



# INTRODUCTION TO MICROWAVES

BY:

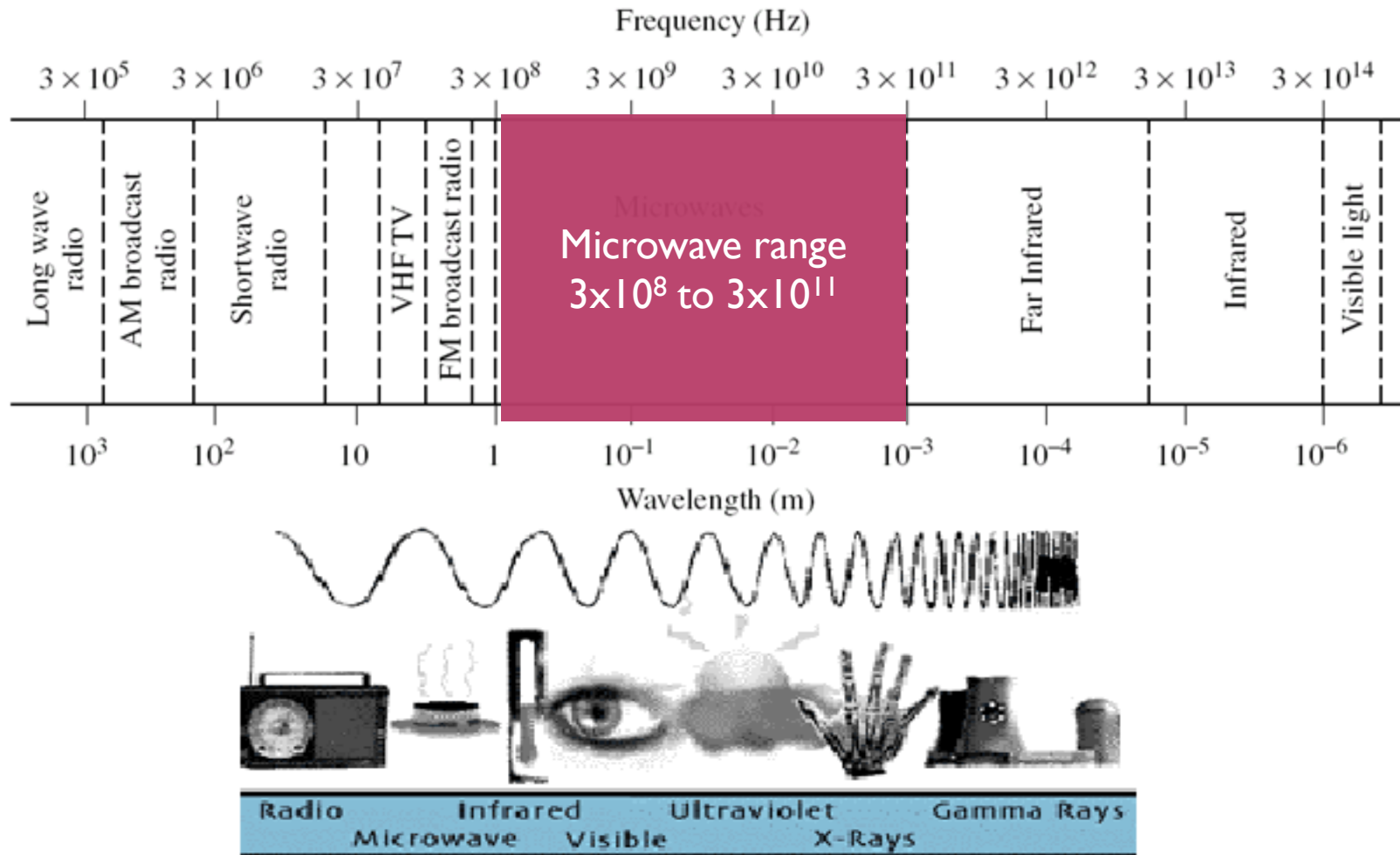
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# Microwave engineering

- Engineering and design of communication/navigation systems in the microwave frequency range.

# I.I Microwave Frequencies



# I.I Microwave frequencies

## Approximate Band Designations

Medium frequency	300 kHz to 3 MHz
High frequency (HF)	3 MHz to 30 MHz
Very high frequency (VHF)	30 MHz to 300 MHz
Ultra high frequency (UHF)	300 MHz to 3 GHz
L band	1–2 GHz
S band	2–4 GHz
C band	4–8 GHz
X band	8–12 GHz
Ku band	12–18 GHz
K band	18–26 GHz
Ka band	26–40 GHz
U band	40–60 GHz
V band	50-75 GHz
E band	60-90 GHz
W band	75-110 GHz
F band	90-140 GHz

## 1.2 Advantages of Microwave

- Broader bandwidth
- Improved directivity and higher gain of antennas.
- Higher reliability
- Lower Transmitter Power requirements.

# 1.2 Advantages of microwave

- Band width:
  - Telegraph, speech, music and video signal may be transmitted directly through wire line or cable as a baseband signal covering baseband width for each type of signals.
  - Telegraph channel – BW 120Hz, Speech – BW 2-3kHz, Music channel – BW 10-20 kHz each one has the base bandwidth. TV requires BW of 7 MHz (5MHz video + 2MHz audio)
  - Now the entire frequency range up to 1GHz is crowded with various channels.
  - With advent of frequency modulation we have to go in for higher bandwidths in order to achieve a high S/N ratio. Thus the band congestion was becoming a major problem in radio communication.
  - Hence we go in for microwave frequencies. In microwave range, the number of channels that can be accommodated simultaneously in any single microwave band is very large.

## 1.2 Advantages of microwave

- Improved directivity and higher gain of antennas
  - At microwave frequencies, size of dipole is very small. Hence the aerial array consisting of a greater number of dipoles giving very high directivity and gain compared to an omnidirectional antenna.
  - A parabolic reflector antenna with a horn feed is universally employed at microwaves to have high directivity and gain, the two antenna parameters being proportional to each other.

# 1.2 Advantages of Microwave

- **Reliability**
  - In shortwave communication, the transfer of energy takes place by reflections from F and E layer ionosphere, whose concentrations vary widely with time and weather. Hence the energy received by receiver is not of uniform strength but there are great variations in the strength of received signal though transmitted power may be constant. This gives rise to **FADING**.
  - At microwave frequencies, there is less fading since the propagation of microwave from transmitter to receiver takes place by line of sight propagation. As the frequency increases, the reception becomes clearer and clearer in microwave ranges. Moreover the foggy weather also does not affect the propagation much.



# 1.2 Advantages of Microwave

- Power Requirements
  - At microwave, the power requirements of the transmitter become very small as compared to that at MF/HF, due to the high gain of the antennas at microwaves. Basic configuration remains same as MF/HF, but components used are different.
  - Disadvantage: Needs the number of repeater stations, as a microwave line of sight link over the ground cannot have a range of greater than about 40-60 km due to earth's curvature.

# 1.3 Microwave Application

- Microwave oven
- Microwave diathermy
  - Produces heat inside the muscle without overheating the skin.
- Microwave drying
  - Used in printing industries.
- Microwave melting
- In agriculture industries
  - For vacuum drying of sliced aromatic plant root, cotton seed, microwave treatment of seed, drying of field corns and heating of corn fields, warming of plants, for use as insecticides in grain, tobaccos and Pecan Weevil and for pasteurization of milks.
- Forest products
  - For drying of veneer (thin covering) and Bending of Wood.

# Medical Applications

- Microwave hyperthermia for cancer therapy
  - A therapy using non-ionizing microwave radiation
- Diagnostic with bioimpedences (BIA)
  - Analysis of resistance and reactance in the human body