

# **SUBJECT :- UEE**

## **Unit -1**

### **ELECTRIC HEATING**

#### **1.WHAT IS ELECTRIC HEATING ? WHAT IS THE PRINCIPLE BEHIND IT ?**

**Electric heating is any process in which ELECTRICAL ENERGY is converted to “HEAT ENERGY”.**

**Electric heating works on the principle of ”JOULE HEATING” (an electric current through a resistor converts electrical energy into heat energy.)**

**Electrical heating is based on the principle of that when electric current passes through a medium heat is produced. Let us take the case of solid material which as resistance ‘R’ ohms and current flowing through it is I amps for ‘t’ seconds than heat produced in the material will be  $H=I^2Rt$  Joules.**

#### **2. DOMESTIC APPLICATION OF ELECTRICAL HEATING**

- Room heater for heating the building
- Immersion heater for water heating
- Hot plates for cooking
- Geysers
- Electric kettles
- Electric Iron
- Electric oven for baking products
- Electric toasters etc...

#### **3.INDUSTRIAL APPLICATION**

#### **4.ADVANTAGES OF ELECTRICAL HEATING OVER OTHER METHOD OF HEATING**

- **Clean and atmosphere / Free from dirt.**

- **No pollution / No flue gas is produced**
- **Response quickly**
- **Accurate Controlled temperature can made easily**
- **Comparatively safe**
- **Localized application**
- **Overall efficiency is much higher**
- **Uniform heating**
- **Highest efficiency of utilization**
- **Cheap furnaces**
- **Mobility of job**

## **5.TRANSFER OF HEAT**

**Conduction:- This phenomenon takes place in solid, liquid and gas.**

**Heat transfer is proportional to the difference of temperatures between two faces.**

**No actual motion of molecules.**

**Convection**

**This phenomenon takes place in liquid and gas. Heat is transferred due to actual motion of molecules**

**Radiation**

**This phenomenon is confined to surfaces. Radiant energy emitted or absorbed is dependent on the nature of the surface. Heat transfer is proportional to the difference of temperatures between two faces.**

**No actual motion of molecules.**

**Convection**

**This phenomenon takes place in liquid and gas. Heat is transferred due to actual motion of molecules**

**Radiation**

**This phenomenon is confined to surfaces. Radiant energy emitted or absorbed is dependent on the nature of the surface.**

## **6.CLASSIFICATION OF ELECTRICAL HEATING**

### **Power Frequency heating**

#### **1. Resistance heating**

##### **a. Direct Resistance heating**

##### **b. Indirect Resistance heating**

#### **2. Arc heating**

##### **a. Direct Arc heating**

##### **b. Indirect Arc heating**

### **High Frequency heating**

#### **1. Induction heating**

##### **a. Direct Core type**

##### **b. Core less type**

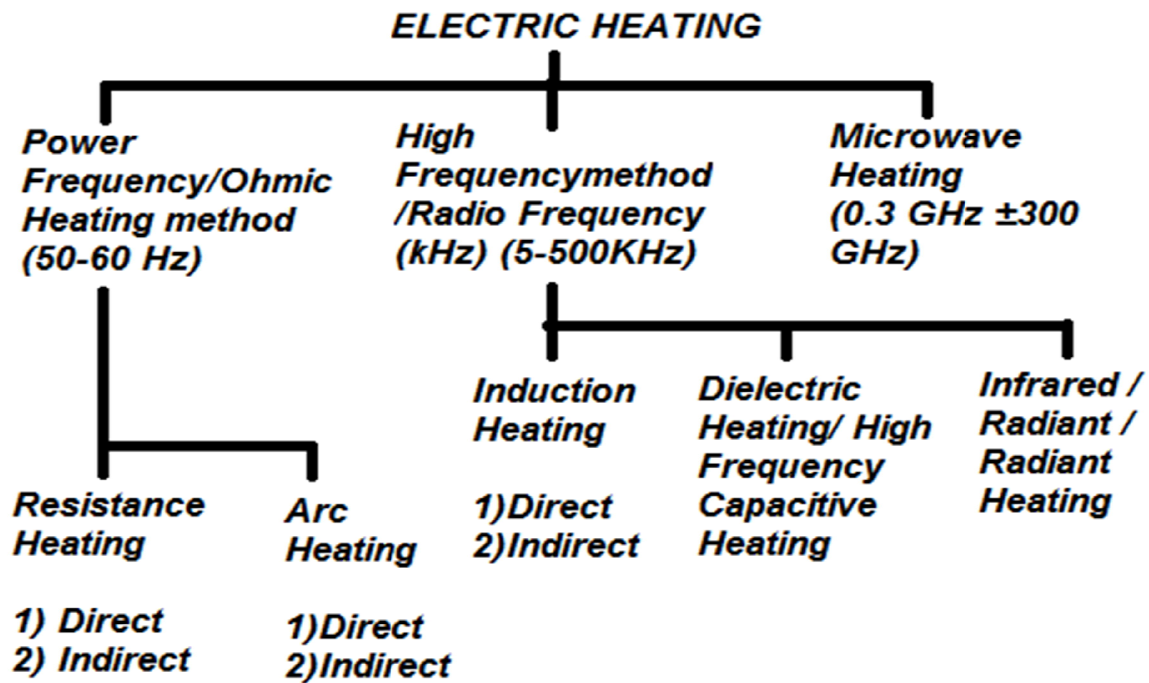
#### **2. Dielectric heating**

## **7.Classification of Heating Method:-**

**Low Temperature Heating  $\pm$  up to 400°C**

**Medium Temperature Heating  $\pm$  from 400°C to 1150 °C**

**High Temperature Heating  $\pm$  above 1150 °C**



## 8.1 Characteristics of Heating Elements

- 1) high resistivity
- 2) able to withstand high temperatures without deterioration
- 3) low temperature coefficient of resistance
- 4) positive temperature coefficient of resistance
- 5) free from oxidation at high temperatures

## 9. RESISTANCE HEATING

(Example – Electric Water Heater)

This method is based upon the  $I^2R$  loss. Whenever current is passed through a resistor material heat is produced because

of  $I^2R$  losses.

The generation of heat is done by electric resistor carrying current.

## **10. RESISTANCE HEATING**

### **DIRECT HEATING**

- Electric current is passed through the body (charge) to be heated.
- High efficiency
- Mode of heat transfer is Conduction
- Example-

1) Electrode boiler for heating water

2) Resistance Welding

### **INDIRECT HEATING**

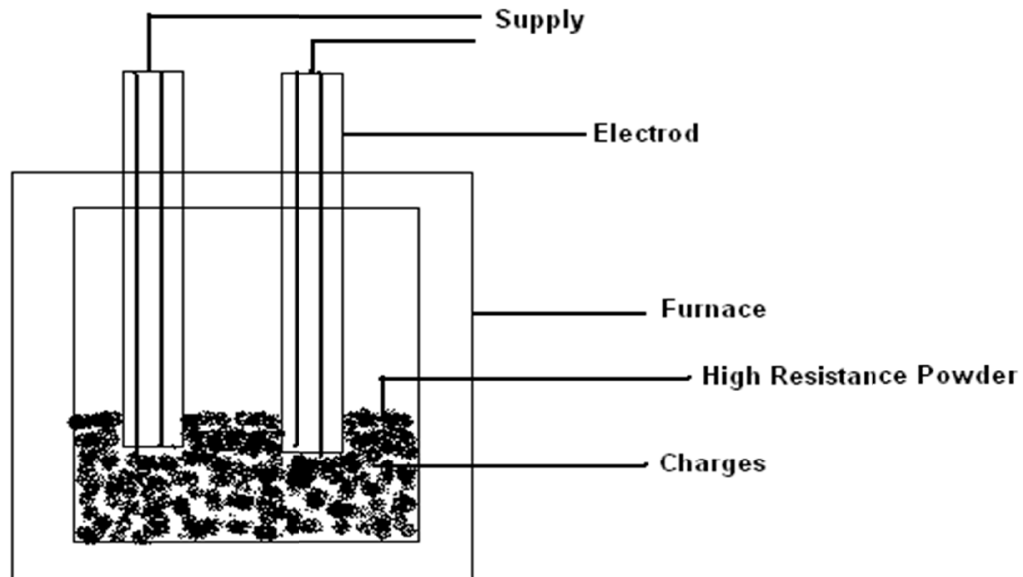
- Electric current is passed through highly resistive material(heating element) placed inside an oven.
- Heat produced due to  $I^2R$  loss in the element is transmitted to the body
- Mode of heat transfer is Conduction &/or Convection &/or Radiation
- Example-

1) Room Heaters

2) Domestic & commercial cooking

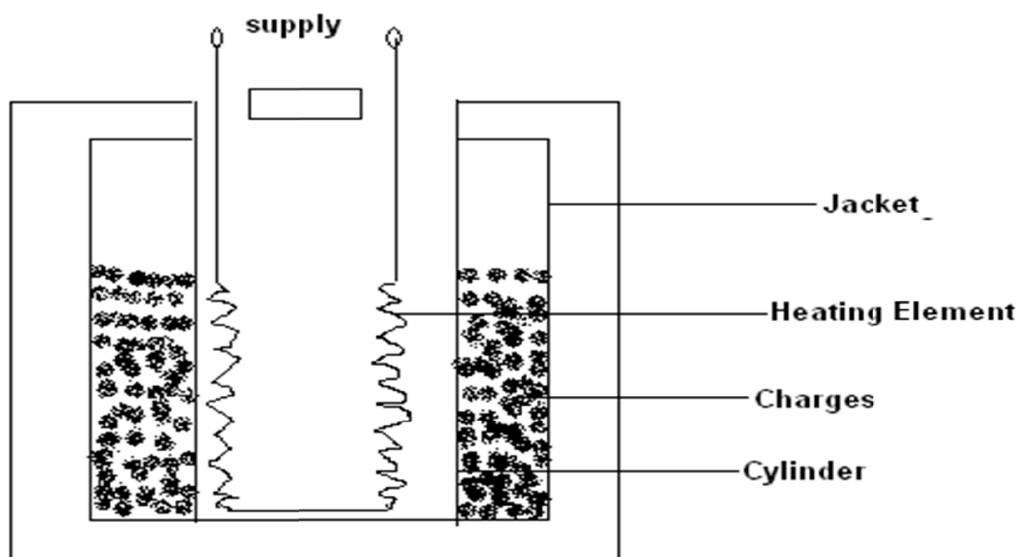
3) Heat treatment of metals

## 10.1 DIRECT RESISTANCE HEATING



KUMAR CHATURVEDULA

## 10.2 INDIRECT RESISTANCE HEATING

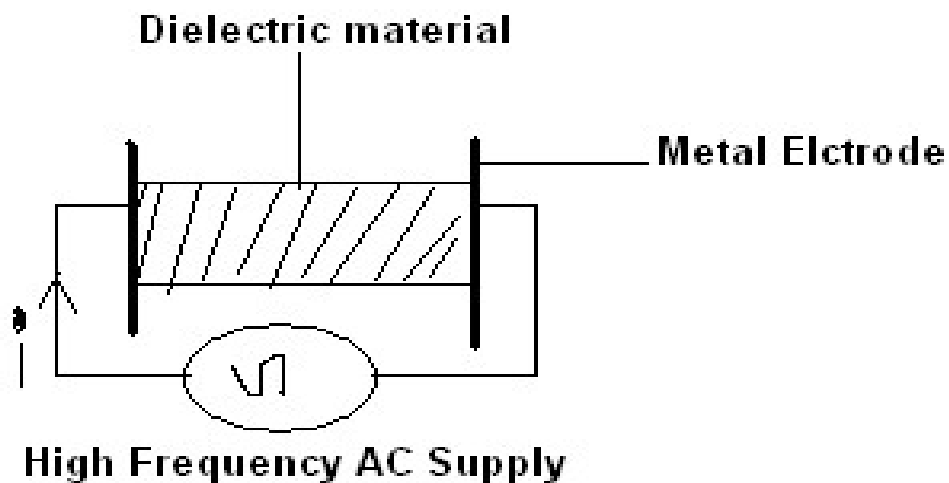


KUMAR CHATURVEDULA

## 10.3 CAUSES OF FAILURE OF HEATING ELEMENTS

- Formation of hot spots.
- Oxidation
- Corrosion
- Mechanical failure

## 11.DIELECTRIC HEATING



### 11.1 DIELECTRIC HEATING

Dielectric heating, also known as electronic heating, RF heating, high-frequency heating and diathermy.

Dielectric heating is a special way of transforming electric current into heat.

By the method of dielectric heating, generally, foils, plates and profiles with a thickness of 0,1-2,0 mm is are welded.

Dielectric Heating (contd...)

- **We understand dielectric heating as the generation of thermal energy (heat) in a non-conducting material by the application of an electromagnetic force or field to it. This is the way a microwave oven heats things placed in it.**





















