NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF ELECTRICAL AND ELECTRONICS ENGINEERING

TELECOMMUNICATIONS ENGINEERING PROGRAM

IT224 – MICROWAVES

I. GENERAL INFORMATION

CODE	**:**	IT224 – Microwaves
SEMESTER	**:**	8
CREDITS	**:**	03
HOURS PER WEEK	**:**	04 (Theory – Practice)
PREREQUISITES	**:**	IT213 – Transmission Lines
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

The course is theoretical-practical in nature, where the student studies the high frequency wave transport structures, the most important passive and active devices used in microwave systems and apply them to the most common circuits in telecommunications systems.

III. COURSE OUTCOMES

At the end of the course the student will:

- Identify, formulate and solve problems where microwave devices and circuits are used.
- Know the concepts necessary to design a network of microwave devices.

IV. LEARNING UNITS

1. INTRODUCTION

Classification of microwave devices. Microwave spectrum. Different types of transmission lines. Coaxial cable. Microtape lines. Slot line. Coplanar line. Characteristics of the dominant mode in each of them. Comparison of planar lines.

2. GUIDED WAVES

Transport structures of high frequency electromagnetic waves. The modal analysis. The rectangular and circular waveguides. Modal Degeneration. Elements of excitation. Attenuation calculation.

3. MATHEMATICAL DESCRIPTION OF THE CIRCUITS

Introduction to microwave circuits. Voltages and equivalent currents in waveguide. N access circuits. Impedance Matrix. Properties. Power waves. Physical meaning. Matrix “S”. Properties. Quadrupole analysis. Gain definitions. Input and output impedances. Cascading quadrupoles.

4. **JOINTS**
   Passive joint elements: groove elements, the post, the directional coupler, T-joints. The ring coupler. Power Dividers. Balanced structures. Smith diagram. Impedance adaptation.

5. **CAVITY RESONATORS**
   Resonant Circuits. Series and parallel resonance. Cavity coupling. Multimodal analysis and orthogonal properties. Mode chart of a cavity. Periodic structures: Bloch waves, Brilouin diagram, Floquet theorem, the helical tape.

6. **PASSIVE DEVICES**
   Passive microwave devices: rotary attenuators, rotary phase shifters. Girotropic characteristics of ferrites. The insulator, the spinner, the circulator.

7. **MICROWAVE TUBES**
   Microwave tubes, the technique of the vacuum, the Klystron, the Magnetron, Tube of traveling waves and Gunn.

8. **SEMICONDUCTOR DEVICES**
   Microwave semiconductor devices: GaAS technology, tunnel diode, Gunn diode, avalanche diodes, FET family, parametric amplifiers.

V. METHODOLOGY

The course is developed in theory and practice sessions. In the theory sessions, the professor presents the microwave circuits and devices, and emphasizes the analysis and their applications in telecommunications. In the practical sessions different microwave circuit problems and their various applications are presented and solved. In all classes the active participation of the student is promoted both in the analysis and in the solution of problems.

VI. EVALUATION FORMULA

The learning will be evaluated through the "G" system:

- Midterm Exam (ME): weights as 1
- Final Exam (FE): weights as 1
- Average of Quizzes (Q): weights as 1

The final grade (FG) is obtained as follows:

$$FG = \frac{ME + FE + Q}{3}$$

VII. BIBLIOGRAPHY

- "Microwave Engineering. Passive Circuits", Peter A. Rizzi, Prentice-Hall, INC., 1998
- "Microwave Engineering, 4th Edition", David M. Pozar, Wiley, 2011
- "Microwave Devices and Circuits Design", Ganesh Prasad, Vijay Laxmi, PHI Learning Pvt. Ltd, 2006.