ECE 549:   RF Design for Wireless

suresh.venkatesh@ncsu.edu
MRC 437

Instructor: Suresh Venkatesh

Instructor Office Hours: TBD
TA Office Hours: TBD

Teaching Assistant: TBD

Online Students: Zoom link will be provided.

 Course Webpage: link here : All annoucements will be posted here

 ***Please use the course bulletin board to ask questions about lectures, HW, projects, etc. It is the best way to broadcast questions that may be of interest to everyone.*

Course Objective: After taking this course, student will be able analyze different metrics of a basic RF and wireless system design. Students will analyze, design, and characterize radio systems, transmission line/ waveguide theory, microwave network analysis, microwave passive devices (filters, couplers, power dividers, etc.). Students will learn to use Advanced Design System (ADS) simulation tool kit provided by Keysight.

Course Description: Topics covered include radio and wireless system design concepts, RF modulation methods, system metrics (gain, link budget, noise analysis), transmission-line/ waveguide theory, impedance matching/ tuning networks, Smith Chart analysis, network analysis, theory/design of basic microwave passive building blocks like couplers, dividers, and filters. Some homeworks and/or projects will include the use of MATLAB/Python and ADS.

Prerequisites: Required: ECE 422 and/or ECE 424,
                    Recommeded: ECE 303 and/or ECE 420

Required Text:
1)   M.B. Steer, Microwave and RF Design Series, 2019.
        (https://repository.lib.ncsu.edu/handle/1840.20/36776)
2)   David. M. Pozar, Microwave Design, 4th Edition. (Also available online with library)

Supplementary Reading:
Will be assigned along the duration of the course as reading materials. Website links will also posted to aid in setting up software tools.

Grading:
Homeworks : 20% (roughly 5-7 assignments)
Project : 15% (1 Project - typically at the end of semester course)
Exams : 30% (1st Mid-term), 30% (2nd Mid-term) and 30% (1 Final-term will be optional)
        2 Midterms are compulsory. Final exam will be optional. Highest two exam scores will be selected for final grade. All exams will be no internet, no laptop/tablet, open notes.
ECE 549 - 001 Students: 5% for in-class participation. Reasonable attendance is expected.

Lectures	Timeline	Topics
Lec 1 – Lec 6	Part 1	RF systems concepts, modulation theory basics, System metric basics (gain/directivity, antenna metrics, link budget, noise analysis), radio architectures, basics of radar systems
Lec 7 – Lec 15	Part 2	EM basics, transmission line theory, T-line network analysis, coplanar/microstrip T-lines/coupled T-lines, analytic modelling of T-line, waveguide, Microwave Network analysis, Parameterized approaches (S-parameter, Z-parameter, Y-parameter, ABCD), Smith Charts
Lec 16 – Lec 25	Part 3	Impedance matching, Passive components, Combiners, dividers, couplers, Filter design

Please refer the NCSU Fall 2023 Academic Calendar for holidays.

Project: Course project will involve the design and analysis of a passive microwave component using ADS. The overall grading of the project will depend upon the quality and content of the design report. Students have to turn in their independent work.

→**Late policy**: Design projects must be submitted on-line before 11:55PM on the due date. Within reason late submissions will be accepted and may incur a penalty.

Homeworks: Approximately 5 to 7 homework assignments will be assigned through the course of the semester, accounting for 20% of the grade.

→**Late policy**: Late homework submisssion will automatically incur a 10% penalty and must be submitted no later than the end of the weekend the week they are due.

Exams: Two in-classroom exams. Exams will be open book but use of Internet, laptops, and other mobile devices will not be permitted. In case of schedule conflict please contact the instructor early.

Grading Rubric:

Low	Letter	High	Low	Letter	High	Low	Letter	High
97 ≤	A+	≤ 100	80 ≤	B-	< 83	63 ≤	D	< 67
93 ≤	A	< 97	77 ≤	C+	< 80	60 ≤	D-	< 63
90 ≤	A-	< 93	73 ≤	C	< 77	0 ≤	F	< 60
87 ≤	B+	< 90	70 ≤	C-	< 73			
83 ≤	B	< 87	67 ≤	D+	< 70			

Academic Integrity:
Students should refer to the University policy on academic integrity found in the Code of Student Conduct (found in Appendix L of the Handbook for Advising and Teaching). *It is the instructor's understanding and expectation that the student's name/signature on any test or assignment means that the student neither gave nor received unauthorized aid.* Authorized aid on an individual assignment includes discussing the interpretation of the problem statement, sharing ideas or approaches for solving the problem, and explaining concepts involved in the problem. Any other aid would be unauthorized and a violation of the academic integrity policy. Any computer work submitted must be completed on your own personal computer or from your own NC State account to avoid confusion about the origin of the file, and no sharing of files in any way is allowed. Students found in violation of the academic integrity policy will be reported to the NC State Office of Student Conduct.

Simulation: Design projects will be mainly performed using MATLAB/Python and ADS. Sufficient tutorials will be provided for ADS simulations. Please see the moodle website for instructions regarding accessing ADS.

Students with Disabilities:
Reasonable accommodations will be made for students with verifiable disabilities. To take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Hearth Center, Campus Box 7509, 515-7653. http://www.ncsu.edu/dso.

Audit Students:
Any student auditing the course is expected to maintain a B average or better on all homework assignments. Audit students do not have to complete design project(s).

Syllabus Modification Statement:
Our syllabus represents a flexible agreement. It outlines the topics we will cover and the order we will cover them in. Dates for assignments represent the earliest possible time they would be due. The pace of the class depends on student mastery and interests. Thus, minor changes in the syllabus can occur if we need to slow down or speed up the pace of instruction.

Supporting Fellow Students in Distress:
As members of the NC State community, we each share a personal responsibility to express concern for one another and to ensure that this classroom and the campus as a whole remains a safe environment for learning. Occasionally, you may come across a fellow classmate whose behavior concerns or worries you. When this is the case, I would encourage you to report this behavior to the NC State Students of Concern website: http://studentsofconcern.ncsu.edu/.

COVID-19

Due to the COVID-19 pandemic, public health measures continue to be implemented across campus. Students should stay current with these practices and expectations through the Protect the Pack website (https://www.ncsu.edu/coronavirus/). The sections below provide expectations and conduct related to COVID-19 issues.

Health and Participation in Class:
We are concerned about your health and the health of your classmates and colleagues.

- If you test positive for COVID-19 or are told by a healthcare provider that you are presumed positive for the virus, you should not attend any face-to-face (F2F) classes. Please follow all university guidelines, including Coronavirus Self Reporting, to help provide support to you and to assist in contact tracing for containing virus spread.
- If you feel unwell, even if you have not been knowingly exposed to COVID-19, please do not come to a F2F class or activity.
- If you are in quarantine, have been notified that you may have been exposed to COVID-19, or have a personal or family situation related to COVID-19 that prevents you from attending this course, please connect with your instructor to make alternative plans, as necessary.
- If you need to make a request for an academic consideration related to COVID-19, such as a discussion about possible options for remote learning, please talk with your instructor.

Course Expectations Related to COVID-19:
- Face Coverings: Optional, pursuant to NC State policy.
- Course Attendance: NC State attendance policies can be found at: REG 02.20.03 – Attendance Regulations – Policies, Regulations & Rules. If you are quarantined or otherwise need to miss class because you have been advised that you may have been exposed to COVID-19, you should not be penalized regarding attendance or class participation; however, you will be expected to develop a plan to keep up with your coursework during any such absences. If you become ill with COVID-19, you should follow the steps outlined in the health and participation section above. COVID 19-related absences will be considered excused; documentation need only involve communication with your instructor.

Community Standards related to COVID-19:
We are all responsible for protecting ourselves and our community. Please see the community standards (which have been updated in 2021) and Rule 04.21.01 regarding Personal Safety Requirements Related to COVID-19 RUL 04.21.01 – Personal Safety Requirements Related to COVID-19 – Policies, Regulations & Rules

Course Delivery Changes Related to COVID-19
Please be aware that the situation regarding COVID-19 is frequently changing, and the delivery mode of this course could change accordingly, including from in-person to remote. Regardless of the delivery method, we strive to provide a high-quality learning experience.

Health and Well-Being Resources:
These remain difficult times, and academic and personal stress are natural results. Everyone is encouraged to take care of themselves and their peers. If you need additional support, there are many resources on campus to help you:
- Student Health Services (Health Services | Student)
- If the personal behavior of a classmate concerns or worries you, either for the classmate's well-being or yours, we encourage you to report this behavior to the NC State CARES team: (Share a Concern).
- If you or someone you know are experiencing food, housing or financial insecurity, please see the Pack Essentials Program (Pack Essentials).

Need Help?
If you find yourself in a place where you need help, academically or otherwise, please review these Step-by-Step Help Topics.

Other Important Resources
- Keep Learning
- Protect the Pack Frequently Asked Questions
- NC State Protect the Pack Resources for Students
- Academic Success Center (tutoring, drop in advising, career and wellness advising)
- NC State Keep Learning Tips for Remote Learning
- Introduction to Zoom for students: https://youtu.be/5LbPzzPbYEw
- Learning with Moodle, a student's guide to using Moodle
- NC State Libraries Technology Lending Program