Preface

The history of human events is characterized by a vast range of thought and actions. Among those of particular consequences are the innumerable *ingenious devices* which have been conceived and produced to serve a variety of human interests. It is this basic and enduring human endeavor which identifies the history and contemporary context of engineering.

In its earliest form, engineering involved the making of stone tools and other artifacts to aid in human survival. During the ensuing millennia, the manufacture of ingenious devices expanded and contributed to the shaping of civilizations, to the establishment of human institutions, and to the enhancement of standards of living. Now, in the 21st century, engineering may be viewed as a profession which involves creative thought and skilled actions related to conceptualizing, planning, designing, developing, making, testing, implementing, using, improving, and disposing of a variety of devices, invariably seeking to meet a perceived societal interest. In these various functions, engineers connect the natural world of materials and phenomena with the societal world of needs and aspirations.

This function of connecting nature and society has traditionally been dominated by the premise that — from an engineering point of view — nature could be viewed as both an immense material resource and a vast depository for discards. But an expanded perspective has emerged, prompted by a wider recognition that the natural world is becoming a threatened meld. To be sure, educators, accreditation boards, and professional associations have long challenged engineers to adopt a broader intellectual versatility in the design of devices and to acquire a deeper sensitivity to the range of their impact. The proposition pursued here is that such a more concordant orientation requires specifically an integrated nature-engineering-society perspective — a perspective well served by a systematic view of historical chronology and recognition

of an interconnected contemporary context of engineering. It is in this process of blending that a much more coherent and informing characterization of engineering can be established.

In order to develop such an engineering characterization, it is important that an overarching sweep of the engineering past, sequentially characterized in terms of selected pace-setting innovations and evolving connections, be related to aspects of the present and projected expectations of relevance to the theory and practice of engineering. For this purpose, selected aspects of the theory and practice of engineering-in-time are developed by an emphasis on three themes:

Part A: Introduction to Engineering, Chapter 1,
Part B: History of Engineering, Chapters 2 to 8,
Part C: Contemporary Context of Engineering, Chapters 9 to 13.

Part A introduces *Engineering in Time* by laying some conceptual and analytical foundations essential to the subsequent development. The idea of a *progression* and its notational incorporation is central for this purpose. A critical definition of engineering, together with two corollaries, is also introduced.

Part B contains two superimposed histories: one is a chronology of engineering invention and innovation from prehistory to contemporary times and the other is a simultaneously evolving interactive connectivity with engineering as a critical functional component. Thus, a traditional engineering history is integrated with its intrinsic and adaptive linkage processes.

Part C provides a contemporary context for an exposition of topics of special relevance to engineering. Among the subjects covered are natural phenomena and dynamics, professionalism and ethics, invention and innovation, device reliability and failure, risk and safety, public interaction, market penetration dynamics, material flow metabolism, and other related issues. Explicit mathematical formulations are selectively introduced and solutions discussed in terms of the graphical interpretation of differential equations.

As a means of insuring both clarity and unity in the development of these themes, the fundamental role of invention and innovation are embedded in informative heterogeneous progressions and illustrative adaptive networks. Then, major emphasis is placed on two principles: a general and systematic exposition is chosen rather than one which is encyclopaedic in case-study detail, and symbolic and graphical means are employed as important pedagogical tools. A decade of teaching using this format has shown that these features are most effective in depicting

the evolving history of engineering as a complex network-based progression while simultaneously highlighting the dynamics of themes of relevance to engineering.

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Instructional Format

Our instructional experience using various earlier versions of this text suggests its use as basic and engineering accreditation related in two distinct undergraduate classroom settings:

(a) The entire text is used in a comprehensive 3 hour/week semester course at the upper division level, or
(b) Part A and Part B are used for a 2 hour/week course at the lower division level with Part C then forming the basis for a subsequent senior discipline-specific seminar course.

Additionally, we have found that this text to be effective in directing and focusing student efforts in support of term papers or group projects which have a historical-developmental component.