



BASIC ELECTRICAL CIRCUITS

PROF. NAGENDRA KRISHNAPURA

Department of Electrical Engineering
IIT Madras

TYPE OF COURSE : Rerun | Core | UG

COURSE DURATION : 8 weeks (20 Jul' 20 - 9 Oct' 20)

EXAM DATE : 18 Oct 2020

PRE-REQUISITES : XII std. level algebra and calculus, electrostatics

INTENDED AUDIENCE : First or second year undergraduate students(This course is intended to be their first introduction to electrical circuits)

INDUSTRIES APPLICABLE TO : This is a basic course that will lay the foundation for other advanced courses relevant to industry

COURSE OUTLINE :

Electrical circuits are everywhere, from tiny ones in integrated circuits in mobile phones and music players, to giant ones that carry power to our homes. This course deals with analysis techniques that can be applied to all such circuits. We will first discuss electrical quantities-voltage and current-relevant to such circuits and learn about basic elements(R, L, C, controlled sources) and their properties. We will then move on to general analysis techniques that can be applied to arbitrary circuits. These will be first carried out for resistive circuits which obey algebraic equations and then extended to circuits with energy storage elements(C, L) which obey differential equations. Along the way, we will also discuss the rudiments of negative feedback circuit using the opamp. After taking this course, one should be able to analyze any linear circuit.

ABOUT INSTRUCTOR :

Prof. Nagendra Krishnapura is a professor in the Integrated Circuits and Systems group of the department of Electrical Engineering of the Indian Institute of Technology, Madras. He works in the area of analog and mixed-signal integrated circuits and signal processing. He graduated with a Ph.D. from Columbia University, New York in Oct. 2000. Between 2000 and 2005, I worked as a senior design engineer at Celight, Inc. and Multilink(later Vitesse Semiconductor) where I designed integrated circuits for high speed communications. From 2003 to 2005, I was an Adjunct Assistant Professor and taught courses on Analog Circuit Design at Columbia University.

COURSE PLAN :

Week 1: Preliminaries; Current and voltage; Electrical elements and circuits; Kirchhoffs laws, Basic elements: Voltage and current sources, R, L, C, M; Linearity of elements

Week 2: Elements in series and parallel, Controlled sources

Week 3: Power and energy in electrical elements, Circuit Analysis Methods

Week 4: Nodal analysis, Extending nodal analysis with different sources

Week 5: Mesh analysis, Circuit theorems

Week 6: More circuit theorems, Two port parameters

Week 7: Two port parameters continued, Reciprocity in resistive networks

Week 8: Opamp and negative feedback, Opamps contd: Example circuits and additional topics

Week 9: First Order Circuits contd

Week 10: First order circuits with time-varying inputs, Sinusoidal steady state response and total response

Week 11: Second order system-Natural response (continued)

Week 12: Direct calculation of steady state response from equivalent components, Magnitude and Phase plots; Maximum power transfer theorem