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Elements Of Microwave Engineering

When Courant prepared the text of his 1942 address to the American Mathematical Society for publication, he added a two-page Appendix to illustrate

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how the variational methods first described by Lord Rayleigh could be put to wider use in potential theory. Choosing piecewise-linear approximants on a set of triangles which he called elements, he dashed off a couple of two-dimensional examples and the finite element method

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Engineering
was born. Finite element activity in electrical engineering began in earnest about 1968-1969. A paper on waveguide analysis was published in Alta Frequenza in early 1969, giving the details of a finite element formulation of the classical hollow waveguide problem. It

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was followed by a rapid succession of papers on magnetic fields in saturable materials, dielectric loaded waveguides, and other well-known boundary value problems of electromagnetics. In the decade of the eighties, finite element methods spread quickly. In several

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technical areas, they assumed a dominant role in field problems. P.P. Silvester, San Miniato (PI), Italy, 1992 Early in the nineties the International Workshop on Finite Elements for Microwave Engineering started. This volume contains the history of the

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Workshop and the
Proceedings of the
13th edition, Florence
(Italy), 2016 . The 14th
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2018.

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and accompanying
software enables you
to quickly and easily
work out challenging
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engineering and high-

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frequency
electromagnetic
problems using the
finite element method
(FEM) Using clear,
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dozens of real-world
application examples,
the book provides a
detailed description of
FEM implementation,
while the software
provides the code and
tools needed to solve

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the three major types of EM problems: guided propagation, scattering, and radiation.

Detailing the active and passive aspects of microwaves, Microwave Engineering: Concepts and Fundamentals covers everything from wave propagation to reflection and

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refraction, guided waves, and transmission lines, providing a comprehensive understanding of the underlying principles at the core of microwave engineering. This encyclopedic text not only encompasses nearly all facets of microwave

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engineering, but also gives all topics—including microwave generation, measurement, and processing—equal emphasis. Packed with illustrations to aid in comprehension, the book: Describes the mathematical theory of waveguides and ferrite devices, devoting an entire chapter to the

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Smith chart and its applications

Discusses different types of microwave components, antennas, tubes, transistors, diodes, and parametric devices Examines various attributes of cavity resonators, semiconductor and RF/microwave devices, and

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microwave integrated circuits Addresses scattering parameters and their properties, as well as planar structures including striplines and microstrips Considers the limitations of conventional tubes, behavior of charged particles in different fields, and the concept of velocity modulation

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Based on the author's own class notes, Microwave Engineering: Concepts and Fundamentals consists of 16 chapters featuring homework problems, references, and numerical examples. PowerPoint® slides and MATLAB®-based solutions are available with qualifying course

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parameters,
basic design
parameters of
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(striplines,
microstrips,
slot lines,
coplanar
waveguides,
finlines),
filter theory,
Smith chart,
inverted Smith
chart,
stability

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circles, noise figure circles and microwave components, are thoroughly explained in the book. The chapters are planned in such a way that readers get a thorough understanding

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to ensure expertise in design. Aimed at senior undergraduates, graduates and researchers in electrical engineering, electromagnetics, microwave circuit design and

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*communications
engineering,
this book: •
Explains basic
tools for
design and
analysis of
microwave
circuits such
as the Smith
chart and
network
parameters •*

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Gives the advantage of realizing the output without wiring the circuit by simulating through MATLAB code • Compares distributed theory with network theory

- Includes*

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*microwave
components,
filters and
amplifiers S.
Raghavan was a
Senior
Professor (HAG)
in the
Department of
Electronics and
Communication
Engineering,
National*

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*Institute of
Technology
(NIT), Trichy,
India and has
39 years of
teaching and
research
experience at
the Institute.
His interests
include:
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*circuits, RF
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selective
surfaces (FSS),
substrate
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(SIW),
biomedical
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Engineering. He has established state-of-the-art MICs and microwave research laboratories at NIT, Trichy with funding from the Indian government. He is a

Fellow/Senior

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Member in more than 24 professional societies including: IEEE (MTT, EMBS, APS), IETE, IEI, CSI, TSI, ISSS, ILA and ISOI. He is twice a recipient of the Best

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*Teacher Award,
and has*

received the

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includes
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*impedance
matching,
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couplers and
hybrids,
microwave
filters,
ferrite
devices, noise,
nonlinear
effects, and
the design of
microwave*

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*oscillators,
amplifiers, and
mixers.*

*Material on
microwave and
RF systems
includes
wireless
communications,
radar,
radiometry, and
radiation
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large number of examples and end-of-chapter problems test the reader's understanding of the material. The 4th edition includes new and updated material on systems, noise,

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*active devices
and circuits,
power waves,
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CMOS circuits,
and more.*

*Annotation This
text serves as
a transition
between
introductory
courses in elec
tromagnetism*

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*and rapid
advances in
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areas such as
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enhance
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networks are presented as an integral part of the author's theoretical methodology.

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Devices And Antennas.
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*Antennas. It Also
Includes Microwave
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Length. The Written
Text Is Supplemented
With A Large Number
Of Suitable Diagrams
And A Good Number
Of Solved Examples
For Reinforcing The
Key Aspects. Each
Chapter Has A Select Bi
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the entire
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control, detection,
and generation.

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measurements.

Microwave
subsystems.

This textbook
presents a unified
treatment of
theory, analysis
and design of
microwave devices

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and circuits. It is designed to address the needs of undergraduate students of electronics and communication engineering for a course in microwave engineering as well as those of the students

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pursuing M.Sc. courses in electronics science. The main objective is to provide students with a thorough understanding of microwave devices and circuits, and to acquaint them with some of the methods used in

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circuit analysis
and design.

Several types of
planar
transmission lines
such as stripline,
microstrip, slot
line and a few
other structures
have been
explained. The
important
concepts of

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scattering matrix and Smith chart related to design problems have been discussed in detail. The performance and geometry of microwave transistors-both bipolar and field effect-have been analysed.

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Microwave passive components such as couplers, power dividers, attenuators, phase shifters and circulators have been comprehensively dealt with. Finally, the analysis and design aspects of microwave

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design of various microwave systems. The book commences with a discussion on microwave basics, EM wave theory, transmission line theory, hollow pipe waveguides, microwave junctions and goes on to provide in-

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depth coverage of
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waveguide
components,
klystrons,
magnetrons and
TWTs. The book
focuses on the
solid-state devices
and microwave
measurements as
well. The book has
an added
advantage of

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exercise section
involving essay
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and Magnetrons
and TWTs are
incorporated into
the book. • Several
sections like
coaxial line
analysis,
microwave link
analysis,
microwave bench
design,
measurement of
phase shift,

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measurement of dielectric constant, and network analyzers have been introduced into the book. • Numerous questions and solved problems have been added to the exercise section of each chapter.

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A Practical Guide
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Introduction to
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The book discusses active devices and circuits for microwave communications. It begins with the basics of device physics and then explores the design of microwave communication

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systems including analysis and the implementation of different circuits.

In addition to classic topics in microwave active devices, such as p-i-n diodes, Schottky diodes, step recovery diodes, BJT, HBT, MESFET, HFET, and various

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microwave circuits like switch, phase shifter, attenuator, detector, amplifier, multiplier and mixer, the book also covers modern areas such as Class-F power amplifiers, direct frequency modulators, linearizers, and equalizers. Most of the examples are

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based on practical devices available in commercial markets and the circuits presented are operational. The book uses analytical methods to derive values of circuit components without the need for any circuit design tools, in order to explain

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the theory of the circuits. All the given analytical expressions are also cross verified using commercially available microwave circuit design tools, and each chapter includes relevant diagrams and solved problems. It is intended for

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field of electronics
and
communication
engineering.*

*CD-ROM contains:
PUFF 2.1 for
construction and
evaluation of
circuits.*

*The book deals
with fundamental
concept, theory
and designs, as*

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well as applications of microwaves in details. In addition it also describes EMI and EMC, Microwave hazards, and applications of microwaves in medicals. Radars and Radar devices, and MASERS have also been

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*Microwave
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described properly
in this book.

*Microwave
antennas have
been explained
with emphasis on
theory of operation
and design
procedures. The
book also focuses
on microwave
measurements
along with
necessary*

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*requirements and
different methods
of measurement.*

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examines the
new and
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technology of
asymmetric

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components for
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circuits. The
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design methods
and ideas set
forth by the
author are
groundbreaking
and have not

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been treated in
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Readers
discover how
these design
methods reduce
the circuit
size of
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integrated
circuits and
are also
critical to

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reducing the cost of equipment such as cellular phones, radars, antennas, automobiles, and robots. An introductory chapter on the history of asymmetric passive

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Engineering
components,
which began
with asymmetric
ring hybrids
first described
by the author,
sets the
background for
the book. It
lays a solid
foundation with
a chapter
examining

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microwave
circuit
parameters such
as scattering,
ABCD,
impedance,
admittance, and
image. A
valuable
feature of this
chapter is a
conversion
table between

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the various
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matrices
characterizing
two-port
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terminated in
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conversion has
also never been
treated in

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previous works.

Next, the author sets forth a thorough treatment of asymmetric passive component design, which covers the basic and indispensable

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elements for
integration
with other
active or
passive
devices,

including: *

Asymmetric ring
hybrids *

Asymmetric
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hybrids *

Asymmetric

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three-port
power dividers
and N-way power
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hybrid phase
shifters and
attenuators *
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filters and
asymmetric
impedance
transformers

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design engineers who want to learn the new and powerful design method for asymmetric passive components. This textbook provides a fundamental approach to RF

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and microwave engineering. It is unusual for the thoroughness with which these areas are presented. The effect is that the reader comes away with a deep insight not only of the

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design
formulation but
answers to how
and why those
formulations
work. This is
especially
valuable for
engineers whose
careers involve
research and
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development,

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wherein the applicability of the applied principles must be understood. The scope of this book extends from topics for a first course in electrical engineering, in which

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impedances are analyzed using complex numbers, through the introduction of transmission lines that are analyzed using the Smith Chart, and on to graduate level subjects,

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such as
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equivalent
circuits for
obstacles in
hollow
waveguides,
analyzed using
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book is a
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Radio Frequency
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Decibel measure
Maximum power
transfer Skin
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VSWR, return
Loss and

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Bode's matching
limits The

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(derived)
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measurement
Constant Q
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Approximating a
transmission
line with
lumped L's and
C's ABCD, Z, Y

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A broadly based
introduction to
high frequency
and microwave
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that covers all
the important
topics in this

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field. With the recent expansion in mobile communications and the increasing use of the microwave frequency bands for these wireless applications,

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attention has become focused on this area. While the treatment is from first principles, due emphasis is placed on practical applications and a number of design examples

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are included to

support the

theory.

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Components in

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Components

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accessible and
informative text
provides an extensive
treatment of
electromagnetism and
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particular emphasis
on microwave and
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applications. Also
stresses
computational
electromagnetics

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through the use of MathCad and finite element methods to elucidate design problems, analysis and applications. Tutorials on the use of MathCad and PSpice are included. An accessible textbook for students and valuable reference for engineers already in the field.

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This second volume of the three-volume complete reference on microwave engineering covers all of the major circuit types used in

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microwave systems, and also covers antennas and propagation, an area vital to microwave systems. The emphasis is on fundamental principles and practical

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providing a
wealth of
information
for engineers
and system
designers.

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Due to the unprecedented growth in wireless applications over the past decade, development of low-cost solutions for RF and microwave

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communication systems has become of great importance. This practical new book is the first comprehensive treatment of lumped elements,

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which are playing a critical role in the development of the circuits that make these cost-effective systems possible. The books offers

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you an in-
depth
understanding
of the
different
types of RF
and microwave
circuit
elements,
including
inductors,
capacitors,

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resistors,
transformers,
via holes,
airbridges,
and
crossovers.
We have
reached the
double
conclusion:
that invention
is choice,

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that this
choice is
imperatively
governed by
the sense of
scientific
beauty.

Hadamard
(1945),
Princeton
University
Press, by

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permission.

The great majority of all sources and amplifiers of microwave energy, and all devices for receiving or detecting microwaves, use a

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active

element. The development of microwave semiconductor devices, described in this book, has proceeded from the simpler, two-terminal,

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devices such as GUNN or IMPATT devices, which originated in the 1960s, to the sophisticated monolithic circuit MESFET three-terminal active

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elements, of the 1980s and 1990s. The microwave field has experienced a renaissance in electrical engineering departments in the last few years, and

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much of this growth has been associated with microwave semiconductor devices. The University of Massachusetts has recently developed a well

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recognized
program in
microwave
engineering.

Much of the
momentum for
this pro gram
has been
provided by
interaction
with
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companies, and the influx of a large number of industry-supported students. This program had a need for a course in microwave semiconductor devices, which

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covered the physical aspects, as well as the aspects of interest to the engineer who incorporates such devices in his designs. It

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was also felt that it would be important to introduce the most recently developed devices (HFETs, HBTs, and other advanced devices) as

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early as
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