ECE113: Network Analysis and Synthesis

Programme: B.Tech. Year: First Semester: II
Course: Program Core Credits: 3 Hours: 40

Course Context and Overview (100 words):

This course introduces the electrical network theory, basically learning network analysis and synthesis. Network analysis is concerned with determining the response, given the excitation and the network. The problem is to design the network given the excitation and the desired response is the part of network synthesis. This course will help in solving and designing complex problems of electrical network.

Prerequisite Courses: All basic course work related to ECE.

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1: develop an understanding of the fundamental principles & theorems of electrical networks
CO2: analyze different electrical networks & determine various parameters using different techniques
CO3: learn the method of synthesizing an electrical network from the given impedance/ admittance function
CO4: verify the concepts of network analysis & synthesis practically
CO5: relate various type of two-ports parameters and transform them and designing of active filters

Course Topics:

Topics	**Lecture Hours**	
UNIT-I: INTRODUCTION	**8**	
• **Signals and Systems:** signal analysis, complex frequency, network analysis and synthesis.	2	
• **Signals and Waveforms:** general characteristics and descriptions of signals, step function and associated waveforms, unit impulse.	2	
• **Fundamentals of Network Analysis:** Introduction, network elements, initial and final conditions, step and impulse response, solution of network equations, analysis of transformers.	4	
UNIT-II: TRANSFORM METHODS	**8**	

• **The Laplace Transform:** the philosophy of transform methods, Laplace transform, property of Laplace transform, use of Laplace transform, partial-fraction expansions, poles and zeros, evaluation of residuals, initial and final value theorems.	4	
• **Transform Methods in Network Analysis:** transformed circuit, Thevenin's and Norton's theorem, system function, step and impulse responses, convolution integral,	4	
UNIT-III: NETWORK ANALYSIS	**8**	
• **Amplitude Phase and Delay:** amplitude and phase response, Bode plot, single and double tuned circuits, on poles and zeros and time delay.	4	
• **Network Analysis:** network function, relationship between two port parameter, transfer function using two-port parameters, interconnection of two-ports, incidental dissipation, analysis of ladder network.	4	
UNIT-IV: NETWORK SYNTHESIS	**8**	
• **Elements of Reliability Theory:** causality and stability, Hurwitz polynomials, positive real functions, elementary synthesis procedures.	4	
• **Synthesis of One-port Networks:** property of LC immittance functions, synthesis of LC driving point immittances, property of RC driving point impedances, synthesis of RC impedances or RL admittances, property of RL impedances and RC admittances, synthesis of central RLC functions.	4	
UNIT-V: SYSNTHESIS OF TRANSFER FUNCTIONS	**8**	
• **Elements of Transfer Function in Synthesis:** property of transfer function, zeros of transmission, synthesis of reverse admittance and immittance with a 1-ohm termination, synthesis of constant resistance networks**.**	3	
• **Active Filter Design:** filter design problem, approximation problem in network theory, maximally flat Low Pass Filter (LPF) approximation, other LPF approximation, transient response of LPFs, method to reduce overshoot in filters, maximally flat delay and controllable magnitude approximation, synthesis of LPFs, magnitude and frequency normalization, frequency transformation.	5	

Textbook references (IEEE format):

Text Book:

[1] Franklin F. Kuo, *Network Analysis and Synthesis*, John Wiley & Sons.

Reference books:

[1] M.E. Van Valkenburg*, Network Analysis,* Pentice Hall.
[2] Sukhija & Nagsarkar, *Circuits and Networks*, Oxford University Press.
[3] S.P. Ghosh & A.K. Chakraborty, *Network Analysis and Synthesis*, (Dhanpat Rai & Co. Pvt. Ltd).

Additional Resources (Web resources etc.): http://learning.lnmiit.ac.in/moodle

Evaluation Methods:

Item	% Weightage
Quiz (best 3 out of 4)	5+5+5
Attendance*	10
Midterm	25
Final Examination	50

* 75% attendance is required to get these marks. Zero marks for attendance below 75% and proportional marks otherwise, such as 90% attendance equal to 9 marks out of 10 marks of the attendance.

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