

B.Sc Part I physics (Hons.)  
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Question:- Define Gibbs function (or potential) of a system. Explain its importance?

Ans:- As we know  $G = H - TS = U + PV - TS$   
 or  $G$  or  $U + PV - TS$   
 $\therefore dG = dU + PdV + VdP - Tds - SdT$   
 $= (Tds - PdV) + PdV + VdP - Tds - SdT$   
 $= VdP - SdT$

At constant pressure

$$dG = -SdT$$

$$\text{or } S = -\left(\frac{dG}{dT}\right) \text{ and similarly}$$

$$V = -\left(\frac{dG}{dP}\right)$$

Thus  $S$  and  $V$  are given by derivatives of  $G$ , and this fact justifies its selection as fourth thermodynamic potential.

Its significance is revealed when we consider reversible isothermal isobaric process.

$$dU = Tds - dW = d(TS) - PdV - dA$$

where  $dA$  is the work done by the system other than the mechanical work which is  $PdV$ .

$$\text{or } dU = d(TS) - d(PV) - dA$$

$$\text{or } d(U + PV - TS) = -dA$$

$$\therefore dG = -dA \quad (\because G = U + PV - TS, \text{ by definition})$$

Thus the significance of  $G$  is that it decreases represents work (other than mechanical work) available from the system in reversible isothermal-isobaric process.

Another significance is isothermal-isobaric process  $dT=0$  and  $dP=0 \therefore dG=0$ , Hence  $G$  is constant in process. This function is particularly important in connection with processes involving a change of phase. Sublimation, fusion and vaporisation take place isothermally and isobarically can be conceived as occurring reversibly, hence during such process, the Gibbs function or Gibbs free energy of the system remain constant.

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