Approval: 14th Senate Meeting

IIT Mandi

Proposal for a New Course

Course Number	: EE622
Course Name	: Microwave Integrated Circuits
Credits	: 3-0-0-3
Prerequisite	: EE507 – Transmission Lines and Basic Microwave Engineering or equivalent, PH521 – Electromagnetic Theory or equivalent,
Intended for	: BTech Third and Final year/M.Tech./MS/PhD
Distribution	: Elective for third and final year Electrical Engineering, MTech VLSI, And Communication and Signal Processing (CSP), M.S., Ph.D.
Semester	: Odd (Aug-Dec)

1. **Preamble:** The proposed course is an advance course towards Microwave Integrated Circuits (MIC) which covers topics like, power-dividers, couplers, printed filters etc. This course will also cover stability analysis of active microwave devises like Amplifiers and oscillators. This course is combination of both passive printed and some of the solid-state devices. To make student aware of latest techniques topics like dielectric resonators, Left-Handed transmission lines are also added. Course objective is to make student to understand following aspects of Microwave Integrated Circuits:

a) Printed circuits and losses in printed transmission lines. Matching techniques in printed transmission lines.

b) Working of basic passive components like power-dividers and couplers.

c) Microwave transistors and amplifiers with their applications. Substrate analysis for Microwave and Millimeter waves.

2. Course Module with quantitative lecture hours:

Module 1. Introduction to Printed Transmission lines and Transitions – Concept of 2 Port-Network and S Parameters, Matching transmission line sections and theory of multiple reflections, Transitions in different transmission lines, Micro-Strip and Strip lines, Left handed transmission lines. Smith chart: Double stub Matching. **[8 hours]**

Module 2. Power Dividers and Directional Couplers: Basic Properties of power dividers and couplers, T junctions, Wilkinson type, quadrature hybrid power dividers, coupled line directional coupler, 90 deg. and 180 deg, - Hybrid branch line couplers. Circulators-Active and Passive. Broad-Band techniques **[6 hours]**

Module 3. Filters and Isolator - Basic Filter design techniques like image parameter and insertion loss, Filter transformations and implementations, low pass filters, coupled line filters, coupled resonator based filters, metamaterial filters. Ferrite isolator circuits and design **[6 hours]**

Module 4. Microwave Amplifiers, - Single Stage Transistor amplifier, Power gain equations, Stability circles, Broad-band amplifier design, Solid state Power amplifiers. **[8 hours]**

Module 5. Microwave diodes and transistors: BJT,GaAs FETs,and their applications, IMPATT, TRAPATT, Gunn diodes. **[4 hours]**

Module 6. Oscillators and Phase-Shifters - Microwave oscillators using Transistors, dielectric resonators, Active and passive Phase-Shifters **[6 hours]**

Module 7. Technologies in MIC: - Monolithic and Hybride substrates, Metamaterial substrates, Millimeter wave techniques, Simulations based study of printed microwave device **[4 hours]**

Note: All the Units will have tutorials and in the end of course there will be a presentation assignment in which student (or a group) will present latest advancement in any-one of the topics taught in class

3. Text Book:

1. David M Pozar: Microwave Engineering, Fourth Edition, John Wiley & Sons Publications
2. G. Gonzalez, "Microwave transistor amplifier; design and analysis, Handbook", 2nd addition. Prentice hall Publications.

4. Reference:

1. Leo Young and H. Sobol, Ed. Advances in Microwaves, vol.2 Academic press.Inc.
2. S. Y. liao, "Microwave circuit and analysis and amplifiers design", Prentice Hall.
3. C. Caloz and T. Itho, "Electromagnetic Metamaterial: Transmission Line Theory and Microwave Applications", Wileys Publications. Research Papers as instructed by course Instructors.

5. Similarity content declaration with existing courses:

S.N.	Course code	Course Content	Approx. % of content