Topic 3: Properties of a pure substance

Relevant course: Thermodynamics / Engineering Thermodynamics / Thermal Science

Relevant Department: Mechanical Engg., Aerospace Engg., Production Engg.,

Relevant Semester: This is for a beginning course which is typically offered in the 2nd,3rd or 4th semesters of the B.Tech. program.

Pre-requisite: None. A course in Physics that covers thermodynamics would be helpful.

Topic Description:

Session 1 –

Pure substance, mixture. Phase

Phases of a pure substance: solid, liquid and vapour.

Phase diagram, p-v-T surface. Triple point, Critical point.

Equilibrium between phases: Liquid-vapour, liquid-solid, Vapour-solid, Solid-liquid-vapour.

Saturated state: saturated liquid, saturated vapour.

Compressed / subcooled liquid.

Superheated vapour. Highly superheated vapour / gas

Ideal gas.

Session 2 –

Properties of a pure substance: Pressure (p), Specific volume (v), Temperature (T), Specific internal

energy (u), specific enthalpy (h), specific entropy (s), Specific Gibbs function (g), Specific Helmholtz

function (ψ).

Relations between properties. Maxwell's relations.

Equation(s) of state.

Properties required to specify state - pure substance. (mixture).

Evaluating properties. Property diagrams. Property charts.

Property software/web-based data.

Session 3 –

Property calculation examples.

Compressibility. Compressibility factor. Ideal gas equation of state and its modifications.

Property relations. Property diagrams.

Examples and applications.

Depicting processes with schematics (flow diagrams). Common symbols for equipment and fittings