

RF/Microwave Passive Circuits

EEL 4421 (Section 0002) / 5426 (Section 0001)

Class Periods: Tuesday 2-3 periods (8:30 am – 10:25 am), Thursday 3 period (9:35 am – 10:25 am)

Location: Larsen 225 (On-line)

Academic Term: Spring 2021

Instructor:

Name: Yong-Kyu “YK” Yoon

Email: ykyoon@ece.ufl.edu or yongkyu.yoon@ufl.edu

Office Phone Number: (352) 392-5985

Office Hours: Tue and Wed 1 – 2 pm, Larsen Hall 225

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Please contact through the Canvas website

- N/A

Course Description

Course on the radio frequency (RF)/microwave passive components and circuits such as transmission lines, waveguides, couplers, filters, resonators, and magnetic devices (3 credit hours)

Course Pre-Requisites / Co-Requisites

EEL 3472 Electromagnetic Fields and Applications and EEL 3111C Circuits 1 or their equivalent,

Co-requisites: None

Course Objectives

To let students understand the concepts of basic RF/microwave passive components and circuits, and enable to design and analyze various RF passive circuits using analytical and numerical means.

Materials and Supply Fees

N/A

Required Textbooks and Software

- Title: Microwave Engineering
- Author: David M. Pozar
- Publication date and edition: 2013, Wiley, 4th Edition
- ISBN number: **0470631554**

Recommended Materials

- Title: Microwave and RF Design
- Author: Michael Steer
- Publication date and edition: 2010, Scitech
- ISBN number

Software:

High Frequency Structure Simulator (HFSS, ANSYS Inc.) Manual

Designer (ANSYS Inc.)

ADS (Agilent Inc.)

Course Schedule

Tentative Schedule

	Impedance Matching	Read	Skim
1/12	1. Course Introduction, background evaluation	1.1	1.2-1.9
1/12	2. Review of T- line theory: lumped element ckt model	2.1-2.2	
1/14	3. Review of T- line theory: terminated lossless line	2.3	

1/19	4. Left-handed T-line and CRLH T-line (metamaterials)	Handout	
1/19	5. Review of Smith Chart	2.4-2.7	
1/21	6. Review of impedance matching with Smith Chart	5-1	5.2, 5.3
1/26	7. Stub matching, L matching	5.4	
1/26	8. $\lambda/4$ transformation	5.5	
1/28	9. Binominal broadband matching	5.6	
2/2	10. Chebyshev broadband matching	5.7	
2/2	11. Tapered lines	5.8	5.9
	Transmission Lines and Waveguides		
2/4	12. Review of rectangular waveguide and its wall loss	3.3, 3.4	3.1-3.2
2/9	13. Coaxial cables and microwave connectors	3.5	
2/9	14. Planar waveguides (microstrip, CPW)	3.7-3.8, 3.11	3.9-3.10
2/11	15. T-line calculator	Handout	
2/16	16. Substrate integrated waveguide (SIW) and transition	Handout	
2/16	17. Review		
2/18	Exam #1	Closed book	Formula sheet
	S-parameters and S-matrix		
2/23	18. Impedance concepts	4.1-4.2	
2/23	19. Scattering matrix and properties of s-parameters	4.3	
2/25	20. Transmission (ABCD) matrix	4.4	
3/2	21. Examples of S-parameters	7.1-7.3	
	Couplers		
3/2	22. Branch line coupler (90° hybrid)	7.5	7.4
3/4	23. Coupled line couplers	7.6-7.7	
3/9	24. The 180° hybrid	7.8	7.9
3/9	25. Right and left handed coupler	Handout	
3/11	26. Other couplers	Handout	
3/16	Term project discussion		
3/16	Term project discussion		
3/18	Exam #2	Closed book	Formula sheet
	Resonators		
3/23	27. Series prototype resonators,	6.1	
3/23	28. Parallel prototype resonators, T-line resonator	6.2	
3/25	29. Substrate Integrated Waveguide (SIW) resonator	Handout	6.3-6.4
3/30	30. Excitation of resonators and nonmetallic resonators	6.5-6.6	
	Filters		
3/30	31. Filter design using insertion loss method	8.3	8.1-8.2
4/1	32. Filter transformations	8.4	
4/6	33. Filter implementations	8.5	
4/6	34. Filter implementations	8.6	
	Magnetics		
4/8	35. Ferrimagnetic materials	9.1, 9.2	
4/13	36. Ferrimagnetic materials	9.3	
4/13	37. Isolator, Circulators	9.4, 9.6	
4/15	38. Phase Shifter	9.5	
4/20	Term project presentation		
Final	Final (Follow school schedule)	Open book Open note	TBA

Online Course Recording

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance Policy, Class Expectations, and Make-Up Policy

This class will be presented online using Zoom and requires access to a working webcam and stable internet connection. I prefer that students keep their camera on during the class so that I can see you as I would during normal face-to-face classes. Studies show that if we can see each other's faces then we will have more engagement, more student success, and more faculty success. However, this is not a requirement. I understand if on certain days you can't have your camera on due to internet bandwidth limitations, other family members, health issues, or any other reasons.

Excused absences must be in compliance with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

Evaluation of Grades

Students are expected to attend class lectures and arrive on time. Please turn off cell-phones, pagers, and other electronic devices during the class unless you are asked to use them.

Assignment	Total Points	Percentage of Final Grade
Homework Sets	100 each	10%
Computer lab and projects (presentation and report for 5426)	100	30%
Exam1	100	20%
Exam2	100	20%
Final Exam	100	20%
		100%

Both EEL 4421 and 5426 have computer software based simulation and design while EEL 5426 is required to present term projects and submit final reports.

Grading Policy

The following is given as an example only.

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
83.0 - 86.9	B+	3.33
80.0 - 82.9	B	3.00
77.0 - 79.9	B-	2.67

73.0 - 76.9	C+	2.33
70.0 - 72.9	C	2.00
67.0 - 69.9	C-	1.67
63.0 - 66.9	D+	1.33
60.0 - 62.9	D	1.00
57.0 - 59.9	D-	0.67
0 - 56.9	E	0.00

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.ua.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual

violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.

