

RCA Institutes, Inc.
P.O. Box 972 | Clark, NJ 07066



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RCA
A Course in
**Logic
Design**

RCAZ NLSN154
T NELSON
BOX 1546
POUGHKEEPSIE NY 12603

A unique learning experience
for those who solve digital circuit
design problems, or who evaluate
Logic Design effectiveness

A seminar prepared by the
Institute for Professional
Development of RCA Institutes

Logic Design

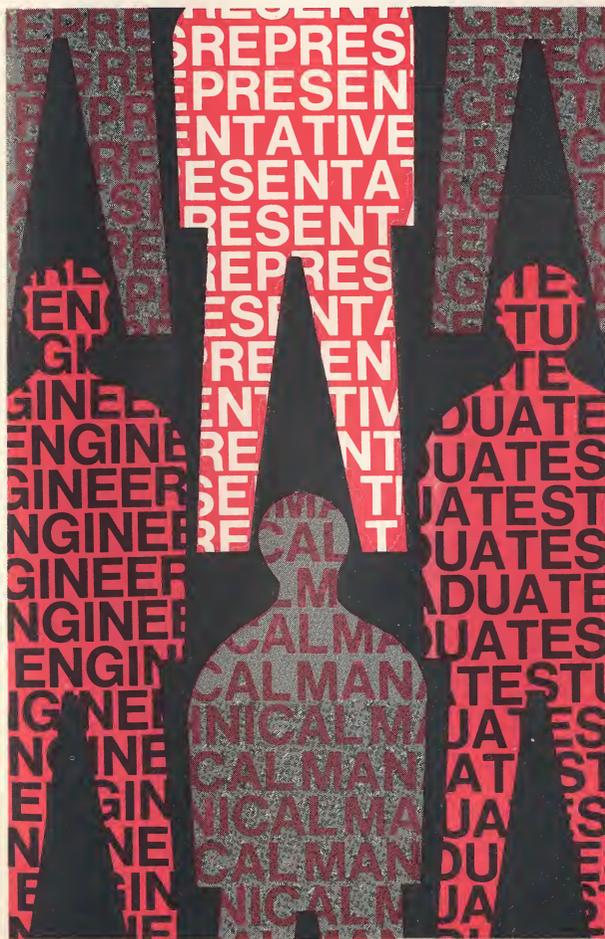


RCA
Institutes

Logic Design

A means of acquiring numerical and matrix tools for solving digital circuit design problems quickly and correctly

A seminar designed to meet the varying needs of many engineering, technical and management men



The RCA Institutes seminar in Logic Design is an intensive 5-day program for those holding responsible positions involving digital engineering.

How can it benefit different persons?

If you're an engineer . . . the Logic Design seminar will equip you with a state-of-the-art methodology to help you design digital circuits in a highly efficient way

If you're a technical manager . . . you'll sharpen your insights into the problems your staff currently encounters. You will improve your abilities to evaluate performance and results.

If you are just starting out . . . the seminar will make you an effective, productive member of your organization in less time than normally required. It puts the pieces together so that you can make them work now.

Sales representatives . . . find that the seminar helps them improve communications with customers. They increase their understanding of customer needs and ways they can help fulfill them.

And many participants are graduate students of prominent universities who want to put another facet on their learning.

Logic Design



The RCA Institute for Professional Development—a working concept that works

The Logic Design seminar, like all RCA Institutes for Professional Development programs—keeps up with—and close to—state-of-the-art basics.

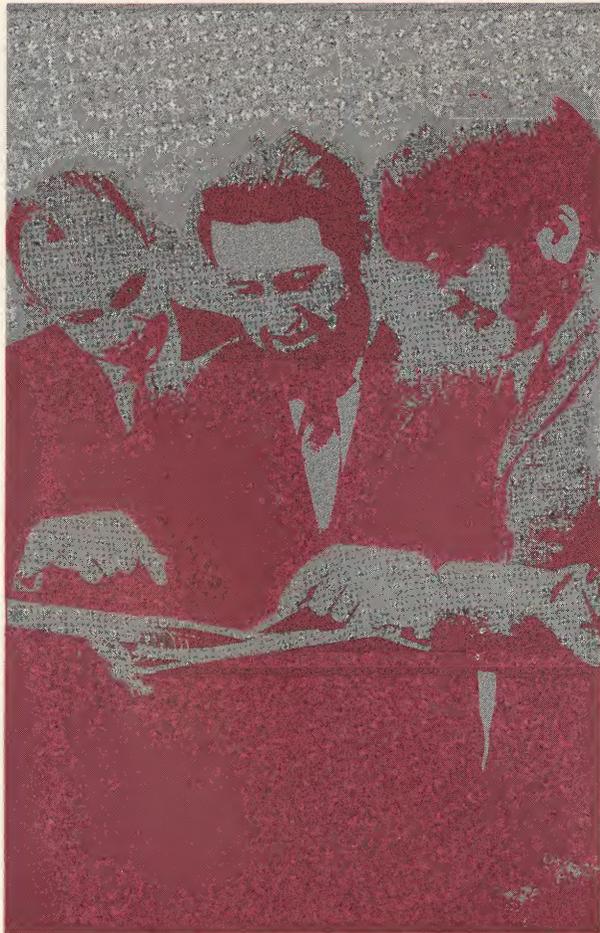
You have thorough knowledge of engineering principles. We concentrate on helping you put the principles to work.

At the seminar, you work with problems that are familiar to you in your day-to-day routine. The seminar shows you how to simplify the route to solving them. The aim is to uncomplicate thinking and acting. If your experience is like that of most other participants, your ability to overcome obstacles intuitively and conceptually will improve dramatically.

An important learning portion of the Logic Design seminar is applying newly acquired skills in practical use. This reinforces your understanding of new approach to digital circuit design.

The seminar equips you with numerical and matrix tools far more powerful than those of classical logic and Boolean Algebra.

Logic Design



Who attends?

More than 1,000 companies, 80 government agencies and 50 universities have sponsored participants in RCA courses for Professional Development, since our programs were first formed in 1964.

Most of our participants come from companies, governmental agencies and learning institutions which previously had enrolled members in similar courses.

You cover a great deal of ground during the five days. **But it is not a cram course.** Nor is it so simplified that you will be disappointed at the lack of challenge and absence of attainment.

The Logic Design seminar represents a highly sophisticated achievement in learning techniques. Wherever possible, mathematical equations have been eliminated in favor of presenting ideas conceptually. You will be working in an atmosphere where you will be intellectually challenged, stimulated and rewarded by the experience.

Advanced Teaching Methods

Teaching techniques are the very newest—and a number of variations have been developed by the

Logic Design

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Institutes. Contents are organized in a Structured format, which provides a high degree of interlacing for smooth, sequential flow during the presentation.

Instructors work with projectors and electronic boards. You see the problem, observe the steps in resolving it, and follow the functioning results on the panel board.

It's a rapid method to acquire information to get from where you are to where you want to be.

Then there is team teaching. Two instructors work together to lead the seminar. They alternate presentation. They monitor each other and observe participant reaction. While one presents, the other audits. If he senses participant drift or confusion, he steps in to restate the material in another way. Team teaching gives the seminar a faster pace. You cover more ground.

Each instructor combines engineering experience with unusual writing, teaching and communicating abilities. There is a great deal of interchange between instructor and participants. Questions are welcomed at any time—and so are comments.

LOGIC DESIGN

The reduction technique to be explored below and used henceforth in our logic design work, is a variation on the Veitch diagram. This modification, introduced by M. V. Mahoney, is designed to work directly from designation numbers; the designer need never see a Boolean expression other than the final, simplified form. With this particular map, the position of each minterm is invariant, regardless of the number of variables, so that the map pattern is easily memorized.

Definitions and Basic Concepts

Let f = any function

$\#f$ = the designation number of f (read "designation f ")

n = number of variables (f is a function of n variables)

p = number of positions in $\#f$

p = number of square subsets in universe

i = position identification

m_i = the minterm occupying position i

We will first assume that $n = 0$. As with the original Venn diagram, the universe will be a rectangle. With $n = 0$, we cannot subdivide this universal set. There is no need to, however, for if $n = 0$, $p = 2^0 = 1$. In other words, there is only one position in $\#f$, the zero position, and only one possible minterm, m_0 . The rectangular universe will represent m_0 and will be marked with the minterm subscript:

$$n = 0$$



No. of subsets (squares)
= no. of minterm positions
= $p = 2^n = 2^0 = 1$

Although there are no variables, there are still $2^p = 2$ functions possible. These functions must be the two constants, 1 and 0.

If $f = 0$, then $\#f = 0$; i.e. m_0 is "empty." This is indicated by leaving the diagram unmarked:



$\#f = 0$ $p = 2^n$
 $f = 0$ $= 1$

If $f = 1$, then $\#f = 1$; i.e., the m_0 position is occupied. This is indicated with a diagonal mark:



$\#f = 1$ $f = m_0$
 $f = 1$

The above maps would, of course, never be needed in a practical problem. Here it is used only as an introduction, for the orderly evolution of the general n -variable map.

Map Development

Visualize the map as a large sheet marked with a checkerboard pattern of squares. Now fold the lower half upwards so it is hidden *behind* the top. Fold the right hand half behind the left. Repeat the above procedures alternately, until only the single upper left square remains visible. This square is the set representing minterm zero, the square used as our starting point.

Logic Design

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Participants play an active roll in keeping the seminar moving ahead. It is a work session with step-by-step application of the material.

There is a great deal of interchange between instructor and participants. Questions are welcomed at any time—and so are comments. Participants become deeply involved and there is a high rate of concentration. It's a work session with step-by-step application of the material.

Seminar settings are carefully chosen hotel or motel meeting rooms. The rooms are quiet, comfortable. You will be provided with a set of lecture notes, which is yours to take with you when the seminar ends. It includes the complete course and your seminar notes, along with the problems you've solved during the program.

Student Requirements

For most participants, a Bachelor's degree in Mathematics, Engineering or Physics is required. However, equivalent experience in switching or digital systems may be accepted.

There are no rigid requirements to meet. If you would like to attend, please let us know of your interest and your reasons for wanting to attend. We shall be more than delighted to consider your interest.

Expenses and Facilities

Enrollment in the Logic Design seminar is \$395.00, which includes the seminar, materials, luncheons and attendance at the five day sessions.

We reserve blocks of rooms at the designated location for each seminar. If you plan to attend, please make your own individual reservations at the location indicated. But, in order to assure the special seminar rate, identify yourself in your request as a seminar participant.

How may we be of further help?

In order to evaluate the worth of the seminar to your operation, we can arrange a one-day sample for one or two of your key people. Just write to let us know of your interest and the location nearest you.

We welcome your inquiries.

Filing your application

An enrollment form is attached. You may enroll as many participants as you wish. If you desire, you may even set up a special presentation of the seminar in your own facility, upon special arrangement.

For immediate answers to your questions, please telephone (201) 485-3900 Ext. TC-397 RCA Institutes, Inc., Box 972, Clark, N. J. 07066

We look forward to seeing you at our next seminar on Logic Design.

Logic Design

Course Description

Monday

Introduction to Logic Design
The Building Block Concept, The Role of the Logic Designer
Review of Number Systems
Definitions and Number Concepts, Number System Conversion, Binary Codes
Symbolic Logic
Propositional Operations/AND, OR and NOT Functions; Boolean Algebra and Symbolic Logic
Set Theory
Definition of Elements and Sets, Set Combination and the Venn Diagram
Boolean Algebra
Boolean Identities; DeMorgan's Theorem, Duality and Its Applications
The Numerical Approach to Logic Designation Number Notation, The Standard Basis, Designation Numbers of Boolean Elements and Functions, Logical Operations with Designation Numbers, Duality; Unique and Primitive Functions
Logic Gates and Symbols

Tuesday

Forms of Functions
Sum-of-Products Form, Product-of-Sums Form, Mongrel Form, Canonical Forms
The Logic Map
Development of the Mahoney Map, The Map in n Variables, Reading the Logic Map, Rules of Map Simplification
Applications of the Map
Conversion to NAND Circuits, Mongrel or Mixed Form, Conversion to NOR Circuits, Other Uses of the Map
Logic Circuit Design
Design of Combinational Circuits, Designing a Circuit from Starting Verbal Specification to Complete Logic Diagram

Wednesday

Constraints in Logic Design
The Constrained Basis and its Resolution
Logical Dependence

Rules of Dependency and Simplification
Multiple Function Design
Common terms, Minterm and Maxterm
Pyramiding, Minterm/Maxterm Building Blocks
The Multiple Function Matrix
The Two-Level Minterm Matrix
The Two-Level Maxterm Matrix
Matrix Simplification
The Use of Implication to Simplify the Minterm Matrix, Simplifying the Maxterm Matrix

Thursday

NAND and NOR Logic Design
NAND and NOR Functions, NAND and NOR Logic Design
Logic Package Characteristics
The Unit Load, Fan-Out, Rise Time and Fall Time, Re-Shaping, Delay Time, Active Versus Passive Gating
Recursive Circuits
Logic Circuits with Recursion, The RS Flip-Flop, the Shift or Type D Flip-Flop, the Complementing or Type T Flip-Flop, The Steering Network, Dual-Rank J-K Flip-Flops

Friday

Serial Counters
Modulus 2^n Counters, Gated Binary Counters, Counters using Binary Codes
Synchronous Counters
Design Procedures for Parallel Counters Using Toggle and Delay Type Flip-Flops
Flip-Flop Registers
Serial and Parallel Transfer, Complementation, Cycle Counters, A Design Procedure for Waveshaping
Binary Adders and Subtractors
The Quarter Adder, Half and Full Adders, the Binary Subtractor
Decoding and Encoding
Decoding Binary or BCD Words, Multiple Level Decoding and Encoding Matrices



BUSINESS REPLY MAIL

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Mr. Charles H. Saville, Director
Institute for Professional Development
RCA Institutes, Inc.
P.O. Box 972 | Clark, NJ 07066

No Postage
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United States.

*'I really enjoyed the Logic Design course
and I derived great benefits from it.'*
Electrical Engineer-IC

*'I would like to congratulate you for a job well done.
This training was used as a springboard to solve
digital logic design problems associated with a
memory core my section has just recently purchased.'*
Section Supervisor

*'Your training programs have proven to be
a great asset and have allowed us to provide
simpler more economical fluidic control systems.'*
Manager, Research & Systems

**A partial list of the companies
that have attended our seminars**

Aerospace Corporation
The Bendix Corp.
The Boeing Company
Columbia Broadcasting System, Inc.
Eastman Kodak Co.
Ford Motor Company
General Dynamics Electronics
General Electric Co.
General Motors Corp.
Grumman Aircraft Engineering Corp.
Honeywell Inc.
Johns Hopkins University
Leeds & Northrup Co.
The Magnavox Company
Motorola Semiconductor Products Division
MIT
North American Aviation Inc.
Philco-Ford
Pitney-Bowes, Inc.
Raytheon Co.
Sperry Rand Corp.
Sylvania
Texaco Research Labs.
The Budd Co.
United Air Lines
Westinghouse Electric Corp.
Western Electric Co.
Xerox Corporation

**SEMINAR
LOCATION**

For our five day seminar in the MONTREAL area, the Institute for Professional Development has chosen the Sheraton-Mt. Royal as our theatre of operations.

Location: 1455 Peel Street
Montreal, Quebec

Dates: August 24-28, 1970
8:30 a.m. to 4:30 p.m.

For room reservations, call the hotel directly at (514) 842-7777.

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Registration Form

I would like to reserve place(s) in the forthcoming Logic Design Seminar to be conducted _____
(Date of beginning)

at _____
(Location of Seminar)

There will be _____ attending in my group.

Purchase order enclosed Payment enclosed Please bill
(Indicate department to which bill should be sent)

Name Title

Firm

Address

City State Zip

Name Title

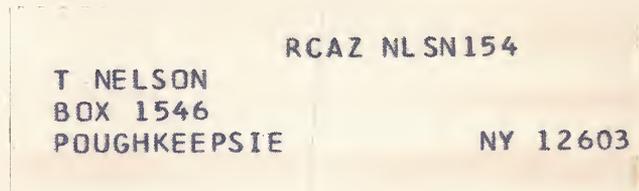
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Address

City State Zip

Registration fee \$395.00 U.S.

Please make checks payable to RCA Institutes, Inc.
Telephone (201) 485-3900 Ext. TC-397



Please return entire coupon including mailing label above 1