RF Circuit Design (ECE321/521)

Instructor: Dr. Mohammad S. Hashmi

Class Timings: Tuesday (11:00 – 12:30) & Thursday (11:00 – 12:30)

Lab Timings: Wednesday (14:00 – 15:30)

Office Hours: Monday (14:00 – 15:00) & Tuesday (14:00 – 15:00)

RF Circuit Design

Teacher: "*Mogli*, do you even know your multiplication tables?"
Mogli: "*Well*, I know of them".

Like Mogli and his multiplication tables, many electrical engineers know of the concepts of RF Circuit Design.

However, Concepts such as characteristic impedance, scattering parameters, Smith charts and the like are familiar, but we often find that a **complete**, **thorough**, and **unambiguous** understanding of these concepts can be somewhat lacking.

Thus, the goals of this class are for you to:

- Obtain a complete, thorough, and unambiguous understanding of the fundamental concepts on RF and High Frequency Engineering
- Apply these concepts to the design and analysis of useful high frequency devices

Pre-requisites:

Circuit Theory Fundamentals, Fields and Waves Fundamentals

Course Outline:

Available at: http://www.iiitd.edu.in/~mshashmi/teaching

Course Focus:

High Frequency Circuit and System Design for Cellular, WIFI, WLAN, and Bluetooth Applications

Tentative Break-up of Lecture Contents

- **Lecture 1-2:** Introduction, Fundamentals, RF Behavior of Circuit Components
- **Lecture 3-5:** Transmission Line (TL) Analysis, Equivalent Circuit Representation, General TL Equations, Terminated Lossless TL, Special Termination Conditions
- **Lecture 6-9:** The Smith Chart
- **Lecture 10-13:** Single- and Multi-port Networks, S-Parameters, Signal Flow Graphs
- **Lecture 14-15:** Impedance Matching and Tuning
- **Lecture 16-19:** Power Dividers, Splitters, and Directional Couplers
- **Lecture 20-22:** RF Filter Design
- **Lecture 23-26:** RF Amplifier Design

Lab Components:

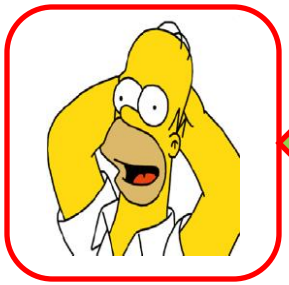
- Introduction to ADS (It will be mostly self learning, will be required for course projects) – TAs can help
- Introduction to VNA and Spectrum Analyzer and their Usage

Attendance and Classroom Behavior:

- Attendance not necessary
- Students will be responsible for any notes, announcements etc. made during the class
- Prompt arrival to the class is requested
- No eating, drinking, smoking allowed in the class

Evaluation Mechanism

- Assignments – 24% weightage
- 6 assignments (all compulsory!)



- Surprise Quizzes – 16% weightage
- 4 (all compulsory!)

- Exams and Project – 60% weightage
- Project (30%)
- Mid-Sem (15%)
- End-Sem (15%)

Projects Grading and Evaluation

1. Each student team (2 people max.) must work alone on projects – the design and analysis must represent each team's effort and knowledge only. Working with other teams will be considered academic misconduct and all students involved will receive **zero marks**. You are forbidden from viewing the report of other project teams

2. However, you may ask your colleagues about how to operate/use **ADS**

3. Likewise, you may confer with fellow students about any **general** questions about the theory associated with the projects. However, these questions must be **general**

4. A report that receives top marks will exhibit three characteristics:
   - **Accurate** – the design and analyses are correctly done
   - **Professional** – the results are clearly, completely, and unambiguously presented
   - **Insightful** – the report convinces me that you understand what you have done and why the result appear the way they do. In other words, after reading your report, I wish to be **impressed** with your knowledge and insight of the subject

Projects Grading and Evaluation

5. You may **extend** the projects beyond what is called for in the project description. If done correctly, this will likely impress me and help me conclude that you are a very motivated, knowledgeable, and professional student! Your grade will thus reflect this favorable opinion

However, this does not mean that an extension of projects scope is required – you will get full credit with a well-done report that addresses only the projects scope

Text Book:

- "RF Circuit Design: Theory and Applications" ***by*** R. Ludwig, 2nd Ed., Pearson International

Other Recommended Books:

- Microwave Engineering ***by*** D. M. Pozar, 4th Ed., John Wiley and Sons Inc.
- RF Circuit Design ***by*** C. Bowick, 2nd Ed., Newnes
- Secrets of RF Circuit Design ***by*** Joseph J. Carr, 3rd Ed., McGraw Hill
- RF Transistor Amplifier ***by*** G. Gonzalez, 2nd Ed., Prentice Hall
- IEEE Xplore, IEL, etc.

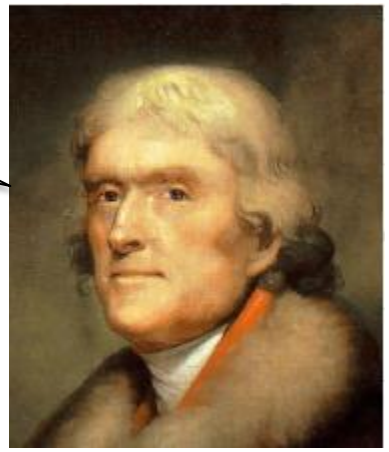
Course Website:

http://www.iiitd.edu.in/~mshashmi/teaching

Info related to ECE321/521 can be found here

Hints for Success in RF Circuit Design

These tips are Gul-Durn important! Only a SUPERMAN type student can choose to ignore them!



1. **Be thorough** – The text and lecture slides are **not** an encyclopedia or manual! Each slide builds on the previous one – you must read them **completely** and in **order**. When you come to a line, paragraph or page that you **don't understand**, do you **stop** and figure it out, or just skip it and go on?
2. **Get help!** – **Office hours** are a great time to learn. All I ask is that you be **knowledgeable** of your **ignorance!**
3. **Be prepared for each lecture** – Attend each class having **read the notes** from the previous lecture, and having read the relevant **text** for the **current** lecture. Come to class prepared to learn!