University of Tehran
School of Electrical and Computer Engineering

<table>
<tr><td>Course:</td><td>8101329 – Microwave 2</td></tr>
<tr><td>Course type:</td><td>
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<tr><td></td><td colspan="6">EE*</td><td colspan="3">CE*</td><td rowspan="2">Credit: 3</td></tr>
<tr><td></td><td>Com</td><td>E</td><td>P</td><td>B</td><td>Con</td><td>D</td><td>SW</td><td>HW</td><td>IT</td></tr>
<tr><td>Required</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td></td></tr>
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<tr><td>Level:</td><td>Undergraduate ☐
Graduate ■</td></tr>
<tr><td>Co-requisite(s):</td><td>None</td></tr>
<tr><td>Prerequisite(s):</td><td>Microwave 1 (8101328)</td></tr>
<tr><td>Prerequisite by topic:</td><td>Microwave theory and engineering, circuit theory</td></tr>
<tr><td>Textbook(s):</td><td>[1] R. Mittra and T. Itoh, “Analysis of Microstrip Transmission Lines,” in Advances in Microwaves, vol. 8, pp. 67-141, 1974.
[2] D. M. Pozar, Microwave Engineering. John-Wiley, 1998.
[3] R. E. Collin, Foundations for Microwave Engineering. McGraw-Hill, 1992.</td></tr>
<tr><td>Coordinator:</td><td>Mahmoud Shahabadi, Professor, School of ECE</td></tr>
<tr><td>Goals:</td><td>This course deals with various planar and co-planar waveguides used in advanced microwave and millimeter-wave circuits. Various analytical and computational techniques for the analysis and design of such waveguides will be introduced. Various geometrical and electrical properties of planar waveguides which affect their dispersion characteristics, attenuation, mode impedance, and mode field are also investigated. Moreover, passive devices using such waveguides, e.g. directional couplers, are introduced. Those planar microwave circuits such as filters benefiting from planar waveguides are investigated, and the methods for their design are discussed. Some practical aspects in regard to measurement of planar microwave circuits are presented. We also study microwave vacuum tube for high-power microwave generation or amplification.</td></tr>
<tr><td>Outcome:</td><td>Upon successful completion of the course, students will be able
1. to choose an appropriate numerical technique for the analysis of</td></tr>
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	planar or co-planar microwave waveguides, 2. to understand the propagation mechanism (mode field lines, dispersion characteristics, excitation, etc.) of various waveguides used in today's microwave circuits, 3. to make use of the introduced planar and co-planar waveguides in devices such as directional couplers and filters, 4. to understand challenges involved in measurement of microwave and millimeter-wave circuits, 5. to explain the mechanism of amplification in microwave vacuum tubes and perform basic calculations involved in their design.
Topics:	1. **Introduction** 2. **Planar Microwave Transmission Lines** (various techniques for the analysis and design of microstrip, coplanar waveguide, slot line, strip line, and substrate integrated waveguide (SIW)) 3. **Coupled Lines and Directional Couplers** (TEM couplers, quasi-TEM couplers, 3dB hybrids) 4. **Microwave Filters** (filter design methods, Kuroda's transformations, coupled-line filters, coupled-resonator filters, stepped-impedance low-pass filters) 5. **Introduction to Microwave Measurements** (vector network analyzers, spectrum analyzers, calibration techniques) 6. **Introduction to Microwave Tubes** (Klystron, Magnetron, and Traveling-Wave Tube)
Computer usage:	MATLAB, ADS, Momentum, Ansoft HFSS
Assignments:	12 homework assignments
Projects:	• Computational projects (modal analysis of planar and coplanar microwave waveguides, filter analysis and design)
Grading:	Assignments: 20 % Midterm exams: 20 % Final exam: 30 % Project: 30 %
Further readings:	[1] Course handouts [2] Related papers mainly from IEEE Transactions on Microwave Theory and Techniques, IEE, and IET journals [3] R. K. Hoffman, *Handbook of Microwave Integrated Circuits*. Artech House, 1985.
Prepared by:	Mahmoud Shahabadi
Date:	December, 2017.

*EE: Electrical Engineering	CE: Computer Engineering

Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics		
Con	Control		
D	Digital System		