

## Thermodynamic processes:

Process in which state of thermodynamic variables like  $P, V, T$  changes are called thermodynamic processes.

Given fixed number of moles / closed system ( $n = \text{constant}$ ) under ideal conditions is assumed ( $PV = nRT$  is applicable)

Constant volume process / Isochoric process / Isometric process:

Gas is confined in a piston cylinder arrangement having fixed piston.

$$V = \text{constant}$$

$$PV = nRT \Rightarrow \frac{P}{T} = \left(\frac{nR}{V}\right) = \text{const.}$$

Process equation:  $\frac{P}{T} = \text{constant}$

Between two states  $(P_1, V, T_1)$  and  $(P_2, V, T_2)$

$$\text{one can use: } \frac{P_1}{T_1} = \frac{P_2}{T_2} \quad \left\{ T_1, T_2 \text{ must be in kelvin} \right\}$$

Example: A given mass of an ideal gas is confined in a vessel of fixed volume. At  $27^\circ\text{C}$  pressure of the gas is found to be  $2.4 \text{ atm}$ . Find its pressure if the gas is heated to  $52^\circ\text{C}$ .

$$\begin{aligned} \text{Sol: } P_1 &= 2.4 \text{ atm} & , & T_1 = 273 + 27 = 300 \text{ K} \\ P_2 &= ? & , & T_2 = 273 + 52 = 325 \text{ K} \\ \frac{P_1}{T_1} &= \frac{P_2}{T_2} \Rightarrow P_2 = \frac{T_2}{T_1} \times P_1 = \frac{325}{300} \times 2.4 = 2.6 \text{ atm} \\ & & & \text{(answer)} \end{aligned}$$



# Chemical Engineering Thermodynamics Lecture Notes

**J Elliott**



## **Chemical Engineering Thermodynamics Lecture Notes:**

**Chemical Engineering Thermodynamics** AHUJA, PRADEEP, 2008-12 This book offers a full account of thermodynamic systems in chemical engineering It provides a solid understanding of the basic concepts of the laws of thermodynamics as well as their applications with a thorough discussion of phase and chemical reaction equilibria At the outset the text explains the various key terms of thermodynamics with suitable examples and then thoroughly deals with the virial and cubic equations of state by showing the P V T pressure molar volume and temperature relation of fluids It elaborates on the first and second laws of thermodynamics and their applications with the help of numerous engineering examples The text further discusses the concepts of exergy standard property changes of chemical reactions thermodynamic property relations and fugacity The book also includes detailed discussions on residual and excess properties of mixtures various activity coefficient models local composition models and group contribution methods In addition the text focuses on vapour liquid and other phase equilibrium calculations and analyzes chemical reaction equilibria and adiabatic reaction temperature for systems with complete and incomplete conversion of reactants Key Features Includes a large number of fully worked out examples to help students master the concepts discussed Provides well graded problems with answers at the end of each chapter to test and foster students conceptual understanding of the subject The total number of solved examples and end chapter exercises in the book are over 600 Contains chapter summaries that review the major concepts covered The book is primarily designed for the undergraduate students of chemical engineering and its related disciplines such as petroleum engineering and polymer engineering It can also be useful to professionals The Solution Manual containing the complete worked out solutions to chapter end exercises and problems is available for instructors

**Lectures in Classical Thermodynamics with an Introduction to Statistical Mechanics** Daniel Blankschtein, 2021-03-15 This textbook facilitates students ability to apply fundamental principles and concepts in classical thermodynamics to solve challenging problems relevant to industry and everyday life It also introduces the reader to the fundamentals of statistical mechanics including understanding how the microscopic properties of atoms and molecules and their associated intermolecular interactions can be accounted for to calculate various average properties of macroscopic systems The author emphasizes application of the fundamental principles outlined above to the calculation of a variety of thermodynamic properties to the estimation of conversion efficiencies for work production by heat interactions and to the solution of practical thermodynamic problems related to the behavior of non ideal pure fluids and fluid mixtures including phase equilibria and chemical reaction equilibria The book contains detailed solutions to many challenging sample problems in classical thermodynamics and statistical mechanics that will help the reader crystallize the material taught Class tested and perfected over 30 years of use by nine time Best Teaching Award recipient Professor Daniel Blankschtein of the Department of Chemical Engineering at MIT the book is ideal for students of Chemical and Mechanical Engineering Chemistry and Materials Science who will benefit greatly from in depth

discussions and pedagogical explanations of key concepts Distills critical concepts methods and applications from leading full length textbooks along with the author s own deep understanding of the material taught into a concise yet rigorous graduate and advanced undergraduate text Enriches the standard curriculum with succinct problem based learning strategies derived from the content of 50 lectures given over the years in the Department of Chemical Engineering at MIT Reinforces concepts covered with detailed solutions to illuminating and challenging homework problems *Notes on Chemical Engineering Thermodynamics* Swinburne College of Technology. Publications Dept,1965 **Notes on chemical engineering thermodynamics** ,1965 *Biothermodynamics* Mustafa Ozilgen,Esra Sorguven Oner,2016-11-18 Over the past several decades there has been increasing research interest in thermodynamics as applied to biological systems This concerns topics such as muscle work and internal energy such as fat and starch Applications of the first and second laws of thermodynamics to the human body are important to dieticians and health science experts and applications of these concepts to the animal body are a major concern of animal scientists This book covers these key topics which are typically not covered in classic or traditional thermodynamics texts used in mechanical and chemical engineering *Kelvin, Thermodynamics and the Natural World* M.W. Collins,R.C. Dougal,C. Koenig,I. Ruddock, Strathclyde University, UK,2015-12-14 This volume looks afresh at the life and works of Lord Kelvin including his standing and relationships with Charles Darwin T S Huxley and the X club thereby throwing new light on the nineteenth century conflict between the British energy and biology specialists It focuses on two principal issues Firstly there is the contribution made by Kelvin to the formulation of the Laws of Thermodynamics both personal and in the content of the scientific communications exchanged with other workers such as Joule and Clausius Secondly there is Kelvin s impact on the wider field of science such as thermoelectricity and geology determination of the age of the earth Of late a number of studies and initiatives including the Centenary celebrations of Kelvin s death and exhibits such as that of the Revolutionary Scientist in the Hunterian Museum Glasgow have been undertaken aiding the redefinition of Kelvin s greatness and achievements The book also raises awareness to improve our approach to the teaching of elementary thermodynamics by attempting to empathise with Kelvin s perspective It is completed by a full biography overviews of various monuments to his memory and short Stories in Pictures on the Atlantic cable Maxwell s Demon the universities associated with the development of thermodynamics and the Royal Society of Edinburgh Scientists and engineers with an interest in thermodynamics and anyone interested in the work of Lord Kelvin will find benefit in Kelvin Thermodynamics and the Natural World *Heat Transfer* Y.V. Rao,2001-09 Heat Transfer is a compulsory core course in the curriculum of almost all branches of engineering in several engineering and technical institutions and universities An outcome of the lecture notes prepared by the author this book has been prepared primarily for an introductory course in Heat and Mass Transfer **Journal of Chemical Engineering Education** ,1962 *Bowker's Complete Video Directory 2001* ,2001 **Makers of Jadavpur: A Technological Perspective** Rajat Baisya,2021-04-02 This volume is authored by

Rajat K Baisya alumnus of the department of Food Technology and Biochemical Engineering and a distinguished scholar author and management consultant The foundations of Jadavpur university and its origins as a technological institution imagined in a nationalist mould established as a counter to the colonial British education and as a part of the movement for independence are relatively well known What is less explored is the journey that the National Council of Education underwent to transform itself into the Jadavpur University As a premier institution of higher learning in India at the present time Jadavpur University has a number of stalwart professors to thank for its worldwide reputation This book covers the biographies of twenty two such professors of the Faculty of Engineering and Technology Written from the technological perspective the book attempts to trace a form of history of Jadavpur University through the microhistories of the individuals responsible for its beginnings and subsequent growth

**Chemical Heritage** ,2001    **The Journal of Industrial and Engineering Chemistry** ,1922    **Journal of Industrial and Engineering Chemistry** ,1922    *The Newman Lectures on Thermodynamics* John S. Newman,Vincent S. Battaglia,2019-06-21 Prof Newman is considered one of the great chemical engineers of his time His reputation derives from his mastery of all phases of the subject matter his clarity of thought and his ability to reduce complex problems to their essential core elements He has been teaching undergraduate and graduate core subject courses at the University of California Berkeley UC Berkeley USA since joining the faculty in 1966 His method is to write out in long form everything he expects to convey to his class on a subject on any given day He has maintained and updated his lecture notes from notepad to computer throughout his career This book is an exact reproduction of those notes The book presents concepts needed to define single and multi component systems starting with the Gibbs function It helps readers derive concepts of entropy and temperature and the development of material properties of pure substances It acquaints them with applications of thermodynamics such as cycles open systems and phase transitions and eventually leads them to concepts of multiple component systems in particular chemical and phase equilibria It clearly presents all concepts that are necessary for engineers

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