Dunia Teknik ELEKTRO

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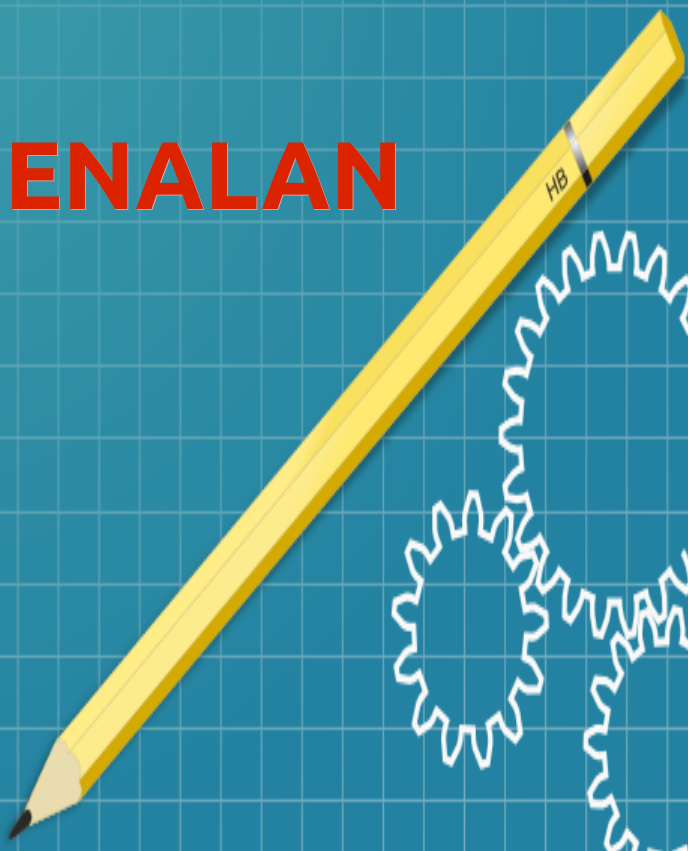

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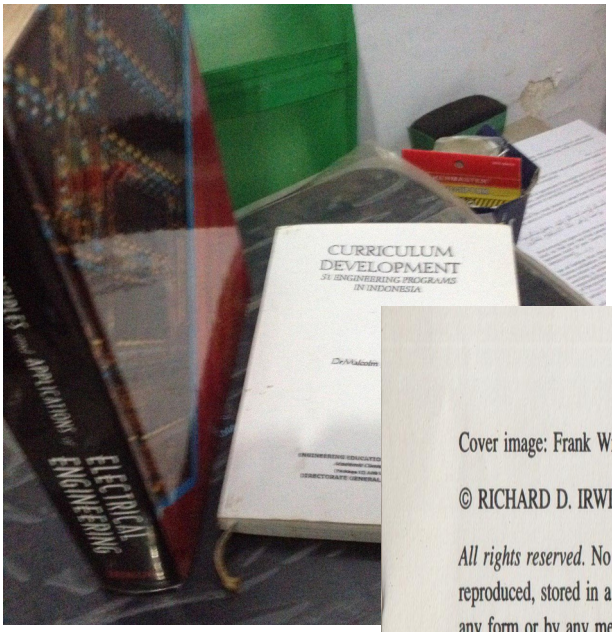

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PREFACE

Curriculum Development – S1 Engineering Programs in Indonesia has been produced as a contribution of the Academic Consultancy Services' (ACS) to the Engineering Education Development Project, funded by the Asian Development Bank (ADB Loan No. 1432-INO) for the Indonesian Directorate General of Higher Education. The financial support in publishing the book is acknowledged.

This book combines the major output of the ACS Curriculum Specialists (six volumes), supplemented by additional material from the ACS Quality Assurance Specialist and the editor, into a single, compact volume.

Curriculum review is fundamental to improving the quality and relevance of engineering education throughout Indonesia, and the quality and competitiveness of its graduates in the global market. The hope is that by presenting this valuable information in a more convenient and more accessible format, all Indonesian Higher Education Institutions and academic staff engaged in S1 engineering programs will have access to it, examine its value and relevance to their situation, and discuss its findings and recommendations.

The editor acknowledges the support and assistance from helpful discussions with Professor Nirwan Idrus, the ACS Quality Assurance Specialist. Ir Suherman (Project Director, EEDP) and Dr Ari Samadhi (Deputy Project Director, EEDP) have read and made helpful comments and suggestions on earlier drafts of this text during its development. Their contributions are also gratefully acknowledged.

The book would not exist without the valuable work of the ACS-EEDP Team. The members of the ACS-EDP Team responsible for the source material were:

Chemical Engineering	Dr Jim Ness and Dr Ir Danu Ariono
Civil Engineering	Dr Peter Kneen and Dr Ir Ofyar Tamin
Electrical Engineering	Mr Ian Moore and Dr Ir Parouli Pakpahan
Mechanical Engineering	Dr John Wager and Dr Ir Hendrawan
Quality Assurance	Professor Nirwan Idrus

Whilst every effort has been made to faithfully present the ideas and findings of the source documents and to avoid reinterpretation, the editor accepts full responsibility for any unintentional misrepresentations, as well as transmission and editorial lapses.

June 2000 Edition

1.1 ELECTRICAL ENGINEERING

The typical curriculum of an undergraduate electrical engineering student includes the subjects listed in Table 1.1. Although the distinction between some of these subjects is not always clear-cut, the table is sufficiently representative to serve our purposes. Figure 1.1 illustrates a possible interconnection between the disciplines of Table 1.1. The aim of this book is to introduce the non-electrical engineering student to those aspects of electrical engineering that are likely to be most relevant to his or her professional career. Virtually all of the topics of Table 1.1 will be touched on in the book,

Table 1.1 Electrical engineering disciplines

Circuit analysis
Electromagnetics
Solid-state electronics
Electric machines
Electric power systems
Digital logic circuits
Computer systems
Communication systems
Electro-optics
Instrumentation
Control systems

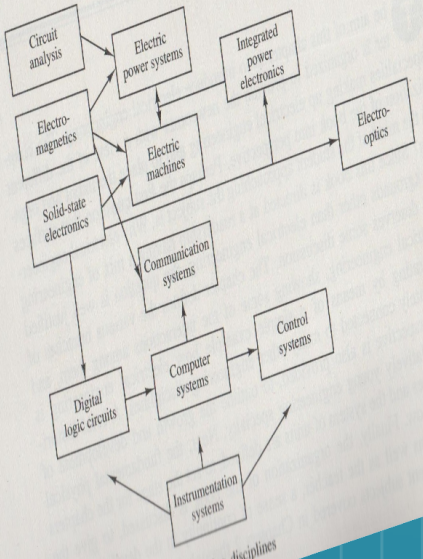


Figure 1.1 Electrical engineering disciplines

with varying degrees of emphasis. The following example illustrates the pervasive presence of electrical, electronic, and electromechanical devices and systems in a very common application: the automobile. As you read through the example, it will be instructive to refer to Figure 1.1 and Table 1.1.

Example 1.1 Electrical Systems in a Passenger Automobile

It may be enlightening to consider a familiar example to illustrate how the seemingly disparate specialties of electrical engineering actually interact to permit the operation of a very familiar engineering system: the automobile. Figure 1.2 presents a view of electrical engineering systems in a modern automobile. Even in older vehicles, the electrical system—in effect, an *electric circuit*—plays a very important part in the overall operation. An inductor coil generates a sufficiently high voltage to allow a spark to form across the spark plug gap, and to ignite the air and fuel mixture; the coil is supplied by a DC voltage provided by a lead-acid battery. In addition to providing the energy for the ignition circuits, the battery also supplies power to

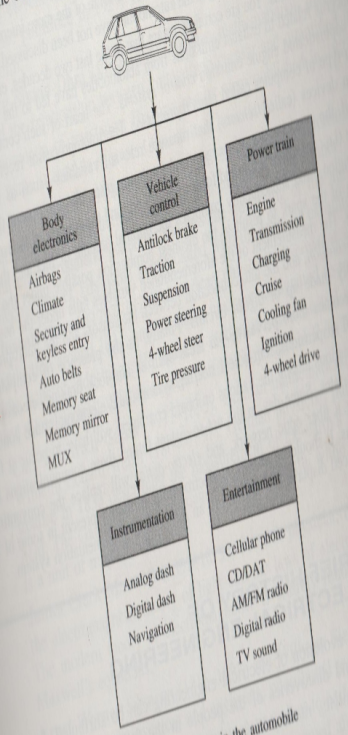
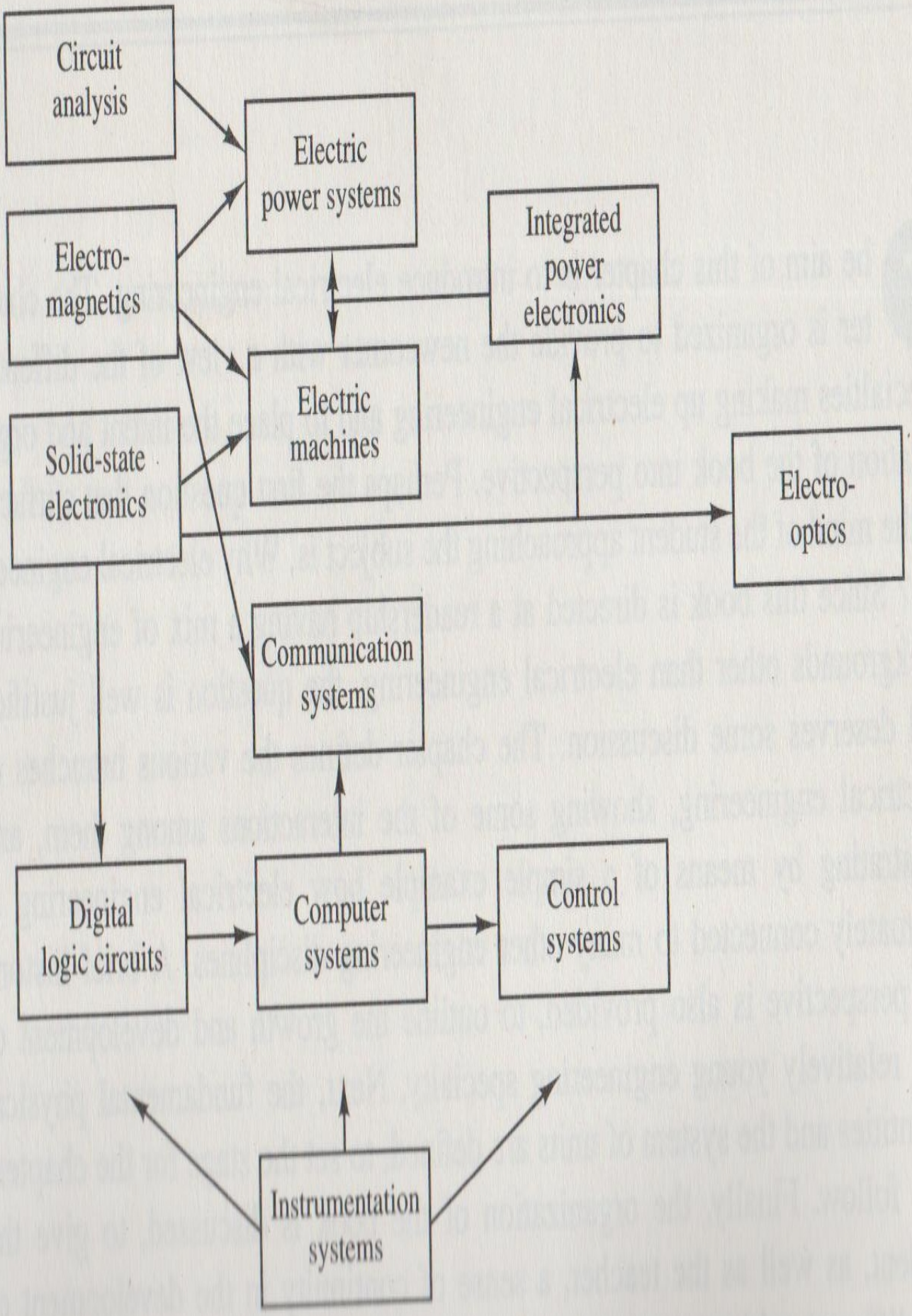
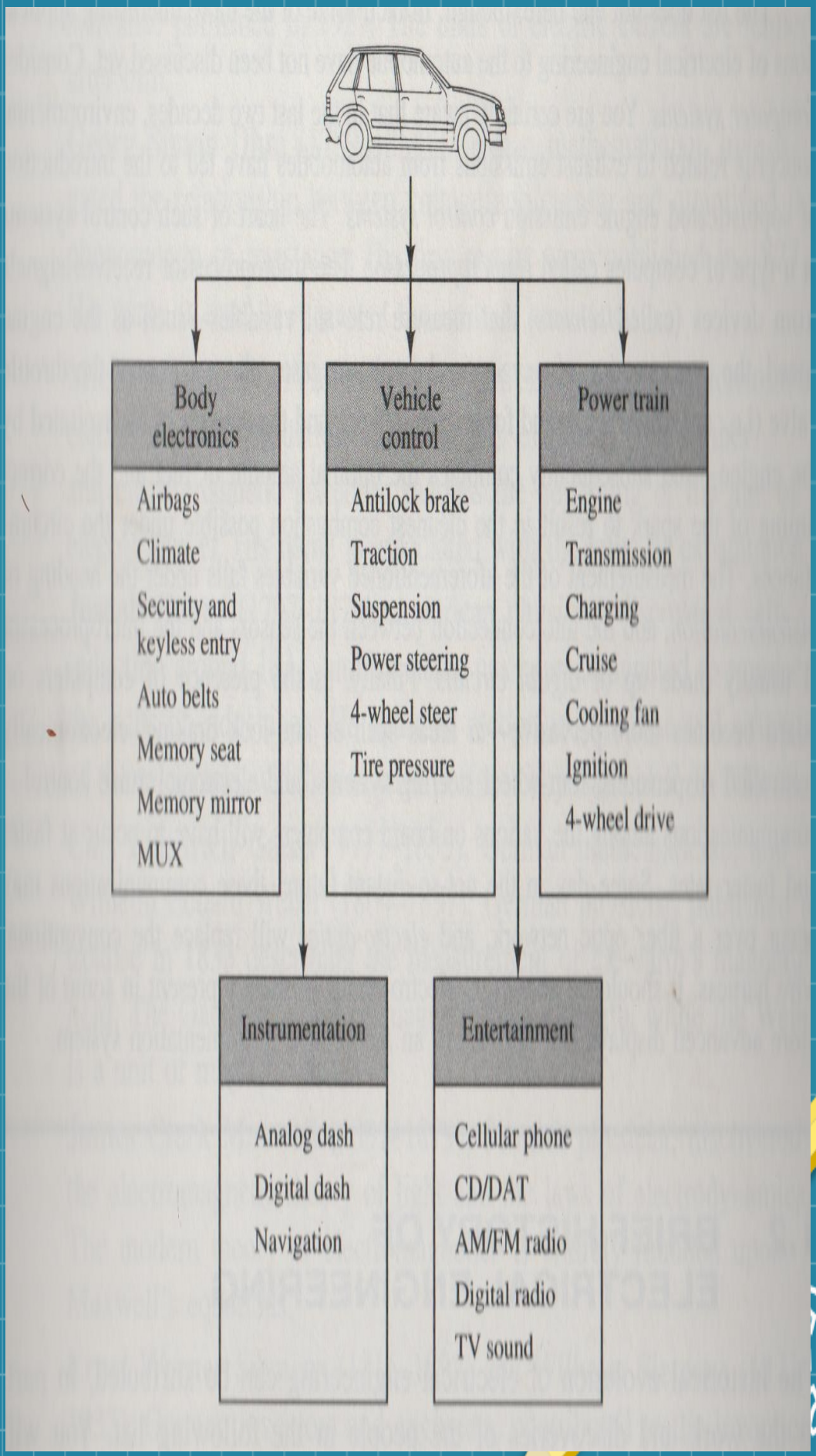


Figure 1.2 Electrical engineering systems in the automobile


Circuit analysis
Electric power systems
Integrated power electronics
Electro-magnetics
Electric machines
Solid-state electronics
Electro-optics
Communication systems
Digital logic circuits
Computer systems
Control systems
Instrumentation systems


Body electronics
Airbags
Climate
Security and keyless entry
Auto belts
Memory seat
Memory mirror
MUX
Vehicle control
Antilock brake
Traction
Suspension
Power steering
4-wheel steer
Tire pressure
Power train
Engine
Transmission
Charging
Cruise
Cooling fan
Ignition
4-wheel drive
Instrumentation
Analog dash
Digital dash
Navigation
Entertainment
Cellular phone
CD/DAT
AM/FM radio
Digital radio
TV sound

9.1.3 *Mathematics in Electrical Engineering*

Objective of Mathematics

The mathematics category provides the underpinning mathematical knowledge for a student entering into electrical engineering studies.

The emphasis of the studies of mathematics must emphasise concepts and principles rather than computation.

Use of Computers in Mathematics

The students should be introduced to the use of computers as tools in mathematics, basically seen as an extension of the calculator, currently in common use.

Students should become competent:

- In the use of Spreadsheets, e.g. Microsoft EXCEL to an advanced level, i.e. use of functions, user-defined functions using Visual Basic, looping and decision making etc.;
- In the more advanced mathematics software packages, eg. MatLab and many of its toolboxes for higher level usage.
- Computer Assisted Learning (CAL) should be introduced where possible, particularly in the more conceptual topics.

Topics Included in Mathematics

Topic	Sub-Topic
Differential and Integral Calculus	Differential calculus; mathematical induction, Rolle's and Mean Value theorem, curve sketching, maxima and minima; Integration: numerical approximation of integrals, integrals over infinite intervals, techniques of integration; inverse functions, indeterminate forms
Differential Equations	Differential equations, use of Laplace transforms, solutions by series; partial differential equations and their solution for selected physical problems, use of Fourier Series
Probability & Statistics	Basic probability, random variables and their distributions, expectations, joint distributions, limit theorems, statistical estimation, standard errors, sampling distributions, hypothesis testing and discrimination
Linear Algebra	Inner products, orthonormal vectors and Gram-Schmidt process; symmetric and positive definite matrices, quadratic forms; complex vector spaces; orthogonal expansion
Complex Variables	Elementary properties of analytic functions of a complex variable; differential and integral calculus for analytic functions
Discrete Mathematics	Role of proof in mathematics: logical reasoning and implication; different types of proof; Sets: algebra of sets, operations on sets; Mathematical logic: truth tables, syntax, induction; Graphs and directed graphs, basic graph algorithms; Counting, combinational identities, binomial and multinomial theorems; Binary operations and their properties, groups and semi-groups, ordered structures; Recursion relations; Application to network theory, assignment problems and population growth.

Table 9-3: Mathematics in Electrical Engineering

9.2.3 Basic Science in Electrical Engineering

Objective of Basic Science

The objective of the studies in basic sciences is to acquire fundamental knowledge about nature and its phenomena, including quantitative expression. These studies must include both general chemistry and calculus-based general physics at appropriate levels, with at least a two-semester (or equivalent) sequence of study in either area.[3]

Use of Computers in Basic Science

The students should be introduced to the use of computers in Chemistry and Physics, particularly in the use of Spreadsheets for data manipulation, numerical calculations and graphing.

Computer-Aided Instruction (CAI) should be introduced where possible, particularly in the more conceptual topics.

Topics Included in Basic Science

Topic	Sub-Topic
CHEMISTRY	
Inorganic Chemistry:	Atomic Structure and Periodic Trends of Properties; Models of Bonding; Solubility & Acid-base Equilibrium in Aqueous Solution; Electro-chemistry; Changes of Enthalpy, Entropy & Free-Energy During Reactions; Properties of Solutions; Structures of Molecules and Crystals;
Organic Chemistry	Properties, Preparation, Reactions and Uses of various classes of Organic Compounds
BASIC PHYSICS	
Waves and Optics	Harmonic Oscillations, the Wave Equation; Mechanical Waves: Sound Waves, Light Waves; Light and Matter, Interference, Diffraction.
Electricity and Magnetism	Flux & Gauss's Law, Electric Field & potential, Potential Energy, Capacitance, Dielectrics, Energy Density, Electric Current (not Circuit Theory), Magnetic Field, Lorentz Force, Magnetic Moment, Torque on a Dipole, Biot-Savart Law, Ampere's Law, Field of Wires and Solenoids, Induction, Induction, Stored Energy, Electromagnetic waves.
Heat & Properties of Matter	Temperature, Heat, Work & First Law of Thermodynamics, Entropy & the Second Law, Low Temperatures & the Third Law Kinetic Theory of gases, Elastic Moduli, Hydrostatics, Fluid Dynamics.
Quantum Mechanics	Quantum Phenomena; Atomic Spectra; The Wave Function; Instruments & Techniques; Solid-state Materials
Electrical Engineering Materials	Band Theory of Semiconductors, Effect of Impurities, Fermi Level, Diffusion & Recombination, Diodes and Rectifiers, Junction Width & Capacitance, Transistor Mechanisms, Hall Effect, Photodiodes, Solar Cells; Electrical properties of materials

Table 9-7: Basic Science in Electrical Engineering

9.3.3 *Applied Sciences in Electrical Engineering*

Objective of Electrical Engineering Principles and IT

Engineering principles have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences and engineering practice.

While the specialisations will provide depth in one area of electrical engineering, this category provides the introduction to all areas of specialisation.

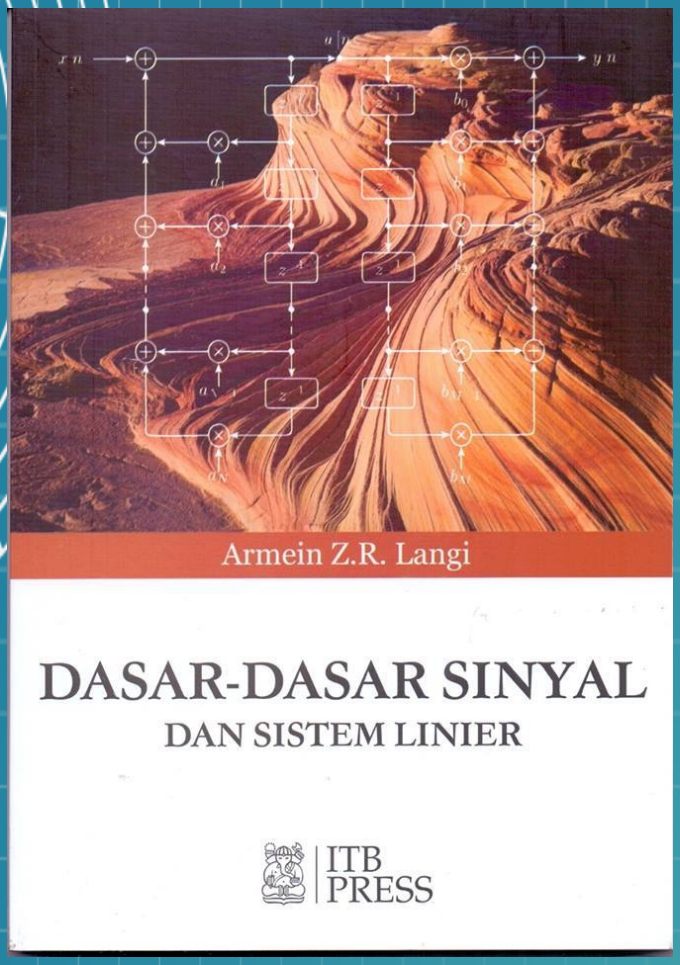
Use of Computers in Electrical Engineering Principles and IT

Students should be exposed to, and become proficient in the use of computers for:

- Computer-aided Instruction;
- Hardware and software design of electrical and electronic systems;
- The use of application packages for design and production;
- The design and development of application packages in engineering.

Topic	Sub-Topic
Circuits and Systems	Circuit Analysis; Linear Continuous and Discrete-time Systems
Analogue Electronic Devices and Circuits	Semiconductor Theory & Devices; Analogue Electronic Circuit Design
Electrical Systems	Transformers; Electrical Machines;
Electro-magnetics	Electrostatics; Magnetostatics; Time Varying Electromagnetic Fields and Maxwell Equation
Digital circuit	Number systems; Combinatorial Logic; Arithmetic Logic Unit; A/D and D/A – Converter; Coding & Conversion
Digital Electronics	Microprocessor hardware and programming; Microprocessor Interfacing; Microcomputer Systems.
Data Communications:	Communication Medium; Communication Standards - RS-232, RS-485 etc.; OSI Model; Modems; Industrial Standards.
Electrical Engineering Programming	Discipline of Programming; Algorithms; Top-down Design; ANSI C Programming Language; Software Design Cycles.
Software Engineering	The Analysis and Design of Large Systems; Analysis and Design Techniques; Cohesion and Coherence as Measures of Design Quality; Project Management; Revision Control; Overview of Other Programming Languages; Operating System Fundamentals.
Process Control	System Modelling and Stability Analysis; Bode, Nyquist, Root Locus Analysis and Design; PID Controllers; State-space Approach to Continuous Time Systems; System Design; Programmable Logic Controllers (PLCs).
Digital Signal Processing	Digital Filter Design; Finite & Infinite Impulse Filter Response; Finite Word Length Effects; Kalman Filters; Spectrum Estimation and Analysis;

Table 9-11: Applied Sciences in Electrical Engineering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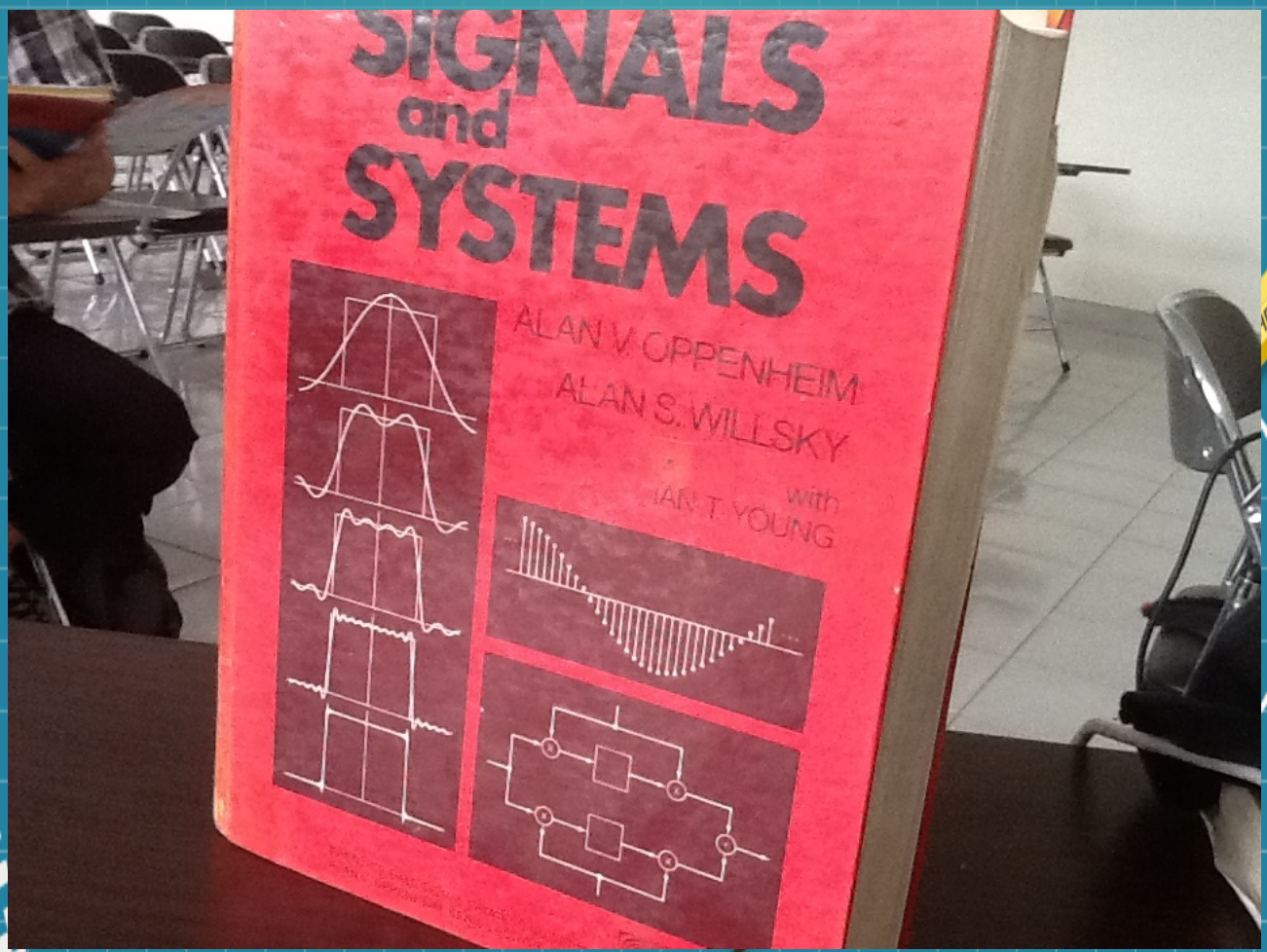
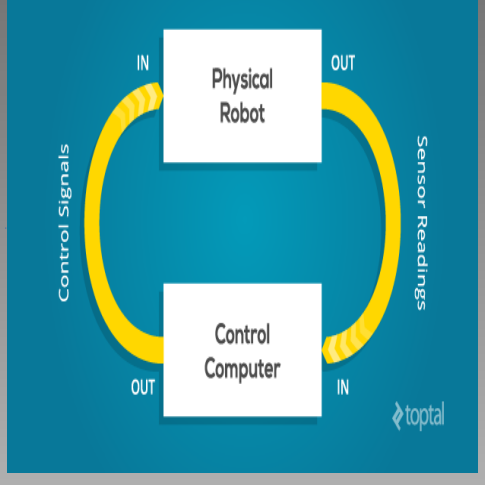
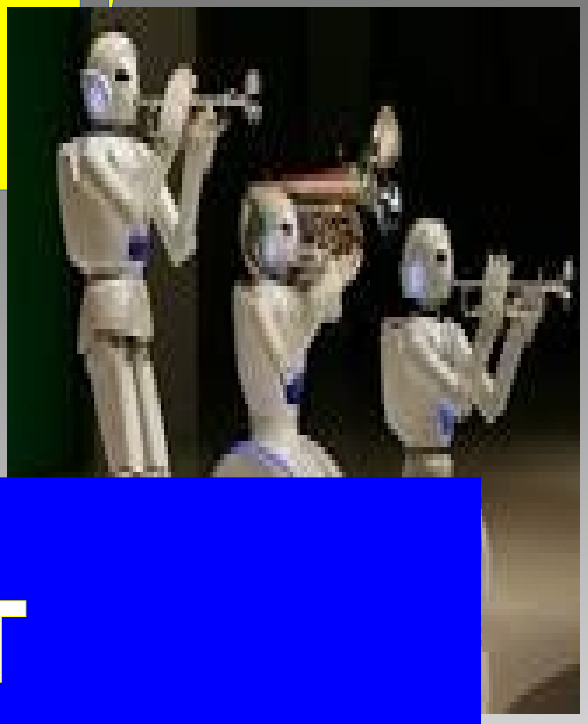
PRESS


ELECTRICAL
ENGINEERING


SIGNALS
and
SYSTEMS
ALAN V. OPPENHEIM
ALAN S. WILLSKY
with
IAN T. YOUNG

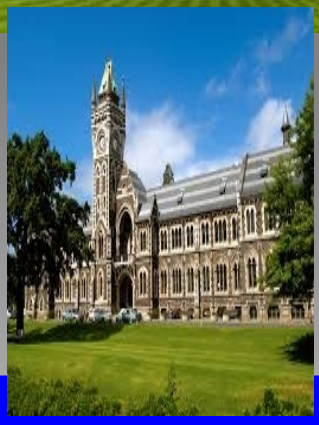
ROBOT HUMANOID





ROBOT PROGRAMMING

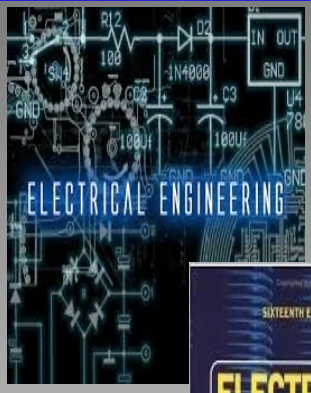
KBK

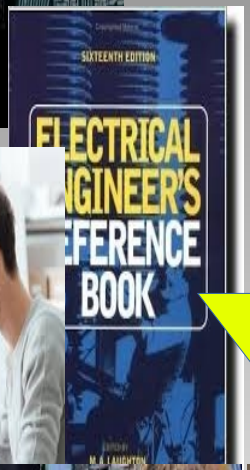


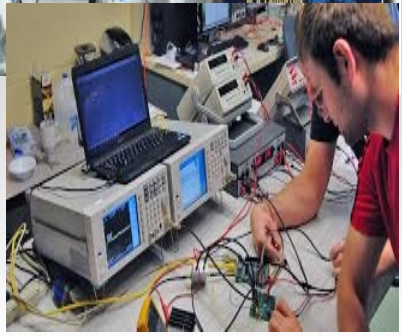
PROGRAM STUDI

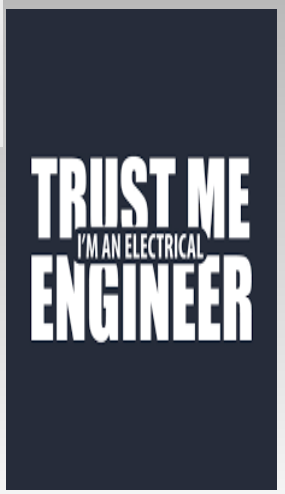
KBK

PROGRAM STUDI TEKNIK ELEKTRO







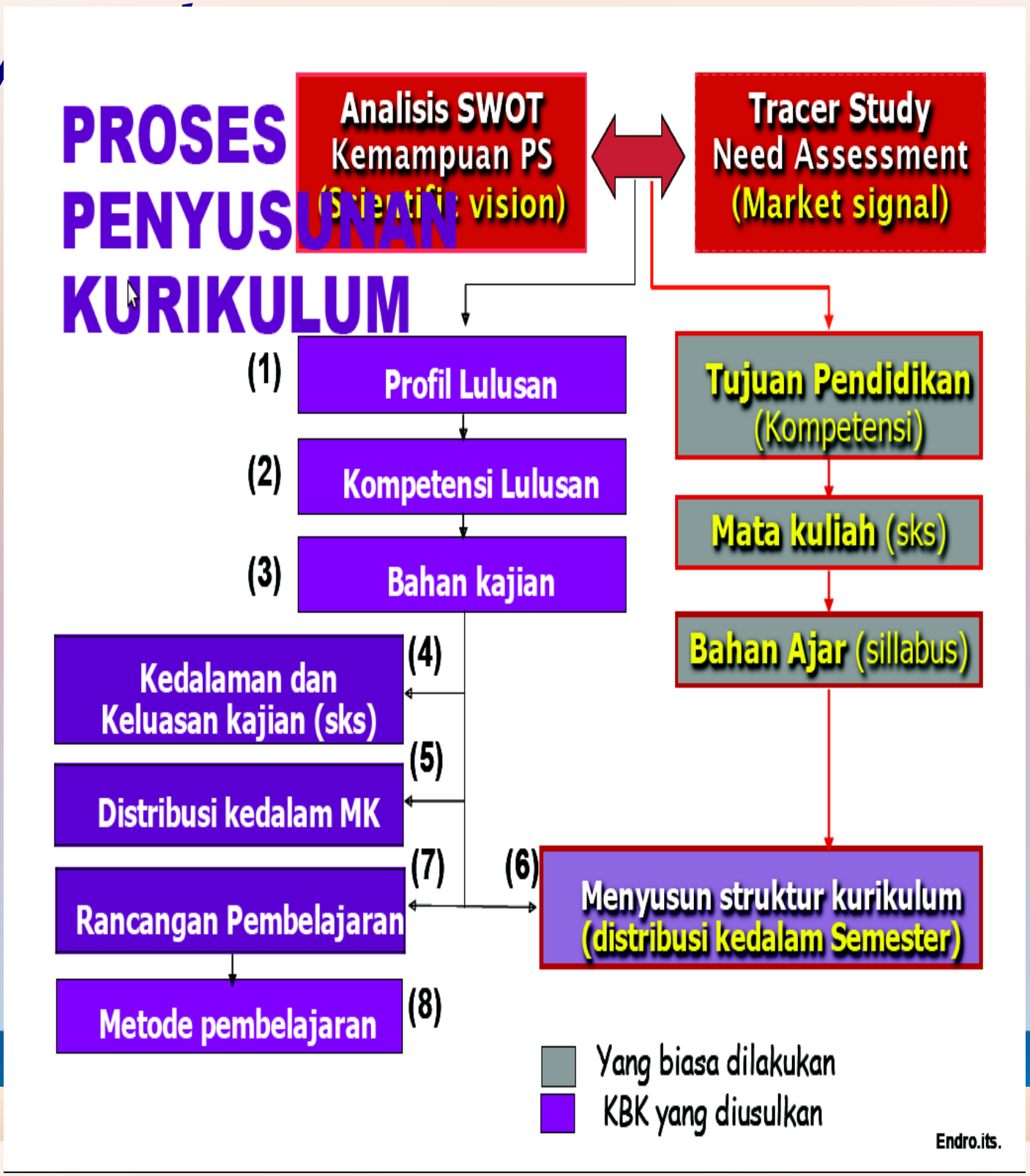


Latar Belakang
Competency-based Curriculum
KBK

- Sekolah pada jaman kolonial .....
- 100 tahunan yang lalu: **POLITIK ETIKA**
- Sekolah-sekolah didirikan Pemerintah Kolonial Hindia Belanda untuk mengisi **lowongan kerja**, yang seandainya pun seluruh penduduk Negeri Belanda pindah ke Hindia Belanda..... tidak akan cukup

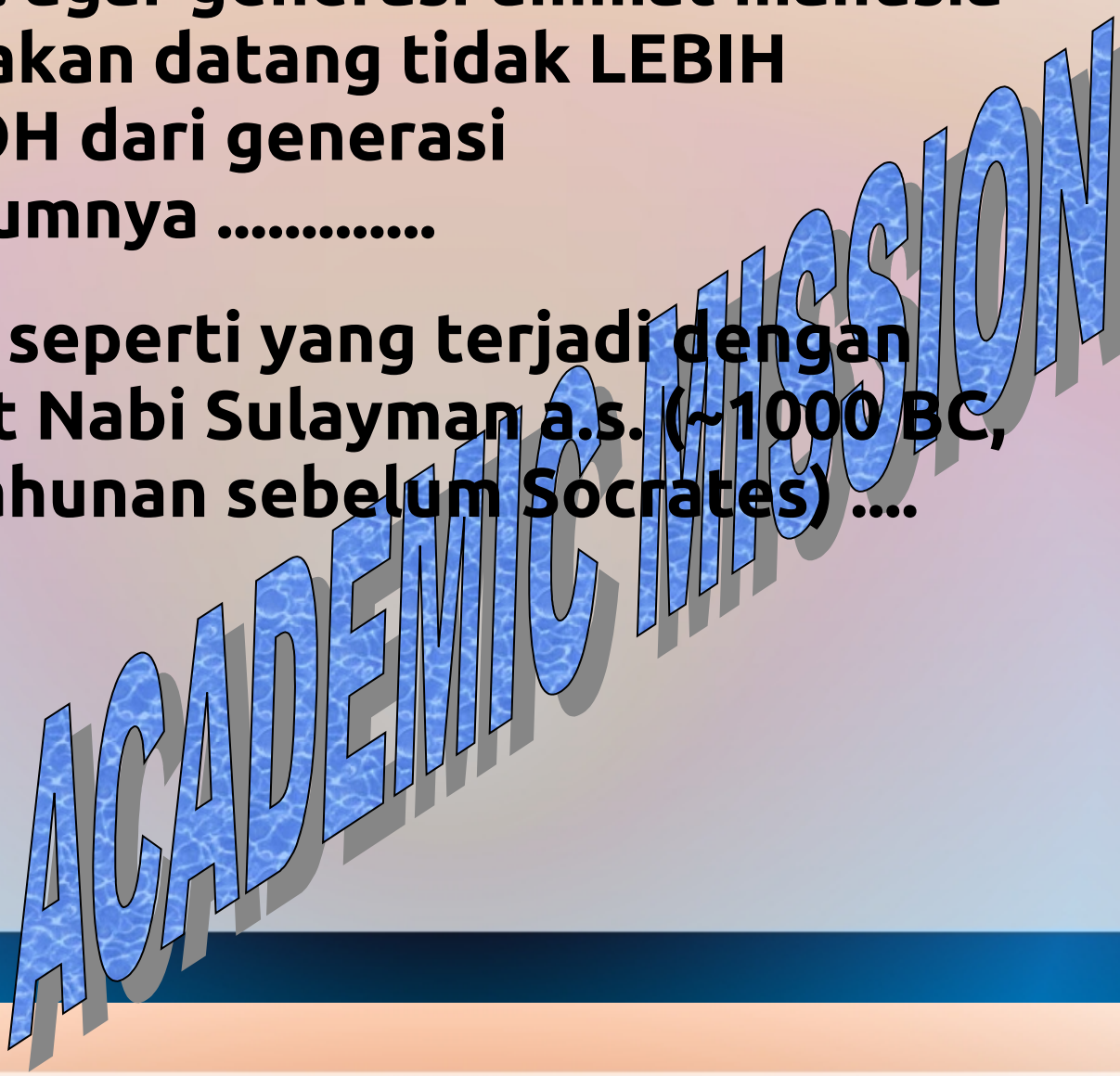
- HIS, MULO, AMS, HBS, ... NIAS, STOVIA, THS

Sampai sekarang .....



Kembali ke *ACADEMIC MISSION* yang ASLI (*Socrates*, ~500 BC)

- **Melestarikan dan mengembangkan Ilmu Pengetahuan**
- **…… agar generasi ummat manusia yang akan datang tidak LEBIH BODOH dari generasi sebelumnya ……**
- **…… seperti yang terjadi dengan rakyat Nabi Sulayman a.s. (~1000 BC, 500 tahunan sebelum Socrates) ….**



THE END

SELESAI