COURSE SYLLABUS

1 ECE 5690 - Microwave Networks

2 Meeting Information

4 credits, 5 contact hours Two 75-minute lectures, One 120-minute laboratory session

a. **Section 001:**
Lecture: TR from 11:30 am to 12:45 pm, **Tolentine Hall 426**
Lab: Tfrom 02:30 pm to 04:30 pm, **CEER 214**

3 Course Instructor(s), TA(s)

a. **Section 001:**
Class Instructor: Robert H. Caverly
Office Hours: $verbatim)Mondaynoon-1:20pmviaZoom-emailtoattend(https://villanova.zoom.us/j/95044526746)$verbatim), or by appt.

Lab Instructor: Robert H. Caverly
Office Hours: , or by appt.

TA: None

4 Textbook

David Pozar, *Microwave Engineering, 4th ed*, John Wiley (available through BlackBoard via the Affordable Course Materials Project), 2011. ISBN: 0470631554. REQUIRED.

a. **Other Supplemental Materials:** Laboratory projects (provided via BlackBoard)

5 Specific Course Information

a. **Catalog Description**
Plane wave propagation; propagation in TEM transmission lines and waveguides; IMPATT; TRAPAT; Gunn-Effect and parametric devices; microstrip lines and microwave integrated circuits; laboratory work includes measurement of SWR, impedance, and power at microwave frequencies. Three lecture hours and a two-hour practicum per week.

b. **Prerequisites:** ECE 3530 and ECE 3690; **Co-requisites:** None

c. EE Track Elective

6 Course-specific Goals

a. Modern communication systems, regardless of whether the system is primarily digital or analog, all require high frequency systems to extract or inject the appropriate signal into the transmission medium. The course objectives of ECE 5690 are to provide you with an introduction to the tools the modern microwave engineer uses in the analysis and design of microwave systems. These tools include a theoretical background in transmission lines and network theory as well as some solid-state devices, a knowledge of modern microwave simulation tools, and the ability to use, perform and understand microwave measurement equipment.

Various in-class and out of class assignments will be used to help you in understanding and using these tools.

b.

ABET Student Outcomes						
1	2	3	4	5	6	7
X	X	X			X	X

The above student outcomes are defined by the Accreditation Board for Engineering and Technology (ABET) as:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

7 List of Covered Topics

1. Network Theory
2. n Z and Y one and two port parameters
3. n S and T two port parameters
4. n S parameters examples and uses
5. Transmission Line Theory
6. n Transmission Line Equivalent Circuit
7. n Lossless Lines, the Smith Chart and Impedance Transformation
8. n Impedance Matching
9. n Lossy Lines
10. Practical Transmission Lines
11. n Waveguides
12. n Coaxial lines
13. n Strip-style transmission lines
14. n Transmission line filters
15. Directing Microwave Energy
16. n Power Dividers
17. n Directional Couplers
18. Microwave Filters
19. n Lumped element filters, LC prototype filters
20. Microwave and RF System Fundamentals

21. § Noise and Noise Figure and Temperature
22. § System Nonlinearities, including harmonic and intermodulation
23. § System Gain and Dynamic Range

8 Tentative Schedule

Tentative schedules for all sections follow. Be sure to refer to the schedule for your specific section, if more than one is provided.

Tentative Schedule for **Section 001**

9 Grading Policy

There will be two tests given during the semester that comprise 60% of your final grade. 25% of your grade will be based on your performance on homework quizzes, laboratory reports and other assignments, and a final project (which will be worth 15%). Besides being a portion of your grade, I strongly urge you to do the homework and review the solutions when they are made available since these exercises are helpful in understanding microwave concepts. Missing a homework quiz without a valid excuse approval will result in a zero for that quiz. Missing a quiz with excuse approval will not suffer a penalty. Any missed test with a valid excuse (see attendance policy) will make the other 40% of the course grade increase accordingly.

Letter grade scale: A(93–100), A–(90–92), B+(87–89), B(83–86), B–(80–82), C+(77–79), C(73–76), C–(70–72), D+(67–69), D(63–66), D–(60–62), F(<60)

10 HW Assignment and Laboratory Report Submission Policy

You will also be responsible for use of a microwave circuit simulator for completing a number of projects as part of the course requirements. Laboratory time will be spent with tutorials on the use of these circuit simulators and well as traditional and contemporary equipment (as available). If available, the Microwave Electromagnetics Laboratory in CEER 214 will be used for the hardware tests, and each laboratory exercise will be based on equipment available in that laboratory or in the laboratory parts kit provided to you. Laboratory handouts will be provided on the day of the exercise.

11 Attendance Policy

Attendance is strongly encouraged for the lecture class, whether it be seated and ready to start class in a classroom setting, or being at your laptop with camera on if virtual. Attendance for the laboratory portion of the course is mandatory (unless with an excused absence), whether it be seated and ready to start the laboratory, or being at your laptop with camera on if virtual. Problems in class will be reviewed and sometimes laptops will be used to reinforce concepts. Where possible, students should inform their instructors if they plan to be late or absent from class. Missing a test or a quiz will require an excused absence approval from the Dean's office.

Whenever possible, students should inform the instructor if they plan to be late or absent from class. In all cases, documentation is required to petition for *excused* absences to the Associate Dean

for Student and Strategic Programs, Dr. Stephen Jones. The excused absence form is posted at: https://www1.villanova.edu/villanova/engineering/resources/undergraduates.html.

Excused absences do not count towards a failure in the course for first year students. Absence from class does not release the student from assigned work. Students who miss an in-class obligation such as an exam, a presentation, etc., due to an excused absence will not be penalized - the instructor may offer a make-up test, arrange an alternative time for a presentation, exempt a student from the assignment, or provide another arrangement. In the case of illness or injury, the form must be submitted within 24 hours of missing a class. The University's list of excused absences for all students includes the following:

1. Participation in NCAA athletic competitions
2. Participation in special academic events such as: conferences, field trips, project competitions, etc., and in official university business such as student representatives attending meetings related to university governance
3. Attendance at significant events of the immediate family such as: funerals, weddings, etc.
4. Religious holidays - see the University's policy on Religious Holidays
5. College-approved participation in placement activities such as: job interviews, graduate school interviews, job fairs
6. Legally required absence such as: jury duty, court appearance, short-term military service
7. Documented serious illness or disability

12 Examination Policy

The College of Engineering has adopted the following general examination guidelines:

1. Students must arrive before the start of the examination. Under exceptional circumstances a student may need to arrive late, but he/she can enter the examination room no later than five (5) minutes after the start of the exam.
2. Cell phones must be turned off until the student exits the examination room.
3. The official Villanova class attendance policy must be followed when requesting excuses for absences or lateness to an examination.
4. Each student must write and sign the following statement, "I have neither given nor received any unauthorized assistance in the completion of this examination."
5. For online examinations, the instructor may implement video proctoring or other measures to ensure academic integrity. For consent purposes, the instructor will inform students in advance if (s)he plans to use any form of video-proctoring and whether the examination will be recorded.

13 Academic Integrity Policy

The College of Engineering is committed to creating an environment of academic integrity and ethical decision-making that we hope is reflected in the actions of our students and graduates. As Villanova students, integrity is central to the University mission. As engineers, our code of conduct requires us to place honor and integrity at the forefront of everything we do. As engineering students, it is expected that you will begin to adopt these values and instill them into your work habits. Students violating the academic integrity policy will receive a zero on that assignment or exam and the violation will be reported to the Associate Dean for Academic Affairs. The University's academic integrity policy can be found on the following web page:
https://www1.villanova.edu/villanova/provost/resources/student/policies/integrity.html.

14 Adherence to the Student Code of Conduct

Students are expected to act in a professional and respectful manner to their fellow students, faculty, and staff. Students should become acquainted with and understand the responsibilities set forth in the Student Handbook, especially those in the sections on Policy and Regulations. Adherence to university regulations is expected and required for successful completion of the program of studies. Enforcement within the classroom of policies regarding classroom behavior is the responsibility of the faculty member. All other discipline problems are to be referred to the Dean of Students.

15 Online Expectations

To foster a professional environment, please wear appropriate clothes, mute if you are not talking to cut down on background noise, refrain from eating, and select an appropriate setting when we are meeting online.

16 Inclusive Classroom

This classroom is a place where you will be treated with respect; we welcome individuals of all ages, backgrounds, beliefs, ethnicities, gender, gender identities and expressions, sexual orientation, and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment to allow all among us to learn and flourish.

17 Students with Disabilities

It is the policy of the university to make reasonable academic accommodations for qualified individuals with disabilities. If you are a person with a disability (non-physical) please register with the office of Learning Support Services (LSS) by emailing Learning.support.services@villanova.edu or by phoning 610-519-5176 as soon as possible. Registration is *required* in order to receive accommodations.

The Office of Disability Services (ODS) collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The ODS provides Villanova University students with physical disabilities the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact and register with Gregory Hannah, advisor to students with disabilities at 610-519-3209 or visit the office on the second floor of the Connelly Center.

18 Tutoring Services

Villanova's tutoring services include The Writing Center, The Learner's Studio, and The Center for Speaking and Presentation. These services are offered free of charge to students. Drop in as-needed or book a regular weekly session to supercharge your academic success. Sessions can be 30 or 60 minutes in length.

Register for an account and book sessions in advance at villanova.mywconline.com. If you don't see your class listed, request a tutor for a missing subject at: tutorrequest.villanova.edu For more information, contact Juliana Struder at juliana.studer@villanova.edu or at 610-519-5862.

19 Electronics Policy

The use of electronic devices, such as phones, laptops, tablets, calculators, etc., during class is generally allowed, unless their use causes a disturbance to others. During examinations, the use of any electronic device is prohibited, unless it is expressly authorized by the instructor.

Students are prohibited from making any audio or visual recordings (including taking photographs) of lectures, discussions, or other classroom activities, unless a student (1) has written permission in advance from the instructor, or (2) is permitted to record under terms and conditions as approved by the University's Office of Disability Services or Learning Support Services. Students who have received approval to record classes as an academic accommodation must provide supporting documentation from the Office of Disability Services or Learning Support Services in advance of any recording. Students may use authorized recordings only for the purposes of individual study in the course, and may not disseminate or share them with a wider audience without explicit permission.

20 Copyright Policy

The materials used in Villanova University courses ("Course Materials") generally represent the intellectual property of course instructors, third parties and/or the university which may not be disseminated or reproduced in any form for public distribution (e.g., sale, exchange, etc.) without the written permission of the course instructor. Course materials include all written or electronic documents and materials, including syllabi, current and past examination questions/answers, and presentations such as lectures, videos, slides, etc., provided by a course instructor. Course materials may only be used by students enrolled in the course for academic (course-related) purposes.

Published course readings (book chapters, articles, reports, etc.) available in "Blackboard" are copyrighted materials. These works are made available to students through licensed databases or fair use. They are protected by copyright law, and may not be further disseminated or reproduced in any form for distribution (e.g. uploading to websites, sale, exchange, etc.) without the permission of the copyright owner.

Follow these links for more information on Intellectual Property, Copyright, and Computer Acceptable Use.

21 Professorial Duties

It is important to note that teaching is one of the many duties that professors perform as part of their job responsibilities. In addition to teaching, professors perform research, advise graduate students, edit journals and review journal articles, serve on committees for the university and professional societies, travel to conferences to remain abreast of current developments and to present their results... to name just a few commitments.