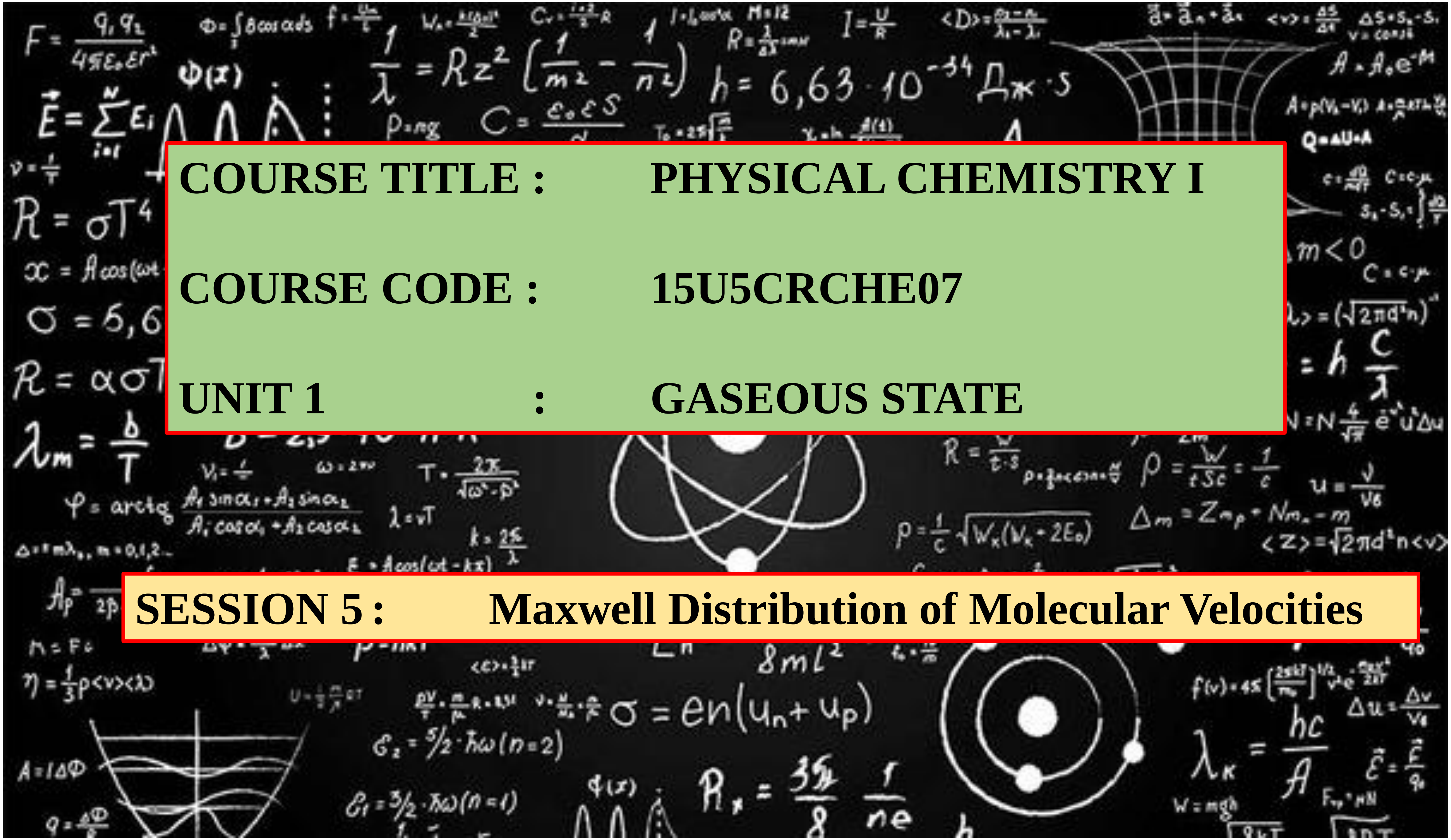


COURSE TITLE : PHYSICAL CHEMISTRY I

COURSE CODE : 15U5CRCHE07

UNIT 1 : GASEOUS STATE

SESSION 5 : Maxwell Distribution of Molecular Velocities

MAXWELL'S DISTRIBUTION OF MOLECULAR VELOCITIES

- Molecules in a given sample of gas do not have same velocity – due to molecular collisions.
- Velocity and energies keep on changing.

Maxwell and Boltzmann distribution of molecular velocities

$$\frac{dNc}{N} = 4\pi\left(\frac{M}{2\pi RT}\right)^{3/2}.c^2.\exp\left(\frac{-Mc^2}{2RT}\right).dc$$

$\frac{dNc}{N}$ - The fraction of molecules having velocities between c and (c + dc).

M is the molar mass of the gas

c is the velocity of the gas and T is the temperature

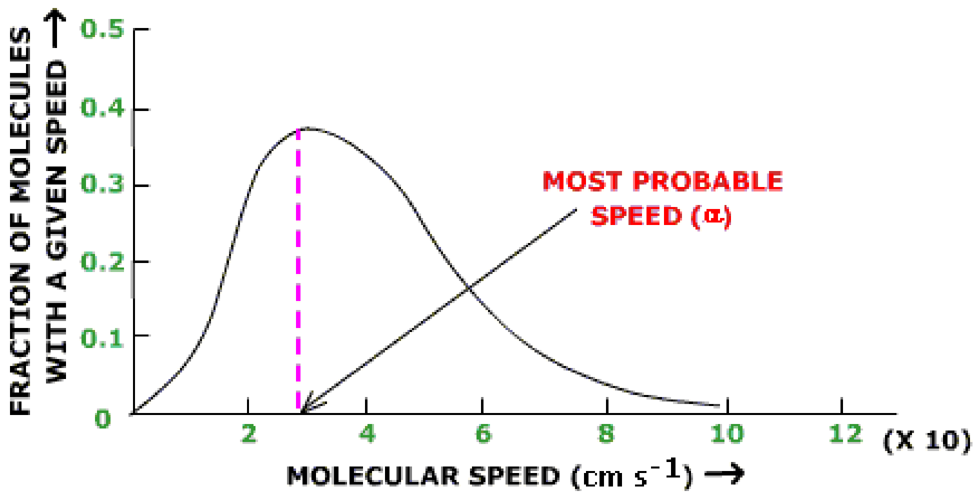
$$\frac{dNc}{N} = 4\pi\left(\frac{M}{2\pi RT}\right)^{3/2}.c^2.\exp\left(\frac{-Mc^2}{2RT}\right).dc$$

$$\frac{1}{N}\frac{dNc}{dc} = 4\pi\left(\frac{M}{2\pi RT}\right)^{3/2}.c^2.\exp\left(\frac{-Mc^2}{2RT}\right)$$

$$\frac{1}{N}\frac{dNc}{dc} = \text{Probability } p(c) \text{ of finding molecules having velocity } c$$

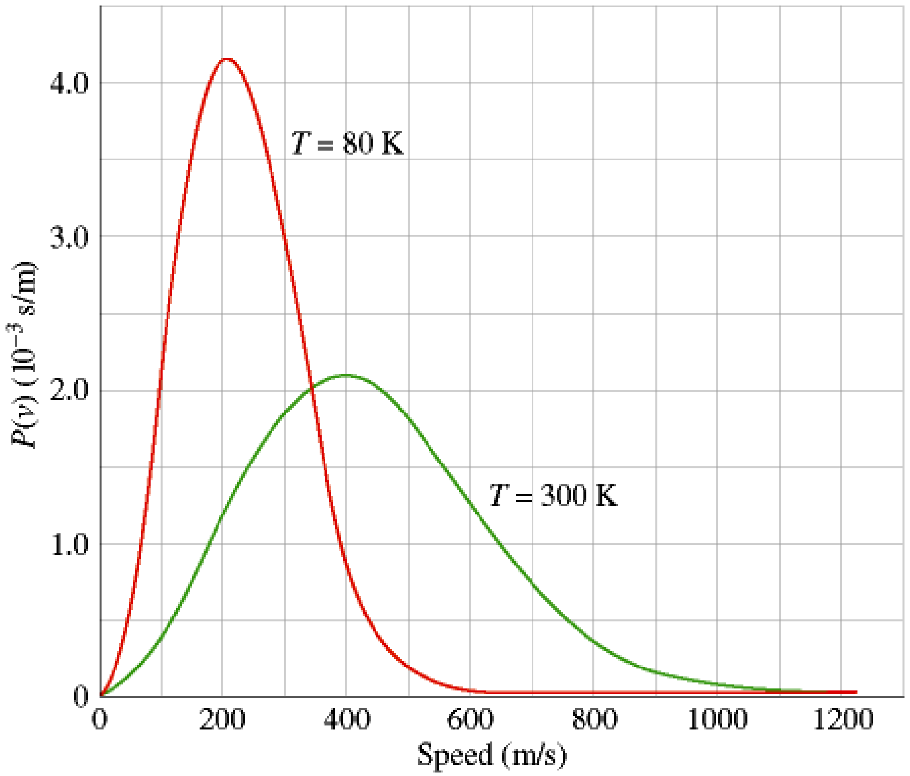
Significance of Maxwells Equation:

Probability *vs* velocity graph



- The probability of molecules being motionless at any instant is very small.
- Only small fraction of molecules has either very low or very high velocity.
- Peak of the distribution curve at a given temperature gives the velocity possessed by the maximum number of gas molecules at that temperature – **Most probable velocity (α)**
- The total area under the curve is a measure of the total number of molecules.

INFLUENCE OF TEMPERATURE



With increase in temperature:

- Rise in the fraction of molecules with higher velocities.
- The **Most probable velocity (α)** increases
- Fraction of molecules possessing the **Most probable velocity (α)** decreases.
- Distribution curve broadens, shifts to the right and flattens downward at the top.
- The total area under the curve is a measure of the total number of molecules.
- The influence of T is prominently due to **Boltzmann factor**.

$$\frac{1}{N}\frac{dNc}{dc} = 4\pi\left(\frac{M}{2\pi RT}\right)^{3/2} . c^2 . \exp\left(\frac{-Mc^2}{2RT}\right)$$