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KEY=COMBUSTION - JAX BEARD

Fundamentals of Combustion Processes Springer Science & Business Media *Fundamentals of Combustion Processes is designed as a textbook for an upper-division undergraduate and graduate level combustion course in mechanical engineering. The authors focus on the fundamental theory of combustion and provide a simplified discussion of basic combustion parameters and processes such as thermodynamics, chemical kinetics, ignition, diffusion and pre-mixed flames. The text includes exploration of applications, example exercises, suggested homework problems and videos of laboratory demonstrations*

Analytic Combustion With Thermodynamics, Chemical Kinetics and Mass Transfer Cambridge University Press *Combustion involves change in the chemical state of a substance from a fuel-state to a product-state via chemical reaction accompanied by release of heat energy. Design or performance evaluation of equipment also requires knowledge of the RATE of change of state. This rate is governed by the laws of thermodynamics and by the empirical sciences of heat and mass transfer, chemical kinetics and fluid dynamics. Theoretical treatment of combustion requires integrated knowledge of these subjects and strong mathematical and numerical skills. ANALYTIC COMBUSTION is written for advanced undergraduates, graduate students and professionals in mechanical, aeronautical, and chemical engineering. Topics were carefully selected and presented to facilitate learning with emphasis on effective mathematical formulations and solution strategies. The book features over 60 solved numerical problems and analytical derivations and nearly 145 end-of-chapter exercise problems. The presentation is gradual starting from Thermodynamics of Pure and Mixture substances, Chemical Equilibrium, building to a uniquely strong chapter on Application Case-Studies.*

Dynamics of Combustion Systems Springer Science & Business Media *The Dynamics of Combustion Systems are presented in three parts in this book. Together they provide a step towards the automatic control of explosions. The exothermic character of combustion systems, their fluid dynamic features, and explosive nature, are covered by this work which also provides a technical monograph for readers with some background in combustion technology. The book is likely to appeal to graduate students, and researchers in academia and industry.*

Combustion Thermodynamics and Dynamics Cambridge University Press *Combustion Thermodynamics and Dynamics builds on a foundation of thermal science, chemistry, and applied mathematics that will be familiar to most undergraduate aerospace, mechanical, and chemical engineers to give a first-year graduate-level exposition of the thermodynamics, physical chemistry, and dynamics of advection-reaction-diffusion. Special effort is made to link notions of time-independent classical thermodynamics with time-dependent reactive fluid dynamics. In particular, concepts of classical thermochemical equilibrium and stability are discussed in the context of modern nonlinear dynamical systems theory. The first half focuses on time-dependent spatially homogeneous reaction, while the second half considers effects of spatially inhomogeneous advection and diffusion on the reaction dynamics. Attention is focused on systems with realistic detailed chemical kinetics as well as simplified kinetics. Many mathematical details are presented, and several quantitative examples given. Topics include foundations of thermochemistry, reduced kinetics, reactive Navier-Stokes equations, reaction-diffusion systems, laminar flame, oscillatory combustion, and detonation.*

Fluid Mechanics Aspects of Fire and Smoke Dynamics in Enclosures CRC Press *This book provides essential understanding of flows in fire and smoke dynamics in enclosures, covering combustion, heat transfer and fire suppression in more detail than other introductory books. It moves from the basic equations for turbulent flows with combustion, through a discussion of the structure of flames, to fire and smoke plumes and their interaction with enclosure boundaries. This is then applied to fire dynamics and smoke and heat control in enclosures. This new edition provides considerably more on the fluid mechanics of the effect of water, and on fire dynamics modelling using Computational Fluid Dynamics. Presents worked examples taken from practical, everyday fire-related problems Covers a broad range of topics, from the basics to state-of-the-art computer simulations of fire and smoke-related fluid mechanics, including the effect of water Provides extensive treatment of the interaction of water sprays with a fire-driven flow Contains a chapter on Computational Fluid Dynamics, the increasingly popular calculation method in the field of fire safety science The book serves as a comprehensive guide at the undergraduate and starting researcher level on fire and smoke dynamics in enclosures, with an emphasis on fluid mechanics.*

Modeling and Simulation of Turbulent Mixing and Reaction For Power, Energy and Flight Springer Nature *This book highlights recent research advances in the area of turbulent flows from both industry and academia for applications in the area of Aerospace and Mechanical engineering. Contributions include modeling, simulations and experiments meant for researchers, professionals and students in the area.*

Soot Formation in Combustion Mechanisms and Models Springer Science & Business Media *Soot Formation in Combustion represents an up-to-date overview. The contributions trace back to the 1991 Heidelberg symposium entitled "Mechanism and Models of Soot Formation" and have all been reedited by Prof. Bockhorn in close contact with the original authors. The book gives an easy introduction to the field for newcomers, and provides detailed treatments for the specialists. The following list of contents illustrates the topics under review:*

Combustion Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation Springer Science

& Business Media This book provides a rigorous treatment of the coupling of chemical reactions and fluid flow. Combustion-specific topics of chemistry and fluid mechanics are considered and tools described for the simulation of combustion processes. This edition is completely restructured. Mathematical Formulae and derivations as well as the space-consuming reaction mechanisms have been replaced from the text to appendix. A new chapter discusses the impact of combustion processes on the atmosphere, the chapter on auto-ignition is extended to combustion in Otto- and Diesel-engines, and the chapters on heterogeneous combustion and on soot formation are heavily revised. **Scientific and Technical Data in a New Era CRC Press** Topics dealt with: Bioscience and biotechnology; Industry and technology; Safety and environmental protection; Geo- and space sciences; Scientific aspects of collecting and distributing data; Legal and social aspects of data dissemination; Innovations in data handling. **Application of Clean Fuels in Combustion Engines Springer** This book discusses the impact of fuels characteristics and their effects on the combustion processes in internal combustion engines. It includes the analysis of a variety of biofuels (alcohol fuels and biodiesel) and biogases (natural gas, hydrogen, etc.), providing valuable information related to consequent effects on performance and emissions. The contents focus on recent results and current trends of fuel utilization in the transport sector. State-of-the-art of clean fuels application are also discussed. This book will be of interest to those in academia and industry involved in fuels, IC engines, engine instrumentation, and environmental research. **Chemical Rockets Performance Prediction and Internal Ballistics Design Springer Nature** The purpose of this book is to discuss, at the graduate level, the methods of performance prediction for chemical rocket propulsion. A pedagogical presentation of such methods has been unavailable thus far and this text, based upon lectures, fills this gap. The first part contains the energy-minimization to calculate the propellant-combustion composition and the subsequent computation of rocket performance. While incremental analysis is for high performance solid motors, equilibrium-pressure analysis is for low performance ones. Both are detailed in the book's second part for the prediction of ignition and tail-off transients, and equilibrium operation. Computer codes, adopting the incremental analysis along with erosive burning effect, are included. The material is encouraged to be used and presented at lectures. Senior undergraduate and graduate students in universities, as well as practicing engineers and scientists in rocket industries, form the readership. **Principles of Heat Transfer John Wiley & Sons** CD-ROM contains: Equations and relations (models) for thermal circuit modeling. **Gas-Phase Combustion Chemistry Springer Science & Business Media** Superseding Gardiner's "Combustion Chemistry", this is an updated, comprehensive coverage of those aspects of combustion chemistry relevant to gas-phase combustion of hydrocarbons. The book includes an extended discussion of air pollutant chemistry and aspects of combustion, and reviews elementary reactions of nitrogen, sulfur and chlorine compounds that are relevant to combustion. Methods of combustion modeling and rate coefficient estimation are presented, as well as access to databases for combustion thermochemistry and modeling. **Handbook of Explosion Prevention and Protection John Wiley & Sons** The new definitive reference in the field. Between them, the renowned team of editors and authors have amassed unparalleled experience at such institutes as BAM, PTB, Pittsburgh National Institute for Occupational Health and Safety, BASF AG, and the University of Göttingen. In this work -- the first of its kind for 35 years -- they describe in detail those measures that prevent or limit industrial explosions and the damage so caused. They cover various preventative methods, as well as the current state of technology combined with data gained through experimentation. This handbook offers operational, planning, design and safety engineers working in industry, government agencies and professional associations in-depth knowledge of the scientific and technical basics, allowing them to apply explosion protection according to any given situation. **Turbulent Combustion Modeling Advances, New Trends and Perspectives Springer Science & Business Media** Turbulent combustion sits at the interface of two important nonlinear, multiscale phenomena: chemistry and turbulence. Its study is extremely timely in view of the need to develop new combustion technologies in order to address challenges associated with climate change, energy source uncertainty, and air pollution. Despite the fact that modeling of turbulent combustion is a subject that has been researched for a number of years, its complexity implies that key issues are still eluding, and a theoretical description that is accurate enough to make turbulent combustion models rigorous and quantitative for industrial use is still lacking. In this book, prominent experts review most of the available approaches in modeling turbulent combustion, with particular focus on the exploding increase in computational resources that has allowed the simulation of increasingly detailed phenomena. The relevant algorithms are presented, the theoretical methods are explained, and various application examples are given. The book is intended for a relatively broad audience, including seasoned researchers and graduate students in engineering, applied mathematics and computational science, engine designers and computational fluid dynamics (CFD) practitioners, scientists at funding agencies, and anyone wishing to understand the state-of-the-art and the future directions of this scientifically challenging and practically important field. **Biomass Chars: Elaboration, Characterization and Applications II MDPI** Biomass can be converted to energy, biofuels, and bioproducts via thermochemical conversion processes, such as combustion, pyrolysis, and gasification. Combustion technology is most widely applied on an industrial scale. However, biomass gasification and pyrolysis processes are still in the research and development stage. The major products from these processes are syngas, bio-oil, and char (called also biochar for agronomic application). Among these products, biomass chars have received increasing attention for different applications, such as gasification, co-combustion, catalysts or adsorbents precursors, soil amendment, carbon fuel cells, and supercapacitors. This Special Issue provides an overview of biomass char production methods (pyrolysis, hydrothermal carbonization, etc.), characterization techniques (e.g., scanning electronic microscopy, X-ray fluorescence, nitrogen adsorption, Raman spectroscopy, nuclear magnetic resonance spectroscopy, X-ray photoelectron spectroscopy, and temperature programmed desorption and mass spectrometry), their properties, and their suitable recovery processes. **Modelling Diesel Combustion Springer Science & Business Media** Phenomenology of Diesel Combustion and Modeling Diesel is the most efficient combustion engine today and it plays an important role in transport of goods and passengers on land and on high seas. The emissions must be controlled as stipulated by the society without sacrificing the legendary fuel economy of the diesel engines. These important drivers caused innovations in diesel engineering like re-entrant combustion chambers in the piston, lower swirl support and high pressure injection, in turn reducing the ignition delay and hence the nitric oxides. The limits on emissions are being continually reduced. Therefore, the required accuracy of the models to predict the emissions and efficiency of the engines is high. The phenomenological combustion models based on physical and chemical description of the processes in the engine are practical to describe diesel engine

combustion and to carry out parametric studies. This is because the injection process, which can be relatively well predicted, has the dominant effect on mixture formation and subsequent course of combustion. The need for improving these models by incorporating new developments in engine designs is explained in Chapter 2. With “model based control programs” used in the Electronic Control Units of the engines, phenomenological models are assuming more importance now because the detailed CFD based models are too slow to be handled by the Electronic Control Units. Experimental work is necessary to develop the basic understanding of the processes. **Issues in Mechanical Engineering: 2012 Edition ScholarlyEditions** *Issues in Mechanical Engineering / 2012 Edition* is a ScholarlyEditions™ eBook that delivers timely, authoritative, and comprehensive information about Lubrication Technology. The editors have built *Issues in Mechanical Engineering: 2012 Edition* on the vast information databases of ScholarlyNews.™ You can expect the information about Lubrication Technology in this eBook to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of *Issues in Mechanical Engineering: 2012 Edition* has been produced by the world’s leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at <http://www.ScholarlyEditions.com/>. **Reciprocating Engine Combustion Diagnostics In-Cylinder Pressure Measurement and Analysis Springer** *This book deals with in-cylinder pressure measurement and its post-processing for combustion quality analysis of conventional and advanced reciprocating engines. It offers insight into knocking and combustion stability analysis techniques and algorithms in SI, CI, and LTC engines, and places special emphasis on the digital signal processing of in-cylinder pressure signal for online and offline applications. The text gives a detailed description on sensors for combustion measurement, data acquisition, and methods for estimation of performance and combustion parameters. The information provided in this book enhances readers’ basic knowledge of engine combustion diagnostics and serves as a comprehensive, ready reference for a broad audience including graduate students, course instructors, researchers, and practicing engineers in the automotive, oil and other industries concerned with internal combustion engines.* **Combustion Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation Springer Science & Business Media** *This book provides a rigorous treatment of the coupling of chemical reactions and fluid flow. Combustion-specific topics of chemistry and fluid mechanics are considered and tools described for the simulation of combustion processes. This edition is completely restructured. Mathematical Formulae and derivations as well as the space-consuming reaction mechanisms have been replaced from the text to appendix. A new chapter discusses the impact of combustion processes on the atmosphere, the chapter on auto-ignition is extended to combustion in Otto- and Diesel-engines, and the chapters on heterogeneous combustion and on soot formation are heavily revised.* **Combustion Technology Essentials of Flames and Burners Springer Nature** *This textbook is intended for post-graduate students in mechanical and allied engineering disciplines. It will also be helpful to scientists and engineers working in the areas of combustion to recapitulate the fundamental and generally applied aspects of combustion. This textbook comprehensively covers the fundamental aspects of combustion. It includes physical descriptions of premixed and non-premixed flames. It provides a detailed analysis of the basic ideas and design characteristics of burners for gaseous, liquid and solid fuels. A chapter on alternative renewable fuels has also been included to bring out the need, characteristics and usage of alternative fuels. Review questions have been provided at the end of each chapter which will help the students to evaluate their understanding of the important concepts covered in that chapter. Several standard text books have been cited in the chapters and are listed towards the end, as suggested reading, to enable the readers to refer them when required. The textbook will be useful for students in mechanical, aerospace and related fields of engineering. It will also be a good resource for professionals and researchers working in the areas of combustion technology.* **Enriched Methane The First Step Towards the Hydrogen Economy Springer** *This book brings together recent research from across the world on enriched methane, and examines the production, distribution and use of this resource in internal combustion engines and gas turbines. It aims to provide readers with an extensive account of potential technological breakthroughs which have the capacity to revolutionize energy systems. Enriched methane, a gas mixture composed by methane and hydrogen (10-30%vol), constitutes the first realistic step towards the application of hydrogen as an energy vector. It provides strong benefits in terms of emissions reduction, that is -11% of CO₂, eq emission with the combustion of a 30%vol H₂ mixture, if hydrogen is produced from renewable energy sources. Enriched methane offers the following advantages: • it can be produced at competitive costs; • it can be distributed by means of the medium pressure natural gas grid; • it can be stored in traditional natural gas storage systems; • it can feed natural gas internal combustion engine, improving conversion efficiency. /divdivThis book is intended for academics in chemical engineering and energy production, distribution and storage. It is also intended for energy producers, engineering companies and R&D organizations./divdiv* **Multiphase Catalytic Reactors Theory, Design, Manufacturing, and Applications John Wiley & Sons** *Provides a holistic approach to multiphase catalytic reactors from their modeling and design to their applications in industrial manufacturing of chemicals Covers theoretical aspects and examples of fixed-bed, fluidized-bed, trickle-bed, slurry, monolith and microchannel reactors Includes chapters covering experimental techniques and practical guidelines for lab-scale testing of multiphase reactors Includes mathematical content focused on design equations and empirical relationships characterizing different multiphase reactor types together with an assortment of computational tools Involves detailed coverage of multiphase reactor applications such as Fischer-Tropsch synthesis, fuel processing for fuel cells, hydrotreating of oil fractions and biofuels processing* **Dynamics of Deflagrations and Reactive Systems AIAA Radiative Heat Transfer in Turbulent Combustion Systems Theory and Applications Springer** *This introduction reviews why combustion and radiation are important, as well as the technical challenges posed by radiation. Emphasis is on interactions among turbulence, chemistry and radiation (turbulence-chemistry-radiation interactions - TCRI) in Reynolds-averaged and large-eddy simulations. Subsequent chapters cover: chemically reacting turbulent flows; radiation properties, Reynolds transport equation (RTE) solution methods, and TCRI; radiation effects in laminar flames; TCRI in turbulent flames; and high-pressure combustion systems. This Brief presents integrated approach that includes radiation at the outset, rather than as an afterthought. It stands as the most recent developments in physical modeling, numerical algorithms, and applications collected in one monograph.* **Combustion Physics Cambridge University Press** *This graduate-level 2006 text incorporates these advances in a comprehensive*

treatment of the fundamental principles of combustion physics. The presentation emphasises analytical proficiency and physical insight, with the former achieved through complete, though abbreviated, derivations at different levels of rigor, and the latter through physical interpretations of analytical solutions, experimental observations, and computational simulations. Exercises are mostly derivative in nature in order to further strengthen the student's mastery of the theory. Implications of the fundamental knowledge gained herein on practical phenomena are discussed whenever appropriate. These distinguishing features provide a solid foundation for an academic program in combustion science and engineering.

Combustion Chemistry Springer Science & Business Media Detailed study of the rates and mechanisms of combustion reactions has not been in the mainstream of combustion research until the recent recognition that further progress in optimizing burner performance and reducing pollutant emission can only be done with fundamental understanding of combustion chemistry. This has become apparent at a time when our understanding of the chemistry, at least of small-molecule combustion, and our ability to model combustion processes on large computers have developed to the point that real confidence can be placed in the results. This book is an introduction for outsiders or beginners as well as a reference work for people already active in the field. Because the spectrum of combustion scientists ranges from chemists with little computing experience to engineers who have had only one college chemistry course, everything needed to bring all kinds of beginners up to the level of current practice in detailed combustion modeling is included. It was a temptation to include critical discussions of modeling results and computer programs that would enable outsiders to start quickly into problem solving. We elected not to do either, because we feel that the former are better put into the primary research literature and that people who are going to do combustion modeling should either write their own programs or collaborate with experts. The only exception to this is in the thermochemical area, where programs have been included to do routine fitting operations. For reference purposes there are tables of thermochemical, transport-property, and rate coefficient data.

Particulate Carbon Formation During Combustion Springer The goal of the symposium, "Particulate Carbon: Formation During Combustion", held at the General Motors Research Laboratories on October 15 and 16, 1980, was to discuss fundamental aspects of soot formation and oxidation in combustion systems and to stimulate new research by extensive interactions among the participants. This book contains the papers and discussions of that symposium, the 26th in an annual series covering many different disciplines which are timely and of interest to both General Motors and the technical community at large. The subject of this symposium has considerable relevance for man in his effort to control and preserve his environment. Emission of particulate carbon into the atmosphere from combustion sources is of concern to scientists and laymen alike. The hope of reducing this emission clearly requires an understanding of its formation during the combustion process, itself an area of considerable long-term research interest. It is our hope that this symposium has served to summarize what is known so that what remains to be learned can be pursued with greater vigor.

Catalog of Books and Reports in the Bureau of Mines Technical Library, Pittsburgh, Pa Misconceptions in Chemistry Addressing Perceptions in Chemical Education Springer Science & Business Media Over the last decades several researchers discovered that children, pupils and even young adults develop their own understanding of "how nature really works". These pre-concepts concerning combustion, gases or conservation of mass are brought into lectures and teachers have to diagnose and to reflect on them for better instruction. In addition, there are 'school-made misconceptions' concerning equilibrium, acid-base or redox reactions which originate from inappropriate curriculum and instruction materials. The primary goal of this monograph is to help teachers at universities, colleges and schools to diagnose and 'cure' the pre-concepts. In case of the school-made misconceptions it will help to prevent them from the very beginning through reflective teaching. The volume includes detailed descriptions of class-room experiments and structural models to cure and to prevent these misconceptions.

Automotive Model Predictive Control Models, Methods and Applications Springer Automotive control has developed over the decades from an auxiliary technology to a key element without which the actual performances, emission, safety and consumption targets could not be met. Accordingly, automotive control has been increasing its authority and responsibility - at the price of complexity and difficult tuning. The progressive evolution has been mainly led by specific applications and short-term targets, with the consequence that automotive control is to a very large extent more heuristic than systematic. Product requirements are still increasing and new challenges are coming from potentially huge markets like India and China, and against this background there is wide consensus both in the industry and academia that the current state is not satisfactory. Model-based control could be an approach to improve performance while reducing development and tuning times and possibly costs. Model predictive control is a kind of model-based control design approach which has experienced a growing success since the middle of the 1980s for "slow" complex plants, in particular of the chemical and process industry. In the last decades, several developments have allowed using these methods also for "fast" systems and this has supported a growing interest in its use also for automotive applications, with several promising results reported. Still there is no consensus on whether model predictive control with its high requirements on model quality and on computational power is a sensible choice for automotive control.

Gas Turbine Emissions Cambridge University Press The development of clean, sustainable energy systems is one of the preeminent issues of our time. Most projections indicate that combustion-based energy conversion systems will continue to be the predominant approach for the majority of our energy usage, and gas turbines will continue to be important combustion-based energy conversion devices for many decades to come, used for aircraft propulsion, ground-based power generation, and mechanical-drive applications. This book compiles the key scientific and technological knowledge associated with gas turbine emissions into a single authoritative source. The book has three sections: the first section reviews major issues with gas turbine combustion, including design approaches and constraints, within the context of emissions. The second section addresses fundamental issues associated with pollutant formation, modeling, and prediction. The third section features case studies from manufacturers and technology developers, emphasizing the system-level and practical issues that must be addressed in developing different types of gas turbines that emit pollutants at acceptable levels.

Numerical Methods in Thermal Problems Proceedings of the Seventh International Conference Held in Stanford, U.S.A. on July 8-12th, 1991 Subsonic Combustion Ramjet Design Springer Nature This book presents a step-by-step methodology for the design of ramjet engines. It explores ramjet combustion, provides guidelines on how to size the engines, and discusses performance analysis. The book begins with an introduction to ramjet design, including fundamental definitions in the field. It then discusses ramjet engine performance, and fuels which can be used. Several types of ramjet engines are then explored,

and guidelines for their design are presented, including flame holders, injectors, and combustors. Finally, the book concludes with a discussion of the types of materials which should be used for ramjet engines. This book is of interest to engine designers and engineers, researchers, and graduate students, as it collates research in a succinct, clear guide to the issue of designing ramjet engines. **Review**

NRL Review Turbulent Combustion Cambridge University Press The combustion of fossil fuels remains a key technology for the foreseeable future. It is therefore important that we understand the mechanisms of combustion and, in particular, the role of turbulence within this process. Combustion always takes place within a turbulent flow field for two reasons: turbulence increases the mixing process and enhances combustion, but at the same time combustion releases heat which generates flow instability through buoyancy, thus enhancing the transition to turbulence. The four chapters of this book present a thorough introduction to the field of turbulent combustion. After an overview of modeling approaches, the three remaining chapters consider the three distinct cases of premixed, non-premixed, and partially premixed combustion, respectively. This book will be of value to researchers and students of engineering and applied mathematics by demonstrating the current theories of turbulent combustion within a unified presentation of the field. **Fossil Energy Update Encyclopedia of Automotive Engineering Part 1: Engines - Fundamentals John Wiley & Sons Fuel Economy in Road Vehicles Powered by Spark Ignition Engines Springer Science & Business Media** Concern about the reduced availability and the increased cost of petroleum fuels prompted great efforts in recent years to reduce the fuel consumption of auto mobiles. The ongoing efforts to reduce fuel consumption have addressed many relevant factors, including increased engine performance, reduced friction, use of lightweight materials, and reduced aerodynamic drag. The results of the investigations assessing the various factors affecting fuel economy have been published in journals, conference proceedings, and in company and government reports. This proliferation of technical information makes it difficult for workers to keep abreast of aU developments. The material presented in this book brings together in a single volume much of the relevant materials, summarizes many of the state-of-the-art theories and data, and provides extensive lists of references. Thus, it is hoped that this book will be a useful reference for specialists and practicing engineers interested in the fuel economy of automobiles. J. C. HILLIARD o. S. SPRINGER vii CONTENTS 1. AUTOMOTIVE FUEL ECONOMY David Cole I. Introduction and Background. 1 n. Fuel Economy Factors 9 A. Engine..... 11 B. Drive Train. 20 C. Vehicle Factors. 22 D. Operating Factors. 28 E. Test Cycles 32 References 33 2. FUEL ECONOMY AND EMISSIONS J. T. Kummer I. Introduction 35 n. Emission Regulations