9. REVIEW QUESTIONS

1. Summarize for yourself the important points of the magnetic field: its definition, its relation with material properties, and the idea of magnetization.

2. What constitutes a magnetic dipole? What is significant about the dipole that makes it a useful device?

3. Does a magnetic dipole have to be a circular loop? If not, what is the important condition that makes a loop a dipole?

4. What is magnetization? Compare magnetization of magnetic materials with polarization of dielectrics in **Chapter 4**. Can you find "equivalencies" between the two properties?

5. Describe the function of a permanent magnet in terms of equivalent current densities.

6. Why must magnetic field lines be closed?

7. Suppose that somebody claims that magnetic fields lines can be open. What are the implications of such a claim on the postulates of the magnetic field?

8. What are the magnetic properties of superconductors?

9. Summarize the magnetic properties of materials. Among the various properties, which do you think are most important for engineering applications?

10. The magnetic field of a permanent magnet is produced as follows (mark correct statements):

(a) The material is intrinsically magnetic; that is, the magnetic field is always there, cannot be changed, and cannot be imparted to the material.
(b) By properly mixing different materials.
(c) By aligning the electron-spins in preferred directions.
(d) By supplying enough energy to the material to allow the magnetic domains to align.

11. By measuring a magnetic flux density at a point in space, you can tell if the field is that due to a permanent magnet or due to a current *T/F*. Explain.

12. Explain the following statement: The magnetic field due to a permanent magnet can always be replaced by an equivalent field produced by a current or a system of currents.

13. Which of the following is true for the magnetic interface conditions:

(a) H_t and B_n are always continuous at an interface.
(b) B_n is always continuous, but H_t can be discontinuous.
(c) B_n is discontinuous, but B_t is continuous.
(d) All field components can be discontinuous.

14. The discontinuity in the tangential component of **H** equals the surface current density if a current density exists on the interface *T/F*.

15. Summarize the magnetic interface conditions between two materials.

16. Write and discuss the magnetic interface conditions between free space and a ferromagnetic material.

17. Write and discuss the magnetic interface conditions between free space and a superconductor.

18. What is inductance? What is an inductor? How can you build an inductor?

19. What is the definition of self- **and mutual inductance?**

20. How can inductances be computed based on the definition?

21. What happens if there are multiple turns in coils?

22. How can the inductances of an infinite solenoid and of a toroidal coil be computed?

23. Compare self-inductance to capacitance. What can you say about the equivalent quantities?

24. Define mutual inductance. How does it differ from self-inductance?

25. What is flux linkage? How does flux linkage relate to flux?

26. Inductance of infinite structures is infinite *T/F*.

27. To calculate inductance there must be a current and a flux in the inductor, but the inductance itself must be independent of current *T/F*.

28. The total series inductance of two inductors equals (mark correct statement):

(a) The sum of the self-inductances.
(b) The sum of the two self-inductances plus the two mutual inductances.
(c) The sum of the two self-inductances minus the two mutual inductances.
(d) The sum of the two self-inductances ± the two mutual inductances, depending on the relations between the fluxes of the two inductors.

29. Mutual inductance can only be defined between pairs of inductors. Why is this so?

30. Compare the relation for stored magnetic energy in an inductor to that of stored electric energy in a capacitor.

31. It is possible to calculate the inductance of a system of inductors based on the total stored energy in the system. When doing so, the following is obtained (mark correct answer):

(a) Self-inductance only.
(b) Mutual inductance only.
(c) Total inductance only.

32. State the requirements for a magnetic structure to be a magnetic circuit.

How can the energy be computed if the inductance is known? How is the energy computed via volume integration?

33. Are there electric systems which do not satisfy the requirements of electric circuits? Give an example of a simple electric circuit that cannot be analyzed using circuit theory methods. Hint: Try to define a circuit in which the current leaks out of conductors.

34. The force in magnetic circuits is proportional to current density and flux density as well as the volume in which the current density exists *T/F*.

35. Two currents .owing in opposite directions in two parallel wires (mark correct answer):

(a) Attract each other.

(b) Repel each other.

(c) Do not react with each other.

36. Magnetic force is always in the direction perpendicular to the current and the field. Explain why it must be so.

37. In the method of virtual work, there is no work performed. Only the possibility, or the inference of work. Explain the physical process behind the method.

38. Forces in the magnetic field are much larger than forces in the electric field *T/F*. Justify your answer.