

# The Islamia University of Bahawalpur

University College of Engineering & Technology  
Department of Telecommunication Engineering

## Course Outline: Microwave Engineering

### General Information:

<b>Course:</b>	Microwave Engineering	<b>Instructor</b>	Dr. Abdul Aziz
<b>Credit Hours</b>	3+1	<b>Office</b>	Antenna Lab
<b>Contact Hours</b>	3 lectures of one hour each per week	<b>Email</b>	abdul.aziz@iub.edu.pk
<b>Pre-Requisite(s)</b>	Electromagnetic Field Theory	<b>Office Hours</b>	11:30-1:30

### Course Description:

Communication at RF and microwave frequencies, the lumped-elements and distributed circuit model for a transmission line, terminated lossless transmission line, generator and load mismatches, lossy transmission line, the Smith Chart analysis, general solution for TEM, TE and TM waves, rectangular waveguide, circular waveguide, microstrip and stripline, impedance and admittance matrices, the scattering matrix, the transmission ABCD Matrix, signal flow graph, impedance matching with lumped elements, single stub Tuning, double stub tuning, quarter wave transformer, series and parallel resonator circuit, transmission line resonators, rectangular waveguide cavities, basic properties of dividers and couplers, the T-junction power divider, the Wilkinson power divider, microwave oscillators and mixers, microwave filter design by the insertion loss method, filter transformation, filter implementation.

### Textbook:

1. David M Pozar, (2012), "Microwave Engineering" 4th Edition, by John Wiley

### Reference Books:

1. R E Collins, (1992), "Foundations for Microwave Engineering", 2nd Edition, McGraw-Hill
2. Liao, (2007) "Microwave Devices and Circuits", 3rd Edition, Prentice Hall
3. Guillermo Gonzalez, (2008) "Microwave Transistors, Amplifiers, Analysis and Design", 2nd Edition, Prentice Hall
4. Ahmad Shahid Khan, (2014), "Microwave Engineering: Concepts and Fundamentals", ISBN-13: 978-1466591417

### Course Learning Outcomes (CLOs):

CLOs	Description	Domain	PLOs
<b>Theory</b>			
CLO1	To understand the theoretical principles underlying microwave devices and microwave network analysis methods.	Cognitive-2	PLO1
CLO2	To apply theoretical principles to determine circuit properties of passive/active microwave devices.	Cognitive-3	PLO2
CLO3	To analyze transmission and waveguide structures and use of these elements in impedance matching and filter circuits.	Cognitive-4	PLO2
CLO4	To design various microwave components like resonators, power dividers, couplers, hybrid junctions, filters, oscillators, mixers and matched transmission lines (with stubs & lumped elements).	Cognitive-3	PLO3
<b>Lab</b>			
CLO5	To Configure and properly operate microwave trainer to analyze characteristics for different types of microwave devices and to simulate a microwave device in CST/ HFSS.	Psychomotor-5	PLO5
CLO7	To work effectively as an individual or in a group while performing laboratory experiments.	Affective -3	PLO9
CLO8	To Communicate effectively in Viva Voce and in preparing lab reports about each lab work.	Affective -3	PLO10
<b>Complex Engineering Problem</b>			
CLO8	To DESIGN a microwave device using CST and HFSS to achieve required characteristics for the given design specifications.	Cognitive-6	PLO3
CLO9	To Investigate the performance parameters of designed microwave device.	Cognitive -5	PLO4
CLO10	To Recognize importance of microwave engineering and its impact on society.	Affective -3	PLO6
CLO11	To Demonstrate knowledge of microwave devices and its need for	Affective -3	PLO7

	sustainable development.		
CLO12	To Adapt management skills to manage projects of antenna design in a multidisciplinary environment.	Affective -4	PLO11
CLO13	To Adapt lifelong learning skills required to achieve technological developments in the field of microwave filter design.	Affective -4	PLO12

#### Lecture Plan:

S. No.	Topics	Book Reading	Lecture Notes	Video Lectures	Assignments
1	Introduction to Microwave Engineering, The Lumped-Element circuit Model for a transmission line, Terminated Lossless Transmission line, The Smith Chart analysis for Generator and Load Mismatches, Lossy Transmission line	Chapter 1&2: Introduction to Microwave Engineering & Transmission Line Theory (Pozar)	Chapter-1 & 2 (Notes)	<a href="https://www.youtube.com/watch?v=bi1nDg9CqRo&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=2">https://www.youtube.com/watch?v=bi1nDg9CqRo&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=2</a> <a href="https://www.youtube.com/watch?v=it0Pwm0CnrM&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=3">https://www.youtube.com/watch?v=it0Pwm0CnrM&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=3</a> <a href="https://www.youtube.com/watch?v=FN-I5VPsyq4&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=4">https://www.youtube.com/watch?v=FN-I5VPsyq4&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=4</a> <a href="https://www.youtube.com/watch?v=k-zeCttEYVQ&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=5">https://www.youtube.com/watch?v=k-zeCttEYVQ&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=5</a> <a href="https://www.youtube.com/watch?v=c8YzoS0tFqc&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=17">https://www.youtube.com/watch?v=c8YzoS0tFqc&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=17</a> <a href="https://www.youtube.com/watch?v=0wEvEoKU6R0&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=18">https://www.youtube.com/watch?v=0wEvEoKU6R0&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=18</a> <a href="https://www.youtube.com/watch?v=59CrunAmdyw&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=19">https://www.youtube.com/watch?v=59CrunAmdyw&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=19</a> <a href="https://www.youtube.com/watch?v=6CChYOK75-Y&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=23">https://www.youtube.com/watch?v=6CChYOK75-Y&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=23</a>	End Problems: 1.2, 1.5, 1.7, 1.8, 1.9 & 2.1, 2.2, 2.8, 2.9, 2.10, 2.14, 2.15, 2.24
2	General Solution For TEM, TE and TM waves, Rectangular Waveguide, Circular Waveguide, Microstrip, Stripline	Chapter 3: Transmission Lines & Waveguides (Pozar)	Chapter-3 (Notes)	<a href="https://www.youtube.com/watch?v=k-zeCttEYVQ&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=6">https://www.youtube.com/watch?v=k-zeCttEYVQ&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=6</a> <a href="https://www.youtube.com/watch?v=d0wWbgqkwJc&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=7">https://www.youtube.com/watch?v=d0wWbgqkwJc&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=7</a> <a href="https://www.youtube.com/watch?v=LfpeoJqkBwI&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=8">https://www.youtube.com/watch?v=LfpeoJqkBwI&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=8</a> <a href="https://www.youtube.com/watch?v=FZYFaW4ciTY&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=45">https://www.youtube.com/watch?v=FZYFaW4ciTY&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=45</a> <a href="https://www.youtube.com/watch?v=wj02Sb2oj6Q&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=46">https://www.youtube.com/watch?v=wj02Sb2oj6Q&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=46</a> <a href="https://www.youtube.com/watch?v=x2oPSaXsGRI&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=43">https://www.youtube.com/watch?v=x2oPSaXsGRI&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=43</a> <a href="https://www.youtube.com/watch?v=cIOASZaRNgg&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=47">https://www.youtube.com/watch?v=cIOASZaRNgg&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=47</a> <a href="https://www.youtube.com/watch?v=ypRKW1Je6Dg&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=48">https://www.youtube.com/watch?v=ypRKW1Je6Dg&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=48</a>	End Problems: 3.3, 3.4, 3.5, 3.13, 3.19, 3.20, 3.21, 3.22, 3.27, 3.29
3	Impedance and Admittance matrices, The Scattering Matrix, The Transmission ABCD Matrix, Signal flow graph	Chapter 4: Microwave Network Analysis (Pozar)	Chapter-4 (Notes)	<a href="https://www.youtube.com/watch?v=7bjelBiyWyM&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=9">https://www.youtube.com/watch?v=7bjelBiyWyM&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=9</a> <a href="https://www.youtube.com/watch?v=PycKLOq4g50&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=10">https://www.youtube.com/watch?v=PycKLOq4g50&amp;list=PLwdnzlV3ogoUe3QVmrNzDTJYikG0lYjj-&amp;index=10</a> <a href="https://www.youtube.com/watch?v=oyegBQEA2e">https://www.youtube.com/watch?v=oyegBQEA2e</a>	End Problems: 4.14, 4.20, 4.23, 4.24, 4.27

				<a href="https://www.youtube.com/watch?v=rpZIVfPwosA&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=32">8&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=12</a> <a href="https://www.youtube.com/watch?v=f-uV6urU9y0&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=11">https://www.youtube.com/watch?v=f-uV6urU9y0&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=11</a> <a href="https://www.youtube.com/watch?v=JWNvvTGoBvc&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=13">https://www.youtube.com/watch?v=JWNvvTGoBvc&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=13</a> <a href="https://www.youtube.com/watch?v=QyMjbKx0B0&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=14">https://www.youtube.com/watch?v=QyMjbKx0B0&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=14</a> <a href="https://www.youtube.com/watch?v=cuBuprzJuRc&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=24">https://www.youtube.com/watch?v=cuBuprzJuRc&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=24</a>	
4	Matching With Lumped Element , Single Stub Tuning , Double Stub Tuning , Quarter Wave Transformer	Chapter 5: Impedance Matching and Tuning (Pozar)	Chapter-5 (Notes)	<a href="https://www.youtube.com/watch?v=rTtYqWN7tuE&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=15">https://www.youtube.com/watch?v=rTtYqWN7tuE&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=15</a> <a href="https://www.youtube.com/watch?v=SjmISHvDk9o&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=16">https://www.youtube.com/watch?v=SjmISHvDk9o&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=16</a> <a href="https://www.youtube.com/watch?v=K4b7xcXY9mY&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=17">https://www.youtube.com/watch?v=K4b7xcXY9mY&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=17</a>	End Problems: 5.1, 5.4, 5.5, 5.7, 5.9, 5.17, 5.19
5	Series and Parallel resonator circuit , Transmission line resonators , Rectangular waveguide cavities	Chapter 6: Microwave Resonators (Pozar)	Chapter-6 (Notes)	<a href="https://www.youtube.com/watch?v=12kNGg9RtY&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=18">https://www.youtube.com/watch?v=12kNGg9RtY&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=18</a> <a href="https://www.youtube.com/watch?v=44mBn7nyMlM&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=19">https://www.youtube.com/watch?v=44mBn7nyMlM&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=19</a> <a href="https://www.youtube.com/watch?v=05LX8zzKhZ0&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=50">https://www.youtube.com/watch?v=05LX8zzKhZ0&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=50</a> <a href="https://www.youtube.com/watch?v=1vmq5QCledY&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=53">https://www.youtube.com/watch?v=1vmq5QCledY&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=53</a> <a href="https://www.youtube.com/watch?v=Spwq6vg-c1g&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=55">https://www.youtube.com/watch?v=Spwq6vg-c1g&amp;list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW&amp;index=55</a>	End Problems: 6.3, 6.5, 6.9, 6.14, 6.15, 6.16
6	Basic Properties of Dividers and Couplers , The T Junction Power Divider , The Wilkinson Power Divider	Chapter 7: Power Dividers and Directional Couplers (Pozar)	Chapter-7 (Notes)	<a href="https://www.youtube.com/watch?v=XeYXUrr7MeU&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=20">https://www.youtube.com/watch?v=XeYXUrr7MeU&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=20</a> <a href="https://www.youtube.com/watch?v=qoo_VYspej0&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=21">https://www.youtube.com/watch?v=qoo_VYspej0&amp;list=PLwdnzlV3ogoUe3QVmRNzDTJYikG0lYjj-&amp;index=21</a>	End Problems: 7.2, 7.3, 7.6, 7.8, 7.10
7	Filter Design by the insertion loss method , Filter Transformation , Filter implementation	Chapter 8: Microwave Filters (Pozar)	Chapter-8 (Notes)		End Problems: 8.7, 8.8, 8.9, 8.10, 8.16, 8.17

-----END-----