

Microwave Engineering Curricula at the School of Electrical and Computer Engineering – National Technical University of Athens

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Abstract - The Microwave Engineering related curricula at the School of Electrical and Computer Engineering National Technical University of Athens is described. Both Diplom Engineering and Postgraduate – Ph.D. studies are presented. The relation of Microwave Engineering topic courses to the general Diplom Engineering studies curricula is analysed. Postgraduate studies related to Microwave Engineering is also presented.

I. INTRODUCTION

National Technical University of Athens (NTUA)¹ has been the first higher technological institution of modern Greece established in 1837. Throughout the two centuries NTUA played an essential role in the technological development of Greece and has been the founder of the other polytechnic Schools in other regions of Greece. The School of Electrical and Computer Engineering of NTUA emerged in 1975 from the School of Mechanical and Electrical Engineering.

Presently the studies leading to Diplom Engineer Degree are based on a 5 year education program consisting of 9 semesters coursework plus one semester Diploma Thesis work. The academic curricula of Diplom Engineer degree is based on the concept of providing a strong fundamental science and engineering related topics (5 semesters) while a “stream of courses” of 4 semesters duration study program is pursued to complete the coursework.

In Greece starting the year of 1964 a central University entrance examination is used to select students. This system despite its criticism (mainly because of degrading the secondary school education since students the last two years they are focused only to the preparation to entrance examination) it has the benefit of selecting the best students to the schools and departments of high interest. In the framework of this selection mechanism the School of Electrical and Computer Engineering (SECE) of NTUA has hosted the best students of Greece. Each year the number entering SECE-NTUA are 400 including students coming from Cyprus where an a parallel entrance system is used.

¹In Greek: Ethniko Metsobio Politechneio, Metsovo is a mountainous town in northern Greece where the donators to establish NTUA were born.

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II. ACADEMIC CURRICULA PROGRAM AT SECE - NTUA

The Academic Curricula Program consists of two consequent course programs:

- Foundation Program
- Stream Course Program

The program was introduced at the academic year 1993-94 and has been in practice then with minor alterations.

The Foundation program includes 33 courses and carried out through 5 semesters. Among the 33 courses those of basic science courses are 13 while the rest 20 are related to introductory and fundamental topics of electrical and computer engineering. Then each student at the end of 5th semester has to choose on of the following directors:

- Electronics and Systems
- Informatics
- Communication
- Energy

In each of the these four directions students has the opportunity to select courses among the following streams:

- ❖ Computer Systems
- ❖ Software Engineering
- ❖ Electronics – Circuits – materials
- ❖ Communications and Computer Networks
- ❖ Information Transmission Systems
- ❖ Signals, Controls and Robotics
- ❖ Electrical Power Systems
- ❖ Decision Systems
- ❖ Biomedical Engineering
- ❖ Physics
- ❖ Mathematics

Depending on the direction chosen each student could select either 3 major streams plus 2 minor courses. The courses to be followed among the streams are 24 while 3 courses are of free selection.

The basic philosophy behind this academic curricula program is to develop engineers having the capability “to know how to think and learn”.

III. MICROWAVE ENGINEERING TOPICS IN DIPLOM ENGINEER STUDIES

The primary course taught to engineering student is the “Introduction to Microwaves” at the 6th semester. This course is included within the stream “Information

Transmission Systems". Already the students to take the course have studied to a good degree Maxwell Electromagnetic Field Theory as well Circuit Theory. The Course includes the following subjects as chapters:

"Introduction to Microwaves"

- Introduction to free space waves and fundamental wave propagation phenomena such as attenuation, dispersion, polarization, phase and group velocities.
- Transmission line theory: basic equations and their solutions along the line axis, impedance properties, Smith chart, matching of loads with various methods, non-uniform transmission lines and coupled lines.
- Waveguides: Parallel plate conductor wall guides, rectangular and circular cross section conductor wall guides, coaxial and microstrip lines.
- Microwave Network Theory, S-parameters, multiple port circuits and relations of S parameter elements, directional couplers circuits, circulators.
- In the framework of the Course an Introductory seminar is given to all students on the Agilent ADS CAD and each student is assigned to carry out two projects on the design of a filter and matching circuit.

The other two courses taught as a follow of the above course are:

"Telecommunication Electronics"

- Noise Theory of RF and Microwave Circuits.
- Design of RF and Microwave Amplifiers using S-parameter theory.
- Non-linear circuit theory and analysis of telecommunication circuits using the methods: harmonic balance, decomposition to linear and non-linear blocks, Volterra series, characterization of non-linear properties of circuits.
- Design of critical elements such as oscillators, signal generators, phase lock loops, filters.
- Design of various type circuit units.
- In the framework of the Course each student has to solve two design problems using Agilent ADS CAD related to an Amplifier and Mixer Design.

"Radar Systems"

- Fundamental of Radar systems and basic equation.
- Scattering theory and its applications in computing radar cross section of targets. Numerical and asymptotic methods.
- Moving Target Indicator and Pulse Doppler Radars.
- Synthetic Aperture Radars
- Ambiguity function theory and coherent radar systems.
- Signal processing methods for Radar systems.

"Fiber Optics Telecommunications"

- Analysis of planar dielectric waveguides and application of electromagnetic methods in analyzing planar dielectric guide structures. Excitation of planar guides and the spectrum of guided and radiated modes. Curved waveguides and coupling in planar guides.
- Propagation of fiber waveguides by applying a full electromagnetic analysis. Propagation properties of fundamental modes in case of single mode fiber. Analysis of multimode waveguides.
- Dispersion phenomena in fibres.
- Design of optical transceivers based on a stochastic analysis of photo detection phenomenon and taking into account system characteristics of telecommunication systems.

In relation to above courses each year a number of 15-20 students carry out their Masters(Diploma) Thesis work.

IV. POSTGRADUATE STUDIES

The Postgraduate studies at the SECE/NTUA primarily consist of Ph.D. studies including Coursework and Research work to be carried out by each Ph.D. candidate. Concerning the Ph.D. Courses the following two courses are taught by the Microwave and Fiber Optics Laboratory are:

- Computational Electromagnetics
- Bioelectromagnetism

During the period 1985-2009 more than 40 Ph.D. has been issued in the field of Microwave Technology Theory and Technology.