4. (a) Define the term electric potential at a point due to a point charge. Write its S.I. unit. Establish an expression for electric potential at a distance ‘r’ from a point charge ‘q’ in air.

(b) Why does an electric charge moving in a magnetic field experience force? On what factors does this force depend? State the rule used for determination of direction of this force.

(c) Give the symbolic representation of a semiconductor diode. Explain the movement of majority charge carriers through a P-N Junction when it is (i) forward biased (ii) reverse biased. How is this behaviour of P-N junction made use of for practical purposes?

OR

What are N-type and P-type semiconductors? Name the majority charge carriers in these materials. Explain, with the help of a diagram, the movement of charge carriers across a P-N Junction.
(क) बिन्दु आवेश के कारण किसी बिन्दु पर विद्युत विभव की परिभाषा लिखिए। इसका S.I. मात्रक लिखिए। वायु में रखे किसी बिन्दु आवेश 'q' से ‘r' दूरी पर स्थित किसी बिन्दु पर विद्युत विभव के लिए व्यंजक चुम्बन कीजिए।

(ख) किसी चुम्बकीय क्षेत्र में गतिमान कोई विद्युत आवेश बल का अनुभव क्यों करता है ? यह बल किन कारकों पर निर्भर करता है ? इस बल की दिशा निर्धारित करने वाला नियम लिखिए।

(ग) किसी अर्धचालक डायोड का प्रतीकात्मक निरूपण कीजिए। (i) अग्रदिशिक बायस (ii) पश्चदिशिक बायस में किसी P-N संधि से होने वाली वहुसंख्यक आवेश वाहकों की गति स्पष्ट कीजिए। P-N संधि के इस व्यवहार का व्यावहारिक प्रयोगों के लिए कैसे उपयोग किया जाता है ?

अध्ययन

N-प्रकार तथा P-प्रकार के अर्धचालक क्या होते हैं ? इन पदार्थों में वहुसंख्यक आवेश वाहकों के नाम लिखिए। किसी P-N संधि के आर-पार होने वाली आवेश वाहकों की गति को आरख के स्पष्ट कीजिए।

Physical Constants:
भौतिक नियतांक :

\[ \varepsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1} \]
\[ \mu_0 = 4\pi \times 10^{-7} \text{ H m}^{-1} \]

Charge on the electron = 1.6×10⁻¹⁹ C

इलेक्ट्रॉन पर आवेश

\[ \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ N m}^2\text{C}^{-2} \]