Q.2 a. What are soft and hard ferrites and where they are used?
b. Why Iron Silicon alloys are preferred for power transformers, motors and generators?
c. Give the applications of following material
(i) Alnico (ii) Hard Ferrites

Answer:

Q.N.2 (a) Soft magnetic material have a steeply rising magnetisation curve. These material have high permeabilities. The are used as core material in magnetic ckts of electromagnetic equipment e.g Soft iron, silicon, steel etc } 3

Hard magnetic material are characterized by a high maximum magnetic energy product $(B\text{-}H)_{max}$. These materials have gradually rising magnetisation curve. These materials are employed as permanent magnets. Caelon steel, tungsten steel, Cobalt steel etc

(b) because Silicon Iron increases the electrical resistivity of iron, it increases permeability at low and moderate flux densities but decreases at higher densities. Addition of silicon reduces hysteresis loss. The magnetostriction effect is also reduced } 4m

(c) Alnico find applications in loudspeaker, microwave devices, motors, generators, meters, magnetos, separators, communication devices and vending machines } 3m

Hard ferrite: The magnets are made in the form of rings, blocks and arcs. These are used in applications for loud speakers, dc motors, microwave oven, magnetron tubes, travelling wave tubes, holding magnet etc. } 3m

Q.3 a. Explain, what causes the decrease in resistivity of an intrinsic semiconductor at high temperature?
b. What is Hall effect? What are the applications of Hall effect generator?
c. What are important properties of semiconductor?
d. Compare in brief the materials used in IC packaging.

Answer:

(a) At room temp. covalent bonding is very strong and no free electronis available therefor semiconductor in pure state behave as an insulator but as temp. increases their resistivity decreas due to negative temp coefficient

(b) When a current carrying conductor is placed in a magnetic field, a voltage is produced which acts in perpendicular direction to the current as well as to the magnetic field. it

Hall effect ~~carrega~~ generator to measure
(1) magnetic field strength
(2) used in flux meters
(3) The indium is used in analogous computers
(4) Indium antimonide is used to make compasses with high degree of sensitivity

(c) (1) The resistivity of semiconductor lies in between conductor and insulator. i.e. 0.6 Ωm
(2) Resistance of conductors increases with the increase of temperature. but semi conductor resistance decreases with temperature.
(3) When a controlled quantity of a foreign material is added to a semiconductor its properties are further changed and it shows good conductivity.

(d) DIP package is preferred because it is easy to mount as mounting does not repired bending of leads. Ceramic DIP is preferred where power dissipation is more in comparasion to plastic package. Metal can package if preferred in power dissipation is much higher. flat pack is used in applications where reliability and low weight are considerations

Q.4 a. What are different types of diode? Discuss each briefly.
b. What are different methods of manufacturing transistor? Explain Alloy type method in detail.

Answer:

Q.N. 4 (a) Different type of Diodes are

(i) Tunnel diode (ii) Zener Diode (iii) Schottky diode
(iv) Varactor diode (v) Photo diode (vi) LEDs
(vii) Power Diode

(i) Tunnel Diode: This diode is fabricated by doping the semiconductor materials that will form the p-n junction at a level one hundred to several thousand times that of a typical semiconductor diode which reduce depletion layer and due to depletion, many carriers can "tunnel" through

(ii) Zener Diode: for these diode doping density is very high. Zener breakdown occurs at a reverse bias potential of V_Z. The Zener voltage of a diode can be controlled by changing doping levels, producing an increase in number of added impurities, will decrease

Schottky Diode: These diode have metal semiconductor junction. The semiconductor is usually n type Silicon, while a host of different metals such as molybdenum, platinum etc are used. Different construction techniques results increased frequency range, lower forward bias etc

Varactor Diode: A simple diode under reverse bias condition constitutes varactor diode and acts as a voltage variable capacitor. The depletion region acts as a dielectric between two conducting plates. The width of depletion layers varies with applied voltage

LEDS: It is a PN junction when forward biased, emits light due to charge carrier recombination occurs at the junction, charge carriers gives up energy in the form of light and heat. The material used for manufacture of LED is gallium arsenide, phosphide etc.

Photo Diode: It is a reverse biased junction diode with light permitted to fall on one surface of the device across the junction, keeping the remaining sides unilluminated. The PN junction is embedded in clear plastic package

Power Diode: These diode are designed to handle high power and high temperature demands of some applications. Most of power diode are constructed using silicon because of higher current, temperature and PIV rating.

(b). Manufacturing Transistor methods are
(i) Grown type (ii) Alloy type (iii) Diffusion type
(iv) Epitaxial type

Alloy type: This technique is also called the fused concentration. The centre section is a thin wafer of n type material. Two small dots of indium are attached to opposite sides of the wafer and the whole structure is raised for a short time to a high temperature, above the melting point of Indium but below that of germanium. The indium dissolves the germanium under it and forms a saturation solution. On cooling the germanium in contact with the base material recrystallizes with enough indium concentration to change it from n type to p type. The collector is made larger than the emitter so that the collector subtends a large angle as viewed from the emitter. Because of this geometrical arrangement, very little emitter current follows a diffusion path which carries it to the base rather than to the collector.

Q.5 a. Describe the construction detail of relays and List common type of relays.

b. An air capacitor of capacitance 0.005 μF is connected to direct voltage of 500V, is disconnected and then immersed to oil with a relative permittivity of 2.5. Find the energy stored in the capacitor before and after immersion.

Answer:

5 (a) Relay consists of three basic elements

(i) an actuating element called as exciting coil

(ii) linkage to transfer the actuation/de-actuation of input to output

(iii) Output elements or the contacts

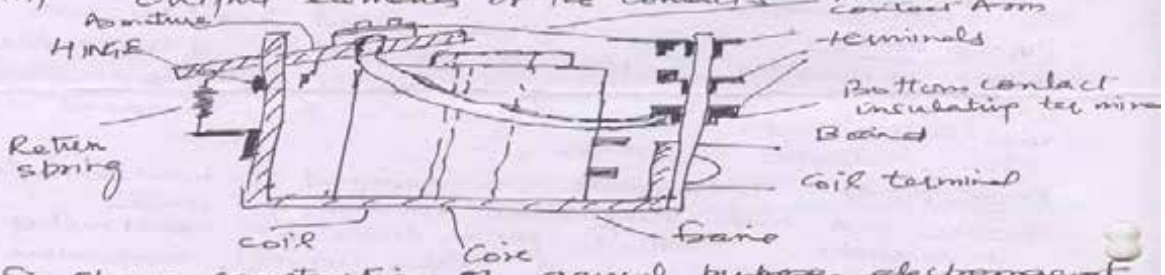


Fig shows construction of general purpose electromagnet relay. It contains core surrounding by coil of wires. The core is mounted on metal frame. The movable part of relay is called armature when a voltage is applied to the coil, current flowing through it produce a magnetic field in the core. In other words the core acts as electromagnet and attract the metal armature. When the armature is attract to the core, the magnetic path is from the core through armature through the frame and back to the core. On removing the voltage, the spring attached to the armature returns the armature to the original position.

In this position there is small gap. Hence more power is needed to keep it hold in the attracted position.

Common type of Relays

(i) Latching Relay (ii) Rotary stepping relay (iii) Ratchet Relay (iv) Polarized relay (v) Solenoid relay (vi) Solid State Relay (vii) Power Relay 2m

(b) Energy before immersion is

$$E_1 = \frac{1}{2}CV^2 = \frac{1}{2} \times 0.005 \times 10^{-6} \times (500)^2 = 625 \times 10^{-6} J$$ 2 mark

When immersed in oil, its capacitance is increased 2-5 times. Since charge is constant, voltage must becomes 2.5 times. Hence now capacitance becomes $2.5 \times 0.005 = 0.0125\ \mu F$ and now voltage $= \frac{500}{2.5} = 200\ V$ 3m

$$E_2 = \frac{1}{2} \times 0.0125 \times 10^{-6} \times (200)^2 = 250 \times 10^{-6} J$$ 3 mark

Q.6 a. Explain the following processes of fabrication technology.
(i) Oxidation (ii) Metallization

Answer:

Q.No 6 (a) Oxidation: An oxide layer is grown on the silicon surface. The characteristics are

(a) It is capable of being etched by hydrogen flaviride (HF) to which underlying silicon is impervious

(b) The impurities used to dope the silicon do not penetrate the silicon dioxide - So when used with the masking techniques selective doping of specific region of chip is accomplished

Thermal oxidation is achieved in the presence of water vapours - The chemical reaction is

$$Si + 2H_2O \longrightarrow SiO_2 + 2H_2$$

The thickness of the oxide layer is generally of the order of 0.02 to 2 μm. the specific value selected depends on the basic impurity concentration required to prevent dopant penetration and process temp processing time

are some of the factors that decide the thickness of the SiO_2 layer.

The Si_3N_4 (Silicon nitride) is used as a sandwich between two SiO_2 layers

Metallization: This process is used to form the interconnections of the components on the chip. These are formed by the deposition of a thin layer of aluminium over the entire surface of the chip. Deposition is achieved by high vacuum evaporation inside a bell jar. The aluminium is heated until it is vapings the gaseous molecules formed uniformly radiate in all directions & completely cover the wafer surface. A mask is used to define the connection pattern between the components and the unwanted aluminium is etched & removed

their finish

b. Describe 'Grown Junction' method of Fabrication in brief.

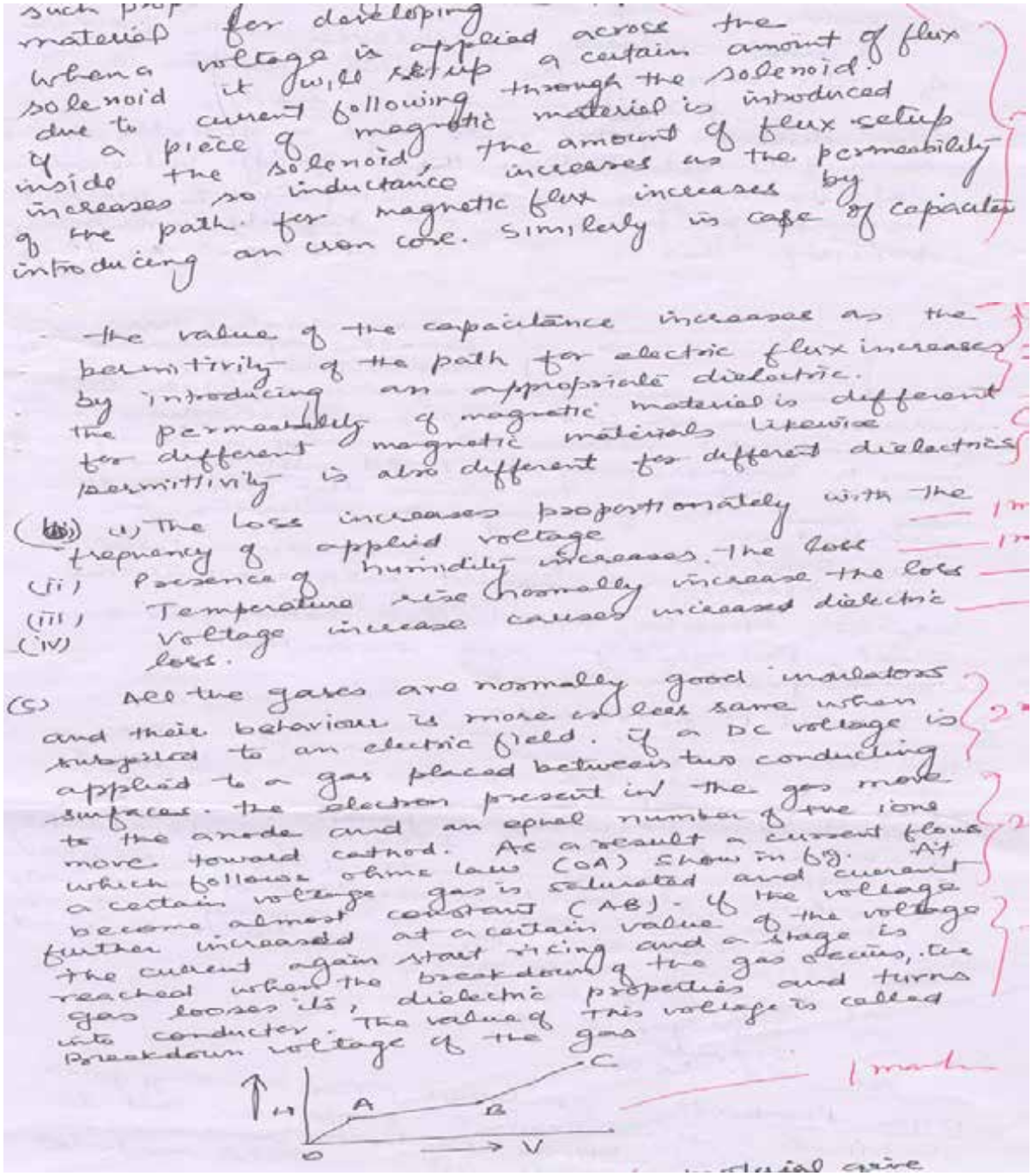
Answer: Page Number 392 OF Text Book

Q.7 a. Explain, how permittivity of a dielectric material is analogous to permeability of magnetic material ?

b. State the factors which affects the dielectric loss of an insulating material.

c. Explain Dielectric breakdown in gasses.

Answer:

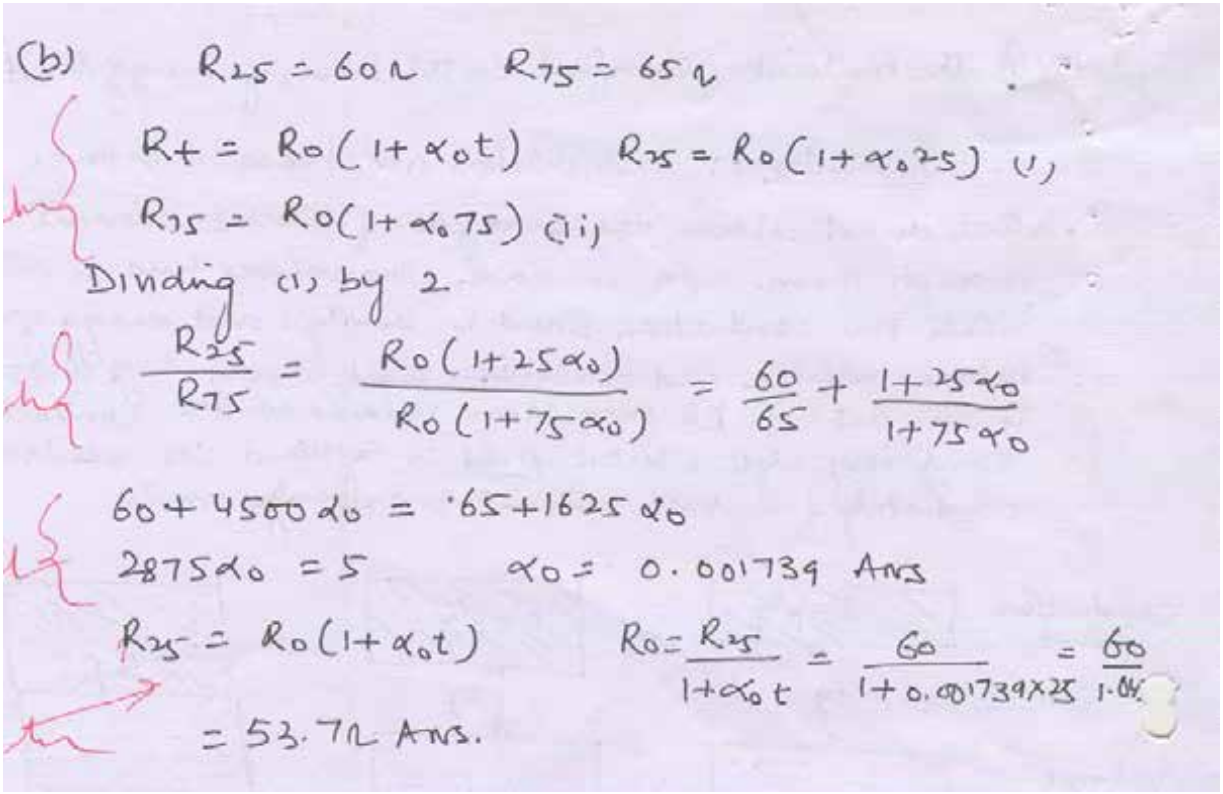


Q.8 a. What is Mobility? Describe in brief.

Answer: Page Number 93 of Text Book

b. The resistance of a wire is 60 Ω or 25°C and 65 Ω at 75°C. Find the resistance of wire at 10°C and value of temperature coefficients at 0°C

Answer:



Q.9 Explain polarization mechanism and give the comparison of electronic, ionic and dipole polarization.

Answer: Page Number 142-143 of Text Book

TEXT BOOK

Introduction to Electrical Engineering Materials by C.S. Indulkar and S. Thiruvengadam, 4th Edition, Reprint 2006 Edition, S. Chand and Company, New Delhi.