



ME 301

CONDUCTION AND RADIATION HEAT TRANSFER

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Download Course Materials from

www.mislam.info/ocw.html



Suggested Reference books

- Heat and Mass transfer – A Practical Approach by Yunus A Cengel
- Heat Transfer – A Basic Approach by M. Nekati Ozisik
- Fundamentals of Heat and mass Transfer by Incropera and Dewitt
- Heat Transfer by J P Holman



TODAY'S TOPIC

- Basic ideas of Radiation Heat Transfer
- Thermal Radiation
- Electromagnetic Spectra



THREE BASIC MODES OF HEAT TRANSFER

- Conduction
- Convection
- Radiation



RADIATION HEAT TRANSFER IN CONTRAST WITH OTHER TWO MODE OF HEAT TRANSFER

- Conduction and convection are short range phenomena, Mean Free Path (MFP) is very small
- Radiation is a long range phenomena. MFP varies widely from 10^{-10} to 10^{10} m
- Different in terms of required medium



THUS THERMAL RADIATION HEAT TRANSFER IS IMPORTANT IN

- Combustion application (Fire, Furnace, Engines etc)
- Nuclear Reactions (in the sun, fusion reactor etc)
- Atmospheric **Re-entry** space vehicle
- Others are solar energy collector and the green house effect both due to radiation from high temp sun
- Radiation heat transfer is important for **LOW** temperature application too!



EXAMPLE OF LOW TEMP RADIATION HEAT TRANSFER WITH PRESENCE OF OTHER MODE OF HEAT TRANSFER

- A florist used plastic coverings over flower flats. He observed water collecting in the plastic has formed ice a quarter inch thick (at night), when the official temp reading was far above freezing.
- **So why Ice was formed?**
- **Its due to the radiation loss occurring between the water covered surface and the very cooled outer space and the evaporative heat loss from the water**



EXAMPLE OF LOW TEMP RADIATION HEAT TRANSFER WITH PRESENCE OF OTHER MODE OF HEAT TRANSFER

- Ancient Egyptians made ice by putting water filled porous earthen pot on the roof of the house during clear night.
- **So why Ice was formed?**



EXAMPLES OF RADIATION HEAT TRANSFER

- A hot object is enclosed in a evacuated chamber

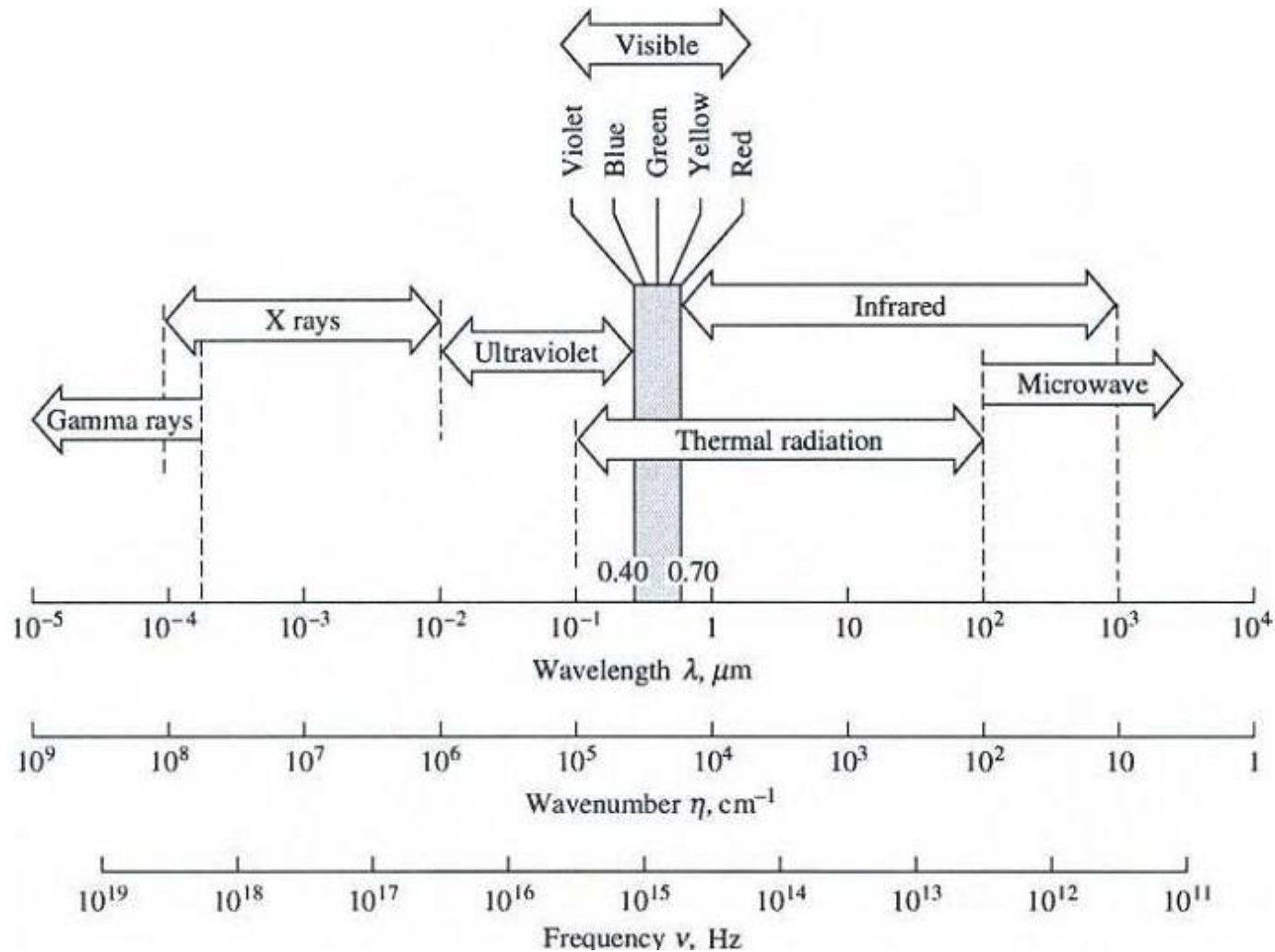


THERMAL RADIATION MECHANISM

- **Electromagnetic Waves**– Maxwell's Electro-magnetic wave theory
 - Can easily predict radiative properties of liquid and solids (including tiny particles)
- **Photons**- Max Plank's Quantum Mechanics
 - Can explain radiative properties of gases



ELECTROMAGNETIC SPECTRA





THAT'S ALL ABOUT TODAY...

