

Lecture 1 - Introduction

Lecture 2 - First Order systems

Lecture 3 - Classification of Equilibrium points

Lecture 4 - Lipschitz Functions

Lecture 5 - Existence/uniqueness theorems

Lecture 6 - Existence/uniqueness of solutions to differential equations

Lecture 7 - Lyapunov theorem on stability

Lecture 8 - Extension of Lyapunov's Theorem in different contexts

Lecture 9 - LaSalle's Invariance principle, Barbashin and Krasovski theorems, periodic orbits

Lecture 10 - Bendixson criterion and Poincare-Bendixson criterion. Example: Lotka Volterra predator prey model

Lecture 11 - Bendixson and Poincare-Bendixson criteria van-der-Pol Oscillator

Lecture 12 - Scilab simulation of Lotka Volterra predator prey model, van-der-Pol Oscillator Review of linearization, operating point/operating trajectory

Lecture 13 - Signals, operators

Lecture 14 - Norms of signals, systems (operators), Finite gain L2 stable

Lecture 15 - Nyquist plots and Nyquist criterion for stability

Lecture 16 - Interconnection between linear system & non-linearity, passive filters

Lecture 17 - Passive filters, Dissipation equality, positive real lemma

Lecture 18 - Positive real lemma proof

Lecture 19 - Definition for positive realness and Kalman Yakubovich-Popov Theorem

Lecture 20 - Kalman-Yakubovich-Popov Lemma/theorem and memoryless nonlinearities

Lecture 21 - Loop transformations and circle criterion

Lecture 22 - Nonlinearities based on circle criterion

Lecture 23 - Limit cycles

Lecture 24 - Popov criterion continuous, frequency-domain theorem

Lecture 25 - Popov criterion continuous, frequency-domain theorem

Lecture 26 - Describing function method

Lecture 27 - Describing Function : 2

Lecture 28 - Describing : optimal gain

Lecture 29 - Describing : optimal gain

Lecture 30 - Describing functions : Jump Hysteresis

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

[Lecture 31 - Describing functions : sufficient conditions for existence of periodic orbits non existence of periodic orbits](#)

[Lecture 32 - Describing functions for nonlinearities](#)

[Lecture 33 - Ideal relay with Hysteresis and dead zone](#)

[Lecture 34 - Dynamical systems on manifolds-1](#)

[Lecture 35 - Dynamical systems on manifolds-2](#)

Lecture 1 - Introduction

Lecture 2 - Introduction

Lecture 3 - Analysis of Dynamical Systems

Lecture 4 - Analysis of Dynamical Systems (Continued.)

Lecture 5 - Analysis of LINEAR Time Invariant Dynamical Systems

Lecture 6 - Analysis of LINEAR Time Invariant Dynamical Systems (Continued.)

Lecture 7 - Stiff Systems, Multi Time Scale Modeling

Lecture 8 - Numerical Integration

Lecture 9 - Numerical Integration (Continued.)

Lecture 10 - Numerical Integration (Continued.)

Lecture 11 - Modeling of Synchronous Machines

Lecture 12 - Modeling of Synchronous Machines (Continued.)

Lecture 13 - Modeling of Synchronous Machines (Continued.)

Lecture 14 - Modeling of Synchronous Machines. dq0 transformation (Continued.)

Lecture 15 - Modeling of Synchronous Machines. Standard Parameters

Lecture 16 - Modeling of Synchronous Machines. Standard Parameters

Lecture 17 - Synchronous Generator Models using Standard Parameters

Lecture 18 - Synchronous Generator Models using Standard Parameters. PER UNIT REPRESENTATION

Lecture 19 - Open Circuit Response of a Synchronous Generator

Lecture 20 - Synchronous Machine Modeling. Short Circuit Analysis (Continued.)

Lecture 21 - Synchronous Machine Modeling. Short Circuit Analysis (Continued.) Synchronization of a Synchronous Machine

Lecture 22 - Synchronization of a Synchronous Machine (Continued.)

Lecture 23 - Simplified Synchronous Machine Models

Lecture 24 - Excitation Systems

Lecture 25 - Excitation System Modeling

Lecture 26 - Excitation System Modeling. Automatic Voltage Regulator

Lecture 27 - Excitation System Modeling. Automatic Voltage Regulator (Continued.)

Lecture 28 - Excitation System Modeling. Automatic Voltage Regulator (Simulation)

Lecture 29 - Excitation System Modeling. Automatic Voltage Regulator (Simulation) â€œ (Continued.)

Lecture 30 - Excitation System Modeling. Automatic Voltage Regulator. Linearized Analysis

Lecture 31 - Load Modeling

[Lecture 32 - Induction Machines, Transmission Lines](#)

[Lecture 33 - Transmission Lines. Prime Mover Systems](#)

[Lecture 34 - Transmission Lines \(Continued.\) Prime Mover Systems](#)

[Lecture 35 - Prime Mover Systems. Stability in Integrated Power System](#)

[Lecture 36 - Stability in Integrated Power System: Two Machine Example](#)

[Lecture 37 - Two Machine System \(Continued.\)](#)

[Lecture 38 - Stability in Integrated Power System: Large Systems](#)

[Lecture 39 - Frequency/Angular Stability Programs. Stability Phenomena: Voltage Stability Example](#)

[Lecture 40 - Voltage Stability Example \(Continued.\). Fast Transients: Tools and Phenomena](#)

[Lecture 41 - Torsional Transients: Phenomena of Sub-Synchronous Resonance](#)

[Lecture 42 - Sub-Synchronous Resonance. Stability Improvement](#)

[Lecture 43 - Stability Improvement](#)

[Lecture 44 - Stability Improvement. Power System Stabilizers](#)

[Lecture 45 - Stability Improvement \(Large Disturbance Stability\)](#)

Lecture 1 - The Control Problem

Lecture 2 - Some More Examples

Lecture 3 - Different Kinds of Control Systems

Lecture 4 - History of Feedback

Lecture 5 - Modern Control Problems

Lecture 6 - DC Motor Speed Control

Lecture 7 - System Modelling, Analogy

Lecture 8 - Causes of System Error

Lecture 9 - Calculation of Error

Lecture 10 - Control System Sensitivity

Lecture 11 - Automatic Control of DC Motor

Lecture 12 - Proportional Control

Lecture 13 - Non-Unity Feedback

Lecture 14 - Signal-Flow Graph

Lecture 15 - Mason's Gain Formula

Lecture 16 - Signal-Flow Graph for DC Motor Control

Lecture 17 - Steady-State Calculations

Lecture 18 - Differential Equation Model and Laplace Transformation Model

Lecture 19 - D-Operator Method

Lecture 20 - Second-Order System Response

Lecture 21 - Frequency Response

Lecture 22 - Laplace Transformation Theorems

Lecture 23 - Final Value Theorem

Lecture 24 - Transfer Function and Pole-Zero Diagram

Lecture 25 - 'Good' Poles and 'Bad' Poles

Lecture 26 - Signal Flow Graph with Transfer Functions

Lecture 27 - s-Domain and t-Domain

Lecture 28 - Second-Order System Response in s-Domain

Lecture 29 - Integral Feedback

Lecture 30 - Root-Locus Method

Lecture 31 - Root-Locus Rules

[Lecture 32 - Asymptotes of Root Locus](#)

[Lecture 33 - Routh Array](#)

[Lecture 34 - Singular Cases](#)

[Lecture 35 - Closed Loop Poles](#)

[Lecture 36 - Controller in the Forwarded Path](#)

[Lecture 37 - Mapping of Control in the Complex-Plane](#)

[Lecture 38 - Encirclement by a Curve](#)

[Lecture 39 - Nyquist Criterion](#)

[Lecture 40 - Application of the Nyquist Criterion](#)

[Lecture 41 - Polar Plot and Bode Plots](#)

[Lecture 42 - Logarithmic Scale for Frequency](#)

[Lecture 43 - 'Asymptotic' DB Gain](#)

[Lecture 44 - Compensating Network](#)

[Lecture 45 - Nichols' Chart](#)

[Lecture 46 - Time Domain Methods of Analysis and Design](#)

[Lecture 47 - State-Variable Equations](#)

NPTEL : Power Electronics (Electrical Engineering)

Co-ordinators : Prof. Kishore Chatterjee, Prof. B.G. Fernandes

[Lecture 1 - Power Electronics](#)

[Lecture 2 - Power Electronics](#)

[Lecture 3 - Power Electronics](#)

[Lecture 4 - Power Electronics](#)

[Lecture 5 - Power Electronics](#)

[Lecture 6 - Power Electronics](#)

[Lecture 7 - Power Electronics](#)

[Lecture 8 - Power Electronics](#)

[Lecture 9 - Power Electronics](#)

[Lecture 10 - Power Electronics](#)

[Lecture 11 - Power Electronics](#)

[Lecture 12 - Power Electronics](#)

[Lecture 13 - Power Electronics](#)

[Lecture 14 - Power Electronics](#)

[Lecture 15 - Power Electronics](#)

[Lecture 16 - Power Electronics](#)

[Lecture 17 - Power Electronics](#)

[Lecture 18 - Power Electronics](#)

[Lecture 19 - Power Electronics](#)

[Lecture 20 - Power Electronics](#)

[Lecture 21 - Power Electronics](#)

[Lecture 22 - Power Electronics](#)

[Lecture 23 - Power Electronics](#)

[Lecture 24 - Power Electronics](#)

[Lecture 25 - Power Electronics](#)

[Lecture 26 - Power Electronics](#)

[Lecture 27 - Power Electronics](#)

[Lecture 28 - Power Electronics](#)

[Lecture 29 - Power Electronics](#)

[Lecture 30 - Power Electronics](#)

[Lecture 31 - Power Electronics](#)

[Lecture 32 - Power Electronics](#)

[Lecture 33 - Power Electronics](#)

[Lecture 34 - Power Electronics](#)

[Lecture 35 - Power Electronics](#)

[Lecture 36 - Power Electronics](#)

[Lecture 37 - Power Electronics](#)

[Lecture 38 - Power Electronics](#)

[Lecture 39 - Power Electronics](#)

[Lecture 40 - Power Electronics](#)

[Lecture 41 - Power Electronics](#)

[Lecture 42 - Power Electronics](#)

[Lecture 43 - Power Electronics](#)

Lecture 1 - Introduction Micro to Nano A Journey into Intergrated Circuit Technology

Lecture 2 - Introduction Micro to Nano A Journey into Intergrated Circuit Technology

Lecture 3 - Crystal Properties and Silico Growth

Lecture 4 - Crystal Properties and Silico Growth (Continued...)

Lecture 5 - IC Fab Labs and Fabrication of IC

Lecture 6 - Diffusion

Lecture 7 - Diffusion (Continued...)

Lecture 8 - Solid State Diffusion

Lecture 9 - Solid State Diffusion (Continued...)

Lecture 10 - Solid State Diffusion (Continued...)

Lecture 11 - Thermal Oxidation of Silicons

Lecture 12 - Thermal Oxidation of Silicons

Lecture 13 - Thermal Oxidation of Silicons

Lecture 14 - Thermal Oxidation of Silicons (Continued...)

Lecture 15 - Thermal Oxidation of Silicons (Continued...)

Lecture 16 - Lithography

Lecture 17 - Lithography

Lecture 18 - Lithography

Lecture 19 - ION Implantation

Lecture 20 - ION Implantation

Lecture 21 - ION Implantation and Silicon IC Processing Flow for CMOS Technology

Lecture 22 - ION Implantation and Silicon IC Processing Flow for CMOS Technology

Lecture 23 - Silicon IC Processing Flow for CMOS Technology

Lecture 24 - Thin Film Deposition

Lecture 25 - Thin Film Deposition

Lecture 26 - Thin Film Deposition

Lecture 27 - Thin Film Deposition and Etching in VLSI Processing

Lecture 28 - Etching in VLSI Processing and Back -End Technology

[Lecture 1 - Lecture 1](#)

[Lecture 2 - Lecture 2](#)

[Lecture 3 - Lecture 3](#)

[Lecture 4 - Exercise 1](#)

[Lecture 5 - Exercise 2](#)

[Lecture 6 - Exercise 3](#)

[Lecture 7 - Lab Tour 1](#)

[Lecture 8 - Summary week 1](#)

[Lecture 9 - Lecture 4](#)

[Lecture 10 - Lecture 5](#)

[Lecture 11 - Exercise 4](#)

[Lecture 12 - Exercise 5](#)

[Lecture 13 - Exercise 6](#)

[Lecture 14 - Summary Week 2](#)

[Lecture 15 - Lecture 6](#)

[Lecture 16 - Lecture 7](#)

[Lecture 17 - Lecture 8](#)

[Lecture 18 - Exercise 7](#)

[Lecture 19 - Exercise 8](#)

[Lecture 20 - Summary Week 3](#)

[Lecture 21 - Lecture 9](#)

[Lecture 22 - Lecture 10](#)

[Lecture 23 - Lecture 11](#)

[Lecture 24 - Lecture 12](#)

[Lecture 25 - Lecture 13](#)

[Lecture 26 - Lecture 14](#)

[Lecture 27 - Exercise 9](#)

[Lecture 28 - Lab Tour - 2](#)

[Lecture 29 - Summary Week 4](#)

[Lecture 30 - Lecture 15](#)

[Lecture 31 - Lecture 16](#)

[Lecture 32 - Lecture 17](#)

[Lecture 33 - Lecture 18](#)

[Lecture 34 - Exercise 10](#)

[Lecture 35 - Summary week 5](#)

[Lecture 36 - Lecture 19](#)

[Lecture 37 - Lecture 20](#)

[Lecture 38 - Lecture 21](#)

[Lecture 39 - Lecture 22](#)

[Lecture 40 - Exercise 11](#)

[Lecture 41 - Summary week 6](#)

[Lecture 42 - Exercise 12](#)

[Lecture 43 - Exercise 13](#)

[Lecture 44 - Exercise 14](#)

[Lecture 45 - Exercise 15](#)

[Lecture 46 - Exercise 16](#)

[Lecture 47 - Exercise 17](#)

[Lecture 48 - Summary week 7](#)

[Lecture 49 - Lecture 23](#)

[Lecture 50 - Lecture 24](#)

[Lecture 51 - Lecture 25](#)

[Lecture 52 - Exercise 18](#)

[Lecture 53 - Exercise 19](#)

[Lecture 54 - Lab tour 3](#)

[Lecture 55 - Summary week 8](#)

[Lecture 56 - Lecture 26](#)

[Lecture 57 - Lecture 27](#)

[Lecture 58 - Lecture 28](#)

[Lecture 59 - Lecture 29](#)

[Lecture 60 - Lecture 30](#)

[Lecture 61 - Lecture 31](#)

[Lecture 62 - Lab tour 4](#)

[Lecture 63 - Summary week 9](#)

[Lecture 64 - Lecture 32](#)

[Lecture 65 - Lecture 33](#)

[Lecture 66 - Lecture 34](#)

[Lecture 67 - Lecture 35](#)

[Lecture 68 - Exercise 20](#)

[Lecture 69 - Lab tour 5](#)

[Lecture 70 - Summary week 10](#)

[Lecture 71 - Lecture 36](#)

[Lecture 72 - Lecture 37](#)

[Lecture 73 - Lecture 38](#)

[Lecture 74 - Lecture 39](#)

[Lecture 75 - Lecture 40](#)

[Lecture 76 - Summary week 11](#)

[Lecture 77 - Lecture 41](#)

[Lecture 78 - Lecture 42](#)

[Lecture 79 - Lecture 43](#)

[Lecture 80 - Lecture 44](#)

[Lecture 81 - Exercise 21](#)

[Lecture 82 - Exercise 22](#)

[Lecture 83 - Summary week 12](#)

Lecture 1 - A brief history of electronics

Lecture 2 - Superposition

Lecture 3 - Useful circuit techniques - 1

Lecture 4 - Useful circuit techniques - 2

Lecture 5 - Phasors - 1

Lecture 6 - Phasors - 2

Lecture 7 - RC/RL circuits in time domain - 1

Lecture 8 - RC/RL circuits in time domain - 2

Lecture 9 - RC/RL circuits in time domain - 3

Lecture 10 - RC/RL circuits in time domain - 4

Lecture 11 - RC/RL circuits in time domain - 5

Lecture 12 - Simulation of RC circuit

Lecture 13 - Diode circuits - 1

Lecture 14 - Diode circuits - 2

Lecture 15 - Diode circuits - 3

Lecture 16 - Diode circuits - 4

Lecture 17 - Diode circuits - 5

Lecture 18 - Diode circuits - 6

Lecture 19 - Diode rectifiers - 1

Lecture 20 - Diode rectifiers - 2

Lecture 21 - Diode rectifiers - 3

Lecture 22 - Bipolar Junction Transistor - 1

Lecture 23 - Bipolar Junction Transistor - 2

Lecture 24 - Bipolar Junction Transistor - 3

Lecture 25 - BJT amplifier - 1

Lecture 26 - BJT amplifier - 2

Lecture 27 - BJT amplifier - 3

Lecture 28 - BJT amplifier - 4

Lecture 29 - BJT amplifier - 5

Lecture 30 - BJT amplifier - 6

Lecture 31 - BJT amplifier - 7

Lecture 32 - Introduction to op-amps

Lecture 33 - Op-amp circuits - 1

Lecture 34 - Op-amp circuits - 2

Lecture 35 - Op-amp circuits - 3

Lecture 36 - Difference amplifier

Lecture 37 - Instrumentation amplifier - 1

Lecture 38 - Instrumentation amplifier - 2

Lecture 39 - Op-amp nonidealities - 1

Lecture 40 - Op-amp nonidealities - 2

Lecture 41 - Bode plots - 1

Lecture 42 - Bode plots - 2

Lecture 43 - Bode plots - 3

Lecture 44 - Op-amp filters

Lecture 45 - Simulation of op-amp filter

Lecture 46 - Precision rectifiers - 1

Lecture 47 - Precision rectifiers - 2

Lecture 48 - Precision rectifiers - 3

Lecture 49 - Simulation of triangle-to-sine converter

Lecture 50 - Schmitt triggers - 1

Lecture 51 - Schmitt triggers - 2

Lecture 52 - Schmitt triggers - 3

Lecture 53 - Sinusoidal oscillators - 1

Lecture 54 - Sinusoidal oscillators - 2

Lecture 55 - Introduction to digital circuits

Lecture 56 - Boolean algebra

Lecture 57 - Karnaugh maps

Lecture 58 - Combinatorial circuits - 1

Lecture 59 - Combinatorial circuits - 2

Lecture 60 - Combinatorial circuits - 3

Lecture 61 - Introduction to sequential circuits

Lecture 62 - Latch and flip-flop

Lecture 63 - JK flip-flop

Lecture 64 - D flip-flop

[Lecture 65 - Shift registers](#)

[Lecture 66 - Counters - 1](#)

[Lecture 67 - Counters - 2](#)

[Lecture 68 - Simulation of a synchronous counter](#)

[Lecture 69 - 555 timer](#)

[Lecture 70 - Digital-to-analog conversion - 1](#)

[Lecture 71 - Digital-to-analog conversion - 2](#)

[Lecture 72 - Analog-to-digital conversion](#)

- Lecture 1 - Antenna Introduction - I
- Lecture 2 - Antenna Introduction - II
- Lecture 3 - Antenna Introduction - III
- Lecture 4 - Antenna Fundamentals - I
- Lecture 5 - Antenna Fundamentals - II
- Lecture 6 - Antenna Radiation Hazards - I
- Lecture 7 - Antenna Radiation Hazards - II
- Lecture 8 - Dipole Antennas - I
- Lecture 9 - Dipole Antennas - II
- Lecture 10 - Dipole Antennas - III
- Lecture 11 - Monopole Antennas - I
- Lecture 12 - Monopole Antennas - II
- Lecture 13 - Loop Antennas
- Lecture 14 - Slot Antennas
- Lecture 15 - Linear Arrays - I
- Lecture 16 - Linear Arrays - II
- Lecture 17 - Linear Arrays - III
- Lecture 18 - Planar Arrays
- Lecture 19 - Microstrip Antennas (MSA)
- Lecture 20 - Rectangular MSA
- Lecture 21 - MSA Parametric Analysis - I
- Lecture 22 - MSA Parametric Analysis - II
- Lecture 23 - Circular MSA
- Lecture 24 - Broadband MSA - I
- Lecture 25 - Broadband MSA - II
- Lecture 26 - Broadband MSA - III
- Lecture 27 - Broadband MSA - IV
- Lecture 28 - Broadband MSA - V
- Lecture 29 - Compact MSA - I
- Lecture 30 - Compact MSA - II
- Lecture 31 - Compact MSA - III

- Lecture 32 - Tunable MSA - I
- Lecture 33 - Tunable MSA - II
- Lecture 34 - Circularly Polarized MSA - I
- Lecture 35 - Circularly Polarized MSA - II
- Lecture 36 - Circularly Polarized MSA - III
- Lecture 37 - MSA Arrays - I
- Lecture 38 - MSA Arrays - II
- Lecture 39 - MSA Arrays - III
- Lecture 40 - Helical Antennas - I
- Lecture 41 - Helical Antennas - II
- Lecture 42 - Helical Antennas - III
- Lecture 43 - Helical Antennas - IV
- Lecture 44 - Helical Antennas - V
- Lecture 45 - Horn Antennas - I
- Lecture 46 - Horn Antennas - II
- Lecture 47 - Horn Antennas - III
- Lecture 48 - Horn Antennas - IV
- Lecture 49 - Horn Antennas - V
- Lecture 50 - Yagi-Uda and Log-Periodic Antennas - I
- Lecture 51 - Yagi-Uda and Log-Periodic Antennas - II
- Lecture 52 - Yagi-Uda and Log-Periodic Antennas - III
- Lecture 53 - IE3D Session TA - I
- Lecture 54 - IE3D Session TA - II
- Lecture 55 - IE3D Session TA - III
- Lecture 56 - Reflector Antennas - I
- Lecture 57 - Reflector Antennas - II
- Lecture 58 - Reflector Antennas - III
- Lecture 59 - Reflector Antennas - IV
- Lecture 60 - Lab Session

Lecture 1 - Module 1 - Lecture 1 - Introduction

Lecture 2 - Module 1 - Lecture 2 - Origin of Wavelets

Lecture 3 - Module 1 - Lecture 3 - Haar Wavelet

Lecture 4 - Module 2 - Lecture 1 - Dyadic Wavelet

Lecture 5 - Module 2 - Lecture 2 - Dilates and Translates of Haar Wavelets

Lecture 6 - Module 2 - Lecture 3 - L2 Norm of a Function

Lecture 7 - Module 3 - Lecture 1 - Piecewise Constant Representation of a Function

Lecture 8 - Module 3 - Lecture 2 - Ladder of Subspaces

Lecture 9 - Module 3 - Lecture 3 - Scaling Function for Haar Wavelet Demo

Lecture 10 - Demonstration 1: Piecewise constant approximation of functions

Lecture 11 - Module 4 - Lecture 1 - Vector Representation of Sequences

Lecture 12 - Module 4 - Lecture 2 - Properties of Norm

Lecture 13 - Module 4 - Lecture 3 - Parseval's Theorem

Lecture 14 - Module 5 - Lecture 1 - Equivalence of sequences and functions

Lecture 15 - Module 5 - Lecture 2 - Angle between Functions and their Decomposition

Lecture 16 - Demonstration 2: Additional Information on Direct-Sum

Lecture 17 - Module 6 - Lecture 1 - Introduction to filter banks

Lecture 18 - Module 6 - Lecture 2 - Haar Analysis Filter Bank in Z-domain

Lecture 19 - Module 6 - Lecture 3 - Haar Synthesis Filter Bank in Z-domain

Lecture 20 - Module 7 - Lecture 1 - Moving from Z-domain to frequency domain

Lecture 21 - Module 7 - Lecture 2 - Frequency Response of Haar Analysis Low pass Filter bank

Lecture 22 - Module 7 - Lecture 3 - Frequency Response of Haar Analysis High pass Filter bank

Lecture 23 - Module 8 - Lecture 1 - Ideal two-band filter bank

Lecture 24 - Module 8 - Lecture 2 - Disqualification of Ideal filter bank

Lecture 25 - Module 8 - Lecture 3 - Realizable two-band filter bank

Lecture 26 - Demonstration 3: Demonstration: DWT of images

Lecture 27 - Module 9 - Lecture 1 - Relating Fourier transform of scaling function to filter bank

Lecture 28 - Module 9 - Lecture 2 - Fourier transform of scaling function

Lecture 29 - Module 9 - Lecture 3 - Construction of scaling and wavelet functions from filter bank

Lecture 30 - Demonstration 4: Demonstration: Constructing scaling and wavelet functions

Lecture 31 - Module 10 - Lecture 1 - Introduction to upsampling and down sampling as Multirate operations

- Lecture 32 - Module 10 - Lecture 2 - Up sampling by a general factor M- a Z-domain analysis.
- Lecture 33 - Module 10 - Lecture 3 - Down sampling by a general factor M- a Z-domain analysis
- Lecture 34 - Module 11 - Lecture 1 - Z domain analysis of 2 channel filter bank.
- Lecture 35 - Module 11 - Lecture 2 - Effect of X (-Z) in time domain and aliasing
- Lecture 36 - Module 11 - Lecture 3 - Consequences of aliasing and simple approach to avoid it
- Lecture 37 - Module 12 - Lecture 1 - Revisiting aliasing and the Idea of perfect reconstruction
- Lecture 38 - Module 12 - Lecture 2 - Applying perfect reconstruction and alias cancellation on Haar MRA
- Lecture 39 - Module 12 - Lecture 3 - Introduction to Daubechies family of MRA
- Lecture 40 - Module 13 - Lecture 1 - Power Complementarity of low pass filter
- Lecture 41 - Module 13 - Lecture 2 - Applying perfect reconstruction condition to obtain filter coefficient
- Lecture 42 - Module 14 - Lecture 1 - Effect of minimum phase requirement on filter coefficients
- Lecture 43 - Module 14 - Lecture 2 - Building compactly supported scaling functions
- Lecture 44 - Module 14 - Lecture 3 - Second member of Daubechies family
- Lecture 45 - Module 15 - Lecture 1 - Fourier transform analysis of Haar scaling and Wavelet functions
- Lecture 46 - Module 15 - Lecture 2 - Revisiting Fourier Transform and Parseval's theorem
- Lecture 47 - Module 15 - Lecture 3 - Transform Analysis of Haar Wavelet function
- Lecture 48 - Module 16 - Lecture 1 - Nature of Haar scaling and Wavelet functions in frequency domain
- Lecture 49 - Module 16 - Lecture 2 - The Idea of Time-Frequency Resolution
- Lecture 50 - Module 16 - Lecture 3 - Some thoughts on Ideal time- frequency domain behavior
- Lecture 51 - Module 17 - Lecture 1 - Defining Probability Density function
- Lecture 52 - Module 17 - Lecture 2 - Defining Mean, Variance and \hat{A} “containment in a given domain \hat{A} ”
- Lecture 53 - Module 17 - Lecture 3 - Example: Haar Scaling function
- Lecture 54 - Module 17 - Lecture 4 - Variance from a slightly different perspective
- Lecture 55 - Module 18 - Lecture 1 - Signal transformations: effect on mean and variance
- Lecture 56 - Module 18 - Lecture 2 - Time-Bandwidth product and its properties
- Lecture 57 - Module 18 - Lecture 3 - Simplification of Time-Bandwidth formulae
- Lecture 58 - Module 19 - Lecture 1 - Introduction
- Lecture 59 - Module 19 - Lecture 2 - Evaluation of Time-Bandwidth product
- Lecture 60 - Module 19 - Lecture 3 - Optimal function in the sense of Time-Bandwidth product
- Lecture 61 - Module 20 - Lecture 1 - Discontent with the \hat{A} “Optimal function \hat{A} ”.
- Lecture 62 - Module 20 - Lecture 2 - Journey from infinite to finite Time-Bandwidth product of Haar scaling function
- Lecture 63 - Module 20 - Lecture 3 - More insights about Time-Bandwidth product
- Lecture 64 - Module 20 - Lecture 4 - Time-frequency plane

[Lecture 65 - Module 20 - Lecture 5 - Tiling the Time-frequency plane](#)

[Lecture 66 - Module 21 - Lecture 1 - STFT: Conditions for valid windows](#)

[Lecture 67 - Module 21 - Lecture 2 - STFT: Time domain and frequency domain formulations](#)

[Lecture 68 - Module 21 - Lecture 3 - STFT: Duality in the interpretations](#)

[Lecture 69 - Module 21 - Lecture 4 - Continuous Wavelet Transform \(CWT\)](#)

[Lecture 70 - Demonstration 5](#)

[Lecture 71 - Student's Presentation](#)

Lecture 1 - Module 1 - Introduction

Lecture 2 - Module 2 - Poles and zeros

Lecture 3 - Module 3 - OP-AMPS

Lecture 4 - Module 4 - Application of Op-Amps

Lecture 5 - Module 5 - Inverting amplifier and Non Inverting amplifier

Lecture 6 - Module 1 - Non Idealities in Op-AMP (Finite Gain, Finite Bandwidth and Slew Rate)

Lecture 7 - Module 2 - Non Idealities in Op-AMP (Offset Voltage and Bias Current)

Lecture 8 - Module 3 - Bode Plot

Lecture 9 - Module 4 - Frequency Response

Lecture 10 - Module 1 - Frequency Response (High Frequency Response)

Lecture 11 - Module 2 - Frequency Response example

Lecture 12 - Module 3 - Feedback

Lecture 13 - Module 4 - Effects of Feedback

Lecture 14 - Tutorial 1 and 2

Lecture 15 - Module 1 - Effect of feedback and stability

Lecture 16 - Module 2 - Stability

Lecture 17 - Module 3 - Stability and pole location

Lecture 18 - Module 4 - Stability and Pole location continuation

Lecture 19 - Tutorial 3

Lecture 20 - Module 1 - Gain Margin \hat{A} – An example

Lecture 21 - Module 2 - Frequency Compensation

Lecture 22 - Module 3 - Filters

Lecture 23 - Module 4 - Filter prototypes

Lecture 24 - Tutorial 4

Lecture 25 - Tutorial 5

Lecture 26 - Tutorial 6

Lecture 27 - Module 1 - Chebyshev Prototype, Filter transformation

Lecture 28 - Module 2 - Filter Transformations (Continued....)

Lecture 29 - Module 3 - Active Filters

Lecture 30 - Module 4 - Non Linear Applications of OPAMPS

Lecture 31 - Module 5 - Limiter, Diodes

[Lecture 32 - Module 1 - Oscillators](#)

[Lecture 33 - Module 2 - Oscillator Amplitude Control , Quadrature Oscillator](#)

[Lecture 34 - Module 3 - Multivibators](#)

[Lecture 35 - Module 4 - Multivibrators \(Continued...\)](#)

[Lecture 36 - Module 5 - Monostable Multivibrator](#)

[Lecture 37 - Module 1 - Zener Effect, Rectifiers](#)

[Lecture 38 - Module 2 - Rectifiers](#)

[Lecture 39 - Module 3 - Clamper, Peak Rectifier, Super diodes](#)

[Lecture 40 - Module 4 - BJT DC Circuits](#)

[Lecture 41 - Module 5 - Current Mirror](#)

Lecture 1 - Microwave Theory and Techniques Introduction - I

Lecture 2 - Microwave Theory and Techniques Introduction - II

Lecture 3 - Microwave Theory and Techniques Introduction - III

Lecture 4 - Effects of Microwaves on Human Body - I

Lecture 5 - Effects of Microwaves on Human Body - II

Lecture 6 - Waveguides - I: Parallel Plane Waveguides

Lecture 7 - Waveguides - II: Parallel Plane Waveguides

Lecture 8 - Waveguides - III: Rectangular Waveguides

Lecture 9 - Transmission Lines - I: Coaxial Cables, Strip Lines and Microstrip Lines

Lecture 10 - Transmission Lines - II: Transmission Line Model, Open and Short Circuited Lossless Transmission Lines

Lecture 11 - Smith Chart and Impedance Matching - I: using Quarter Wave Transformer

Lecture 12 - Smith Chart and Impedance Matching - II: using Lumped Components

Lecture 13 - Smith Chart and Impedance Matching - III: using Short and Open Circuited Stubs

Lecture 14 - ABCD - Parameters

Lecture 15 - S - Parameters

Lecture 16 - Power Dividers - I: Two-way, Three-way and Four-way Equal Power Dividers

Lecture 17 - Power Dividers - II: Unequal, Broadband and Compact Power Dividers

Lecture 18 - Microwave Couplers - I: Coupled Line Directional Couplers

Lecture 19 - Microwave Couplers - II: Branch Line Couplers

Lecture 20 - Microwave Couplers - III: Rat race Coupler and Applications

Lecture 21 - Microwave Filters - I: Filters and Low Pass Butterworth Filter

Lecture 22 - Microwave Filters - II: Low Pass Chebyshev Filters

Lecture 23 - Microwave Filters - III: Microstrip Realization, Transformation from LPF to other Filters

Lecture 24 - Microwave Filters - IV: Band Pass Filters

Lecture 25 - Microwave Filters - V: Coupled Line and Tunable Band Pass Filters

Lecture 26 - Microwave Diodes: PN Junction , Varactor, Schottky, PIN, Tunnel, and GUNN Diodes

Lecture 27 - Microwave Attenuators: Fixed and Variable Attenuators

Lecture 28 - Microwave RF Switches: Series and Shunt SPST

Lecture 29 - Series and Shunt SPDT Switches and Introduction to Phase Shifters

Lecture 30 - Microwave Phase Shifters: Switched and Loaded Line

Lecture 31 - Microwave Transistors: BJT, HBT, JFET, MOSFET, MESFET and HEMT

[Lecture 32 - Microwave Amplifiers - I: Basics and Power Gain Expressions](#)

[Lecture 33 - Microwave Amplifiers - II: Stability and Constant Gain Circles](#)

[Lecture 34 - Microwave Amplifiers - III: Design Example](#)

[Lecture 35 - Low Noise Amplifiers - I: Noise Sources and Noise Figure](#)

[Lecture 36 - Low Noise Amplifiers - II: NF Circles and LNA Design](#)

[Lecture 37 - Power Amplifiers](#)

[Lecture 38 - Microwave Tubes - I : Linear Beam Tubes- Two Cavity Klystron](#)

[Lecture 39 - Microwave Tubes - II: Linear Beam Tubes- Reflex Klystron and TWT](#)

[Lecture 40 - Microwave Tubes - III: Crossed Field Tubes- Magnetron](#)

[Lecture 41 - Microwave Oscillators - I](#)

[Lecture 42 - Microwave Oscillators - II](#)

[Lecture 43 - Microwave Mixers - I: Fundamentals](#)

[Lecture 44 - Microwave Mixers - II: Circuits](#)

[Lecture 45 - Microwave Mixers - III: Design](#)

[Lecture 46 - Fundamentals of Antennas](#)

[Lecture 47 - Dipole, Monopole, loop and Slot Antennas](#)

[Lecture 48 - Linear and Planar Arrays](#)

[Lecture 49 - Microstrip Antennas](#)

[Lecture 50 - Horn and Helical Antennas](#)

[Lecture 51 - Yagi - Uda, Log-Periodic and Reflector Antennas](#)

[Lecture 52 - RF MEMS and Microwave Imaging](#)

[Lecture 53 - Microwave Systems](#)

[Lecture 54 - Microwave Measurements and Lab Demonstration](#)

[Lecture 55 - CST Software Introduction with Filter Design](#)

[Lecture 56 - Power Divider and Combiner Design in CST](#)

[Lecture 57 - Hybrid Coupler Design](#)

[Lecture 58 - Antenna Design and Amplifier Simulation in CST](#)

[Lecture 59 - Mixer Design in NI AWR Software - I](#)

[Lecture 60 - Mixer Design in NI AWR Software - II](#)

- Lecture 1 - Course Overview
- Lecture 2 - Introduction to Information Theory
- Lecture 3 - Entropy and its properties
- Lecture 4 - Lossless Source Coding Theorem
- Lecture 5 - Prefix Codes and Kraft's Inequality
- Lecture 6 - Huffman Coding
- Lecture 7 - Discrete Memory-less Channels : Mutual Information
- Lecture 8 - Channel Capacity - I
- Lecture 9 - Channel Capacity - II
- Lecture 10 - Channel Coding Theorem
- Lecture 11 - Differential Entropy - I
- Lecture 12 - Differential Entropy - II
- Lecture 13 - Channel Capacity - III
- Lecture 14 - Channel Capacity - IV
- Lecture 15 - Summary of Information Theory
- Lecture 16 - Signal Space Representations - I
- Lecture 17 - Signal Space Representations - II
- Lecture 18 - Vector Representation of a Random Process
- Lecture 19 - AWGN Vector Channel
- Lecture 20 - Basics of Signal Detection: ML,MAP Detection
- Lecture 21 - ML,MAP Detectors for AWGN Channel
- Lecture 22 - Optimal Receiver: Matched Filter
- Lecture 23 - Probability of error for Optimal Receiver
- Lecture 24 - Probability of Error for M-ary Scheme
- Lecture 25 - Pulse Code Modulation: Quantization
- Lecture 26 - Uniform Quantizer
- Lecture 27 - Step Size and Quantization Noise
- Lecture 28 - Non-uniform Quantizer (Lloyd-Max Quantizer)
- Lecture 29 - Companded Quantization - I
- Lecture 30 - Companded Quantization - II
- Lecture 31 - Differential Pulse Code Modulation DPCM - I

- Lecture 32 - DPCM-II (Linear Prediction)
- Lecture 33 - Delta Modulation
- Lecture 34 - M-ary PCM/PAM - I
- Lecture 35 - M-ary PCM/PAM - II
- Lecture 36 - Line Coding - I
- Lecture 37 - Line Coding - II
- Lecture 38 - Line Coding - III
- Lecture 39 - Pulse Shaping for Zero ISI - I
- Lecture 40 - Pulse Shaping for Zero ISI - II
- Lecture 41 - Pulse Shaping for Zero ISI - III
- Lecture 42 - Partial Response Signaling - I
- Lecture 43 - Partial Response Signaling - II
- Lecture 44 - Principle of Invariance of Probability of Error
- Lecture 45 - Binary ASK and PSK
- Lecture 46 - Binary Frequency Shift Keying - I
- Lecture 47 - Binary Frequency Shift Keying - II
- Lecture 48 - Quadrature Phase Shift Keying - I
- Lecture 49 - Quadrature Phase Shift Keying - II
- Lecture 50 - Quadrature Phase Shift Keying - III
- Lecture 51 - Continuous Phase Frequency Shift Keying
- Lecture 52 - Minimum Shift Keying - I
- Lecture 53 - Minimum Shift Keying - II
- Lecture 54 - M-ary Coherent ASK (M-ASK)
- Lecture 55 - M-ary PSK
- Lecture 56 - M-ary Quadrature Amplitude Modulation (M-QAM)
- Lecture 57 - M-ary FSK
- Lecture 58 - Comparison of M-ary Schemes
- Lecture 59 - Non-coherent BFSK
- Lecture 60 - Differential Phase Shift Keying
- Lecture 61 - Channel Coding - I
- Lecture 62 - Channel Coding - II
- Lecture 63 - Channel Coding - III
- Lecture 64 - Channel Coding: Hamming Codes

- Lecture 1 - Familiarization with Power Electronic Systems
- Lecture 2 - Overview of Basic Power Electronic Circuits from Laymans Point of View
- Lecture 3 - Applications, Definitions, and Nature of Power Electronic Circuits
- Lecture 4 - Components of a Power Electronic System
- Lecture 5 - Analysis of Switched Networks
- Lecture 6 - Review of engineering maths for power electronic circuit analysis
- Lecture 7 - Review of semiconductor physics
- Lecture 8 - P-N Junction
- Lecture 9 - Power Diodes
- Lecture 10 - Thyristors
- Lecture 11 - Motivation for rectifier capacitor filter
- Lecture 12 - Circuit Operation
- Lecture 13 - Designing the circuit
- Lecture 14 - Simulation setup for NgSpice and gEDA schematic capture
- Lecture 15 - Simulating the circuit
- Lecture 16 - Practicals
- Lecture 17 - Inrush current limiting - Intro
- Lecture 18 - Inrush current limiting - Resistor solution
- Lecture 19 - Inrush current limiting - Thermistor solution
- Lecture 20 - Inrush current limiting - Transformer solution
- Lecture 21 - Inrush current limiting - MOSFET solution
- Lecture 22 - Inrush current limiting - Relay, contactor
- Lecture 23 - Three phase rectifier capacitor filter
- Lecture 24 - Simulation - 3 phase rectifier capacitor filter
- Lecture 25 - Power factor - Motivation
- Lecture 26 - Power factor - Discussion
- Lecture 27 - Power factor - Sinusoidal
- Lecture 28 - Power factor for rectifier cap filter
- Lecture 29 - Passive power improvement circuit
- Lecture 30 - Simulation - power factor improvement
- Lecture 31 - Linear regulators - Intro

- Lecture 32 - Shunt regulator
- Lecture 33 - Example on shunt regulator
- Lecture 34 - Non-ideality and solution
- Lecture 35 - Applications of shunt regulator
- Lecture 36 - Series regulator
- Lecture 37 - Efficiency of series
- Lecture 38 - Negative and dual voltage regulators
- Lecture 39 - Over current limiting circuits
- Lecture 40 - Improvements to series regulator
- Lecture 41 - Regulator performance parameters
- Lecture 42 - Datasheet of few IC regulators
- Lecture 43 - Common IC regulator circuits
- Lecture 44 - Practicals 1
- Lecture 45 - Switched mode DC-DC converter intro
- Lecture 46 - Volt-sec and Amp-sec balance
- Lecture 47 - Input-output relationship
- Lecture 48 - Buck converter - operation and waveforms
- Lecture 49 - Buck converter - component selection
- Lecture 50 - Primary configurations
- Lecture 51 - Boost converter
- Lecture 52 - Buck-Boost converter
- Lecture 53 - Simulating the primary converters
- Lecture 54 - Forward converter
- Lecture 55 - Core reset in forward converter
- Lecture 56 - Simulating with lossy core reset
- Lecture 57 - Simulating with lossless core reset
- Lecture 58 - Flyback converter
- Lecture 59 - Simulating the flyback converter
- Lecture 60 - Octave mfile for design
- Lecture 61 - Magnetics design intro
- Lecture 62 - Magnetics review
- Lecture 63 - Permeance
- Lecture 64 - Inductor value and energy storage

- Lecture 65 - Inductor area product
- Lecture 66 - Inductor design
- Lecture 67 - Inductor example
- Lecture 68 - Transformer design
- Lecture 69 - Transformer example
- Lecture 70 - Forward converter design mfile
- Lecture 71 - Pushpull converter
- Lecture 72 - Flux walking in pushpull
- Lecture 73 - PWM generation
- Lecture 74 - Simulation of pushpull converter
- Lecture 75 - Half bridge converter
- Lecture 76 - Simulation of halfbridge converter
- Lecture 77 - Full bridge converter
- Lecture 78 - Simulation of fullbridge converter
- Lecture 79 - Area products and mfiles
- Lecture 80 - Intro for drive circuits
- Lecture 81 - BJT base drive
- Lecture 82 - BJT base drive example
- Lecture 83 - Multi-stage base drive
- Lecture 84 - Base drive with speed-up circuit
- Lecture 85 - Base drive with isolation
- Lecture 86 - MOSFET gate drive
- Lecture 87 - MOSFET drive with isolation
- Lecture 88 - Over-current protection
- Lecture 89 - Snubber circuits
- Lecture 90 - Intro for close loop control
- Lecture 91 - Close looping dc-dc converters
- Lecture 92 - Simulation of close loop control
- Lecture 93 - Current control for battery charger application
- Lecture 94 - Instability in current control and slope compensation
- Lecture 95 - Slope compensated current control
- Lecture 96 - Simulation of current control
- Lecture 97 - Single phase inverter with sinusoidal pwm

Lecture 98 - Simulation of sinusoidal PWM

Lecture 1 - Course Outline and Introduction

Lecture 2 - Analytical and Numerical Methods

Lecture 3 - Revisiting EM Concepts: Vector Algebra and Coordinate Systems

Lecture 4 - Revisiting EM Concepts: Vector Calculus and Electrostatics

Lecture 5 - Revisiting EM Concepts: Current Densities and Electric Fields in Materials

Lecture 6 - Revisiting EM Concepts: Electrostatic Boundary Conditions and Shielding

Lecture 7 - Revisiting EM Concepts: Magnetostatics

Lecture 8 - Revisiting EM Concepts: Magnetic Forces and Materials

Lecture 9 - Revisiting EM Concepts: Time Varying Fields

Lecture 10 - Revisiting EM Concepts: Theory of Eddy Currents

Lecture 11 - FEM: Variational Approach

Lecture 12 - Finding Functional for PDEs

Lecture 13 - Whole Domain Approximation

Lecture 14 - 1D FEM: Problem Definition and Shape Function

Lecture 15 - 1D FEM: Procedure

Lecture 16 - 1D FEM: Scilab Code

Lecture 17 - 2D FEM: Problem Definition and Shape Functions

Lecture 18 - 2D FEM: Procedure

Lecture 19 - 2D FEM Scilab Code: Manual Meshing

Lecture 20 - 2D FEM Code: Gmsh and Scilab

Lecture 21 - Computation of B and H Field and Method of Weighted Residuals

Lecture 22 - Galerkin Method

Lecture 23 - Calculation of Leakage Inductance of a Transformer

Lecture 24 - Calculation of Inductance of an Induction Motor and a Gapped-Core Shunt Reactor

Lecture 25 - Insulation Design Using FE Analysis

Lecture 26 - Quadratic Finite Elements

Lecture 27 - Time Harmonic FE Analysis

Lecture 28 - Calculation of Eddy Current Losses

Lecture 29 - Eddy Losses in Transformer Windings

Lecture 30 - Torque Speed Characteristics of an Induction Motor and FE Analysis of Axisymmetric Problem

Lecture 31 - Permanent Magnets: Theory

[Lecture 32 - Permanent Magnets: FEM Implementation](#)

[Lecture 33 - Periodic and Antiperiodic Boundary Conditions in Rotating Machines](#)

[Lecture 34 - FE Analysis of Rotating Machines](#)

[Lecture 35 - Voltage Fed Coupled Circuit Field Analysis](#)

[Lecture 36 - Current Fed Coupled Circuit Field Analysis](#)

[Lecture 37 - Transient FE Analysis](#)

[Lecture 38 - Nonlinear FE Analysis](#)

[Lecture 39 - Computation of Forces using Maxwell Stress Tensor](#)

[Lecture 40 - Computation of force using virtual work method](#)

- Lecture 1 - Introduction: Digital signal processing and its objectives
- Lecture 2 - Introduction to sampling and Fourier Transform
- Lecture 3 - Sampling of sine wave and associate complication
- Lecture 4 - Review of Sampling Theorem
- Lecture 5 - Idealized Sampling, Reconstruction
- Lecture 6 - Filters And Discrete System
- Lecture 7 - Answering questions from previous lectures
- Lecture 8 - Desired requirements for discrete system
- Lecture 9 - Introduction to phasors
- Lecture 10 - Advantages of phasors in discrete systems
- Lecture 11 - What do we want from a discrete system?
- Lecture 12 - Linearity - Homogeneity and Additivity
- Lecture 13 - Shift Invariance and Characterization of LTI systems
- Lecture 14 - Characterization of LSI system using its impulse response
- Lecture 15 - Introduction to convolution
- Lecture 16 - Convolution: Deeper ideas and understanding
- Lecture 17 - Characterisation of LSI systems, Convolution-properties
- Lecture 18 - Response of LSI Systems to Complex Sinusoids
- Lecture 19 - Convergence of Convolution and Bibo Stability
- Lecture 20 - Commutativity and Associativity
- Lecture 21 - BIBO Stability of an LSI system
- Lecture 22 - Causality and memory of an LSI system
- Lecture 23 - Frequency response of an LSI system
- Lecture 24 - Introduction and conditions of Stability
- Lecture 25 - Vectors and Inner Product
- Lecture 26 - Interpretation of Frequency Response as Dot Product
- Lecture 27 - Interpretation of Frequency Response as Eigenvalues
- Lecture 28 - Discrete time fourier transform
- Lecture 29 - DTFT in LSI System and Convolution Theorem.
- Lecture 30 - Definitions of sequences and Properties of DTFT
- Lecture 31 - Introduction to DTFT, IDTFT

Lecture 32 - Dual to convolution property

Lecture 33 - Multiplication Property, Introduction to Parseval's theorem

Lecture 34 - Introduction and Property of DTFT

Lecture 35 - Review of Inverse DTFT

Lecture 36 - Parseval's Theorem and energy and time spectral density

Lecture 37 - Discussion on Unit Step

Lecture 38 - Introduction to Z transform

Lecture 39 - Example of Z transform

Lecture 40 - Region of Convergence

Lecture 41 - Properties of Z transform

Lecture 42 - Z- Transform

Lecture 43 - Rational System

Lecture 44 - Introduction and Examples of Rational Z Transform and their Inverses

Lecture 45 - Double Pole Examples and their Inverse Z Transform

Lecture 46 - Partial Fraction Decomposition

Lecture 47 - LSI System Examples

Lecture 48 - Why are Rational Systems so important?

Lecture 49 - Solving Linear constant coefficient difference equations which are valid over a finite range of time

Lecture 50 - Introduction to Resonance in Rational Systems

Lecture 51 - Characterization of Rational LSI system

Lecture 52 - Causality and stability of the ROC of the system function

Lecture 53 - Recap of Rational Systems and Discrete Time Filters

Lecture 54 - Specifications for Filter Design

Lecture 55 - Four Ideal Piecewise Constant Filters

Lecture 56 - Important Characteristics Of Ideal Filters

Lecture 57 - Synthesis of Discrete Time Filters, Realizable specifications

Lecture 58 - Realistic Specifications for low pass filter. Filter Design Process

Lecture 59 - Introduction to Filter Design. Analog IIR Filter, FIR discrete-time filter, IIR discrete-time filter

Lecture 60 - Analog to discrete transform

Lecture 61 - Intuitive transforms, Bilinear Transformation

Lecture 62 - Steps for IIR filter design

Lecture 63 - Analog filter design using Butterworth Approximation

Lecture 64 - Butterworth filter Derivation And Analysis of butterworth system function

Lecture 65 - Chebychev filter Derivation

Lecture 66 - Midsem paper review discussion

Lecture 67 - The Chebyshev Approximation

Lecture 68 - Next step in design: Obtain poles

Lecture 69 - Introduction to Frequency Transformations in the Analog Domain

Lecture 70 - High pass transformation

Lecture 71 - Band pass transformation

Lecture 72 - Frequency Transformation

Lecture 73 - Different types of filters

Lecture 74 - Impulse invariant method and ideal impulse response

Lecture 75 - Design of FIR of length $(2N+1)$ by the truncation method, Plotting the function $V(\omega)$

Lecture 76 - IIR filter using rectangular window, IIR filter using triangular window

Lecture 77 - Proof that frequency response of an fir filter using rectangular window function centred at 0 is real

Lecture 78 - Introduction to window functions

Lecture 79 - Examples of window functions

Lecture 80 - Explanation of Gibbs Phenomenon and its application

Lecture 81 - Comparison of FIR And IIR Filter

Lecture 82 - Comparison of FIR And IIR Filter

Lecture 83 - Comparison of FIR And IIR Filter

Lecture 84 - Introduction and approach to realization (causal rational system)

Lecture 85 - Comprehension of Signal Flow Graphs and Achievement of Pseudo Assembly Language Code

Lecture 86 - Introduction to IIR Filter Realization and Cascade Structure

Lecture 87 - Cascade Parallel Structure

Lecture 88 - Lattice Structure

Lecture 89 - Recap And Review of Lattice Structure, Realization of FIR Function

Lecture 90 - Backward recursion, Change in the recursive equation of lattice

Lecture 91 - Lattice structure for an arbitrary rational system

Lecture 92 - Example realization of lattice structure for rational system

Lecture 93 - Introductory Remarks of Discrete Fourier Transform and Frequency Domain Sampling

Lecture 94 - Principle of Duality, The Circular Convolution

Lecture 1 - Decision Making under Uncertainty

Lecture 2 - Expected Utility Theory - I

Lecture 3 - Expected Utility Theory - II

Lecture 4 - Expected Utility Theory - III

Lecture 5 - Role of Information in Decision Making

Lecture 6 - State Space Modelling of Sequential Decision Making, Example of Inventory Control

Lecture 7 - Inventory Control Problem (Continued...)

Lecture 8 - Policy-A Closed Loop Solution to Stochastic Control Problem

Lecture 9 - Introduction to Markov Decision Processes (MDP)

Lecture 10 - Types of Policy in MDP

Lecture 11 - Interpreting randomised decision rules

Lecture 12 - Stationary Transition Probability: State Diagram Representation and example of Markov policies

Lecture 13 - Example of History Dependent Policies

Lecture 14 - Complexity of the problem using brute force approach

Lecture 15 - Principle of Optimality

Lecture 16 - Dynamic Programming Algorithm

Lecture 17 - DP Algo applied to Inventory Control Problem

Lecture 18 - DP Algo applied to Inventory Control Problem (Continued...)

Lecture 19 - DP Algo applied to Inventory Control Problem (Continued...)

Lecture 20 - Optimal Stopping Problem

Lecture 21 - Optimal Stopping Example: Secretary Problem

Lecture 22 - Optimal Stopping Example: Secretary Problem (Continued...)

Lecture 23 - Optimal Stopping Example: Secretary Problem (Continued...)

Lecture 24 - Linear System Quadratic Cost Problem

Lecture 25 - Linear System Quadratic Cost Problem (Continued...)

Lecture 26 - Solving it via DP algorithm (Continued...)

Lecture 27 - Equivalence between Optimal HR Policy and optimal Markov Deterministic Policy

Lecture 28 - Stochastic Control under incomplete state information

Lecture 29 - Stochastic Control under incomplete state information (Continued...)

Lecture 30 - Stochastic Control under incomplete state information: Example

Lecture 31 - Stochastic Control under incomplete state information: Example (Continued...)

[Lecture 32 - Stochastic Control under incomplete state information: Example \(Continued...\)](#)

[Lecture 33 - Stochastic Control under incomplete state information: Example \(Continued...\)](#)

[Lecture 34 - LQ systems with Imperfect Information - I](#)

[Lecture 35 - LQ systems with Imperfect Information - II](#)

[Lecture 36 - LQ systems with Imperfect Information - III](#)

[Lecture 37 - LQ systems with Imperfect Information - IV](#)

[Lecture 38 - Filtering - I](#)

[Lecture 39 - Filtering - II](#)

[Lecture 40 - Kalman Filtering - I](#)

[Lecture 41 - Kalman Filtering - II](#)

[Lecture 42 - Kalman Filtering - III](#)

[Lecture 43 - Belief State Formulation - I](#)

[Lecture 44 - Belief State Formulation - II](#)

[Lecture 45 - Information Structures - I](#)

[Lecture 46 - Information Structures - II](#)

[Lecture 47 - Witsenhausen Problem - I](#)

[Lecture 48 - Witsenhausen Problem - II](#)

[Lecture 49 - Witsenhausen Problem - III](#)

[Lecture 50 - Witsenhausen Problem - IV](#)

[Lecture 51 - Witsenhausen Problem - V](#)

[Lecture 52 - Witsenhausen Problem - VI](#)

[Lecture 53 - Witsenhausen Problem - VII](#)

[Lecture 54 - Team Decision Theory - I](#)

[Lecture 55 - Team Decision Theory - II](#)

[Lecture 56 - Team Decision Theory - III](#)

[Lecture 57 - Team Decision Theory - IV](#)

[Lecture 58 - Team Decision Theory - V](#)

[Lecture 59 - Team Decision Theory - VI](#)

[Lecture 60 - Team Decision Theory - VII](#)

[Lecture 61 - Communication Theory - I](#)

[Lecture 62 - Communication Theory - II](#)

[Lecture 63 - Communication Theory - III](#)

[Lecture 64 - Communication Theory - IV](#)

Lecture 1 - Introduction - Part A

Lecture 2 - Introduction - Part B

Lecture 3 - Introduction - Part C

Lecture 4 - Equivalent Systems - Part A

Lecture 5 - Equivalent Systems - Part B

Lecture 6 - Equivalent Systems - Part C

Lecture 7 - Solution of $Ax = b$ - Part A

Lecture 8 - Solution of $Ax = b$ - Part B

Lecture 9 - Solution of $Ax = b$ - Part C

Lecture 10 - Rings, Integral Domains and Fields - Part A

Lecture 11 - Rings, Integral Domains and Fields - Part B

Lecture 12 - Rings, Integral Domains and Fields - Part C

Lecture 13 - Vector Spaces and Subspaces - Part A

Lecture 14 - Vector Spaces and Subspaces - Part B

Lecture 15 - Vector Spaces and Subspaces - Part C

Lecture 16 - Unions, Intersection, Sums of Subspaces - Part A

Lecture 17 - Unions, Intersection, Sums of Subspaces - Part B

Lecture 18 - Generating sets, Linear independence and basis - Part A

Lecture 19 - Generating sets, Linear independence and basis - Part B

Lecture 20 - Generating sets, Linear independence and basis - Part C

Lecture 21 - Ordered basis and co-ordinates - Part A

Lecture 22 - Ordered basis and co-ordinates - Part B

Lecture 23 - Ordered basis and co-ordinates - Part C

Lecture 24 - Rank-Nullity Theorem (Matrices) - Part A

Lecture 25 - Rank-Nullity Theorem (Matrices) - Part B

Lecture 26 - Rank-Nullity Theorem (Matrices) - Part C

Lecture 27 - Rank-Nullity Theorem (Linear Transformation) - Part A

Lecture 28 - Rank-Nullity Theorem (Linear Transformation) - Part B

Lecture 29 - Rank-Nullity Theorem (Linear Transformation) - Part C

Lecture 30 - Isomorphism and Inverses - Part A

Lecture 31 - Isomorphism and Inverses - Part B

- Lecture 32 - Isomorphism and Inverses - Part C
- Lecture 33 - Dual Basis and Annihilator - Part A
- Lecture 34 - Dual Basis and Annihilator - Part B
- Lecture 35 - Dual Basis and Annihilator - Part C
- Lecture 36 - Dual maps and double dual - Part A
- Lecture 37 - Dual maps and double dual - Part B
- Lecture 38 - Dual maps and double dual - Part C
- Lecture 39 - Quotient spaces and quotient map - Part A
- Lecture 40 - Quotient spaces and quotient map - Part B
- Lecture 41 - Quotient spaces and quotient map - Part C
- Lecture 42 - Inner Product Spaces - Part A
- Lecture 43 - Inner Product Spaces - Part B
- Lecture 44 - Inner Product Spaces - Part C
- Lecture 45 - Gram Schmidt Procedure - Part A
- Lecture 46 - Gram Schmidt Procedure - Part B
- Lecture 47 - Gram Schmidt Procedure - Part C
- Lecture 48 - Best Approximation of a Vector - Part A
- Lecture 49 - Best Approximation of a Vector - Part B
- Lecture 50 - Best Approximation of a Vector - Part C
- Lecture 51 - Projection map and summary of $Ax = b$ - Part A
- Lecture 52 - Projection map and summary of $Ax = b$ - Part B
- Lecture 53 - Projection map and summary of $Ax = b$ - Part C
- Lecture 54 - Linear Differential Equations - Part A
- Lecture 55 - Linear Differential Equations - Part B
- Lecture 56 - Introduction to Eigen values and Eigen vectors - Part A
- Lecture 57 - Introduction to Eigen values and Eigen vectors - Part B
- Lecture 58 - Introduction to Eigen values and Eigen vectors - Part C
- Lecture 59 - Singular Value Decomposition - Part A
- Lecture 60 - Singular Value Decomposition - Part B
- Lecture 61 - Singular Value Decomposition - Part C
- Lecture 62 - Algebraic and geometric multiplicities - Part A
- Lecture 63 - Algebraic and geometric multiplicities - Part B
- Lecture 64 - A-Invariant Subspaces - Part A

[Lecture 65 - A-Invariant Subspaces - Part B](#)

[Lecture 66 - A-Invariant Subspaces - Part C](#)

[Lecture 67 - Minimal Polynomial-I - Part A](#)

[Lecture 68 - Minimal Polynomial-I - Part B](#)

[Lecture 69 - Minimal Polynomial-I - Part C](#)

[Lecture 70 - Minimal Polynomial-I - Part D](#)

[Lecture 71 - Minimal Polynomial-II - Part A](#)

[Lecture 72 - Minimal Polynomial-II - Part B](#)

[Lecture 73 - Minimal Polynomial-II - Part C](#)

[Lecture 74 - Minimal Polynomial-II - Part D](#)

[Lecture 75 - Cayley Hamilton Theorem - Part A](#)

[Lecture 76 - Cayley Hamilton Theorem - Part B](#)

[Lecture 77 - Cayley Hamilton Theorem - Part C](#)

[Lecture 78 - Jordan Canonical Form - Part A](#)

[Lecture 79 - Jordan Canonical Form - Part B](#)

[Lecture 80 - Jordan Canonical Form - Part C](#)

[Lecture 81 - Algebraic Graph Theory and Consensus - Part A](#)

[Lecture 82 - Algebraic Graph Theory and Consensus - Part B](#)

[Lecture 83 - Algebraic Graph Theory and Consensus - Part C](#)

[Lecture 84 - Positive Matrices and Leontieff's Model - Part A](#)

[Lecture 85 - Positive Matrices and Leontieff's Model - Part B](#)

Lecture 1 - Introduction to Digital Communication

Lecture 2 - Understanding GNU Radio features for Digital Communication: Basic blocks, input and output

Lecture 3 - Understanding GNU Radio features for Digital Communication: Advanced blocks, hardware interfacing

Lecture 4 - Fundamentals of Digital Communication: Signal Processing methods, vectors, and relevant GNU Radio Examples - Part 1

Lecture 5 - Fundamentals of Digital Communication: Signal Processing methods, vectors, and relevant GNU Radio Examples - Part 2

Lecture 6 - Complex Baseband Signal Representation

Lecture 7 - Real Passband Signal Representation, Up and Down Conversion of Complex Baseband Signals

Lecture 8 - Random Variables and Random Processes

Lecture 9 - Fundamentals of Digital Modulation

Lecture 10 - Linear Modulation Methods: Amplitude Shift Keying (ASK)

Lecture 11 - Linear Modulation Methods: Phase Shift Keying (PSK)

Lecture 12 - Linear Modulation Methods: Quadrature Amplitude Modulation (QAM) and Frequency Shift Keying (FSK)

Lecture 13 - Pulse Shaping for ISI Free Signaling

Lecture 14 - ASK using Raised Cosine (RC) and Root-Raised Cosine (RRC) Pulse Shaping

Lecture 15 - Basics of Detection: Properties of Gaussian Random Variables

Lecture 16 - Basics of Detection: Gaussian Random Vectors and Hypothesis Testing

Lecture 17 - Optimal Receivers for M-ary Signaling

Lecture 18 - Gram-Schmidt Orthogonalisation

Lecture 19 - Optimal Reception of M-ary Signals in AWGN

Lecture 20 - Detection and Optimal Decision for On-Off Signaling in AWGN Channel

Lecture 21 - Detection and Optimal Decision for M-ary Signaling

Lecture 22 - Python for GNU Radio

Lecture 23 - Extending GNU Radio Features using Python

Lecture 24 - Constructing and Visualising Constellations using GNU Radio

Lecture 25 - Understanding matched filtering using GNU Radio

Lecture 26 - Histograms in GNU Radio

Lecture 27 - Visualising Symbol Error Rate in GNU Radio

Lecture 28 - Signal-to-Noise Ratio and Symbol Error Probability - Part 1

Lecture 29 - Signal-to-Noise Ratio and Symbol Error Probability - Part 2

Lecture 30 - Symbol error rate and Bit error rate

Lecture 31 - Computing bit error rates in GNU Radio

- Lecture 32 - End-to-end Digital Communication System Simulation in GNU Radio
- Lecture 33 - Parameter Estimation for Practical Receivers - Part 1
- Lecture 34 - Parameter Estimation for Practical Receivers - Part 2
- Lecture 35 - Phase Locked Loop and Differential Modulation
- Lecture 36 - Maximum Likelihood delay estimate for a single symbol in GNU Radio
- Lecture 37 - Maximum Likelihood delay estimate for multiple symbols in GNU Radio
- Lecture 38 - Phase offset estimation in GNU Radio
- Lecture 39 - Phase Locked Loop in GNU Radio
- Lecture 40 - Costas Loop and Differential PSK in GNU Radio
- Lecture 41 - Channel Equalisation
- Lecture 42 - Detection Strategy for Dispersive Channels
- Lecture 43 - Maximum Likelihood sequence estimation: Viterbi Algorithm
- Lecture 44 - Suboptimal Channel Equalisation: Zero-forcing Receiver
- Lecture 45 - Zero forcing Receiver in GNU Radio
- Lecture 46 - Suboptimal Channel Equalisation: Linear Minimum mean-square error receiver
- Lecture 47 - LMMSE Receiver in GNU Radio
- Lecture 48 - Parallelising Frequency Selective Channels
- Lecture 49 - Orthogonal Frequency Division Multiplexing (OFDM)
- Lecture 50 - OFDM in the presence of dispersive channels
- Lecture 51 - Equalisation using OFDM in GNU Radio
- Lecture 52 - Error Control Coding: Parity Check Codes
- Lecture 53 - Error Control Coding: Repetition Codes
- Lecture 54 - Error Control Coding: Linear Block Codes
- Lecture 55 - Repetition Codes in GNU Radio
- Lecture 56 - Error Control Coding: Perfect Codes
- Lecture 57 - Error Control Coding: Hamming Codes
- Lecture 58 - (7,4) Hamming Code in GNU Radio
- Lecture 59 - Rate and error-free Communication
- Lecture 60 - Quantisation
- Lecture 61 - Visualising Quantisation in GNU Radio
- Lecture 62 - Course Summary

NPTEL : Circuit Theory (Electrical Engineering)

Co-ordinators : Prof. S.C. Dutta Roy

- Lecture 1 - Review of Signals and Systems
- Lecture 2 - Review of Signals and Systems
- Lecture 3 - Network Equations; Initial and Final Conditions
- Lecture 4 - Problem Session 1
- Lecture 5 - Step, Impulse and Complete Responses
- Lecture 6 - 2nd Order Circuits:Magnetically Coupled Circuits
- Lecture 7 - Transformer Transform Domain Analysis
- Lecture 8 - Problem Session 2 : Step,Impulse
- Lecture 9 - Network Theorems and Network Functions
- Lecture 10 - Network Functions (Continued.)
- Lecture 11 - Amplitude and Phase of Network Functions
- Lecture 12 - Problem Session 3 : Network Theorems Transform
- Lecture 13 - Poles, Zeros and Network Response
- Lecture 14 - Single Tuned Circuits
- Lecture 15 - Single Tuned Circuits (Continued.)
- Lecture 16 - Double Tuned Circuits
- Lecture 17 - Double Tuned Circuits (Continued.)
- Lecture 18 - Problem Session 4 : Network Functions, Analysis
- Lecture 19 - Double Tuned Circuits (Continued.)
- Lecture 20 - Concept of Delay and Introduction
- Lecture 21 - Two-port Networks (Continued.)
- Lecture 22 - Problem Session 5
- Lecture 23 - Minor - 1
- Lecture 24 - The Hybrid & Transmission Parameters of 2 ports
- Lecture 25 - Problem Session 6 : Two - port networks
- Lecture 26 - Two - port Network parameters
- Lecture 27 - Two-port Interconnections
- Lecture 28 - Interconnection of Two-port Networks (Continued.)
- Lecture 29 - Problem Session 7 : Two-port Networks (Continued.)
- Lecture 30 - Scattering Matrix
- Lecture 31 - Scattering Parameters of a Two-port

Lecture 32 - Problem Session 8 : Two- port Parameters

Lecture 33 - Solutions of Minor - 2 Problems

Lecture 34 - Insertion Loss

Lecture 35 - Example of Insertion Loss and Elements

Lecture 36 - Elements of Realizability Theory (Continued.)

Lecture 37 - Positive Real Functions

Lecture 38 - Testing of Positive Real Functions

Lecture 39 - Problem Session 9

Lecture 40 - More on PRF's and their Synthesis

Lecture 41 - LC Driving Point Functions

Lecture 42 - LC Driving Point Synthesis (Continued.)

Lecture 43 - RC and RL Driving Point Synthesis

Lecture 44 - Problem Session 10 : LC Driving Point Synthesis

Lecture 45 - RC & RL One-port Synthesis (Continued.)

Lecture 46 - Elementary RLC One-port Synthesis

Lecture 47 - Properties and Synthesis of Transfer Parameters

Lecture 48 - Resistance Terminated LC Ladder

Lecture 49 - Resistance Terminated LC Ladder (Continued.)

Lecture 50 - Problem session 11: Two-port Synthesis

Lecture 51 - Network Transmission Criteria

Lecture 1 - Introduction to control problem

Lecture 2 - Basic Feedback Structure

Lecture 3 - Introduction to Control Problem (Continued.)

Lecture 4 - Dynamic Systems and Dynamic Response

Lecture 5 - Dynamic Systems and Dynamic Response (Continued.)

Lecture 6 - Dynamic Systems and Dynamic Response (Continued.)

Lecture 7 - Dynamic Systems and Dynamic Response (Continued.)

Lecture 8 - Dynamic Systems and Dynamic Response (Continued.)

Lecture 9 - Dynamic Systems and Dynamic Response (Continued.)

Lecture 10 - Models of Industrial Control Devices and Systems

Lecture 11 - Models of Industrial Control Devices and Systems (Continued.)

Lecture 12 - Models of Industrial Control Devices and Systems(Continued.)

Lecture 13 - Models of Industrial Control Devices and Systems(Continued.)

Lecture 14 - Models of Industrial Control Devices and Systems(Continued.)

Lecture 15 - Models of Industrial Control Devices and Systems(Continued.)

Lecture 16 - Models of Industrial Control Devices and Systems (Continued.)

Lecture 17 - Models of Industrial Control Devices and Systems (Continued.)

Lecture 18 - Models of Industrial Control Devices and Systems (Continued.)

Lecture 19 - Basic Principles of Feedback Control

Lecture 20 - Basic Principles of Feedback Control (Continued.)

Lecture 21 - Basic Principles of Feedback Control (Continued.)

Lecture 22 - Basic Principles of Feedback Control (Continued.)

Lecture 23 - Concepts of stability and Routh Stability Criterion

Lecture 24 - Concepts of stability and Routh Stability Criterion (Continued.)

Lecture 25 - Concepts of stability and Routh Stability Criterion (Continued.)

Lecture 26 - The Performance of Feedback Systems

Lecture 27 - The Performance of Feedback Systems (Continued.)

Lecture 28 - The Performance of Feedback Systems (Continued.)

Lecture 29 - The Performance of Feedback Systems (Continued.)

Lecture 30 - Compensator Design Using Root Locus Plots

Lecture 31 - Compensator Design Using Root Locus Plots (Continued.)

[Lecture 32 - Compensator Design Using Root Locus Plots \(Continued.\)](#)

[Lecture 33 - Compensator Design Using Root Locus Plots \(Continued.\)](#)

[Lecture 34 - Compensator Design Using Root Locus Plots \(Continued.\)](#)

[Lecture 35 - The Nyquist Stability Criterion and Stability Margins](#)

[Lecture 36 - The Nyquist Stability Criterion and Stability Margins \(Continued.\)](#)

[Lecture 37 - The Nyquist Stability Criterion and Stability Margins \(Continued.\)](#)

[Lecture 38 - The Nyquist Stability Criterion and Stability Margins \(Continued.\)](#)

[Lecture 39 - Feedback System Performance Based on the Frequency Response](#)

[Lecture 40 - Feedback System Performance Based on the Frequency Response \(Continued.\)](#)

[Lecture 41 - Compensator Design Using Frequency Response Plots](#)

Lecture 1 - Embedded Systems: Introduction

Lecture 2 - Embedded Hardware

Lecture 3 - PIC: Instruction Set

Lecture 4 - PIC Peripherals On Chip

Lecture 5 - ARM Processor

Lecture 6 - More ARM Instructions

Lecture 7 - ARM: Interrupt Processing

Lecture 8 - Digital Signal Processors

Lecture 9 - More on DSP Processors

Lecture 10 - System On Chip (SOC)

Lecture 11 - Memory

Lecture 12 - Memory Organization

Lecture 13 - Virtual Memory and Memory Management Unit

Lecture 14 - Bus Structure

Lecture 15 - Bus Structure - 2

Lecture 16 - Bus Structure - 3 Serial Interfaces

Lecture 17 - Serial Interfaces

Lecture 18 - Power Aware Architecture

Lecture 19 - Software for Embedded Systems

Lecture 20 - Fundamentals of Embedded Operating Systems

Lecture 21 - Scheduling Policies

Lecture 22 - Resource Management

Lecture 23 - Embedded - OS

Lecture 24 - Networked Embedded Systems - I

Lecture 25 - Networked Embedded Systems - II

Lecture 26 - Networked Embedded Systems - III

Lecture 27 - Networked Embedded Systems - IV

Lecture 28 - Designing Embedded Systems - I

Lecture 29 - Designing Embedded Systems - II

Lecture 30 - Designing Embedded Systems- III

Lecture 31 - Embedded System Design - IV

[Lecture 32 - Designing Embedded Systems - V](#)

[Lecture 33 - Platform Based Design](#)

[Lecture 34 - Compilers for Embedded Systems](#)

[Lecture 35 - Developing Embedded Systems](#)

[Lecture 36 - Building Dependable Embedded Systems](#)

[Lecture 37 - Pervasive and Ubiquitous Computing](#)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : Power System Generation, Transmission and Distribution (Encapsulated from earlier Video) (Electrical Engineering)

Co-ordinators : Prof. D.P. Kothari

Lecture 1 - Electric Energy Systems A Perspective

Lecture 2 - Structure of Power Systems

Lecture 3 - Conventional Sources of Electric Energy

Lecture 4 - Hydroelectric Power Generation

Lecture 5 - Non Conventional Energy Sources

Lecture 6 - Renewable Energy (Continued.)

Lecture 7 - Energy Storage

Lecture 8 - Deregulation

Lecture 9 - Air Pollutants

Lecture 10 - Transmission Line Parameters

Lecture 11 - Capacitance of Transmission Lines

Lecture 12 - Characteristics and Performance of Transmission Lines

Lecture 13 - Voltage Regulation (VR)

Lecture 14 - Power Flow through a Line

Lecture 15 - Methods of Voltage Control

Lecture 16 - Compensation of Transmission Lines

Lecture 17 - Compensation of Transmission Lines (Continued.)

Lecture 18 - Underground Cables

Lecture 19 - Cables (Continued.)

Lecture 20 - Insulators for Overhead Lines

Lecture 21 - HVDC

Lecture 22 - HVDC (Continued.)

Lecture 23 - Distribution Systems

Lecture 24 - Automatic Generation Control

Lecture 25 - Automatic Generation Control (Continued.)

Lecture 26 - Load Flow Studies

Lecture 27 - Load Flow Problem

Lecture 28 - Load Flow Analysis (Continued.), Gauss Siedel Method

Lecture 29 - Newton Raphson (NR), Load Flow Method

Lecture 30 - Fast Decoupled Load Flow

Lecture 31 - Control of Voltage Profile

[Lecture 32 - Optimal System Operation \(Economic Operation\)](#)

[Lecture 33 - Optimal Unit Commitment](#)

[Lecture 34 - Optimal Generation Scheduling](#)

[Lecture 35 - Optimal Load Flow \(Continued.\) and Hydro Thermal Scheduling](#)

- Lecture 1 - Introduction to Power System Stability Problem - Part-1
- Lecture 2 - Introduction to Power System Stability Problem - Part-2
- Lecture 3 - Introduction to Power System Stability Problem - Part-3
- Lecture 4 - Solution of Switching Equation
- Lecture 5 - The Equal Area Criterion for Stability - Part-1
- Lecture 6 - The Equal Area Criterion for Stability - Part-2
- Lecture 7 - Transient Stability Analysis of a Multi Machine System
- Lecture 8 - Modeling of Synchronous Machine - Part-1
- Lecture 9 - Modeling of Synchronous Machine - Part-2
- Lecture 10 - Modeling of Synchronous Machine - Part-3
- Lecture 11 - Modeling of Synchronous Machine - Part-4
- Lecture 12 - Synchronous Machine Representation for Stability Studies - Part-1
- Lecture 13 - Synchronous Machine Representation for Stability Studies - Part-2
- Lecture 14 - Excitation Systems - Part-1
- Lecture 15 - Excitation Systems - Part-2
- Lecture 16 - Modeling of Excitation Systems - Part-1
- Lecture 17 - Modeling of Excitation Systems - Part-2
- Lecture 18 - Small Signal Stability of a Single Machine Infinite Bus System - Part-1
- Lecture 19 - Small Signal Stability of a Single Machine Infinite Bus System - Part-2
- Lecture 20 - Small Signal Stability of a Single Machine Infinite Bus System - Part-3
- Lecture 21 - Small Signal Stability of a Single Machine Infinite Bus System - Part-4
- Lecture 22 - Small Signal Stability of a Single Machine Infinite Bus System - Part-5
- Lecture 23 - Dynamic Modeling of Steam turbines and Governors
- Lecture 24 - Dynamic modeling of Hydro Turbines and Governors
- Lecture 25 - Load modeling for Stability Studies
- Lecture 26 - Numerical Integration Methods for Solving a Set of Ordinary Nonlinear Differential Equation
- Lecture 27 - Simulation of Power System Dynamic Response
- Lecture 28 - Dynamic Equivalents for Large Scale Systems - Part-1
- Lecture 29 - Dynamic Equivalents for Large Scale Systems - Part-2
- Lecture 30 - Dynamic Equivalents for Large Scale Systems - Part-3
- Lecture 31 - Direct Method of Transient Stability Analysis - Part-1

[Lecture 32 - Direct Method of Transient Stability Analysis - Part-2](#)

[Lecture 33 - Sub Synchronous Oscillations - Part-1](#)

[Lecture 34 - Sub Synchronous Oscillations - Part-2](#)

[Lecture 35 - Voltage Stability - Part-1](#)

[Lecture 36 - Voltage Stability - Part-2](#)

[Lecture 37 - Voltage Stability - Part-3](#)

[Lecture 38 - Voltage Stability - Part-4](#)

[Lecture 39 - Methods of Improving Stability - Part-1](#)

[Lecture 40 - Methods of Improving Stability - Part-2](#)

Lecture 1 - Review of DC Models of Diodes & BJT's

Lecture 2 - Review of DC Models of BJT (Continued...) and FET

Lecture 3 - FET Characteristics and Models

Lecture 4 - Problem Session-1 on DC Analysis of BJT Circuits

Lecture 5 - BJT Biasing and Bias Stability

Lecture 6 - BJT Bias Stability (Continued...)

Lecture 7 - FET Biasing, Current Sources

Lecture 8 - Problem Session-2 on FET and BJT Characteristics and Biasing

Lecture 9 - Current Mirrors; BJT Small Signal Models

Lecture 10 - Small Signal Amplifiers: Mid Frequency Analysis

Lecture 11 - Mid Frequency Analysis of the CE and CB Amplifier

Lecture 12 - Problem Session-3 on Mid- Frequency Analysis of CE Amplifiers

Lecture 13 - Midband Analysis of CB and CC Amplifiers

Lecture 14 - Midband Analysis of FET Amplifiers

Lecture 15 - Problem Session-4 on Midband Analysis of Amplifiers

Lecture 16 - High Frequency Response of Small Signal Amplifiers

Lecture 17 - High Frequency Response of Small Signal Amplifiers (Continued...)

Lecture 18 - Low Frequency Response of Small Signal Amplifiers

Lecture 19 - Problem Session-5 on Frequency Response of Small Signal Amplifiers

Lecture 20 - Differential Amplifiers

Lecture 21 - Differential Amplifiers (Continued...)

Lecture 22 - Discussion on Minor-1 Problems and Differential Amplifiers (Continued...)

Lecture 23 - Problem Session-6 on Frequency Response of Small Signal Amplifiers (Continued...) and Differential Amplifiers

Lecture 24 - Use of Current Mirrors in Differential Amplifiers

Lecture 25 - FET Differential Amplifiers and Introduction to Power Amplifiers

Lecture 26 - Class B, Class AB and Class A Power Amplifiers

Lecture 27 - Class A Power Amplifiers; Efficiency Considerations

Lecture 28 - Problem Session-7 on Deferential and Power Amplifiers

Lecture 29 - Introduction to Feedback Amplifiers

Lecture 30 - Advantages of Negative Feedback Amplifiers

Lecture 31 - Analysis of Feedback Amplifiers

[Lecture 32 - Analysis of the Series - Series and Other Feedback Configurations](#)

[Lecture 33 - Problem Session-8 on Feedback Amplifiers](#)

[Lecture 34 - Sinusoidal Oscillators : An Example of Positive Feedback](#)

[Lecture 35 - More on Oscillators](#)

[Lecture 36 - Solutions to Minor-2 Exam and Concluding Discussions on Oscillators](#)

[Lecture 37 - Problem Session-9 on Oscillators](#)

[Lecture 38 - Tuned \(or Narrowband\) Amplifiers](#)

[Lecture 39 - Widebanding Techniques : Introduction & Use of Inductors](#)

[Lecture 40 - Widebanding By Using an Inductance](#)

[Lecture 41 - Problem Session-10 on Tuned Amplifiers](#)

[Lecture 42 - Widebanding by Using Compound Devices](#)

[Lecture 43 - Cascode Configuration as Wideband Amplifier](#)

[Lecture 44 - Widebanding by Local Feedback](#)

[Lecture 45 - Problem Session-11 on Minor-3 Problems & Widebanding by Compound Devices](#)

[Lecture 46 - Widebanding by Local Feedback and Feedback Cascades](#)

[Lecture 47 - Widebanding by Overall Feedback and Dual Loop Feedback](#)

[Lecture 48 - The Differential Pair and the Gilbert Cell as Wideband Amplifiers](#)

[Lecture 49 - Correction to Gilbert Cell Analysis and Operational Amplifier Imperfections](#)

[Lecture 50 - Op-Amp offsets, Compensation and Slew Rate](#)

[Lecture 51 - Op-Amp Compensation, Slew Rate and Some Problems](#)

Lecture 1 - Introduction to the Course

Lecture 2 - Digital Representation of Analog Signals, Delta Modulation

Lecture 3 - Digital Representation of Analog Signals, Pulse Code Modulation

Lecture 4 - Digital Representation of Analog Signals

Lecture 5 - Quantization Noise in Delta Modulation (Continued...) and Time Division Multiplexing

Lecture 6 - Introduction to Line Coding

Lecture 7 - Spectral Properties of Line Codes: General Relations

Lecture 8 - Spectral Properties of Line Codes: On-off / Polar / Bipolar Signalling

Lecture 9 - Spectral Properties of Line Codes: Duobinary Manchester and HDB Codes

Lecture 10 - Baseband Pulse Shaping: Nyquist's First Criterion

Lecture 11 - Baseband Pulse Shaping: Raised Cosine Family of Pulses

Lecture 12 - Partial Response Signalling: Duobinary and Modified Duobinary Pulse Shaping

Lecture 13 - Precoding for Duobinary and Modified Duobinary Systems

Lecture 14 - Precoding for Modified Duobinary Systems (Continued...) and General Partial Response Signalling

Lecture 15 - Binary Baseband Digital Modulation Techniques

Lecture 16 - M-ary Baseband Digital Modulation Techniques

Lecture 17 - Passband Digital Modulations - I : PSK and QPSK

Lecture 18 - Passband Digital Modulations - II : Offset QPSK

Lecture 19 - Passband Digital Modulations - III : Minimum Shift Keying (MSK)

Lecture 20 - Passband Digital Modulations - IV : MSK (Continued...) : Passband Waveforms for M-ary Signalling

Lecture 21 - Passband Modulations for Band Limited Channels

Lecture 22 - Baseband and Passband Digital Demodulations : General Issues and Concepts

Lecture 23 - Digital Modulation Part - II Matched Filters

Lecture 24 - Matched Filters and Coherent Demodulation-I

Lecture 25 - Coherent Demodulation for Binary Wave Form

Lecture 26 - Demodulators for Binary Waveforms (Continued...) : Coherent and Noncoherent Receivers for Orthogonal Signalling (OOK and FSK)

Lecture 27 - Performance Analysis of Binary Digital Modulations: Signal and Noise Statistics in Coherent and Noncoherent Receivers

Lecture 28 - Error Rates for Binary Signalling : Coherent Receivers

Lecture 29 - Performance of Non Coherent FSK and Differential Phase Shift Keying

Lecture 30 - Demodulation of DPSK and M-ary Signals

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

[Lecture 31 - Performance of M'ary Digital Modulations](#)

[Lecture 32 - Performance of M'ary Digital Modulations \(Continued...\)](#)

[Lecture 33 - Introduction to Information Theory, Part-1](#)

[Lecture 34 - Source Coding](#)

[Lecture 35 - Error Free Communication Over a Noisy Channel](#)

[Lecture 36 - The Concept of Channel Capacity](#)

[Lecture 37 - Error Correcting Codes](#)

[Lecture 38 - Error Correcting Codes \(Continued...\)](#)

NPTEL : Introduction To Electronic Circuits (Electrical Engineering)

Co-ordinators : Prof. S.C. Dutta Roy

- Lecture 1 - Introduction to the Course and Basic Electrical Quantity
- Lecture 2 - R.L.C. Components, Energy Considerations, Sources and Circuit Laws
- Lecture 3 - KCL, KVL and Network Analysis
- Lecture 4 - Networks Theorems (Thevenin's Norton's)
- Lecture 5 - Source Transformation; Super Position Theorem and Non-Linear One-Ports
- Lecture 6 - Signal Wave Forms
- Lecture 7 - Periodic Wave Forms and Elements of Amplifiers
- Lecture 8 - Operational Amplifiers and Diodes
- Lecture 9 - Rectifiers and Power Supplies
- Lecture 10 - Wave Shaping Circuits
- Lecture 11 - More on Wave Shaping Circuits and Introduction to Natural Response of Circuits
- Lecture 12 - Natural Response (Continued...)
- Lecture 13 - Natural Response of 2nd Order Circuit
- Lecture 14 - Natural Response of 2nd Order Circuit (Continued...)
- Lecture 15 - Impedance Functions, Poles, Zeros and their Applications
- Lecture 16 - Natural Response and Poles and Zeros and Introduction to Forced Response
- Lecture 17 - Phasors and their Applications in AC Ckts, analysis
- Lecture 18 - More About Phasors and Introduction to Complete Response
- Lecture 19 - Complete Response of Electrical Circuits
- Lecture 20 - AC Circuit Analysis
- Lecture 21 - Filter Circuits and Resonance
- Lecture 22 - Resonance (Continued...)
- Lecture 23 - General Network Analysis
- Lecture 24 - Two-Port Networks
- Lecture 25 - Semiconductor Physics
- Lecture 26 - Semiconductor Physics (Continued...)
- Lecture 27 - More About Diodes Including Zener Diodes
- Lecture 28 - Bipolar Junction Transistors
- Lecture 29 - Transistors Characteristics and Biasing
- Lecture 30 - BJT Biasing and Introduction to Power Amplifiers
- Lecture 31 - BJT Power Amplifiers

[Lecture 32 - Power Amplifier](#)

[Lecture 33 - Power Amplifiers \(Continued...\) and an Introduction to Small Signal Modelling of BJT](#)

[Lecture 34 - Small Signal Model and Small Signal Amplifiers](#)

[Lecture 35 - Small Signal Amplifiers \(Continued...\)](#)

[Lecture 36 - Small Signal Amplifier \(Continued...\)](#)

[Lecture 37 - Small Signal Amplifiers \(Continued...\)](#)

[Lecture 38 - Negative Feedback](#)

[Lecture 39 - Digital Circuits](#)

[Lecture 40 - Digital Circuits \(Continued...\)](#)

Lecture 1 - Introduction to Analog Circuits Introduction to the Diode

Lecture 2 - Diodes, Introduction to The Transistor

Lecture 3 - MOS Device, Characteristics

Lecture 4 - DC operating point

Lecture 5 - DC operating point, amplifier design

Lecture 6 - Common source amplifier, small signal analysis

Lecture 7 - Common gate, common drain

Lecture 8 - Common gate circuit

Lecture 9 - Source degenerated amplifier

Lecture 10 - Swing limits

Lecture 11 - Swing limits (Continued...), multi transistor amplifiers

Lecture 12 - Multi-transistor amplifiers

Lecture 13 - Introduction to current sources

Lecture 14 - Current sources/mirrors (Continued...)

Lecture 15 - Current sources, biasing

Lecture 16 - Differential circuits

Lecture 17 - Differential amplifiers-I

Lecture 18 - Differential amplifiers-II

Lecture 19 - Differential amplifiers-III

Lecture 20 - Self biased active load diff. amp

Lecture 21 - Diff. Cascode amplifier, two stage amplifiers

Lecture 22 - Two stage diff. amps, op-amps

Lecture 23 - Op-amps, OTAs

Lecture 24 - Circuits with op-amps

Lecture 25 - Capacitance in MOS devices

Lecture 26 - Common source, drain, gate-revisited

Lecture 27 - Common gate, common drain with capacitances

Lecture 28 - Cascode, cascade-revisit with capacitance

Lecture 29 - Cascade amplifier (with capacitance)

Lecture 30 - Diversion: 2-pole systems phase margin

Lecture 31 - Diversion Continued: Two Pole Systems

[Lecture 32 - Compensation](#)

[Lecture 33 - Op-amp Design with Compensation](#)

[Lecture 34 - Unity Gain Bandwidth](#)

[Lecture 35 - Power Amplification](#)

[Lecture 36 - Power Amplifiers-2](#)

[Lecture 37 - Power Amplifiers- Class A,B,AB,C ClassD](#)

[Lecture 38 - Class D Amplifiers, Push-pull Amplifiers](#)

[Lecture 39 - Introduction to Voltage Regulators](#)

[Lecture 40 - Voltage Regulators- line, load; Conclusion Regulation](#)

[Lecture 1 - Introduction](#)

[Lecture 2 - Preliminaries](#)

[Lecture 3 - Model Reference Adaptive Control - Part 1](#)

[Lecture 4 - Model Reference Adaptive Control - Part 2](#)

[Lecture 5 - Model Reference Adaptive Control - Part 3](#)

[Lecture 6 - Adaptive Command Tracking](#)

[Lecture 7 - Robust Model Reference Adaptive Control - Part 1](#)

[Lecture 8 - Robust Model Reference Adaptive Control - Part 2](#)

[Lecture 9 - Robust Model Reference Adaptive Control - Part 3](#)

[Lecture 10 - Robust Model Reference Adaptive Control - Part 4](#)

Lecture 1 - Introduction to Information Theory

Lecture 2 - Entropy, Mutual Information, Conditional and Joint Entropy

Lecture 3 - Measures for Continuous, Random Variable, Relative Entropy

Lecture 4 - Variable Length Codes, Prefix Codes

Lecture 5 - Source Coding Theorem

Lecture 6 - various source coding Techniques: Huffman, Arithmetic, Lempel Ziv, Run Length

Lecture 7 - Optimum Quantizer, Practical Application of Source Coding: JPEG Compression

Lecture 8 - Introduction to Super Information

Lecture 9 - Channel Models and Channel Capacity

Lecture 10 - Noisy Channel Coding Theorem

Lecture 11 - Gaussian Channel and Information Capacity Theorem

Lecture 12 - Capacity of MIMO Channels

Lecture 13 - Introduction to Error Control Coding

Lecture 14 - Introduction to Galois Field

Lecture 15 - Equivalent Codes, Generator Matrix and Parity Check Matrix

Lecture 16 - Systematic Codes, Error Detections and Correction

Lecture 17 - Erasure and Errors, Standard Array and Syndrome Decoding

Lecture 18 - Probability of Error, Coding Gain and Hamming Bound

Lecture 19 - Hamming Codes, LDPC Codes and MDS Codes

Lecture 20 - Introduction to Cyclic Codes

Lecture 21 - Generator Polynomial, Syndrome Polynomial and Matrix Representation

Lecture 22 - Fire Code, Golay Code, CRC Codes and Circuit Implementation of Cyclic Codes

Lecture 23 - Introduction to BCH Codes: Generator Polynomials

Lecture 24 - Multiple Error Correcting BCH Codes, Decoding of BCH Codes

Lecture 25 - Introduction to Reed Solomon (RS) Codes

Lecture 26 - Introduction to Convolutional Codes

Lecture 27 - Trellis Codes: Generator Polynomial Matrix and Encoding using Trellis

Lecture 28 - Vitrebi Decoding and Known good Convolutional Codes

Lecture 29 - Introduction to Turbo Codes

Lecture 30 - Introduction to Trellis Coded Modulation (TCM)

Lecture 31 - Ungerboeck's Design Rules and Performance Evaluation of TCM Schemes

[Lecture 32 - TCM for Fading Channel and Space Time Trellis Codes \(STTC\)](#)

[Lecture 33 - Introduction to Space Time Block Codes \(STBC\)](#)

[Lecture 34 - Space Time Codes](#)

[Lecture 35 - Space Time Codes \(Continued...\)](#)

[Lecture 36 - Introduction to Cryptography: Symmetric key and Asymmetric Key Cryptography](#)

[Lecture 37 - Some Well-Known Algorithms: DES, IDEA, PGP, DH Protocol](#)

[Lecture 38 - Introduction to Physical Layer Security: Notion of Secrecy Capacity](#)

[Lecture 39 - Secrecy Outage Capacity, Secrecy Outage Probability, Cooperative Jamming](#)

Lecture 1 - Introduction

Lecture 2 - Transmission Lines : Wave Propagation

Lecture 3 - Transmission Lines : Reflection,Transmission; Travelling Waves

Lecture 4 - Transmission Lines : Travelling Waves (Continued...); Sinusoidal Signals; Impedance Transformation

Lecture 5 - Transmission Lines : Standing Wave Ratio:Measurement of Impedance

Lecture 6 - Transmission Lines : General Transmission Lines Equations,Low loss,Transmission Lines,Transmission Lines as Circuit Elements

Lecture 7 - Transmission Lines : Section as Circuit Elements

Lecture 8 - Transmission Lines : Velocities of Propagation, Transmission Lines Charts

Lecture 9 - Transmission Lines : Smith Chart

Lecture 10 - Transmission Lines : Impedance Matching using Stub-Lines

Lecture 11 - Transmission Lines : Transmission Lines Parameters; (primary Constants)

Lecture 12 - Wave Propagation

Lecture 13 - Wave Propagation (Continued...)

Lecture 14 - Wave Propagation : Polarisation,Poynting Vector

Lecture 15 - Wave Propagation : Power Flow,Complex Poynting vector,wave equation for a conducting Medium

Lecture 16 - Wave Propagation : Conducting Medium;Conductors and Dielectrics Depth of Penetration;Surface Impedance

Lecture 17 - Wave Propagation : Surface Impedance; Power Loss in a Conductor Reflection at a Perfect conductor (Normal Inc.)

Lecture 18 - Reflection and Refraction of waves : Reflection at the Surface of a Conducting Medium,Reflection at a Perfect Conductor (Oblique Inc.)

Lecture 19 - Reflection and Refraction of waves (Continued...)

Lecture 20 - Reflection and Refraction of waves (Continued...) - 1

Lecture 21 - Reflection and Refraction of waves (Continued...); The Plane slab

Lecture 22 - Reflection and Refraction of waves (Continued...); Transmission Line Analogy for Planes Waves

Lecture 23 - Wave Guides

Lecture 24 - Wave Guides (Continued...) Parallel plane Guide,Transverse Electric Waves,Field Distribution,Superposition of Plane Waves

Lecture 25 - Wave Guides (Continued...)

Lecture 26 - Wave Guides (Continued...) Parallel plane Guide,Characteristics of TE and Tm Waves,TEM Waves,Wave Impedances

Lecture 27 - Wave Guides (Continued...) - 1

Lecture 28 - Wave Guides (Continued...) - 2

Lecture 29 - Wave Guides (Continued...) Rectangular Wave Guides

[Lecture 30 - Wave Guides \(Continued...\)](#)

[Lecture 31 - Wave Guides \(Continued...\) Rectangular Wave Guides - 1](#)

[Lecture 32 - Resonators General Properties](#)

[Lecture 33 - Resonators \(Continued...\) Transmission Line Resonators](#)

[Lecture 34 - Resonators \(Continued...\) Wave Guide Resonators](#)

[Lecture 35 - Radiation](#)

[Lecture 36 - Radiation \(Continued...\)](#)

[Lecture 37 - Radiation \(Continued...\) - 1](#)

[Lecture 38 - Radiation \(Continued...\) - 2](#)

[Lecture 39 - Radiation \(Continued...\) Monopole Antennas half Wave Dipole Antenna](#)

[Lecture 40 - Radiation \(Continued...\)](#)

[Lecture 41 - Radiation \(Continued...\) 2 - Element Arrays, Yagi-Uda Array](#)

Lecture 1 - Introduction

Lecture 2 - Signal Spaces : Waveforms and Vector Spaces

Lecture 3 - Inner Product and Orthogonal Expansion

Lecture 4 - Signal Spaces : Gram Schmidt Orthogonalization and Receiver Structures

Lecture 5 - Signal Spaces : Fourier Series and Related expansions

Lecture 6 - Signal Spaces : Bandwidth and Degree of Freedom

Lecture 7 - Random Variables and Random Processes : Discrete Random Variable

Lecture 8 - Random Variables and Random Processes : Continuous Random Variable

Lecture 9 - Random Variables and Random Processes : Multiple Random Variable

Lecture 10 - Random Variables and Random Processes : Random Vectors

Lecture 11 - Random Variables and Random Processes : Introduction to Random Process

Lecture 12 - Random Variables and Random Processes : Properties of Random Process

Lecture 13 - Random Variables and Random Processes : Gaussian Random Process - Part 1

Lecture 14 - Random Variables and Random Processes : Gaussian Random Process - Part 2

Lecture 15 - Random Variables and Random Processes : Types of Random Process

Lecture 16 - Random Variables and Random Processes : Random Process through an LTI system

Lecture 17 - Random Variables and Random Processes : Spectral description of Random Process

Lecture 18 - Waveform Coding

Lecture 19 - Modulation : Complex Baseband Representation of Passband Signals - Part 1

Lecture 20 - Modulation : Complex Baseband Representation of Passband Signals - Part 2

Lecture 21 - Modulation : Complex Baseband Representation of Passband Signals - Part 3

Lecture 22 - Modulation : Spectral Description of Sources - Part 1

Lecture 23 - Modulation : Spectral Description of Sources - Part 2

Lecture 24 - Modulation : Spectral Description of Sources using Markov Chains and Cyclostationary Random Processes

Lecture 25 - Modulation : Nyquist Pulses

Lecture 26 - Modulation : Pulse Amplitude Modulation and Quadrature Amplitude Modulation - Part 1

Lecture 27 - Modulation : Pulse Amplitude Modulation and Quadrature Amplitude Modulation - Part 2

Lecture 28 - Modulation : Orthogonal Modulation Schemes

Lecture 29 - Modulation : Differential Modulation Schemes

Lecture 30 - Detection : Maximum A posteriori Probability (MAP) Detector and Maximum Likelihood (ML) Detector

Lecture 31 - Detection : Vector Detection

[Lecture 32 - Detection : Theorem of Irrelevance and Waveform Detection](#)

[Lecture 33 - Detection : Sequence Detection](#)

[Lecture 34 - Detection : Performance of Binary Signalling Schemes](#)

[Lecture 35 - Detection : Performance of M-ary Signaling Schemes](#)

[Lecture 36 - Detection : Performance of Orthogonal Modulation Schemes and Bit-Level Demodulation](#)

[Lecture 37 - Detection : Performance of Non-Coherent Systems Systems](#)

[Lecture 38 - Detection : Fading Channel](#)

- Lecture 1 - Introduction - EV Historical Background
- Lecture 2 - Introduction - EV Benefits of Using EVs
- Lecture 3 - Introduction - EV Overview of types of EVs and its Challenges
- Lecture 4 - Introduction - EV Motor Drive Technologies
- Lecture 5 - Introduction - EV Energy Source Technologies
- Lecture 6 - Introduction - EV Battery Charging Technologies
- Lecture 7 - Introduction - EV Vehicle to Grid
- Lecture 8 - Introduction - EV Subsystems and Configurations
- Lecture 9 - Introduction - HEV Subsystems and Configurations
- Lecture 10 - Introduction - HEV Subsystems and Modes of Operation
- Lecture 11 - Vehicle Dynamics Introduction and tractive effort
- Lecture 12 - Vehicle Dynamics and dynamic equation
- Lecture 13 - Vehicle Dynamics simulation dynamic equation constant F_t
- Lecture 14 - Vehicle Dynamics dynamic equation variable F_t
- Lecture 15 - Vehicle Dynamics simulation dynamic equation variable F_t
- Lecture 16 - Vehicle Dynamics Modelling and simulation in Simulink
- Lecture 17 - Summary Electric Vehicles Part 1 Course
- Lecture 18 - Basics of DC Motor Drive
- Lecture 19 - Realization of DC Chopper
- Lecture 20 - Open Loop Operation of Chopper Fed DC Motor Drive
- Lecture 21 - Review of Control Theory
- Lecture 22 - Modeling and Current Controller Design for Separately Excited DC Motor Drive
- Lecture 23 - Speed Controller Design and Performance Evaluation of DC Motor Drive
- Lecture 24 - Fundamentals of Three Phase Induction Motor
- Lecture 25 - Equivalent Circuit and Torque-Speed Characteristics of Induction Motor
- Lecture 26 - Starting and Speed Control of Induction Motor
- Lecture 27 - Realisation of DC to AC Power Converter
- Lecture 28 - Impact of Non-Sinusoidal Voltage on Induction Motor
- Lecture 29 - Selective Harmonic Elimination and Optimal Pulse Width Modulation Techniques
- Lecture 30 - Switching Energy Losses and Sine-Triangle PWM
- Lecture 31 - Analysis of Sine-Triangle PWM

Lecture 32 - Simulation Studies on Open Loop Induction Motor Drive

- Lecture 1 - Introduction to Power Electronics
- Lecture 2 - Power Devices: Diodes and SCR
- Lecture 3 - Power Devices: SCR, Triac, GTO and BJT
- Lecture 4 - Power Devices: BJT, MOSFET and IGBT
- Lecture 5 - Single-phase Uncontrolled Rectifiers
- Lecture 6 - Single-phase Controlled Rectifiers - I
- Lecture 7 - Single-phase Controlled Rectifiers - II
- Lecture 8 - Three Phase Rectifiers - I
- Lecture 9 - Numericals on devices and Single-phase Rectifiers
- Lecture 10 - Three Phase Rectifiers - II
- Lecture 11 - Dual Converter and Commutation Overlap
- Lecture 12 - Commutation Overlap - II and AC-AC Converter-Introduction
- Lecture 13 - Single-Phase and Three-Phase AC Voltage Controllers
- Lecture 14 - Three-Phase AC Voltage Controllers and Cycloconverters
- Lecture 15 - Non-Isolated DC-DC Converters - I
- Lecture 16 - Non-Isolated DC-DC Converters - II
- Lecture 17 - Isolated DC-DC Converters - I
- Lecture 18 - Isolated DC-DC Converters - II and Cuk Converters
- Lecture 19 - Voltage Source Inverters
- Lecture 20 - VSI PWM Techniques - I
- Lecture 21 - VSI PWM Techniques - II
- Lecture 22 - SPWM and SVM Technique
- Lecture 23 - Current Source Inverter
- Lecture 24 - Power Electronics Applications

Lecture 1 - Introduction to Electrical Machines - I

Lecture 2 - Single-phase and Three-phase AC Circuits, Magnetic circuits

Lecture 3 - Magnetic Circuit - II

Lecture 4 - Magnetic Circuit - III

Lecture 5 - Transformers - Introduction

Lecture 6 - Transformers - Amp-Turn Balance, Ideal and practical transformers

Lecture 7 - Transformer Equivalent circuit and Reducing leakage

Lecture 8 - Transformer equivalent circuit parameter determination

Lecture 9 - Transformers - Voltage regulation and efficiency

Lecture 10 - Auto-transformers

Lecture 11 - PU notation and Introduction to Instrument transformers

Lecture 12 - Instrument Transformers and All Day Efficiency

Lecture 13 - Three Phase Transformers - I

Lecture 14 - Three Phase Transformers - II

Lecture 15 - Electromechanical Energy Conversion - I

Lecture 16 - Electromechanical Energy Conversion - II

Lecture 17 - Electromechanical Energy Conversion - III

Lecture 18 - DC Machines-Introduction, Constructional Features

Lecture 19 - DC Machines - EMF and Torque Equations and Generator Operation

Lecture 20 - DC Machines - OCC and Load Characteristics Classification

Lecture 21 - DC Machines - Armature Reaction

Lecture 22 - DC Machines - Voltage Build-up and Load Characteristics

Lecture 23 - DC Generator Characteristics and Introduction to DC Motors

Lecture 24 - DC Motors: Basics and Speed-Torque Relationship

Lecture 25 - DC Motor: Speed Control (Shunt and Separately Excited Motor)

Lecture 26 - DC Motor: Speed Control (Series and Compound Motor)

Lecture 27 - DC Machine: Starting and Braking

Lecture 28 - DC Machine: Comutation

Lecture 29 - 3 Phase Induction Machine: Constructional Features and Principle of Operation

Lecture 30 - 3 Phase Induction Machine: Equivalent Circuit

Lecture 31 - 3 Phase Induction Machine: Speed Torque Characteristics

[Lecture 32 - Testing of Induction Motor: OC and SC Test](#)

[Lecture 33 - 3 Phase Induction Machine: Starting Methods](#)

[Lecture 34 - Synchronous Machines: Introduction](#)

[Lecture 35 - Synchronous Machines: Constructional Features](#)

[Lecture 36 - Numerical Session](#)

[Lecture 37 - Synchronization of Alternators](#)

[Lecture 38 - Synchronous Machines: Equivalent Circuit and Phasor Diagram](#)

[Lecture 39 - Synchronous Machines: OC and SC Test](#)

[Lecture 40 - Synchronous Machines: Power Angle Relationship, V and Inverted V Curves](#)

[Lecture 41 - Single Phase Induction Motors](#)

Lecture 1 - Special Electromechanical Systems (Introduction)

Lecture 2 - Classification of Machines

Lecture 3 - Single and Two-Phase Motors

Lecture 4 - Single-Phase Induction Motors-Analysis

Lecture 5 - Starting of Single-Phase Induction Motors

Lecture 6 - Single-Phase Induction Motors Analysis

Lecture 7 - Induction Motors Analysis by Symmetrical Components

Lecture 8 - Modelling of 1-Phase Induction Motor (One and Two Windings)

Lecture 9 - Asymmetrical Induction Motor Generalized Rotating Field Theory

Lecture 10 - Generalized Rotating Field Theory (Continued...)

Lecture 11 - Generalized Rotating Field Theory (Continued...)

Lecture 12 - Generalized Rotating Field Theory (Continued...)

Lecture 13 - Analysis of Asymmetrical Machine by Generalized Rotating Field Theory

Lecture 14 - Analysis of Asymmetrical Machine

Lecture 15 - Analysis of Asymmetrical Induction Machine

Lecture 16 - Generalised Rotating-Field Theory of Wound Rotor Ind. Machine Having Asymmetry in Stator and Rotor Windings

Lecture 17 - Generalised Rotating-Field Theory of Wound Rotor Ind. Machine Having Asymmetry in Stator and Rotor Windings (Continued...)

Lecture 18 - Testing of Small Electrical Machines

Lecture 19 - Testing of 1-Phase Induction Motors

Lecture 20 - Variable Reluctance (VR) Motors

Lecture 21 - Switched Reluctance Motor (Continued...)

Lecture 22 - Switched Reluctance Motor (Continued...)

Lecture 23 - Switched Reluctance Motor (Continued...)

Lecture 24 - Stepper Motors

Lecture 25 - Stepper Motors (Continued...)

Lecture 26 - Induction Generators

Lecture 27 - Induction Generators (Continued...)

Lecture 28 - Doubly Fed Induction Generators

Lecture 29 - Self Excited Induction Generators

Lecture 30 - Self Excited Induction Generators (Continued...)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

[Lecture 31 - Permanent Magnet Machines](#)

[Lecture 32 - Squarewave Permanent Magnet Brushless Motor Drive](#)

[Lecture 33 - Sine Wave Permanent Magnet Brushless Motor Drives](#)

[Lecture 34 - Permanent Magnet Synchronous Motors](#)

- Lecture 1 - Basic Understanding of Converter (Introduction to Power Converters)
- Lecture 2 - Basic Understanding of Converter (Half Bridge and Full Bridge Circuit Operation)
- Lecture 3 - Basic Understanding of Converter (Sinusoidal Pulse width Modulation and Three Phase Circuit)
- Lecture 4 - Basic Understanding of Converter (Harmonics in Sinusoidal PWM)
- Lecture 5 - Third harmonic addition in Sine PWM
- Lecture 6 - Introduction to Space Vectors
- Lecture 7 - Space Vector PWM - Timing Calculation
- Lecture 8 - Space Vector PWM - Switching Sequence
- Lecture 9 - Space Vector PWM - Using Carriers
- Lecture 10 - Basic Introduction to Power Devices
- Lecture 11 - Introduction to Multilevel Converters
- Lecture 12 - Cascaded H-bridge Multilevel Converters
- Lecture 13 - Output Voltage Waveform Synthesis in CHB Converter and Basic of Asymmetrical CHB Converters
- Lecture 14 - Cascaded H-Bridge Converters: Phase-Shifted PWM
- Lecture 15 - Cascaded H-Bridge Converters: Level-Shifted PWM
- Lecture 16 - Fault Tolerant Operation of Cascaded H-Bridge Converter - Part I
- Lecture 17 - Fault Tolerant Operation of Cascaded H-Bridge Converter - Part II
- Lecture 18 - Modular Multilevel Converter - Topology and Operation
- Lecture 19 - Modular Multilevel Converter - Arm and Cell Voltage Ratings
- Lecture 20 - Modular Multilevel Converter - Arm Currents
- Lecture 21 - Modular Multilevel Converter - Arm Energy Balancing
- Lecture 22 - Modular Multilevel Converter - Different Circuit Topologies
- Lecture 23 - Modular Multilevel Converter - PWM Technique and Capacitor Voltage Balancing
- Lecture 24 - Modular Multilevel Converter - Fault Tolerant Operation and Commercial Production
- Lecture 25 - Design of Components in MMC
- Lecture 26 - Neutral Point Clamped Converter - Circuit Topology - Part I
- Lecture 27 - Neutral Point Clamped Converter - Circuit Topology - Part II
- Lecture 28 - Neutral Point Clamped Converter - Space Vector Diagram
- Lecture 29 - Neutral Point Clamped Converter - Space Vector PWM
- Lecture 30 - NPC - Sinusoidal PWM and Space Vector PWM using Single Carrier Strategy
- Lecture 31 - Neutral Point Clamped Converter - Mid-point Voltage Fluctuations

[Lecture 32 - Neutral Point Clamped Converter - Capacitor Voltage Balancing](#)

[Lecture 33 - Neutral Point Clamped Converter - Another Strategy of Capacitor Voltage Balancing](#)

[Lecture 34 - Other Topologies of NPC Converters - Higher Level NPC, TNPC and Active NPC](#)

[Lecture 35 - Multipulse Transformer - Part I](#)

[Lecture 36 - Multipulse Transformer - Part II](#)

[Lecture 37 - A Case Study on MMC and CHB](#)

[Lecture 38 - Basics of Gate Driver Circuits](#)

[Lecture 39 - Gate Driver Circuits - Turn-on and Turn-off Process](#)

[Lecture 40 - Gate Driver Circuits - Features of Gate Drivers and Basics of Bootstrap Functionality](#)

[Lecture 41 - Condition Monitoring of Converters](#)

[Lecture 42 - Other Converter Topologies](#)

[Lecture 43 - Summary of the Course](#)

Lecture 1 - Introduction

Lecture 2 - Introduction continued with Project demos

Lecture 3 - Modular Approach to ESD

Lecture 4 - Modular Approach to ESD (Continued...)

Lecture 5 - Salient Features of Modern Microcontrollers

Lecture 6 - Salient Features of Modern Microcontrollers (Continued...)

Lecture 7 - Elements of Microcontroller Ecosystem

Lecture 8 - Elements of Microcontroller Ecosystem (Continued...)

Lecture 9 - Power Supply for Embedded Systems

Lecture 10 - Power Supply for Embedded Systems (Continued...)

Lecture 11 - Introduction to MSP430

Lecture 12 - MSP430 Architecture

Lecture 13 - MSP430 Architecture- (Continued...) And Introduction to Lunchbox

Lecture 14 - Programming Methods for MSP430

Lecture 15 - Physical Interfacing - 1

Lecture 16 - Physical Interfacing - 2

Lecture 17 - Physical Interfacing - 3

Lecture 18 - Physical Interfacing - 4

Lecture 19 - Physical Interfacing - 5

Lecture 20 - Physical Interfacing - 6

Lecture 21 - GIT, CCS Installation and Embedded C

Lecture 22 - MSP430 Digital I/O

Lecture 23 - MSP430 Digital I/O: Switch Interfacing

Lecture 24 - MSP430 Clock System and Reset

Lecture 25 - Interrupts in MSP430

Lecture 26 - Interrupts in MSP430 (Continued...)

Lecture 27 - Interfacing Seven Segment Displays with MSP430; Low Power Modes in MSP430

Lecture 28 - Interfacing Liquid Crystal Displays (LCD)

Lecture 29 - MSP430 Timer Module: Introduction and Timer Capture

Lecture 30 - Pulse Width Modulation, PWM using Timer Capture

Lecture 31 - Analog to Digital Converter in the MSP430

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

[Lecture 32 - ADC and DAC using R2R Ladder and Random number generation using LFSR](#)

[Lecture 33 - Serial Communication Protocols, USCI Module in MSP430](#)

[Lecture 34 - MSP430 Timer in Capture Mode](#)

[Lecture 35 - Coding Ninja](#)

[Lecture 36 - Building an Electronics Project](#)

[Lecture 37 - Circuit Prototyping Techniques](#)

[Lecture 38 - Single Purpose Computers](#)

[Lecture 39 - Single Purpose Computers \(Continued...\)](#)

[Lecture 40 - Recap of Course Coverage and Project Demonstration from Concept to Final](#)

- Lecture 1 - Power Quality - An Introduction
- Lecture 2 - Power Quality Standards and Monitoring
- Lecture 3 - Power Quality Standards and Monitoring (Continued...)
- Lecture 4 - Passive Shunt and Series Compensations
- Lecture 5 - Passive Shunt and Series Compensations (Continued...)
- Lecture 6 - Passive Shunt and Series Compensations (Continued...)
- Lecture 7 - Active Shunt Compensation
- Lecture 8 - Active Shunt Compensation (Continued...)
- Lecture 9 - Active Shunt Compensation (Continued...)
- Lecture 10 - Active Series Compensation
- Lecture 11 - Active Series Compensation (Continued...)
- Lecture 12 - Unified Power Quality Compensators
- Lecture 13 - Unified Power Quality Compensators (Continued...)
- Lecture 14 - Unified Power Quality Compensators (Continued...)
- Lecture 15 - Loads Which Cause Power Quality Problems
- Lecture 16 - Loads Which Cause Power Quality Problems (Continued...)
- Lecture 17 - Passive Power Filters
- Lecture 18 - Passive Power Filters (Continued...)
- Lecture 19 - Passive Power Filters (Continued...)
- Lecture 20 - Shunt Active Power Filters
- Lecture 21 - Shunt Active Power Filters (Continued...)
- Lecture 22 - Shunt Active Power Filters (Continued...)
- Lecture 23 - Active Series Power Filters
- Lecture 24 - Active Series Power Filters (Continued...)
- Lecture 25 - Active Series Power Filters (Continued...)
- Lecture 26 - Hybrid Power Filters
- Lecture 27 - Hybrid Power Filters (Continued...)
- Lecture 28 - Hybrid Power Filters (Continued...)
- Lecture 29 - AC-DC Converters That Cause Power Quality
- Lecture 30 - Improved Power Quality Converters - AC-DC Boost Converters
- Lecture 31 - Improved Power Quality Converters - AC-DC Boost Converters (Continued...)

[Lecture 32 - Improved Power Quality Converters - AC-DC Buck Converters](#)

[Lecture 33 - Improved Power Quality Converters - AC-DC Buck-Boost Converters](#)

[Lecture 34 - Improved Power Quality Converters - AC-DC Buck-Boost Converters \(Continued...\)](#)

[Lecture 35 - Improved Power Quality Converters - AC-DC Buck-Boost Converters \(Continued...\)](#)

[Lecture 36 - Three Phase AC-DC Improved Power Quality Converters](#)

[Lecture 37 - Multipulse Converters](#)

[Lecture 38 - Multipulse Converters \(Continued...\)](#)

[Lecture 39 - Multipulse Converters \(Continued...\)](#)

[Lecture 40 - Power Quality Improvement in Solar Energy Conversion System](#)

[Lecture 41 - Power Quality Improvement in Solar Energy Conversion System \(Continued...\)](#)

[Lecture 42 - Power Quality Improvement in Wind Energy Conversion System](#)

[Lecture 43 - Power Quality Improvement in Diesel Generator Set Based Power Supply System](#)

[Lecture 44 - Power Quality Improvement in Diesel Generator Set Based Power Supply System \(Continued...\)](#)

[Lecture 45 - Power Quality Improvement in Distributed Generation Sources Based Microgrids](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

Lecture 1 - Course Outline and Introduction

Lecture 2 - Fundamental - I

Lecture 3 - Equivalent Circuit Approach to Design

Lecture 4 - Transformer Design - I

Lecture 5 - Transformer Design - II

Lecture 6 - Transformer Design - III

Lecture 7 - Transformer Design - IV

Lecture 8 - Windings in Electrical Machines

Lecture 9 - Design of DC Machine - I

Lecture 10 - Design of DC Machine - II

Lecture 11 - Design of DC Machine - III

Lecture 12 - Design of Three-Phase Induction Motors - I

Lecture 13 - Design of Three-Phase Induction Motors - II

Lecture 14 - Design of Three-Phase Induction Motors - III

Lecture 15 - Design of Three-Phase Induction Motors - IV

Lecture 16 - Design of Single-Phase Induction Machine - I

Lecture 17 - Design of Single-Phase Induction Machine - II

Lecture 18 - Design of Single-Phase Induction Machine - III

Lecture 19 - Design of Three-Phase Synchronous Machines - I

Lecture 20 - Design of Three-Phase Synchronous Machines - II

Lecture 21 - Design of Three-Phase Synchronous Machines - III

Lecture 22 - Design of Three-Phase Synchronous Machines - IV

Lecture 23 - Design of Synchronous Reluctance Machines - I

Lecture 24 - Design of Synchronous Reluctance Machines - II

Lecture 25 - Design of Synchronous Reluctance Machines - III

Lecture 26 - Design of Brushless PM Machines - I

Lecture 27 - Design of Brushless PM Machines - II

Lecture 28 - Design of Brushless PM Machines - III

Lecture 29 - Design of Brushless PM Machines - IV

Lecture 30 - Design of Brushless PM Machines - V

Lecture 31 - Design of Switched Reluctance Machines - I

[Lecture 32 - Design of Switched Reluctance Machines - II](#)

[Lecture 33 - Design of Switched Reluctance Machines - III](#)

[Lecture 34 - Design of Stepper Machines - I](#)

[Lecture 35 - Design of Stepper Machines - II](#)

[Lecture 36 - Design of Axial Flux Machines - I](#)

[Lecture 37 - Design of Axial Flux Machines - II](#)

[Lecture 38 - Computer Aided Design and Analysis Method - I](#)

[Lecture 39 - Computer Aided Design and Analysis Method - II](#)

[Lecture 40 - Case Studies and Tutorials - I and II](#)

[Lecture 41 - Tutorial-III : Determination of Transformer Operating Point](#)

[Lecture 42 - Tutorial-IV](#)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software (Electrical Engineering)

Co-ordinators : Prof. Ankur Gupta

Lecture 1 - Introduction

Lecture 2 - Passive Circuit Elements: R, L and C

Lecture 3 - Resistor color coding, Surface mount capacitors and inductors on PCBs

Lecture 4 - Active Circuit Elements: MOSFET, BJTs

Lecture 5 - Network Analysis: Kirchoff's Laws

Lecture 6 - Network Theorems: Thevenin, Norton, Maximum Power Transfer etc

Lecture 7 - Circuit Simulations using SPICE : Operating point analysis

Lecture 8 - DC Simulations and Importing Third-Party Models

Lecture 9 - Small-Signal Simulations, Transient Simulations

Lecture 10 - PCB Substrate and layers

Lecture 11 - Interconnect design

Lecture 12 - CMOS inverter basics

Lecture 13 - CMOS inverter design

Lecture 14 - Combinational Circuit Design - Part 1

Lecture 15 - Combinational Circuit Design - Part 2

Lecture 16 - Dynamic Logic Circuit Design

Lecture 17 - Sequential Logic Circuit Design

Lecture 18 - Digital Design : Boolean Algebra

Lecture 19 - Logic Families, Component Datasheets

Lecture 20 - TTL/CMOS logic Interfacing Constraints

Lecture 21 - Hardware Description Languages : VHDL and Verilog

Lecture 22 - Introduction to Verilog Simulations Software

Lecture 23 - Combinational Circuit Simulation using iVerilog

Lecture 24 - Adders, Multiplexer Simulation using iVerilog

Lecture 25 - High-Speed PCBs

Lecture 26 - Signal Integrity in PCBs

Lecture 27 - Signal Cross-Talk, Skews and Jitter in PCBs

Lecture 28 - KiCad Software Workflow

Lecture 29 - KiCad Design Modules

Lecture 30 - KiCad Schematic Design Steps

Lecture 31 - KiCad PCB Design Steps

[Lecture 32 - KiCad Custom Symbol and Footprints Creation](#)

[Lecture 33 - KiCad Example : PCB design using OpAmp IC](#)

[Lecture 34 - KiCad Example : PCB design using 555 Timer IC](#)

[Lecture 35 - RF PCB Design Guidelines](#)

[Lecture 36 - RF PCB Example](#)

Lecture 1 - Introduction

Lecture 2 - Control structures and performance measures

Lecture 3 - Time and frequency domain performance measures

Lecture 4 - Design of controller

Lecture 5 - Design of controller for SISO system

Lecture 6 - Controller design for TITO processes

Lecture 7 - Limitations of PID controllers

Lecture 8 - PI-PD controller for SISO system

Lecture 9 - PID-P controller for Two Input Two Output system

Lecture 10 - Effects of measurement noise and load

Lecture 11 - Identification of dynamic models of plants

Lecture 12 - Relay control system for identification

Lecture 13 - Off-line identification of process dynamics

Lecture 14 - On-line identification of plant dynamics

Lecture 15 - State space based identification

Lecture 16 - State space analysis of systems

Lecture 17 - State space based identification of systems - 1

Lecture 18 - State space based identification of systems - 2

Lecture 19 - Identification of simple systems

Lecture 20 - Identification of FOPDT model

Lecture 21 - Identification of second order plus dead time model

Lecture 22 - Identification of SOPDT model

Lecture 23 - Steady state gain from asymmetrical relay test

Lecture 24 - Identification of SOPDT model with pole multiplicity

Lecture 25 - Existence of limit cycle for unstable system

Lecture 26 - Identification procedures

Lecture 27 - Identification of underdamped systems

Lecture 28 - Off-line identification of TITO systems

Lecture 29 - On-line identification of TITO systems

Lecture 30 - Review of time domain based identification

Lecture 31 - DF based analytical expressions for on-line identification

[Lecture 32 - Model parameter accuracy and sensitivity](#)

[Lecture 33 - Improved identification using Fourier series and wavelet transform](#)

[Lecture 34 - Reviews of DF based identification](#)

[Lecture 35 - Advanced Smith predictor controller](#)

[Lecture 36 - Design of controllers for the advanced Smith predictor](#)

[Lecture 37 - Model-free controller design](#)

[Lecture 38 - Model Based PID controller Design - I](#)

[Lecture 39 - Model Based PI-PD controller Design - II](#)

[Lecture 40 - Tuning of reconfigurable PID controllers](#)

Lecture 1 - Introduction to Digital VLSI Design Flow

Lecture 2 - High-level Synthesis (HLS) flow with an example

Lecture 3 - Automation of High-level Synthesis Steps

Lecture 4 - Impact of Coding Style on HLS Results

Lecture 5 - Impact of Compiler Optimizations on HLS Results

Lecture 6 - RTL Optimizations for Timing

Lecture 7 - Retiming

Lecture 8 - RTL Optimizations for Area

Lecture 9 - RTL Optimizations for Power

Lecture 10 - High Level Synthesis: Introduction to Logic Synthesis

Lecture 11 - Overview of FPGA Technology Mapping

Lecture 12 - Introduction to Physical Synthesis

Lecture 13 - Introduction to Digital VLSI Testing - I

Lecture 14 - Introduction to Digital VLSI Testing - II

Lecture 15 - Optimization Techniques for ATPG - Part I

Lecture 16 - Optimization Techniques for ATPG - Part II

Lecture 17 - Optimization Techniques for Design for Testability

Lecture 18 - High-level fault modeling and RTL level Testing

Lecture 19 - LTL/CTL based Verification

Lecture 20 - Verification of Large Scale Systems

Lecture 21 - BDD based verification

Lecture 22 - Verification: ADD based verification, HDD based verification

Lecture 23 - Verification: Symbolic Model Checking

Lecture 24 - Verification: Bounded Model Checking

Lecture 1 - Probability Basics

Lecture 2 - Random Variable - I

Lecture 3 - Random Variable - II

Lecture 4 - Random Vectors and Random Processes

Lecture 5 - Infinite Sequence of Events - I

Lecture 6 - Infinite Sequence of Events - II

Lecture 7 - Convergence of Sequence of Random Variables

Lecture 8 - Weak Convergence - I

Lecture 9 - Weak Convergence - II

Lecture 10 - Laws of Large Numbers

Lecture 11 - Central Limit Theorem

Lecture 12 - Large Deviation Theory

Lecture 13 - Crammer's Theorem for Large Deviation

Lecture 14 - Introduction to Markov Processes

Lecture 15 - Discrete Time Markov Chain - 1

Lecture 16 - Discrete Time Markov Chain - 2

Lecture 17 - Discrete Time Markov Chain - 3

Lecture 18 - Discrete Time Markov Chain - 4

Lecture 19 - Discrete Time Markov Chain - 5

Lecture 20 - Continuous Time Markov Chain - 1

Lecture 21 - Continuous Time Markov Chain - 2

Lecture 22 - Continuous Time Markov Chain - 3

Lecture 23 - Martingale Process - 1

Lecture 24 - Martingale Process - 2

Lecture 1 - Introduction to Microwave Engineering

Lecture 2 - Introduction to Transmission Line Theory

Lecture 3 - Lossy Transmission Line

Lecture 4 - Smith Chart

Lecture 5 - Introduction to Waveguides and Rectangular Waveguide

Lecture 6 - Circular Waveguide

Lecture 7 - Attenuation Waveguide

Lecture 8 - N-port microwave networks and equivalent voltages and currents

Lecture 9 - Scattering Matrix (S-Parameters) Part-1

Lecture 10 - Scattering Matrix (S-parameters) Part-2 and Transmission Matrix (ABCD-Parameters)

Lecture 11 - Impedance Matching Using L-Section and Series Stub Networks

Lecture 12 - Impedance Matching Using Shunt Stub, Double Stub and Quarter wave Transformer

Lecture 13 - Multisection Matching Networks and Tapered Lines

Lecture 14 - Series and Parallel RLC Resonators

Lecture 15 - Transmission Line Resonators

Lecture 16 - Waveguide Resonators

Lecture 17 - Introduction to power dividers

Lecture 18 - Directional couplers

Lecture 19 - Microwave Filters - Part 1

Lecture 20 - Microwave Filters - Part 2

Lecture 21 - Characteristics of Microwave BJT and FET

Lecture 22 - PIN Diodes and Control Circuits

Lecture 23 - Schottky Diodes and Detectors and Tunnel Diodes

Lecture 24 - Gunn Diodes, IMPATT Diodes and Varactor Diodes

Lecture 25 - Two-Port Power Gain and Stability

Lecture 26 - Design of single stage transistor amplifier (for maximum gain, specified gain, low noise)

Lecture 27 - RF oscillator

Lecture 28 - Limitations of Conventional Tubes at Microwave Ranges

Lecture 29 - Introduction to Klystron

Lecture 30 - Reflex Klystron, Magnetron and TWT

Lecture 31 - Ferrite Devices

[Lecture 32 - Planar transmission lines for MIC](#)

[Lecture 33 - Lumped elements for MIC](#)

[Lecture 34 - Lumped inductor, HMIC and MMIC](#)

[Lecture 35 - Overview of Radar](#)

[Lecture 36 - Cellular Communication](#)

[Lecture 37 - Satellite Communication and Applications of Microwave](#)

Lecture 1 - Microprocessor Operations

Lecture 2 - 8086 Flags

Lecture 3 - Functional Diagram of 8086

Lecture 4 - 8086 Common and Minimum Mode Signals

Lecture 5 - 8086 Maximum Mode Signals

Lecture 6 - 8086 Data Transfer Instructions

Lecture 7 - 8086 Arithmetic Instructions - I

Lecture 8 - 8086 Arithmetic Instructions - II

Lecture 9 - 8086 Logical Instructions

Lecture 10 - 8086 Branch and String Instructions

Lecture 11 - 8086 Interrupt and Machine Control Instructions

Lecture 12 - Sum of Products, Multi-byte addition

Lecture 13 - Largest number, 2's complement Programs

Lecture 14 - Programs on Subroutines

Lecture 15 - ROM, RAM

Lecture 16 - Example I

Lecture 17 - Example II

Lecture 18 - Architecture, Interfacing to Simple I/O

Lecture 19 - Keyboard Interface

Lecture 20 - 7-segment Display Interface

Lecture 21 - Multiplexed 7-segment Display Interface

Lecture 22 - Stepper motor, Liquid level control

Lecture 23 - Traffic light control, A/D converter

Lecture 24 - D/A converter

Lecture 25 - Electronic weighing machine

Lecture 26 - Programmable Interval Timer (8254)

Lecture 27 - Modes of 8254

Lecture 28 - Architecture of 8259

Lecture 29 - Initialization command words of 8259

Lecture 30 - Operational command words of 8259

Lecture 31 - 8237 Architecture, interfacing and Programming

[Lecture 32 - Basic Concepts of serial I/O](#)

[Lecture 33 - Basic Concepts of serial I/O \(Continued...\)](#)

[Lecture 34 - Architecture of 8251](#)

- Lecture 1 - Overview of Statistical Signal Processing
- Lecture 2 - Probability and Random Variables
- Lecture 3 - Linear Algebra of Random Variables
- Lecture 4 - Random Processes
- Lecture 5 - Linear Shift Invariant Systems with Random Inputs
- Lecture 6 - White Noise and Spectral Factorization Theorem
- Lecture 7 - Linear Models of Random Signals
- Lecture 8 - Estimation Theory - 1
- Lecture 9 - Estimation Theory - 2: MVUE and Cramer Rao Lower Bound
- Lecture 10 - Cramer Rao Lower Bound 2
- Lecture 11 - MVUE through Sufficient Statistic - 1
- Lecture 12 - MVUE through Sufficient Statistic - 2
- Lecture 13 - Method of Moments and Maximum Likelihood Estimators
- Lecture 14 - Properties of Maximum Likelihood Estimator (MLE)
- Lecture 15 - Bayesian Estimators - 1
- Lecture 16 - Bayesian Estimators - 2
- Lecture 17 - Optimal linear filters: Wiener Filter
- Lecture 18 - FIR Wiener filter
- Lecture 19 - Non-Causal IIR Wiener Filter
- Lecture 20 - Causal IIR Wiener Filter
- Lecture 21 - Linear Prediction of Signals - 1
- Lecture 22 - Linear Prediction of Signals - 2
- Lecture 23 - Linear Prediction of Signals - 3
- Lecture 24 - Review Assignment - 1
- Lecture 25 - Adaptive Filters - 1
- Lecture 26 - Adaptive Filters - 2
- Lecture 27 - Adaptive Filters - 3
- Lecture 28 - Review Assignment - 2
- Lecture 29 - Adaptive Filters - 4
- Lecture 30 - Adaptive Filters - 4 (Continued...)
- Lecture 31 - Review Assignment - 3

[Lecture 32 - Recursive Least Squares \(RLS\) Adaptive Filter - 1](#)

[Lecture 33 - Recursive Least Squares \(RLS\) Adaptive Filter - 2](#)

[Lecture 34 - Review Assignment - 4](#)

[Lecture 35 - Kalman Filter - 1](#)

[Lecture 36 - Vector Kalman Filter](#)

[Lecture 37 - Linear Models of Random Signals](#)

[Lecture 38 - Review - 1](#)

[Lecture 39 - Review - 2](#)

Lecture 1 - Introduction to Digital Image Processing

Lecture 2 - Introduction to Computer Vision

Lecture 3 - Introduction to Computer Vision and Basic Concepts of Image Formation

Lecture 4 - Shape From Shading

Lecture 5 - Image Formation: Geometric Camera Models - I

Lecture 6 - Image Formation: Geometric Camera Models - II

Lecture 7 - Image Formation: Geometric Camera Models - III

Lecture 8 - Image Formation in a Stereo Vision Setup

Lecture 9 - Image Reconstruction from a Series of Projections

Lecture 10 - Image Reconstruction from a Series of Projections

Lecture 11 - Image Transforms - I

Lecture 12 - Image Transforms - II

Lecture 13 - Image Transforms - III

Lecture 14 - Image Transforms - IV

Lecture 15 - Image Enhancement

Lecture 16 - Image Filtering - I

Lecture 17 - Image Filtering - II

Lecture 18 - Colour Image Processing - I

Lecture 19 - Colour Image Processing - II

Lecture 20 - Image Segmentation

Lecture 21 - Image Features and Edge Detection

Lecture 22 - Edge Detection

Lecture 23 - Hough Transform

Lecture 24 - Image Texture Analysis - I

Lecture 25 - Image Texture Analysis - II

Lecture 26 - Object Boundary and Shape Representations - I

Lecture 27 - Object Boundary and Shape Representations - II

Lecture 28 - Interest Point Detectors

Lecture 29 - Image Features - HOG and SIFT

Lecture 30 - Introduction to Machine Learning - I

Lecture 31 - Introduction to Machine Learning - II

[Lecture 32 - Introduction to Machine Learning - III](#)

[Lecture 33 - Introduction to Machine Learning - IV](#)

[Lecture 34 - Introduction to Machine Learning - V](#)

[Lecture 35 - Artificial Neural Network for Pattern Classification - I](#)

[Lecture 36 - Artificial Neural Network for Pattern Classification - II](#)

[Lecture 37 - Introduction to Deep Learning](#)

[Lecture 38 - Gesture Recognition](#)

[Lecture 39 - Background Modelling and Motion Estimation](#)

[Lecture 40 - Object Tracking](#)

[Lecture 41 - Programming Examples](#)

Lecture 1 - Verilog Operators and Modules

Lecture 2 - Verilog Ports, Data types and Assignments

Lecture 3 - Basics of gate level modeling

Lecture 4 - Half adder, full adder and ripple carry adder

Lecture 5 - Parallel adder/subtractor

Lecture 6 - Multiplier and comparator

Lecture 7 - Decoder, encoder and multiplexer

Lecture 8 - Demultiplexer, read only memory

Lecture 9 - Review of flip-flops

Lecture 10 - Verilog modeling of flip-flops

Lecture 11 - Modeling of CMOS gates and Boolean functions

Lecture 12 - Modeling using transmission gates, CMOS delay times

Lecture 13 - Signal strengths

Lecture 14 - Basics of dataflow modeling

Lecture 15 - Examples of dataflow modeling

Lecture 16 - Basics of behavioral modeling

Lecture 17 - Examples of behavioral modeling

Lecture 18 - Verilog modeling of counters

Lecture 19 - Verilog modeling of sequence detector

Lecture 20 - Verilog modeling FSMs and shift registers

Lecture 21 - Combinational circuit examples

Lecture 22 - Sequential circuit examples

Lecture 23 - Arithmetic and Logic Unit (ALU)

Lecture 24 - Static RAM and Braun Multiplier

Lecture 25 - FIR filter implementation

Lecture 26 - Baugh-Wooley signed multiplier architecture

Lecture 27 - IIR filter implementation

Lecture 1 - Introduction to Usability

Lecture 2 - Usability - Historical Foundations

Lecture 3 - Standard Terminologies

Lecture 4 - Elements of User Experience

Lecture 5 - Usability in software development - I

Lecture 6 - Usability in software development - II

Lecture 7 - User Centered Design Process - I

Lecture 8 - User Centered Design Process - II

Lecture 9 - User Centered Design Process - III

Lecture 10 - Requirement Analysis - I (A)

Lecture 11 - Requirement Analysis - I (B)

Lecture 12 - Requirement Analysis - I (C)

Lecture 13 - Requirement Analysis - I (D)

Lecture 14 - Requirement Analysis - I (E)

Lecture 15 - Requirement Analysis - I (F)

Lecture 16 - Requirement Analysis - II (A)

Lecture 17 - Requirement Analysis - II (B)

Lecture 18 - Requirement Analysis - II (C)

Lecture 19 - Requirement Analysis - II (D)

Lecture 20 - Requirement Analysis - III (A)

Lecture 21 - Eye Tracker

Lecture 22 - Demonstration of an Eye tracking device

Lecture 23 - Requirement Analysis - III (B)

Lecture 24 - Mapping Experiences

Lecture 25 - Cognitive Issues - I

Lecture 26 - Cognitive Issues - II

Lecture 27 - Cognitive Issues - III

Lecture 28 - Cognitive Issues - IV

Lecture 29 - Competitive analysis and preparing for design briefing - I

Lecture 30 - Competitive analysis and preparing for design briefing - II

Lecture 31 - Conceptualization and Prototyping - I (A)

[Lecture 32 - Conceptualization and Prototyping - I \(B\)](#)

[Lecture 33 - Conceptualization and Prototyping - I \(C\)](#)

[Lecture 34 - Conceptualization and Prototyping - II \(A\)](#)

[Lecture 35 - Conceptualization and Prototyping - II \(B\)](#)

[Lecture 36 - Usability heuristics and testing - I](#)

[Lecture 37 - Usability heuristics and testing - II](#)

[Lecture 38 - Usability heuristics and testing - III](#)

[Lecture 39 - Usability Testing \(A\)](#)

[Lecture 40 - Usability Testing \(B\)](#)

[Lecture 41 - Usability Testing \(C\)](#)

[Lecture 42 - UI/UX design based on Garret model: a case study](#)

[Lecture 43 - Effective contextual enquiry](#)

[Lecture 44 - Contextual enquiry: case study](#)

Lecture 1 - Introduction

Lecture 2 - Algebra of Events

Lecture 3 - Axioms of Probability

Lecture 4 - Example 1

Lecture 5 - Example 2

Lecture 6 - Example 3

Lecture 7 - Example 4

Lecture 8 - Example 5

Lecture 9 - Conditional Probability

Lecture 10 - Bayes Theorem 1

Lecture 11 - Bayes Theorem 2

Lecture 12 - A Brief Review

Lecture 13 - Example 1

Lecture 14 - Example 2

Lecture 15 - Example 3

Lecture 16 - Example 4

Lecture 17 - Example 5

Lecture 18 - Independent Events

Lecture 19 - A Brief Review

Lecture 20 - Example 1

Lecture 21 - Example 2

Lecture 22 - Example 3

Lecture 23 - Example 4

Lecture 24 - Discrete Random Variables

Lecture 25 - Expectation

Lecture 26 - Moments

Lecture 27 - Variance

Lecture 28 - Binomial Random Variables

Lecture 29 - Poisson Random Variables

Lecture 30 - More on Poission Random Variables

Lecture 31 - Properties of the CDF

[Lecture 32 - A Brief Review - I](#)

[Lecture 33 - A Brief Review - II](#)

[Lecture 34 - Example 1](#)

[Lecture 35 - Example 2](#)

[Lecture 36 - Example 3](#)

[Lecture 37 - Example 4](#)

[Lecture 38 - Example 5](#)

[Lecture 39 - Example 6](#)

[Lecture 40 - Example 7](#)

[Lecture 41 - Example 8](#)

[Lecture 42 - Example 9](#)

[Lecture 43 - Continuous Random Variables](#)

[Lecture 44 - Expectation of Continuous random variables](#)

[Lecture 45 - The uniform and the Gaussian Random variables](#)

[Lecture 46 - The mean and variance of a Gaussian Random Variable](#)

[Lecture 47 - The exponential random variable and other continuous distributions](#)

[Lecture 48 - A Brief Review](#)

[Lecture 49 - Example 1](#)

[Lecture 50 - Example 2](#)

[Lecture 51 - Example 3](#)

[Lecture 52 - Example 4](#)

[Lecture 53 - Example 5](#)

[Lecture 54 - Functions of a random variable](#)

[Lecture 55 - Functions of a random variable](#)

[Lecture 56 - The moment generating function](#)

[Lecture 57 - Conditional Distributions](#)

[Lecture 58 - Bivariate Distributions](#)

[Lecture 59 - Independence of Random Variables](#)

[Lecture 60 - Jointly Gaussian Random Variables and Circular symmetry](#)

[Lecture 61 - Jointly Discrete Random Variables](#)

[Lecture 62 - One Function of two random variables](#)

[Lecture 63 - Order Statistics](#)

[Lecture 64 - Two functions of two random variables](#)

[Lecture 65 - Joint Moments](#)

[Lecture 66 - Joint Characteristic Functions](#)

[Lecture 67 - Conditional Distributions for multiple random variables](#)

[Lecture 68 - Conditional Expectations](#)

[Lecture 69 - Examples](#)

[Lecture 70 - Random Vectors](#)

[Lecture 71 - Independence of Random Variables](#)

[Lecture 72 - Complex Random Variables](#)

[Lecture 73 - Covariance Matrices](#)

[Lecture 74 - Conditional Densities](#)

[Lecture 75 - Gaussianity](#)

[Lecture 76 - Chi Squared Densities](#)

[Lecture 77 - Examples](#)

[Lecture 78 - Estimation Theory](#)

[Lecture 79 - Measurements](#)

[Lecture 80 - Sequences of Random Variables](#)

[Lecture 81 - Laws of large numbers](#)

[Lecture 82 - Random processes](#)

[Lecture 83 - Stationarity, Cyclostationarity, Ergodicity](#)

[Lecture 84 - Random Processes as Signals \(PSD and LTI Response\)](#)

[Lecture 85 - White and Gaussian Processes Noise](#)

Lecture 1 - Introduction

Lecture 2 - Basics of MATLAB

Lecture 3 - Data Types

Lecture 4 - Floating Point Numbers

Lecture 5 - Scripts and Flow of Control

Lecture 6 - The For Loop

Lecture 7 - Arrays

Lecture 8 - Indexing

Lecture 9 - Some Results from Linear Algebra

Lecture 10 - Matrix Multiplication

Lecture 11 - Eigenvalues and Eigenvectors

Lecture 12 - Complex Numbers

Lecture 13 - Hermitian Matrices

Lecture 14 - Matrix Inversion

Lecture 15 - Signals

Lecture 16 - Convolution

Lecture 17 - Probability

Lecture 18 - Bayes Theorem

Lecture 19 - Random Variables

Lecture 20 - Clinical Trials - I

Lecture 21 - Clinical Trials - II

Lecture 22 - Random Numbers

Lecture 23 - Random Distributions

Lecture 24 - Histograms - I

Lecture 25 - Histograms - II

Lecture 26 - Functions of Random Variables

Lecture 27 - Generating Random Distributions

Lecture 28 - Laws of Large numbers

Lecture 29 - Random Processes

Lecture 30 - Properties of Random Processes

Lecture 31 - Power Spectra

[Lecture 32 - Signals and Noise](#)

[Lecture 33 - Stochastic Models](#)

[Lecture 34 - The AR-1 Process](#)

[Lecture 35 - Stochastic Models II](#)

[Lecture 36 - Yule Walker Equations](#)

[Lecture 37 - Markov Chains - I](#)

[Lecture 38 - Markov Chains - II](#)

[Lecture 39 - Markov Chains - III](#)

[Lecture 40 - Analog to Digital Conversion](#)

[Lecture 41 - K Means](#)

[Lecture 42 - Correlation](#)

[Lecture 43 - Predictive Coding](#)

[Lecture 44 - Image Compression](#)

[Lecture 45 - Transform Domain Compression](#)

[Lecture 46 - Multi Resolution Coding](#)

[Lecture 47 - Introduction to Communications](#)

[Lecture 48 - Low Pass and BandPass Signals](#)

[Lecture 49 - Signal Spaces](#)

[Lecture 50 - PAM](#)

[Lecture 51 - Detection](#)

[Lecture 52 - Effects of AWGN](#)

[Lecture 53 - ML Detection - I](#)

[Lecture 54 - ML Detection - II](#)

[Lecture 55 - The Union Bound](#)

[Lecture 56 - Symbol Error Rates](#)

[Lecture 57 - Choosing Constellations](#)

[Lecture 58 - Orthogonal Signalling](#)

[Lecture 59 - Non-Coherent Detection - 1](#)

[Lecture 60 - Non-Coherent Detection - 2](#)

[Lecture 61 - DPSK - I](#)

[Lecture 62 - DPSK - II](#)

[Lecture 63 - Introduction to Wireless Communications](#)

[Lecture 64 - Conclusion](#)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Machine Learning and Deep Learning - Fundamentals and Applications (Electrical Engineering)

Co-ordinators : Prof. M.K. Bhuyan

Lecture 1 - Introduction to Machine Learning

Lecture 2 - Performance Measures of Classification

Lecture 3 - Bias-Variance Tradeoff

Lecture 4 - Regression

Lecture 5 - Bayesian Decision Theory - 1

Lecture 6 - Bayesian Decision Theory - 2

Lecture 7 - Bayes Decision Theory - Binary Features

Lecture 8 - Bayesian Decision Theory - 3

Lecture 9 - Bayesian Decision Theory - 4

Lecture 10 - Bayesian Belief Networks

Lecture 11 - Parameter Estimation and Maximum Likelihood Estimation

Lecture 12 - Parameter Estimation and Bayesian Estimation

Lecture 13 - Concept of non-parametric techniques

Lecture 14 - Density Estimation by Parzen Window

Lecture 15 - Parzen Window and K nearest neighbor algorithm

Lecture 16 - Linear Discriminant Functions and Perceptron Criteria - Part I

Lecture 17 - Linear Discriminant Functions and Perceptron Criteria - Part II

Lecture 18 - Linear Discriminant Functions and Perceptron Criteria - Part III

Lecture 19 - Support Vector Machine - Part I

Lecture 20 - Support Vector Machine - Part II

Lecture 21 - Logistic Regression

Lecture 22 - Decision Tree

Lecture 23 - Hidden Markov Model (HMM)

Lecture 24 - Ensemble Classifiers - Part I

Lecture 25 - Ensemble Classifiers - Part II

Lecture 26 - Dimensionality Problem and Principal Component Analysis

Lecture 27 - Principal Component Analysis

Lecture 28 - Linear Discriminant Analysis (LDA) - Part I

Lecture 29 - Linear Discriminant Analysis (LDA) - Part II

Lecture 30 - Gaussian Mixture Model and EM Algorithm

Lecture 31 - K-means clustering.

[Lecture 32 - Fuzzy K-means clustering](#)

[Lecture 33 - Hierarchical Agglomerative Clustering and Mean-shift Clustering](#)

[Lecture 34 - Artificial Neural Networks for Pattern Classification - Part 1](#)

[Lecture 35 - Artificial Neural Networks for Pattern Classification - Part 2](#)

[Lecture 36 - Artificial Neural Networks for Pattern Classification - Part 3](#)

[Lecture 37 - Introduction to Deep Learning and Convolutional Neural Network \(CNN\)](#)

[Lecture 38 - Vanishing and Exploding Gradients in Deep Neural Networks](#)

[Lecture 39 - CNN Architectures - LeNet-5 and AlexNet](#)

[Lecture 40 - CNN Architectures - VGG 16, GoogLeNet and ResNet](#)

[Lecture 41 - Generative Adversarial Networks \(GAN\) - Fundamentals and Applications](#)

[Lecture 42 - U-Net: Convolutional Networks for Image Segmentation](#)

[Lecture 43 - Introduction to Autoencoder and Recurrent Neural Networks \(RNN\)](#)

[Lecture 44 - Programming Concepts - 1](#)

[Lecture 45 - Programming Concepts - 2](#)

[Lecture 46 - Problem Solving Session - 1](#)

[Lecture 47 - Problem Solving Session - 2](#)

[Lecture 48 - Problem Solving Session - 3](#)

- Lecture 1 - Introduction to Integrated Circuits
- Lecture 2 - Summing and Difference Amplifiers
- Lecture 3 - Instrumentation Amplifier
- Lecture 4 - Integrator and Differentiator
- Lecture 5 - Precision Half Wave and Full Wave Rectifiers
- Lecture 6 - Clipper and Clamper circuits
- Lecture 7 - Logarithmic and Anti-logarithmic Amplifiers
- Lecture 8 - DC Characteristics (Offset Currents and Voltages)
- Lecture 9 - AC Characteristics (Frequency Response)
- Lecture 10 - AC Characteristics (Compensation Techniques and Slew Rate)
- Lecture 11 - Examples on Design of Adder and Subtractor Circuits
- Lecture 12 - Examples on Transfer Function Computation
- Lecture 13 - Examples on Instrumentation Amplifier
- Lecture 14 - Examples on CMRR Computation
- Lecture 15 - First Order Low Pass Filter
- Lecture 16 - Second Order Low Pass Filter
- Lecture 17 - Design of Butterworth Low Pass Filter
- Lecture 18 - Design of Butterworth High Pass Filter
- Lecture 19 - Design of Band Pass Filter
- Lecture 20 - Design of Band Stop Filter
- Lecture 21 - All Pass Filter
- Lecture 22 - RC Phase Shift Oscillator
- Lecture 23 - Wien Bridge, Colpitt's and Hartley Oscillators
- Lecture 24 - Comparator and Schmitt Trigger Circuits
- Lecture 25 - Square Wave and Triangular Waveform Generators
- Lecture 26 - Monostable operation
- Lecture 27 - Monostable applications - I
- Lecture 28 - Monostable applications - II
- Lecture 29 - Astable operation
- Lecture 30 - Phase detectors
- Lecture 31 - Voltage Controlled oscillator

[Lecture 32 - PLL IC 565 operation](#)

[Lecture 33 - PLL Applications](#)

[Lecture 34 - Fixed Voltage Regulator](#)

[Lecture 35 - Adjustable Voltage Regulator](#)

[Lecture 36 - Switching Regulators](#)

[Lecture 37 - Weighted Resistor D/A Converter](#)

[Lecture 38 - R-2R Ladder D/A Converter](#)

[Lecture 39 - Inverted R-2R Ladder D/A Converter](#)

[Lecture 40 - Analog to Digital Converters](#)

[Lecture 41 - CMOS Inverter](#)

[Lecture 42 - CMOS NAND Gate](#)

[Lecture 43 - Transient Response of CMOS NAND and NOR Gates](#)

[Lecture 44 - Boolean function Realization using CMOS and Sizing](#)

- Lecture 1 - Motivation and Introduction to Photonic Crystals
- Lecture 2 - Overview of Photonic Crystal technology
- Lecture 3 - Fundamentals of EM theory of Light
- Lecture 4 - Electromagnetic Properties of Materials
- Lecture 5 - Scaling Properties of Maxwell's Equations
- Lecture 6 - Electromagnetism as an Eigenvalue Problem
- Lecture 7 - Symmetries for Classification of EM Modes
- Lecture 8 - Real and Reciprocal lattices
- Lecture 9 - Photonic band Structure: Computation and Analysis
- Lecture 10 - Fundamentals of 1D Photonic Crystal
- Lecture 11 - Analysis and Engineering of 1D Photonic Band Structure
- Lecture 12 - Applications of 1D Photonic Crystal
- Lecture 13 - Fundamentals of 2D photonic crystals
- Lecture 14 - Analysis and Engineering of 2D Photonic Band Structure
- Lecture 15 - Applications of 2D photonic crystals
- Lecture 16 - Overview of different 3D Photonic Crystals
- Lecture 17 - Crystals with complete bandgap
- Lecture 18 - Applications of 2D and 3D photonic crystals
- Lecture 19 - Overview and Modelling of Periodic Dielectric Waveguides
- Lecture 20 - Point Defects in Periodic Dielectric Waveguides and Q-factors of Lossy Cavities
- Lecture 21 - Applications: Fiber Bragg Grating
- Lecture 22 - Overview of Photonic Crystal Slabs
- Lecture 23 - Different types of defects in Photonic Crystal Slabs
- Lecture 24 - Engineering High-Q resonant Cavity
- Lecture 25 - Overview of photonic crystal fibers
- Lecture 26 - Index-guiding photonic crystal fibers
- Lecture 27 - Band-gap guidance in Holey Fibers
- Lecture 28 - Overview of Bragg Fibers
- Lecture 29 - Losses in Hollow-core Fibers
- Lecture 30 - Applications of Photonic Crystal Fibers
- Lecture 31 - Designing a mirror, waveguide, a cavity

[Lecture 32 - Temporal Coupled Mode Theory: Fundamentals and Applications](#)

[Lecture 33 - Waveguide Splitters, Non-linear Filters, and Bistability](#)

[Lecture 34 - Unusual Refraction and Diffraction Effects](#)

[Lecture 35 - Photonic Crystal Devices for Slow Wave Phenomena](#)

[Lecture 36 - Next Generation Devices based on Photonic Crystals](#)

[Lecture 37 - Simulation Demonstration of Topological Photonic Crystals Based Waveguides - Part 1](#)

[Lecture 38 - Simulation Demonstration of Topological Photonic Crystals Based Waveguides - Part 2](#)

NPTEL : Advanced Electric Drives (Electrical Engineering)

Co-ordinators : Dr. S.P. Das

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

Lecture 1 - High Voltage DC Transmission

Lecture 2 - High Voltage DC Transmission

Lecture 3 - High Voltage DC Transmission

Lecture 4 - High Voltage DC Transmission

Lecture 5 - High Voltage DC Transmission

Lecture 6 - High Voltage DC Transmission

Lecture 7 - High Voltage DC Transmission

Lecture 8 - High Voltage DC Transmission

Lecture 9 - High Voltage DC Transmission

Lecture 10 - High Voltage DC Transmission

Lecture 11 - High Voltage DC Transmission

Lecture 12 - High Voltage DC Transmission

Lecture 13 - High Voltage DC Transmission

Lecture 14 - High Voltage DC Transmission

Lecture 15 - High Voltage DC Transmission

Lecture 16 - High Voltage DC Transmission

Lecture 17 - High Voltage DC Transmission

Lecture 18 - High Voltage DC Transmission

Lecture 19 - High Voltage DC Transmission

Lecture 20 - High Voltage DC Transmission

Lecture 21 - High Voltage DC Transmission

Lecture 22 - High Voltage DC Transmission

Lecture 23 - High Voltage DC Transmission

Lecture 24 - High Voltage DC Transmission

Lecture 25 - High Voltage DC Transmission

Lecture 26 - High Voltage DC Transmission

Lecture 27 - High Voltage DC Transmission

Lecture 28 - High Voltage DC Transmission

Lecture 29 - High Voltage DC Transmission

Lecture 30 - High Voltage DC Transmission

Lecture 31 - High Voltage DC Transmission

[Lecture 32 - High Voltage DC Transmission](#)

[Lecture 33 - High Voltage DC Transmission](#)

[Lecture 34 - High Voltage DC Transmission](#)

[Lecture 35 - High Voltage DC Transmission](#)

[Lecture 36 - High Voltage DC Transmission](#)

[Lecture 37 - High Voltage DC Transmission](#)

- Lecture 1 - Introduction to Intelligent Systems and Control
- Lecture 2 - Linear Neural networks
- Lecture 3 - Multi layered Neural Networks
- Lecture 4 - Back Propagation Algorithm revisited
- Lecture 5 - Non Linear System Analysis - Part I
- Lecture 6 - Non Linear System Analysis - Part II
- Lecture 7 - Radial Basis Function Networks
- Lecture 8 - Adaptive Learning rate
- Lecture 9 - Weight update rules
- Lecture 10 - Recurrent networks Back propagation through time
- Lecture 11 - Recurrent networks Real time recurrent learning
- Lecture 12 - Self organizing Map - Multidimensional networks
- Lecture 13 - Fuzzy sets - A Primer
- Lecture 14 - Fuzzy Relations
- Lecture 15 - Fuzzy Rule base and Approximate Reasoning
- Lecture 16 - Introduction to Fuzzy Logic Control
- Lecture 17 - Neural Control A review
- Lecture 18 - Network inversion and Control
- Lecture 19 - Neural Model of a Robot manipulator
- Lecture 20 - Indirect Adaptive Control of a Robot manipulator
- Lecture 21 - Adaptive neural control for Affine Systems SISO
- Lecture 22 - Adaptive neural control for Affine systems MIMO
- Lecture 23 - Visual Motor Coordination with KSOM
- Lecture 24 - Visual Motor coordination - quantum clustering
- Lecture 25 - Direct Adaptive control of Manipulators - Intro
- Lecture 26 - NN based back stepping control
- Lecture 27 - Fuzzy Control - a Review
- Lecture 28 - Mamdani type flc and parameter optimization
- Lecture 29 - Fuzzy Control of a pH reactor
- Lecture 30 - Fuzzy Lyapunov controller - Computing with words
- Lecture 31 - Controller Design for a T-S Fuzzy model

[Lecture 32 - Linear controllers using T-S fuzzy model](#)

[Module 1 - Lecture 1](#)

[Module 1 - Lecture 2](#)

[Module 1 - Lecture 3](#)

[Module 2 - Lecture 1](#)

[Module 2 - Lecture 2](#)

[Module 2 - Lecture 3](#)

[Module 2 - Lecture 4](#)

[Module 2 - Lecture 5](#)

[Module 2 - Lecture 6](#)

[Module 2 - Lecture 7](#)

[Module 2 - Lecture 8](#)

[Module 2 - Lecture 9](#)

[Module 2 - Lecture 10](#)

[Module 2 - Lecture 11](#)

[Module 2 - Lecture 12](#)

[Module 2 - Lecture 13](#)

[Module 2 - Lecture 14](#)

[Module 3 - Lecture 1](#)

[Module 3 - Lecture 2](#)

[Module 3 - Lecture 3](#)

[Module 3 - Lecture 4](#)

[Module 3 - Lecture 5](#)

[Module 3 - Lecture 6](#)

[Module 3 - Lecture 7](#)

[Module 3 - Lecture 8](#)

[Module 3 - Lecture 9](#)

[Module 3 - Lecture 10](#)

[Module 4 - Lecture 1](#)

[Module 4 - Lecture 2](#)

[Module 4 - Lecture 3](#)

[Module 4 - Lecture 4](#)

[Module 5 - Lecture 1](#)

[Module 5 - Lecture 2](#)

[Module 6 - Lecture 1](#)

[Module 6 - Lecture 2](#)

Lecture 1 - Introduction to EMT

Lecture 2 - Coulombs law

Lecture 3 - Vector analysis-I and Introduction to coordinate system

Lecture 4 - Rectangular coordinate system

Lecture 5 - Vector analysis-II

Lecture 6 - Introduction to Electric field

Lecture 7 - Electric field-I

Lecture 8 - Cylindrical coordinate system

Lecture 9 - Transformation and Electric field-II

Lecture 10 - Electric Potential-I

Lecture 11 - Spherical co-ordinate system and Electric potential-II

Lecture 12 - Vector Analysis-III and Electric potential-III

Lecture 13 - Gauss's law and its application-I

Lecture 14 - Gauss's law and its application-II

Lecture 15 - Divergence and Poisson's and Laplace's equation

Lecture 16 - Gauss's law and its application -III

Lecture 17 - Vector analysis -III (curl and its significance)

Lecture 18 - Conductor and dielectric-I

Lecture 19 - Polarization - I

Lecture 20 - Polarization - II

Lecture 21 - Polarization - II (Continued...)

Lecture 22 - Boundary condition

Lecture 23 - Continuity equation and Conductors - III

Lecture 24 - Conductors - IV

Lecture 25 - Conductors - IV (Continued...) and Capacitor - I

Lecture 26 - Capacitor - II

Lecture 27 - Capacitor - II (Continued...) and Equipotential Surfaces

Lecture 28 - Solution of Laplace's equation-I

Lecture 29 - Solution of Laplace's equation-I I and method of images-I

Lecture 30 - Method of images-II

Lecture 31 - Solution of Laplace's equation-III

- Lecture 32 - Solution of Laplace's equation-IV
- Lecture 33 - Introduction of magnetic field
- Lecture 34 - Biot savart law and its application
- Lecture 35 - Biot savart law and its application-II
- Lecture 36 - Magnetic vector potential
- Lecture 37 - Magnetic force, torque and dipole
- Lecture 38 - Magnetic force, torque and dipole (Continued...)
- Lecture 39 - Magnetic materials-I
- Lecture 40 - Magnetic materials-I (Continued...) and Magnetic moment
- Lecture 41 - Magnetic materials-I (Continued...) and Boundary condition for Magnetic fields
- Lecture 42 - Inductor and calculation of inductance for different shapes
- Lecture 43 - Inductor and calculation of inductance for different shapes (Continued...)
- Lecture 44 - Faradays law and its application-I
- Lecture 45 - Faradays law and its application-II
- Lecture 46 - Displacement current
- Lecture 47 - Maxwell's equation
- Lecture 48 - Wave propagation
- Lecture 49 - Solution of Helmholtz equation
- Lecture 50 - Uniform plane waves
- Lecture 51 - Polarization and Poynting Vector
- Lecture 52 - Wave reflections (Normal incidence)
- Lecture 53 - Waves in imperfect dielectrics and Good conductors
- Lecture 54 - Skin depth/effect
- Lecture 55 - Oblique incidence of waves
- Lecture 56 - Oblique incidence of waves (Continued...)
- Lecture 57 - Transmission line
- Lecture 58 - Transmission line model
- Lecture 59 - Steady state sinusoidal response of T-line-I
- Lecture 60 - Steady state sinusoidal response of T-line-II
- Lecture 61 - Steady state sinusoidal response of T-line-II and Smith chart
- Lecture 62 - Application of smith chart-I
- Lecture 63 - Application of smith chart-II
- Lecture 64 - Impedance matching

- Lecture 65 - Transients on Transmission line-I
- Lecture 66 - Transients on Transmission line-II
- Lecture 67 - Pulse on Transmission line
- Lecture 68 - Capacitive termination in Transmission line
- Lecture 69 - Waveguide
- Lecture 70 - Waveguide Analysis
- Lecture 71 - TM modes in Waveguide
- Lecture 72 - Rectangular waveguide: TM modes
- Lecture 73 - Rectangular waveguide: TE modes
- Lecture 74 - Waveguide: Wavelength, Impedance and power calculation
- Lecture 75 - Waveguide losses
- Lecture 76 - Dielectric Waveguide
- Lecture 77 - Dielectric Waveguide (Continued...)
- Lecture 78 - Radiation and Antenna
- Lecture 79 - Hertzian Dipole Antenna
- Lecture 80 - Hertzian Dipole Antenna (Continued...)
- Lecture 81 - Quasi-statistics-I
- Lecture 82 - Quasi-statistics-II
- Lecture 83 - Long wire Antenna
- Lecture 84 - Group velocity and Phase velocity
- Lecture 85 - Numerical solution of Laplace's equation

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Principles of Communication - Part 1 (Electrical Engineering)

Co-ordinators : Prof. Aditya K. Jagannatham

Lecture 1 - Basics - Definition of Energy and Power of Signals

Lecture 2 - Frequency Domain Representation and Introduction to Discrete Fourier Series

Lecture 3 - Discrete Fourier Series Example and Parseval's Theorem for Periodic Signals

Lecture 4 - Fourier Transform (FT), Inverse Fourier Transform (IFT) of Continuous Signals, Example of FT of Pulse and Sinc Function

Lecture 5 - Modulation Property of Fourier Transform, Dirac Delta or Unit Impulse Function - Definition and Fourier Transform

Lecture 6 - Duality Property of Fourier Transform and Introduction to Linear Time Invariant (LTI) Systems

Lecture 7 - Transmission of Signal through Linear Time Invariant (LTI) Systems and Cross- Correlation of Signals

Lecture 8 - Auto-Correlation of Signal and Energy Spectral Density (ESD)

Lecture 9 - Example for Auto-Correlation of Signal and Energy Spectral Density (ESD)

Lecture 10 - Introduction to Amplitude Modulation (AM), Modulation Index, Envelope Distortion and Over Modulation

Lecture 11 - Spectrum of Amplitude Modulated(AM) Signals and Introduction to Envelope Detection

Lecture 12 - Envelope Detection for Amplitude Modulated (AM) Signals and Time Constant for Capacitor in Envelope Detector

Lecture 13 - Power of Amplitude Modulated (AM) Signals and Power Efficiency of AM Signals

Lecture 14 - Double Sideband (DSB) Suppressed Carrier (SC) Modulation, Spectrum of DSB-SC Signals and Coherent Demodulation

Lecture 15 - Double Sideband(DSB) Suppressed Carrier (SC) Demodulation, Non-coherent demodulation, Impact of Carrier Phase Offset

Lecture 16 - Carrier Phase Offset Example for Double Sideband (DSB) Suppressed Carrier (SC) Demodulation- Wireless Cellular Communication with User Mobility

Lecture 17 - Phase Synchronization using Costas Receiver for Double Sideband (DSB) Suppressed Carrier (SC) Demodulation

Lecture 18 - Introduction to Quadrature Carrier Multiplexing (QCM) and Demodulation of QCM Signals.

Lecture 19 - Introduction to Single Sideband (SSB) Modulation

Lecture 20 - Generation of Single Sideband (SSB) Modulation Signals through Frequency Discrimination

Lecture 21 - Frequency Domain Description of Hilbert Transform \hat{A} – Fourier Spectrum of the Hilbert Transformer

Lecture 22 - Time Domain Description of Hilbert Transform \hat{A} – Impulse Response of the Hilbert Transformer

Lecture 23 - Phase Shifting Method for Generation of Single Sideband (SSB) Modulated Signals based on Hilbert Transform

Lecture 24 - Complex Pre-Envelope and Complex Envelope of Passband Signals

Lecture 25 - Complex Pre- Envelope and Complex Envelope of QCM (Quadrature Carrier Modulated) Signals

Lecture 26 - Introduction to Vestigial Side Band(VSB) Modulation and Non- Ideal Filtering, Spectral Efficiency

Lecture 27 - Properties of Vestigial Side Band Filter for Reconstruction of Message Signal without Distortion

Lecture 28 - Introduction to Angle Modulation, Description of Phase Modulation (PM) and Frequency Modulation (FM)

Lecture 29 - Frequency Modulation (FM) with Sinusoidal Modulation Signal and Pictorial Examples, Insights of PM and FM signals

Lecture 30 - Indirect Method for Generation of FM Signals - Generation of Narrowband FM Signal

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

- Lecture 31 - Indirect Method for Generation of FM Signals - Generation of Wideband FM Signal through Frequency Multiplication
- Lecture 32 - Spectrum of Frequency Modulated (FM) Signals
- Lecture 33 - Bandwidth of Frequency Modulated (FM) Signals - Carson's Rule
- Lecture 34 - Demodulation of Frequency Modulated (FM) Signals, Condition of Envelope Detection
- Lecture 35 - Analog to Digital Conversion of Signals and Introduction to Sampling
- Lecture 36 - Spectrum of Sampled Signal, Aliasing and Nyquist Sampling Theorem
- Lecture 37 - Ideal Impulse Train Sampling, Reconstruction of Original Signal from Samples, Sinc Interpolation
- Lecture 38 - Introduction to Pulse Amplitude Modulation (PAM), Sample and Hold, Flat Top Sampling
- Lecture 39 - Pulse Amplitude Modulation (PAM), Spectrum of PAM Signal, Reconstruction of Original Signal from PAM Signal, Equalization
- Lecture 40 - Introduction to Quantization, Uniform Quantizer, Mid-Tread Quantizer
- Lecture 41 - Quantization, Mid-Rise Quantizer, PDF and Power of Quantization Noise, Quantization Noise Power versus Quantizer Resolution
- Lecture 42 - Introduction to Lloyd-Max Quantization Algorithm, Optimal Quantizer Design
- Lecture 43 - Lloyd-Max Quantization Algorithm, Iterative Computation of Optimal Quantization Levels and Intervals
- Lecture 44 - Companding for Non-Uniform Quantization, Mu-law Compressor, A-law Compressor
- Lecture 45 - Introduction to Delta Modulation, One-bit Quantizer
- Lecture 46 - Signal Reconstruction in Delta Modulation, Schematic Diagrams, Slope Overload Distortion and Granular Noise
- Lecture 47 - Differential Pulse Coded Modulation (DPCM), DPCM Signal Reconstruction and Schematic Diagram
- Lecture 48 - Frequency Mixing and Translation in Communication Systems, Heterodyne and Super Heterodyne Receivers
- Lecture 49 - Frequency Translation and Super Heterodyne Receivers, Problem of Image Frequency
- Lecture 50 - Frequency Division Multiplexing (FDM), Carrier Spacing in FDM
- Lecture 51 - Time Division Multiplexing (TDM), Operation of TDM, Sample Spacing in TDM
- Lecture 52 - Bandwidth Requirements for Time Division Multiplexing (TDM), The T1 TDM System : A Case Study

- Lecture 1 - Introduction to Error Control Coding - I
- Lecture 2 - Introduction to Error Control Coding - II
- Lecture 3 - Introduction to Error Control Coding - III
- Lecture 4 - Introduction to Linear Block Codes, Generator Matrix and Parity Check Matrix
- Lecture 5 - Syndrome, Error Correction and Error Detection
- Lecture 6 - Problem Solving Session - I
- Lecture 7 - Decoding of Linear Block Codes
- Lecture 8 - Distance Properties of Linear Block Codes - I
- Lecture 9 - Distance Properties of Linear Block Codes - II
- Lecture 10 - Problem Solving Session - II
- Lecture 11 - Some Simple Linear Block Codes - I
- Lecture 12 - Some Simple Linear Block Codes - II: Reed Muller Codes
- Lecture 13 - Bounds on the Size of a Code
- Lecture 14 - Problem Solving Session - III
- Lecture 15 - Introduction to Convolutional Codes - I: Encoding
- Lecture 16 - Introduction to Convolutional Codes - II: State Diagram, Trellis Diagram
- Lecture 17 - Convolutional Codes: Classification, Realization
- Lecture 18 - Convolutional Codes:Distance Properties
- Lecture 19 - Decoding of Convolutional Codes - I: Viterbi Algorithm
- Lecture 20 - Decoding of Convolutional Codes - II: BCJR Algorithm
- Lecture 21 - Problem solving session - IV
- Lecture 22 - Problem solving session - V
- Lecture 23 - Performance Bounds for Convolutional Codes
- Lecture 24 - Low Density Parity Check Codes
- Lecture 25 - Decoding of Low Density Parity Check Codes - I
- Lecture 26 - Decoding of Low Density Parity Check Codes - II: Belief Propagation Algorithm
- Lecture 27 - Turbo Codes
- Lecture 28 - Turbo Decoding
- Lecture 29 - Problem Solving Sessions - VI
- Lecture 30 - Distance Properties of Turbo Codes
- Lecture 31 - Convergence of Turbo Codes

[Lecture 32 - Automatic Repeat reQuest \(ARQ\) Schemes](#)

[Lecture 33 - Applications of Linear Codes](#)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Principles of Communication Systems - Part II (Electrical Engineering)

Co-ordinators : Prof. Aditya K. Jagannatham

Lecture 1 - Introduction to Digital Communication Systems

Lecture 2 - Spectrum of Transmitted Digital Communication Signal and Wide Sense Stationarity

Lecture 3 - Spectrum of Transmitted Digital Communication Signal, Autocorrelation Function and Power Spectral Density

Lecture 4 - Spectrum of Transmitted Digital Communication Signal, Relation to Energy Spectral Density and Introduction to AWGN Channel

Lecture 5 - Additive White Gaussian Noise (AWGN) Properties, Gaussian Noise and White Noise

Lecture 6 - Structure of Digital Communication Receiver, Receiver Filter and Signal-to-Noise Power Ratio (SNR)

Lecture 7 - Digital Communication Receiver, Noise Properties and Output Noise Power

Lecture 8 - Digital Communication Receiver, Optimal SNR and Matched Filter

Lecture 9 - Probability of Error in Digital Communication and Probability Density Functions of Output

Lecture 10 - Probability of Error in Digital Communication, Optimal Decision Rule and Gaussian Q function

Lecture 11 - Introduction to Binary Phase Shift Keying (BPSK) Modulation, Optimal Decision Rule and Probability of Bit-Error or Bit-Error Rate (BER)

Lecture 12 - Introduction to Amplitude Shift Keying (ASK) Modulation

Lecture 13 - Optimal Decision Rule for Amplitude Shift Keying (ASK), Bit Error Rate (BER) and Comparison with Binary Phase Shift Keying (BPSK) Modulation

Lecture 14 - Introduction to Signal Space Concept and Orthonormal Basis Signals

Lecture 15 - Introduction to Frequency Shift Keying (FSK)

Lecture 16 - Optimal Decision Rule for FSK, Bit Error Rate (BER) and Comparison with BPSK, ASK

Lecture 17 - Introduction to Quadrature Phase Shift Keying (QPSK)

Lecture 18 - Waveforms of Quadrature Phase Shift Keying (QPSK)

Lecture 19 - Matched Filtering, Bit Error Rate and Symbol Error Rate for Quadrature Phase Shift Keying (QPSK)

Lecture 20 - Introduction to M-ary PAM (Pulse Amplitude Modulation), Average Symbol Power and Decision rules

Lecture 21 - M-ary PAM (Pulse Amplitude Modulation) -Part-II, Optimal Decision Rule and Probability of Error

Lecture 22 - M-ary QAM (Quadrature Amplitude Modulation) Part-I, Introduction, Transmitted Waveform and Average Symbol Energy

Lecture 23 - M-ary QAM (Quadrature Amplitude Modulation) - Part-II, Optimal Decision Rule, Probability of Error and Constellation Diagram

Lecture 24 - M-ary PSK (Phase Shift Keying) Part-I, Introduction , Transmitted Waveform and Constellation Diagram

Lecture 25 - M-ary PSK (Phase Shift Keying) - Part-II, Optimal Decision Rule, Nearest Neighbor Criterion and Approximate Probability of Error

Lecture 26 - Introduction to Information Theory, Relevance of Information Theory and Characterization of Information

Lecture 27 - Definition of Entropy, Average of Information / Uncertainty of source and Properties of Entropy

Lecture 28 - Entropy Example- Binary Source Maximum and Minimum Entropy of Binary Source

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

- Lecture 29 - Maximum Entropy of Source with M-ary Alphabet, Concave/Convex Functions and Jensens Inequality
- Lecture 30 - Joint Entropy , Definition of Joint Entropy of Two Sources and Simple Examples for Joint Entropy Computation
- Lecture 31 - Properties of Joint Entropy and Relation between Joint Entropy and Marginal Entropies
- Lecture 32 - Conditional Entropy, Example of Conditional Entropy and Properties of Conditional Entropy
- Lecture 33 - Mutual Information, Diagrammatic Representation and Properties of Mutual Information
- Lecture 34 - Simple Example of Mutual Information and Practical Example of Mutual Information-Binary Symmetric Channel
- Lecture 35 - Channel Capacity, Implications of Channel Capacity, Claude E. Shannon- Father of Information Theory and Example of Capacity of Binary Symmetric Channel
- Lecture 36 - Differential Entropy and Example for Uniform Probability Density function
- Lecture 37 - Differential Entropy of Gaussian Source and Insights
- Lecture 38 - Joint Conditional/ Differential Entropies and Mutual Information
- Lecture 39 - Capacity of Gaussian channel - Part I
- Lecture 40 - Capacity of Gaussian Channel - Part-II, Practical Implications and Maximum rate in bits/sec
- Lecture 41 - Introduction to Source Coding and Data Compression, Variable Length codes and Unique Decodability
- Lecture 42 - Uniquely Decodable Codes, Prefix-free code, Instantaneous Code and Average Code length
- Lecture 43 - Binary Tree Representation of Code, Example and Kraft Inequality
- Lecture 44 - Lower Bound on Average Code Length and Kullback-Leibler Divergence
- Lecture 45 - Optimal Code length, Constrained Optimization and Morse Code Example
- Lecture 46 - Approaching Lower Bound on Average code length and Block Coding
- Lecture 47 - Huffman Code, Algorithm, Example and Average Code Length
- Lecture 48 - Introduction to channel coding, Rate of Code, Repetition Code and Hamming Distance
- Lecture 49 - Introduction to Convolutional Codes, Binary Field Arithmetic and Linear Codes
- Lecture 50 - Example of Convolutional Code Output and Convolution Operation for Code generation
- Lecture 51 - Matrix Representation of Convolutional Codes, Generator Matrix, Transform Domain Representation and Shift Register Architecture
- Lecture 52 - State Diagram Representation of Convolutional Code, State transitions and Example of Code Generation using State transitions
- Lecture 53 - Trellis Representation of Convolutional Code and Valid Code Words
- Lecture 54 - Decoding of the Convolutional Code, Minimum Hamming distance and Maximum Likelihood Codeword Estimate
- Lecture 55 - Principle of Decoding of Convolutional code
- Lecture 56 - Viterbi Decoder for Maximum Likelihood Decoding of Convolutional Code Using Trellis Representation, Branch Metric Calculation, State Metric Calculation and Example

- Lecture 1 - Introduction to Applied Electromagnetics
- Lecture 2 - Introduction to Transmission lines
- Lecture 3 - Sinusoidal waves on Transmission lines
- Lecture 4 - Terminating T-lines: Reflection and Transmission coefficient
- Lecture 5 - Circuit parameters of a T-line
- Lecture 6 - Lossy Transmission lines and primary constants
- Lecture 7 - When to apply T-line Theory?
- Lecture 8 - Standing Waves on T-lines
- Lecture 9 - Lumped equivalent circuits of T-lines
- Lecture 10 - Impedance transformation and power flow on T-lines
- Lecture 11 - Graphical aid: Smith Chart Derivation
- Lecture 12 - Smith chart applications
- Lecture 13 - Further applications of Smith chart - Part 1
- Lecture 14 - Further applications of Smith chart - Part 2
- Lecture 15 - Impedance matching techniques - Part 1
- Lecture 16 - Impedance matching techniques - Part 2
- Lecture 17 - Impedance matching techniques - Part 3
- Lecture 18 - T-lines in time domain: Lattice diagrams
- Lecture 19 - Further examples of use of lattice diagrams
- Lecture 20 - High-speed digital signal propagation on T-lines
- Lecture 21 - Transient analysis with reactive termination and Time-domain reflectometry
- Lecture 22 - Fault detection using TDR
- Lecture 23 - Why Electromagnetics?
- Lecture 24 - Rectangular coordinate systems
- Lecture 25 - Cylindrical coordinate systems
- Lecture 26 - Review of vector fields and Gradient
- Lecture 27 - Divergence, Curl, and Laplacian operations
- Lecture 28 - Towards Maxwells equations - Part 1
- Lecture 29 - Towards Maxwells equations - Part 2
- Lecture 30 - Faradays law
- Lecture 31 - Completing Maxwells equations and Boundary conditions

- Lecture 32 - Boundary conditions for Electromagnetic fields
- Lecture 33 - Electrostatics-I: Laplace and Poissons equations
- Lecture 34 - Electrostatics-II: Solving Laplaces equation in 1D
- Lecture 35 - Electrostatics-III: Solving Laplaces equation in 2D
- Lecture 36 - Electrostatics-IV: Finite Difference method for solving Laplaces equation
- Lecture 37 - Magnetostatic fields-I: Biot-Savart Law
- Lecture 38 - Magnetostatic fields-II: Calculation of magnetic fields
- Lecture 39 - Inductance calculations
- Lecture 40 - From Maxwells equations to uniform plane waves
- Lecture 41 - Plane wave propagation in lossless dielectric media
- Lecture 42 - Polarization of plane waves
- Lecture 43 - Can an Ideal capacitor exist?
- Lecture 44 - Skin effect in conductors
- Lecture 45 - Skin effect in round wires
- Lecture 46 - Finite difference method
- Lecture 47 - Reflection of uniform plane waves
- Lecture 48 - Application: Reflection from multiple media and anti-reflection coating.
- Lecture 49 - Oblique incidence of plane waves
- Lecture 50 - Total internal reflection
- Lecture 51 - Application: Matrix analysis of reflection from multiple boundaries
- Lecture 52 - Application: Fabry-Perot cavity and Multi-layer films
- Lecture 53 - Introduction to waveguides
- Lecture 54 - Rectangular waveguides
- Lecture 55 - Attenuation and Dispersion in rectangular waveguides
- Lecture 56 - Planar optical waveguides
- Lecture 57 - Application: Optical Fibers
- Lecture 58 - Application: WDM Optical Components
- Lecture 59 - Mach-Zehnder Modulator
- Lecture 60 - Wave Propagation in Anisotropic Medium
- Lecture 61 - Wave Propagation in Ferrites
- Lecture 62 - Magnetic Vector Potential - Part 1
- Lecture 63 - Magnetic Vector Potential - Part 2
- Lecture 64 - Fields of a Dipole Antenna

[Lecture 65 - Antenna Parameters and Long wire Antenna](#)

[Lecture 66 - Friis Transmission Formula](#)

Lecture 1 - Principles of Signals and Systems- Introduction to Signals and Systems, Signal Classification - Continuous and Discrete Time Signals

Lecture 2 - Analog and Digital Signals

Lecture 3 - Energy and Power Signals

Lecture 4 - Real Exponential Signals

Lecture 5 - Memory/Memory-less and Causal/Non-Causal Systems

Lecture 6 - Properties of Linear Systems

Lecture 7 - Example Problems - 1

Lecture 8 - Example Problems - 2

Lecture 9 - Example Problems - 3

Lecture 10 - Properties and Analysis of LTI Systems - I

Lecture 11 - Properties and Analysis of LTI Systems - II

Lecture 12 - Properties and Analysis of LTI Systems - III

Lecture 13 - Properties of Discrete Time LTI Systems

Lecture 14 - Example Problems LTI Systems - I

Lecture 15 - Example Problems LTI Systems - II

Lecture 16 - Example Problems DT-LTI Systems

Lecture 17 - Laplace Transform

Lecture 18 - Laplace Transform Properties - I

Lecture 19 - Laplace Transform Properties - II

Lecture 20 - Laplace Transform of LTI Systems

Lecture 21 - Laplace Transform Example Problems - I

Lecture 22 - Laplace Transform Example Problems - II

Lecture 23 - Laplace Transform of RL, RC Circuit

Lecture 24 - Z-Transform

Lecture 25 - Z-Transform Properties - I

Lecture 26 - Z-Transform Properties - II

Lecture 27 - Z-Transform of LTI Systems

Lecture 28 - Z-Transform Examples - I

Lecture 29 - Z-Transform Examples - II

Lecture 30 - Z-Transform Examples - III

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

Lecture 31 - Z-Transform Examples - IV

Lecture 32 - Inverse Z-Transform

Lecture 33 - Fourier Analysis Introduction

Lecture 34 - Complex Exponential and Trigonometric FS

Lecture 35 - Conditions for Existence of FS

Lecture 36 - Fourier Transform (FT) Introduction

Lecture 37 - Properties of Fourier Transform - I

Lecture 38 - Properties of Fourier Transform - II

Lecture 39 - Fourier Transform - Parseval's Relation

Lecture 40 - Fourier Transform of LTI Systems

Lecture 41 - FT- Ideal and Non-Ideal Filters

Lecture 42 - Fourier Analysis Examples - I

Lecture 43 - Fourier Analysis Examples - II

Lecture 44 - Fourier Analysis Examples - III

Lecture 45 - Fourier Analysis Examples - IV

Lecture 46 - Fourier Analysis Examples - V

Lecture 47 - Fourier Analysis Examples - VI

Lecture 48 - Fourier Analysis Bode Plot - I

Lecture 49 - Fourier Analysis Bode Plot - II

Lecture 50 - Fourier Transform Examples: Filtering - Ideal Low Pass Filter

Lecture 51 - Fourier Transform Problems: Unit Step Response of RC Circuit, Sampling of Continuous Signal

Lecture 52 - Sampling: Spectrum of Sampled Signal, Nyquist Criterion

Lecture 53 - Sampling: Reconstruction from Sampled Signal

Lecture 54 - Fourier Analysis of Discrete Time Signals and Systems - Introduction

Lecture 55 - Fourier Analysis of Discrete Time Signals - Duality, Parseval's Theorem

Lecture 56 - Discrete Time Fourier Transform: Definition, Inverse DTFT, Convergence, Relation between DTFT and z-Transform, DTFT of Common Signals

Lecture 57 - Discrete Time Fourier Transform: Properties of DTFT - Linearity, Time Shifting, Frequency Shifting, Conjugation, Time-Reversal, Duality

Lecture 58 - Discrete Time Fourier Transform: Properties of DTFT - Differentiation in Frequency, Difference in Time, Convolution, Multiplication, Parseval's Relation

Lecture 59 - DTFT: Discrete Time LTI Systems - LTI Systems Characterized by Difference Equations

Lecture 60 - Discrete Fourier Transform - Definition, Inverse DFT, Relation between DFT and DFS, Relation between DFT and DTFT, Properties - Linearity, Time Shifting

Lecture 61 - Discrete Fourier Transform: Properties - Conjugation, Frequency Shift, Duality, Circular Convolution, Multiplication, Parseval's Relation, Example Problems for Fourier Analysis of Discrete Time Signals

[Lecture 62 - Example Problems: DFS Analysis of Discrete Time Signals, Problems on DTFT](#)

[Lecture 63 - Example Problems: DTFT of Cosine, Unit Step Signals](#)

[Lecture 64 - DTFT Example Problems - III](#)

[Lecture 65 - DTFT Example Problems - IV](#)

[Lecture 66 - DTFT Example Problems - V](#)

[Lecture 67 - DFT Example Problems - I](#)

[Lecture 68 - Example Problems: DFT, IDFT in Matrix form](#)

[Lecture 69 - Group/Phase Delay - Part I](#)

[Lecture 70 - Group/Phase Delay - Part II](#)

[Lecture 71 - IIR Filter Structures: DF-I, DF-II](#)

[Lecture 72 - IIR Filter Structures: Transpose Form](#)

[Lecture 73 - IIR Filter Structures: Example](#)

[Lecture 74 - IIR Filter Structures: Cascade Form](#)

[Lecture 75 - IIR Filter: Parallel Form-I and II](#)

Lecture 1 - Vectors and Matrices - Linear Independence and Rank

Lecture 2 - Eigenvectors and Eigenvalues of Matrices and their Properties

Lecture 3 - Positive Semidefinite (PSD) and Positive Definite (PD) Matrices and their Properties

Lecture 4 - Inner Product Space and its Properties: Linearity, Symmetry and Positive Semi-definite

Lecture 5 - Inner Product Space and its Properties: Cauchy Schwarz Inequality

Lecture 6 - Properties of Norm, Gaussian Elimination and Echelon form of matrix

Lecture 7 - Gram Schmidt Orthogonalization Procedure

Lecture 8 - Null Space and Trace of Matrices

Lecture 9 - Eigenvalue Decomposition of Hermitian Matrices and Properties

Lecture 10 - Matrix Inversion Lemma (Woodbury identity)

Lecture 11 - Introduction to Convex Sets and Properties

Lecture 12 - Affine Set Examples and Application

Lecture 13 - Norm Ball and its Practical Applications

Lecture 14 - Ellipsoid and its Practical Applications

Lecture 15 - Norm Cone, Polyhedron and its Applications

Lecture 16 - Applications: Cooperative Cellular Transmission

Lecture 17 - Positive Semi Definite Cone And Positive Semi Definite (PSD) Matrices

Lecture 18 - Introduction to Affine functions and examples

Lecture 19 - norm balls and Matrix properties: Trace, Determinant

Lecture 20 - Inverse of a Positive Definite Matrix

Lecture 21 - Example Problems: Property of Norms, Problems on Convex Sets

Lecture 22 - Problems on Convex Sets (Continued...)

Lecture 23 - Introduction to Convex and Concave Functions

Lecture 24 - Properties of Convex Functions with examples

Lecture 25 - Test for Convexity: Positive Semidefinite Hessian Matrix

Lecture 26 - Application: MIMO Receiver Design as a Least Squares Problem

Lecture 27 - Jensen's Inequality and Practical Application

Lecture 28 - Jensen's Inequality application

Lecture 29 - Properties of Convex Functions

Lecture 30 - Conjugate Function and Examples to prove Convexity of various Functions

Lecture 31 - Examples on Operations Preserving Convexity

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

Lecture 32 - Examples on Test for Convexity, Quasi-Convexity

Lecture 33 - Examples on Convex Functions

Lecture 34 - Practical Application: Beamforming in Multi-antenna Wireless Communication

Lecture 35 - Practical Application: Maximal Ratio Combiner for Wireless Systems

Lecture 36 - Practical Application: Multi-antenna Beamforming with Interfering User

Lecture 37 - Practical Application: Zero-Forcing (ZF) Beamforming with Interfering User

Lecture 38 - Practical Application: Robust Beamforming With Channel Uncertainty for Wireless Systems

Lecture 39 - Practical Application: Robust Beamformer Design for Wireless Systems

Lecture 40 - Practical Application: Detailed Solution for Robust Beamformer Computation in Wireless Systems Text

Lecture 41 - Linear modeling and Approximation Problems: Least Squares

Lecture 42 - Geometric Intuition for Least Squares

Lecture 43 - Practical Application: Multi antenna channel estimation

Lecture 44 - Practical Application: Image deblurring

Lecture 45 - Least Norm Signal Estimation

Lecture 46 - Regularization: Least Squares + Least Norm

Lecture 47 - Convex Optimization Problem representation: Canonical form, Epigraph form

Lecture 48 - Linear Program Practical Application: Base Station Co-operation

Lecture 49 - Stochastic Linear Program, Gaussian Uncertainty

Lecture 50 - Practical Application: Multiple Input Multiple Output (MIMO) Beamforming

Lecture 51 - Practical Application: Multiple Input Multiple Output (MIMO) Beamformer Design

Lecture 52 - Practical Application: Co-operative Communication, Overview and various Protocols used

Lecture 53 - Practical Application: Probability of Error Computation for Co-operative Communication

Lecture 54 - Practical Application: Optimal power allocation factor determination for Co-operative Communication

Lecture 55 - Practical Application: Compressive Sensing

Lecture 56 - Practical Application

Lecture 57 - Practical Application- Orthogonal Matching Pursuit (OMP) algorithm for Compressive Sensing

Lecture 58 - Example Problem: Orthogonal Matching Pursuit (OMP) algorithm

Lecture 59 - Practical Application : L1 norm minimization and regularization approach for Compressive Sensing Optimization problem

Lecture 60 - Practical Application of Machine Learning and Artificial Intelligence: Linear Classification, Overview and Motivation

Lecture 61 - Practical Application: Linear Classifier (Support Vector Machine) Design

Lecture 62 - Practical Application: Approximate Classifier Design

Lecture 63 - Concept of Duality

Lecture 64 - Relation between optimal value of Primal and Dual Problems, concepts of Duality gap and Strong Duality

[Lecture 65 - Example problem on Strong Duality](#)

[Lecture 66 - Karush-Kuhn-Tucker \(KKT\) conditions](#)

[Lecture 67 - Application of KKT condition:Optimal MIMO power allocation \(Waterfilling\)](#)

[Lecture 68 - Optimal MIMO Power allocation \(Waterfilling\)-II](#)

[Lecture 69 - Example problem on Optimal MIMO Power allocation \(Waterfilling\)](#)

[Lecture 70 - Linear objective with box constraints, Linear Programming](#)

[Lecture 71 - Example Problems II](#)

[Lecture 72 - Examples on Quadratic Optimization](#)

[Lecture 73 - Examples on Duality: Dual Norm, Dual of Linear Program \(LP\)](#)

[Lecture 74 - Examples on Duality: Min-Max problem, Analytic Centering](#)

[Lecture 75 - Semi Definite Program \(SDP\) and its application:MIMO symbol vector decoding](#)

[Lecture 76 - Application:SDP for MIMO Maximum Likelihood \(ML\) Detection](#)

[Lecture 77 - Introduction to big Data: Online Recommender System \(Netflix\)](#)

[Lecture 78 - Matrix Completion Problem in Big Data: Netflix-I](#)

[Lecture 79 - Matrix Completion Problem in Big Data: Netflix-II](#)

- Lecture 1 - Overview of fiber-optic communication systems
- Lecture 2 - Review of Maxwell's equations
- Lecture 3 - Uniform plane waves (UWPs) in free-space
- Lecture 4 - Properties of UWPs (propagation constant, polarization, and Poynting vector)
- Lecture 5 - Boundary conditions and reflection from a PEC
- Lecture 6 - Obliquely incident waves-I (TE and TM waves, Snell's laws)
- Lecture 7 - Obliquely incident waves-II (Reflection and transmission coefficients, Brewster angle)
- Lecture 8 - Total internal reflection
- Lecture 9 - Ray theory of dielectric slab waveguides
- Lecture 10 - Transverse resonance condition for slab waveguides
- Lecture 11 - Introduction to optical fibers
- Lecture 12 - Ray theory of light propagation in optical fibers
- Lecture 13 - Concept of waveguide modes
- Lecture 14 - Systematic procedure to obtain modes of a waveguide
- Lecture 15 - Systematic analysis of parallel plate metallic waveguide
- Lecture 16 - Systematic analysis of dielectric slab waveguides
- Lecture 17 - Further discussion on slab waveguides
- Lecture 18 - Modal analysis of step index optical fiber
- Lecture 19 - Properties of modes of step-index optical fiber - I
- Lecture 20 - Properties of modes of step-index optical fiber - II
- Lecture 21 - Linearly polarized modes
- Lecture 22 - Attenuation and power loss in fibers
- Lecture 23 - Introduction to dispersion in fibers
- Lecture 24 - Mathematical modelling of dispersion: Transfer function approach
- Lecture 25 - Pulse propagation equation and its solution
- Lecture 26 - Pre-chirped pulses and Inter and Intra-modal dispersion in optical fibers
- Lecture 27 - Beam Propagation Method
- Lecture 28 - Polarization Effects on Pulse Propagation
- Lecture 29 - Modes in Optical Fibres and Pulse Propagation in Optical Fibres
- Lecture 30 - Graded Index Fibers
- Lecture 31 - Light Sources, Detectors and Amplifiers

- Lecture 32 - Basics of Lasers-I (Structure of Lasers, Process of Photon Emission)
- Lecture 33 - Basics of Lasers-II (Einstein's Theory of Radiation)
- Lecture 34 - Basics of Lasers-III (Population Inversion and Rate Equation for Lasers)
- Lecture 35 - Basic Properties of Semiconductor Laser-I (Energy Gap, Intrinsic and Extrinsic Semiconductors)
- Lecture 36 - Basic Properties of Semiconductor Laser-II (Fermi Level)
- Lecture 37 - Optical Properties of Semiconductors-I (Direct Bandgap and Indirect Bandgap, Density of States)
- Lecture 38 - Optical Properties of Semiconductors-II (Gain, Absorption, Recombination rate) Homojunction Lasers
- Lecture 39 - Double Heterostructure Lasers, Introduction to Quantum Well Lasers
- Lecture 40 - Semiconductor Optical Amplifier
- Lecture 41 - Erbium-doped fiber amplifier
- Lecture 42 - Photodetectors
- Lecture 43 - Noise in Photodetectors
- Lecture 44 - Introduction to WDM components
- Lecture 45 - Couplers, Circulators, FRM and Filters
- Lecture 46 - Filter, MUX/DEMUX, Diffraction grating (FBG and Long period grating)
- Lecture 47 - Optical Modulators-I (Current modulation)
- Lecture 48 - Optical Modulators-II (Electro-optic modulators)
- Lecture 49 - Review of Communication Concepts-I (Deterministic and Random Signals, Baseband and Passband Signals)
- Lecture 50 - Review of Communication Concepts-II (Signal and vectors, Signal energy, Orthonormal basis functions)
- Lecture 51 - Intensity modulation/ Direct Detection
- Lecture 52 - BER discussion for OOK systems
- Lecture 53 - Higher order modulation and Coherent Receiver
- Lecture 54 - Coherent receiver for BPSK systems and BER calculation
- Lecture 55 - Recovering Polarization
- Lecture 56 - DSP algorithms for Chromatic dispersion mitigation
- Lecture 57 - DSP algorithms for Carrier phase estimation - I
- Lecture 58 - DSP algorithms for Carrier phase estimation - II
- Lecture 59 - Nonlinear effects in fiber
- Lecture 60 - Four wave mixing, Loss measurement, Dispersion measurement
- Lecture 61 - Lab Demonstration (Laser diode characteristics, Loss measurement, Optical Intensity Modulation)

Lecture 1 - Introduction and Types of Transmission Lines

Lecture 2 - Distributed Circuit Model of Uniform Transmission Line

Lecture 3 - Voltage and Current Equation of the Transmission line

Lecture 4 - Sinusoidal Excitation of Transmission Line (Propagation constant, Characteristic Impedance)

Lecture 5 - Properties of Transmission Line (Reflection Coefficient, Input Impedance, Standing Wave Ratio)

Lecture 6 - Power Calculations and Introduction to Smith Chart

Lecture 7 - Smith Chart

Lecture 8 - Additional Applications of Smith Chart

Lecture 9 - Time domain Analysis of Transmission Line - I

Lecture 10 - Time domain Analysis of Transmission Line - II

Lecture 11 - Usage of Lattice Diagrams

Lecture 12 - TDR analysis of Transmission Lines

Lecture 13 - Introduction to Propagation of Electromagnetic Waves

Lecture 14 - Uniform Plane Waves - I

Lecture 15 - Uniform Plane Waves - II

Lecture 16 - Poynting Vector, Average Power, Polarization

Lecture 17 - Uniform Plane Waves in Lossy Medium

Lecture 18 - Normal Incidence of Plane Waves

Lecture 19 - Oblique Incidence of Plane Waves - I

Lecture 20 - Oblique Incidence of Plane Waves - II

Lecture 21 - Total Internal Reflection

Lecture 22 - Slab Waveguides

Lecture 23 - Optical Fibers

Lecture 24 - Parallel Plate Waveguides

Lecture 25 - Rectangular Waveguides

Lecture 26 - Modes of Rectangular Waveguides

Lecture 27 - Waveguides summary and Introduction to Radiation

Lecture 28 - Solution to Electric Scalar Potential and Magnetic Vector Potential Equations

Lecture 29 - Further discussion on Magnetic Vector Potential and Elementary Hertzian Dipole

Lecture 30 - Near field and Far-field Antenna and Properties of Antennas

Lecture 31 - Linear antenna - I

[Lecture 32 - Linear antenna - II and Properties of Transmitting and Receiving Antenna](#)

[Lecture 33 - Friis Transmission Formula](#)

[Lecture 34 - Antenna Array](#)

[Lecture 35 - Wireless Channel](#)

[Lecture 36 - Further discussion on Wireless Channel Modelling](#)

[Lecture 37 - Diffraction - I](#)

[Lecture 38 - Diffraction - II](#)

[Lecture 39 - Distribution of Laser Beam](#)

[Lecture 40 - Interference \(Double slit experiment, Fabry Perot Interferometer\)](#)

[Lecture 41 - Summary](#)

Lecture 1 - Basic Concepts

Lecture 2 - Sinusoids and Phasors

Lecture 3 - Circuit Elements - Part 1

Lecture 4 - Circuit Elements - Part 2

Lecture 5 - AC Power Analysis

Lecture 6 - RMS Voltage and Current

Lecture 7 - Topology

Lecture 8 - Star-Delta Transformation and Mesh Analysis

Lecture 9 - Mesh Analysis.

Lecture 10 - Nodal Analysis

Lecture 11 - Linearity Property and Superposition Theorem

Lecture 12 - Source Transformation

Lecture 13 - Duality

Lecture 14 - Thevenin's Theorem - 1

Lecture 15 - Thevenin's Theorem - 2

Lecture 16 - Norton's Theorem - 1

Lecture 17 - Norton's Theorem - 2

Lecture 18 - Maximum Power Transfer Theorem - 1

Lecture 19 - Maximum Power Transfer Theorem - 2

Lecture 20 - Reciprocity and Compensation Theorem

Lecture 21 - First Order RC Circuits

Lecture 22 - First Order RL Circuits

Lecture 23 - Singularity Functions

Lecture 24 - Step Response of RC and RL Circuits

Lecture 25 - Second Order Response

Lecture 26 - Step Response of Second Order Circuits-First Order and Second Order Circuits (Continued...)

Lecture 27 - Step Response of Parallel RLC Circuit-First Order and Second Order Circuits (Continued...)

Lecture 28 - Definition of the Laplace Transform

Lecture 29 - Properties of the Laplace Transform

Lecture 30 - Inverse Laplace Transform

Lecture 31 - Laplace Transform of Circuit Elements

[Lecture 32 - Transfer Function](#)

[Lecture 33 - Convolution Integral](#)

[Lecture 34 - Graphical Approach of Convolution Integral](#)

[Lecture 35 - Network Stability and Network Synthesis](#)

[Lecture 36 - Impedance Parameters](#)

[Lecture 37 - Admittance Parameters](#)

[Lecture 38 - Hybrid Parameters](#)

[Lecture 39 - Transmission Parameters](#)

[Lecture 40 - Interconnection of Networks](#)

[Lecture 41 - Nodal and Mesh Analysis](#)

[Lecture 42 - Superposition Theorem and Source Transformation](#)

[Lecture 43 - Thevenin's, Norton's and, Maximum Power Transfer Theorem](#)

[Lecture 44 - Magnetically Coupled Circuits](#)

[Lecture 45 - Energy in Coupled Circuits and Ideal Transformer](#)

[Lecture 46 - Ideal Transformer and Introduction to Three-Phase Circuits](#)

[Lecture 47 - Balanced Three-Phase Connections](#)

[Lecture 48 - Balanced Wye-Delta and Delta-Delta Connections](#)

[Lecture 49 - Balanced Delta-Wye Connection and Power in Balanced Three-Phase System](#)

[Lecture 50 - Unbalanced Three-Phase System and Three-Phase Power Measurement](#)

[Lecture 51 - Introduction to Graphical Models](#)

[Lecture 52 - State Equations](#)

[Lecture 53 - State Diagram](#)

[Lecture 54 - State Transition Matrix](#)

[Lecture 55 - State Variable Method to Circuit Analysis](#)

[Lecture 56 - Characteristic Equation, Eigenvalues, and Eigenvectors-State Variable Analysis \(Continued...\)](#)

[Lecture 57 - Modeling of Mechanical Systems](#)

[Lecture 58 - Modeling of The Rotational Motion of Mechanical Systems](#)

[Lecture 59 - Modeling of Electrical Systems](#)

[Lecture 60 - Solving Analogous Systems](#)

Lecture 1 - Introduction to Electric Drives

Lecture 2 - Dynamics of Electric Drives, Four Quadrant Operation, Equivalent Drive Parameters

Lecture 3 - Equivalent Drive Parameters, Friction Components, Nature of Load Torque

Lecture 4 - Steady State Stability, Load Equalization

Lecture 5 - Load Equalization, Characteristics of DC Motor

Lecture 6 - Speed Torque Characteristics of Separately Excited DC Motor and Series DC Motor

Lecture 7 - Field Control of Series Motor, Motoring and Braking of Separately Excited and Series DC motors

Lecture 8 - Speed Control of Separately Excited DC Motor Using Controlled Rectifiers

Lecture 9 - Analysis of Single Phase Full Controlled Converter-fed Separately Excited DC Motor

Lecture 10 - Speed Torque Characteristics of Full Controlled Converter-fed Separately Excited DC Motor, Analysis of Single Phase Half Controlled Converter-fed Separately Excited DC Motor

Lecture 11 - Analysis of Single Phase Half Controlled Converter-fed Separately Excited DC Motor.

Lecture 12 - Three Phase Full Controlled Converter-fed Separately Excited DC Motor, Multi-quadrant Operation of DC Motor

Lecture 13 - Dual Converter-fed DC Motor, Multi-quadrant Operation Using Field Current Reversal

Lecture 14 - DC Chopper-fed Separately Excited DC Motor for Motoring and Braking

Lecture 15 - Two-quadrant DC Chopper, Four-quadrant DC Chopper

Lecture 16 - Dynamic Braking of DC Motor by Chopper Controlled Resistor, Closed-loop Operation of DC Drives, Induction Motor Drives

Lecture 17 - Speed Torque Characteristics of Induction Motor, Operation of Induction Motor from Non-sinusoidal Supply

Lecture 18 - Operation of Induction Motor from Non-sinusoidal Supply

Lecture 19 - Stator Current of Induction Motor with Non-sinusoidal Supply, Operation of Induction Motor with Unbalanced Voltage Supply

Lecture 20 - Single Phasing of Induction Motor, Braking of Induction Motor

Lecture 21 - Dynamic braking of induction motor, AC dynamic braking, DC dynamic braking

Lecture 22 - Analysis of DC dynamic braking of induction motor

Lecture 23 - Self-excited dynamic braking of induction motor, Speed control of induction motor using stator voltage regulator, Variable voltage variable frequency control

Lecture 24 - Variable voltage variable frequency control of induction motor, Open loop V/F control

Lecture 25 - Slip speed control of induction motor, Constant Volt/Hz control with slip speed regulation

Lecture 26 - Closed-loop Volt/Hz control of induction motor with slip speed regulation, Multi-quadrant operation of induction motor drive

Lecture 27 - Current Source Inverter (CSI) fed induction motor drive

Lecture 28 - Closed-loop operation of current source inverter (CSI) fed induction motor drive, Control of slip ring induction motor - Static rotor resistance control

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

Lecture 29 - Closed-loop operation of slip ring induction motor with static rotor resistance control, Slip power recovery in slip ring induction motor - Static Kramer drive

Lecture 30 - Static Kramer drive and its closed-loop control, Introduction to synchronous motor

Lecture 31 - Various types of synchronous motors, Equivalent circuit and phasor diagram of cylindrical synchronous motor, Speed-torque characteristics of cylindrical synchronous motor

Lecture 32 - Phasor diagram of salient pole synchronous motor, Expression of power and torque for a salient pole synchronous motor, Synchronous reluctance motor, Open-loop V/f control of synchronous motor

Lecture 33 - Open-loop V/f control, Torque-speed characteristics, Self controlled synchronous motor drive employing load commutated thyristor inverter

Lecture 34 - Detailed analysis of commutation of load commutated thyristor inverter, Derivation of overlap angle and margin angle, Closed-loop speed control scheme for load commutated inverter-fed synchronous motor drive

Lecture 35 - Low cost brushless DC motor (BLDCM), Trapezoidal permanent magnet AC motor

Lecture 36 - Trapezoidal permanent magnet AC motor, Derivation of power and torque, Closed-loop control of trapezoidal BLDC motor, Introduction to switched reluctance motor

Lecture 37 - Construction and operating principle of switched reluctance motor

Lecture 38 - Current/ voltage control for switched reluctance motor, operating modes of switched reluctance motor, Introduction to traction drives

Lecture 39 - Current collector for mainline trains, Nature of traction load, Duty cycle of traction drives

Lecture 40 - Duty cycle of traction drives, Distance between two stops, Calculation of total tractive effort and drive rating

Lecture 1 - Introduction: Fuzzy Sets, Logic and Systems and Applications

Lecture 2 - Introduction: Real Life Applications of Fuzzy Systems

Lecture 3 - Fuzzy Sets and Fuzzy Logic Toolbox in MATLAB - I

Lecture 4 - Fuzzy Sets and Fuzzy Logic Toolbox in MATLAB - II

Lecture 5 - Membership Functions - I

Lecture 6 - Membership Functions - II

Lecture 7 - Nomenclatures used in Fuzzy Set Theory - I

Lecture 8 - Nomenclatures used in Fuzzy Set Theory - II

Lecture 9 - Nomenclatures used in Fuzzy Set Theory - III

Lecture 10 - Set Theoretic Operations on Fuzzy Sets - I

Lecture 11 - Set Theoretic Operations on Fuzzy Sets - II

Lecture 12 - Properties of Fuzzy Sets - I

Lecture 13 - Properties of Fuzzy Sets - II

Lecture 14 - Properties of Fuzzy Sets - III

Lecture 15 - Properties of Fuzzy Sets - IV

Lecture 16 - Properties of Fuzzy Sets - V

Lecture 17 - Distance between Fuzzy Sets - I

Lecture 18 - Distance between Fuzzy Sets - II

Lecture 19 - Distance between Fuzzy Sets - III

Lecture 20 - Arithmetic Operations on Fuzzy Numbers - I

Lecture 21 - Arithmetic Operations on Fuzzy Numbers - II

Lecture 22 - Arithmetic Operations on Fuzzy Numbers - III

Lecture 23 - Complement of Fuzzy Sets

Lecture 24 - T-norm Operators

Lecture 25 - S-norm Operators

Lecture 26 - Parameterized T-Norm Operators

Lecture 27 - Parameterized S-Norm Operators

Lecture 28 - Fuzzy Relation - I

Lecture 29 - Fuzzy Relation - II

Lecture 30 - Operations on Crisp and Fuzzy Relations

Lecture 31 - Projection of Fuzzy Relation Set

[Lecture 32 - Cylindrical Extension of Fuzzy Set](#)

[Lecture 33 - Properties of Fuzzy Relation - I](#)

[Lecture 34 - Properties of Fuzzy Relation - II](#)

[Lecture 35 - Extension Principle](#)

[Lecture 36 - Composition of Fuzzy Relations](#)

[Lecture 37 - Properties of Composition of Fuzzy Relations](#)

[Lecture 38 - Fuzzy Tolerance and Equivalence Relations - I](#)

[Lecture 39 - Fuzzy Tolerance and Equivalence Relations - II](#)

[Lecture 40 - Fuzzy Tolerance and Equivalence Relations - III](#)

[Lecture 41 - Linguistic Hedges](#)

[Lecture 42 - Linguistic Hedges and Negation/ Complement and Connectives](#)

[Lecture 43 - Concentration and Dilation and Composite Linguistic Term and Some Examples](#)

[Lecture 44 - Dilation and Composite Linguistic Term and Some Examples](#)

[Lecture 45 - Some Examples on Composite Linguistic Terms](#)

[Lecture 46 - Contrast Intensification of Fuzzy Sets](#)

[Lecture 47 - Orthogonality of Fuzzy Sets](#)

[Lecture 48 - Fuzzy Rules and Fuzzy Reasoning - I](#)

[Lecture 49 - Fuzzy Rules and Fuzzy Reasoning - II](#)

[Lecture 50 - Fuzzy Inference System](#)

[Lecture 51 - Mamdani Fuzzy Model - I](#)

[Lecture 52 - Mamdani Fuzzy Model - II](#)

[Lecture 53 - Mamdani Fuzzy Model - III](#)

[Lecture 54 - Example on Mamdani Fuzzy Model for Single Antecedent with Three Rules](#)

[Lecture 55 - Example on Mamdani Fuzzy Model for Two Antecedents with Four Rules](#)

[Lecture 56 - Larsen Fuzzy Model - I](#)

[Lecture 57 - Larsen Fuzzy Model - II](#)

[Lecture 58 - Larsen Fuzzy Model - III](#)

[Lecture 59 - Tsukamoto Fuzzy Model](#)

[Lecture 60 - TSK Fuzzy Model](#)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Peer to Peer Networks (Electrical Engineering)

Co-ordinators : Prof. Yatindra N Singh

Lecture 1 - Introduction to Peer to Peer Networks

Lecture 2 - Peer to Peer Network in Telephony:Voice over Internet Telephony (VoIP) and Distributed Hash Table (DHT)

Lecture 3 - Building DHT Networks

Lecture 4 - Logarithmic Partitioning of Node ID Space and Index Entry Authenticity

Lecture 5 - Implementation of Voice over Internet Telephony in P2P Way

Lecture 6 - Leaf Nodes, Core Nodes and Type of Messages in DHT Networks

Lecture 7 - Static and Dynamic Partitioning of Node ID Space: Fixed and Floating Partitioning

Lecture 8 - PASTRY Protocol: The Efficient Use of Internet Infrastructure

Lecture 9 - Understanding the PASTRY Protocol through Example

Lecture 10 - Kademia: A DHT Routing Protocol

Lecture 11 - Tapestry: An Evolution of Kademia

Lecture 12 - Understanding the Tapestry Protocol through Example

Lecture 13 - Multi-dimensional Distributed Hash Table: Mapping of Peers into Multidimensional Space

Lecture 14 - Multi-Layer DHT: A Design for Multiple Services

Lecture 15 - Keeping Pairs at Correct Root Nodes

Lecture 16 - Abrupt and Graceful Exit of Root Node: Maintaining Pairs Alive

Lecture 17 - Resilience of Pairs

Lecture 18 - A P2P Distributed File System

Lecture 19 - Storage Space Problem and Incentives to Share Storage

Lecture 20 - P2P Nodes Communications Challenges in Heterogeneous Network Environments

Lecture 21 - P2P Overlaid Multicast: Basic Design

Lecture 22 - P2P Overlaid Multicast: Alternate Design

Lecture 23 - A Design of P2P Email System

Lecture 24 - P2P Mailing List Services: A Basic Design

Lecture 25 - P2P Mailing List Services: An Alternate Design

Lecture 26 - P2P Web: A Basic Design

Lecture 27 - P2P Web Search Engine: A Basic Design

Lecture 28 - P2P Internet: On Being Anonymous

Lecture 29 - P2P in Blockchain

Lecture 30 - P2P Anonymous Communication

Lecture 31 - The Anonymous Communication on the Internet through TOR Network

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

[Lecture 32 - An Introduction To TOR Browser: The Anonymity Preserving Access of the Web Sites](#)

[Lecture 33 - Hidden Services on TOR Network](#)

[Lecture 34 - MOOC Wrap-Up : Summary of the Course](#)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Applied Linear Algebra for Signal Processing, Data Analytics and Machine Learning (Electrical Engineering)

Co-ordinators : Prof. Aditya K. Jagannatham

- Lecture 1 - Vector Properties: Addition, Linear Combination, Inner Product, Orthogonality, Norm
- Lecture 2 - Vectors: Unit Norm Vector, Cauchy-Schwarz inequality, Radar Application
- Lecture 3 - Inner Product Application: Beamforming in Wireless Communication Systems
- Lecture 4 - Matrices, Definition, Addition and Multiplication of Matrices
- Lecture 5 - Matrix: Column Space, Linear Independence, Rank of Matrix, Gaussian Elimination
- Lecture 6 - Matrix: Determinant, Inverse Computation, Adjoint, Cofactor Concepts
- Lecture 7 - Applications of Matrices: Solution of System of Linear equations, MIMO Wireless Technology
- Lecture 8 - Applications of Matrices: Electric Circuits, Traffic flows
- Lecture 9 - Applications of Matrices: Graph Theory, Social Networks, Dominance Directed Graph, Influential Node
- Lecture 10 - Null Space of Matrix: Definition, Rank-Nullity Theorem, Application in Electric Circuits
- Lecture 11 - Gram-Schmidt Orthogonalization
- Lecture 12 - Gaussian Random Variable: Definition, Mean, Variance, Multivariate Gaussian, Covariance Matrix
- Lecture 13 - Linear Transformation of Gaussian Random Vectors
- Lecture 14 - Machine Learning Application: Gaussian Classification
- Lecture 15 - Eigenvalue: Definition, Characteristic Equation, Eigenvalue Decomposition
- Lecture 16 - Special Matrices: Rotation and Unitary Matrices, Application: Alamouti Code
- Lecture 17 - Positive Semi-definite (PSD) Matrices: Definition, Properties, Eigenvalue Decomposition
- Lecture 18 - Positive Semidefinite Matrix: Example and Illustration of Eigenvalue Decomposition
- Lecture 19 - Machine Learning Application: Principle Component Analysis (PCA)
- Lecture 20 - Computer Vision Application: Face Recognition, Eigenfaces
- Lecture 21 - Least Squares (LS) Solution, Pseudo-Inverse Concept
- Lecture 22 - Least Squares (LS) via Principle of Orthogonality, Projection Matrix, Properties
- Lecture 23 - Application: Pseudo-Inverse and MIMO Zero Forcing (ZF) Receiver
- Lecture 24 - Wireless Application: Multi-Antenna Channel Estimation
- Lecture 25 - Machine Learning Application: Linear Regression
- Lecture 26 - Computation Mathematics Application: Polynomial Fitting
- Lecture 27 - Least Norm Solution
- Lecture 28 - Wireless Application: Multi-user Beamforming
- Lecture 29 - Singular Value Decomposition (SVD): Definition, Properties, Example
- Lecture 30 - SVD Application in MIMO Wireless Technology: Spatial-Multiplexing and High Data Rates
- Lecture 31 - SVD for MIMO wireless optimization, water-filling algorithm, optimal power allocation

Lecture 32 - SVD application for Machine Learning: Principal component analysis (PCA)

Lecture 33 - Multiple signal classification (MUSIC) algorithm: system model

Lecture 34 - MUSIC algorithm for Direction of Arrival (DoA) estimation

Lecture 35 - Linear minimum mean square error (LMMSE) principle

Lecture 36 - LMMSE estimate and error covariance matrix

Lecture 37 - LMMSE estimation in linear systems

Lecture 38 - LMMSE application: Wireless channel estimation and example

Lecture 39 - Time-series prediction via auto-regressive (AR) model

Lecture 40 - Recommender system: design and rating prediction

Lecture 41 - Recommender system: Illustration via movie rating prediction example

Lecture 42 - Fast Fourier transform (FFT) and Inverse fast Fourier transform (IFFT)

Lecture 43 - IFFT/ FFT application in Orthogonal Frequency Division Multiplexing (OFDM) wireless technology

Lecture 44 - OFDM system: Circulant matrices and properties

Lecture 45 - OFDM system model: Transmitter and receiver processing

Lecture 46 - Single-carrier frequency division for multiple access (SC-FDMA) technology

Lecture 47 - Linear dynamical systems: definition and solution via matrix exponential

Lecture 48 - Linear dynamical systems: matrix exponential via SVD

Lecture 49 - Machine Learning application: Support Vector Machines (SVM)

Lecture 50 - Support Vector Machines (SVM): Problem formulation via maximum hyperplane separation

Lecture 51 - Sparse regression: problem formulation and relation to Compressive Sensing (CS)

Lecture 52 - Sparse regression: solution via the Orthogonal Matching Pursuit (OMP) algorithm

Lecture 53 - OMP Example for Sparse Regression

Lecture 54 - Machine Learning Application: Clustering

Lecture 55 - K-Means Clustering algorithm

Lecture 56 - Introduction to Stochastic Processes and Markov Chains

Lecture 57 - Discrete Time Markov Chains and Transition Probability Matrix

Lecture 58 - Discrete Time Markov Chain Examples

Lecture 59 - m-STEP Transition Probabilities for Discrete Time Markov Chains

Lecture 60 - Limiting Behavior of Discrete Time Markov Chains

Lecture 61 - Least Squares Revisited: Rank Deficient Matrix

Lecture 62 - Least Squares using SVD

Lecture 63 - Weighted Least Squares

Lecture 64 - Weighted Least Squares Example

[Lecture 65 - Woodbury Matrix Identity - Matrix Inversion Lemma](#)

[Lecture 66 - Woodbury Matrix Identity - Proof](#)

[Lecture 67 - Conditional Gaussian Density - Mean](#)

[Lecture 68 - Conditional Gaussian Density - Covariance](#)

[Lecture 69 - Scalar Linear Model for Gaussian Estimation](#)

[Lecture 70 - MMSE Estimate and Covariance for the Scalar Linear Model](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48](#)

[Lecture 49](#)

[Lecture 50](#)

[Lecture 51](#)

[Lecture 52](#)

[Lecture 53](#)

[Lecture 54](#)

[Lecture 55](#)

[Lecture 56](#)

[Lecture 57](#)

[Lecture 58](#)

[Lecture 59](#)

[Lecture 60](#)

NPTEL : NOC:Digital Switching (Electrical Engineering)

Co-ordinators : Prof. Yatindra N Singh

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48](#)

[Lecture 49](#)

[Lecture 50](#)

[Lecture 51](#)

[Lecture 52](#)

[Lecture 53](#)

[Lecture 54](#)

[Lecture 55](#)

[Lecture 56](#)

[Lecture 57](#)

[Lecture 58](#)

[Lecture 59](#)

[Lecture 60](#)

[Lecture 61](#)

[Lecture 62](#)

[Lecture 63](#)

[Lecture 64](#)

Lecture 1 - Introduction

Lecture 2 - Operating Principles and Construction of Single Phase Transformers

Lecture 3 - Modeling of Single Phase Transformers

Lecture 4 - Equivalent Circuits of Single Phase Transformers

Lecture 5 - Testing of Single Phase Transformers

Lecture 6 - Efficiency of Single Phase Transformers

Lecture 7 - Voltage Regulation of Single Phase Transformers

Lecture 8 - Parallel Operation of Single Phase Transformers

Lecture 9 - Harmonics and Switching Transients in Single Phase Transformers

Lecture 10 - Introduction to Three Phase Transformer

Lecture 11 - Construction of Three Phase Transformers

Lecture 12 - Three Phase Transformer Connections

Lecture 13 - Three Phase Transformer Phase Groups Part - I

Lecture 14 - Three Phase Transformer Phase Groups Part - II

Lecture 15 - Analysis and Testing of Three Phase Transformers

Lecture 16 - Operation of Three Phase Transformers

Lecture 17 - Auto Transformers

Lecture 18 - Three Winding Transformers

Lecture 19 - Scott Connected Transformers

Lecture 20 - Potential and Current Transformers

Lecture 21 - Operating Principles of DC Machines

Lecture 22 - Constructional Features of DC Machines

Lecture 23 - Generated EMF and Torque in DC Machines

Lecture 24 - Armature Reaction

Lecture 25 - Commutation in DC Machines

Lecture 26 - Separately Excited DC Generators

Lecture 27 - DC Shunt Generators

Lecture 28 - Compound DC Generators

Lecture 29 - Interconnected DC Generators

Lecture 30 - Characteristics of DC Shunt Motors

Lecture 31 - Starting of DC Shunt Motors

[Lecture 32 - Speed Control of DC Shunt Motors](#)

[Lecture 33 - Braking of DC Shunt Motors](#)

[Lecture 34 - Electronic Control of DC Shunt Motors](#)

[Lecture 35 - Testing of DC Shunt Motors](#)

[Lecture 36 - Characteristics of DC Series Motors](#)

[Lecture 37 - Starting and Braking of DC Series Motors](#)

[Lecture 38 - Speed Control and of DC Series Motors](#)

[Lecture 39 - Testing of DC Series Motors](#)

[Lecture 40 - Characteristics of Compound DC Series Motors](#)

NPTEL : Optimal Control (Electrical Engineering)

Co-ordinators : Prof. G.D. Ray

- Lecture 1 - Introduction to Optimization Problem: Some Examples
- Lecture 2 - Introduction to Optimization Problem: Some Examples (Continued.)
- Lecture 3 - Optimality Conditions for Function of Several Variables
- Lecture 4 - Optimality Conditions for Function of Several Variables (Continued.)
- Lecture 5 - Unconstrained Optimization Problem (Numerical Techniques)
- Lecture 6 - Solution of Unconstrained Optimization Problem Using Conjugate Gradient Method and Networks Methods
- Lecture 7 - Solution of Unconstrained Optimization Problem Using Conjugate Gradient Method and Networks Methods (Continued.)
- Lecture 8 - Solution of Constraint Optimization Problem-Karush-Kuhn Tucker (KKT) Conditions
- Lecture 9 - Solution of Constraint Optimization Problem-Karush-Kuhn Tucker (KKT) Conditions (Continued.)
- Lecture 10 - Problem and Solution Session
- Lecture 11 - Post Optimality Analysis, Convex Function and its Properties
- Lecture 12 - Post Optimality Analysis, Convex Function and its Properties (Continued.)
- Lecture 13 - Quadratic Optimization Problem Using Linear Programming
- Lecture 14 - Matrix form of the Simplex Method
- Lecture 15 - Matrix form of the Simplex Method (Continued.)
- Lecture 16 - Solution of Linear Programming Using Simplex Method:- Algebraic Approach
- Lecture 17 - Solution of Linear Programming Using Simplex Method:- Algebraic Approach (Continued.)
- Lecture 18 - Solution of LP Problems with Two Phase Method
- Lecture 19 - Solution of LP Problems with Two Phase Method (Continued.)
- Lecture 20 - Standard Primal and Dual Problems
- Lecture 21 - Relationship Between Primal and Dual Variables
- Lecture 22 - Solution of Quadratic Programming Problem Using Simplex Method
- Lecture 23 - Interior Point Method for Solving Optimization Problems
- Lecture 24 - Interior Point Method for Solving Optimization Problems (Continued.)
- Lecture 25 - Solution of Nonlinear Programming Problem Using Exterior Penalty Function Method
- Lecture 26 - Solution of Nonlinear Programming Problem Using Exterior Penalty Function Method (Continued.)
- Lecture 27 - Solution of Nonlinear Programming Problem Using Interior Penalty Function Method
- Lecture 28 - Solution of Nonlinear Programming Problem Using Interior Penalty Function Method (Continued.)
- Lecture 29 - Multiobjective Optimization Problem
- Lecture 30 - Dynamic Optimization Problem: Basic Concepts and Necessary and Sufficient Condition
- Lecture 31 - Dynamic Optimization Problem: Basic Concepts and Necessary and Sufficient Condition (Continued...I)

- Lecture 32 - Dynamic Optimization Problem: Basic Concepts and Necessary and Sufficient Condition (Continued...2)
- Lecture 33 - Numerical Example and Solution of Optimal Control Problem using Calculus of Variation principle
- Lecture 34 - Numerical Example and Solution of Optimal Control Problem using Calculus of Variation principle (Continued.)
- Lecture 35 - Hamiltonian Formulation for solution of optimal Control problem and numerical example
- Lecture 36 - Hamiltonian Formulation for solution of optimal Control problem and numerical example (Continued.)
- Lecture 37 - Performance Indices and Linear Quadratic Regulator Problem
- Lecture 38 - Performance Indices and Linear Quadratic Regulator Problem (Continued.)
- Lecture 39 - Solution and Stability Analysis of Finite - time LQR Problem: Numerical Example
- Lecture 40 - Solution and Infinite - time LQR Problem and Stability Analysis
- Lecture 41 - Numerical Example and Methods for Solution of A.R.E.
- Lecture 42 - Numerical Example and Methods for Solution of A.R.E. (Continued.)
- Lecture 43 - Frequency Domain Interpretation of LQR Controlled System
- Lecture 44 - Gain and Phase Margin of LQR Controlled System
- Lecture 45 - The Linear Quadratic Gaussian Problem
- Lecture 46 - Loop-Transfer Recovery
- Lecture 47 - Dynamic Programming for Discrete Time Systems
- Lecture 48 - Minimum ∞ Time Control of a Linear Time Invariant System
- Lecture 49 - Solution of Minimum ∞ Time Control Problem with an Example
- Lecture 50 - Constraint in Control Inputs and State Variables
- Lecture 51 - Constraint in Control Inputs and State Variables (Continued...)
- Lecture 52 - Norms for Vectors, Matrices, Signals and Linear Systems
- Lecture 53 - Signal and System Norms
- Lecture 54 - Internal Stability, Sensitivity and Complementary Sensitivity Functions
- Lecture 55 - Internal Stability, Sensitivity and Complementary Sensitivity Functions (Continued...)
- Lecture 56 - Plant Uncertainty and Standard form for Robust Stability Analysis
- Lecture 57 - Plant Uncertainty and Standard form for Robust Stability Analysis (Continued...)
- Lecture 58 - Frequency Response of Linear System and Singular Value Decomposition of System
- Lecture 59 - Control Problem Statement in H- alpha Framework
- Lecture 60 - Control Problem Statement in H - alpha Framework (Continued...)

- Lecture 1 - Representations of Dynamical Systems
- Lecture 2 - Vector Fields of Nonlinear Systems
- Lecture 3 - Limit Cycles
- Lecture 4 - The Lorenz Equation - I
- Lecture 5 - The Lorenz Equation - II
- Lecture 6 - The Rossler Equation and Forced Pendulum
- Lecture 7 - The Chua's Circuit
- Lecture 8 - Discrete Time Dynamical Systems
- Lecture 9 - The Logistic Map and Period doubling
- Lecture 10 - Flip and Tangent Bifurcations
- Lecture 11 - Intermittency Transcritical and pitchfork
- Lecture 12 - Two Dimensional Maps
- Lecture 13 - Bifurcations in Two Dimensional Maps
- Lecture 14 - Introduction to Fractals
- Lecture 15 - Mandelbrot Sets and Julia Sets
- Lecture 16 - The Space Where Fractals Live
- Lecture 17 - Interactive Function Systems
- Lecture 18 - IFS Algorithms
- Lecture 19 - Fractal Image Compression
- Lecture 20 - Stable and Unstable Manifolds
- Lecture 21 - Boundary Crisis and Interior Crisis
- Lecture 22 - Statistics of Chaotic Attractors
- Lecture 23 - Matrix Times Circle : Ellipse
- Lecture 24 - Lyapunov Exponent
- Lecture 25 - Frequency Spectra of Orbits
- Lecture 26 - Dynamics on a Torus
- Lecture 27 - Dynamics on a Torus
- Lecture 28 - Analysis of Chaotic Time Series
- Lecture 29 - Analysis of Chaotic Time Series
- Lecture 30 - Lyapunou Function and Centre Manifold Theory
- Lecture 31 - Non-Smooth Bifurcations

[Lecture 32 - Non-Smooth Bifurcations](#)

[Lecture 33 - Normal form for Piecewise Smooth 2D Maps](#)

[Lecture 34 - Bifurcations in Piecewise Linear 2D Maps](#)

[Lecture 35 - Bifurcations in Piecewise Linear 2D Maps](#)

[Lecture 36 - Multiple Attractor Bifurcation and Dangerous](#)

[Lecture 37 - Dynamics of Discontinuous Maps](#)

[Lecture 38 - Introduction to Floquet Theory](#)

[Lecture 39 - The Monodromy Matrix and the Saltation Matrix](#)

[Lecture 40 - Control of Chaos](#)

- Lecture 1 - Discrete Time Signal and System
- Lecture 2 - Discrete Time Signal and System (Continued...)
- Lecture 3 - Discrete Time Signal and System (Continued...)
- Lecture 4 - Frequency Domain Representation of Discrete Signals
- Lecture 5 - Z-Transform
- Lecture 6 - Z-Transform (Continued...)
- Lecture 7 - Solution of Difference Equation
- Lecture 8 - Tutorial on Discrete Time Signals & Their Transforms
- Lecture 9 - Relation Between Discrete Time and Continuous Signals
- Lecture 10 - Discrete Fourier Transform (DFT)
- Lecture 11 - Discrete Fourier Transform (DFT) (Continued...)
- Lecture 12 - Discrete Fourier Transform (DFT) (Continued...)
- Lecture 13 - State Space Representation
- Lecture 14 - Filters Introduction
- Lecture 15 - FIR Filters
- Lecture 16 - FIR Filters (Continued...) Introduction to IIR Filters
- Lecture 17 - IIR Filters (Continued...)
- Lecture 18 - IIR Filters (Continued...)
- Lecture 19 - IIR Filters (Continued...)
- Lecture 20 - Tutorial & Introduction to Computer Aided Design of Filters
- Lecture 21 - Computer Aided Design of Filters
- Lecture 22 - FFT and Computer Aided Design of Filters
- Lecture 23 - Introduction to Lattice Filter
- Lecture 24 - Lattice Filter (Continued...)
- Lecture 25 - Effects of Quantization
- Lecture 26 - Effects of Quantization (Continued...)
- Lecture 27 - Effects of Quantization (Continued...)
- Lecture 28 - Effects of Quantization (Continued...)
- Lecture 29 - Random Signals
- Lecture 30 - Relationship Between Real and Imaginary Parts of DTFT
- Lecture 31 - Relationship Between Real and Imaginary Parts of DTFT

[Lecture 32 - Relationship Between Real and Imaginary Parts of DTFT](#)

[Lecture 33 - Multi rate Signal Processing](#)

[Lecture 34 - Multi rate Signal Processing \(Continued...\)](#)

[Lecture 35 - Polyphase Decomposition](#)

Lecture 1 - Introduction to System Elements

Lecture 2 - Newton's Method and Constraints

Lecture 3 - Derivation of the Lagrangian Equation

Lecture 4 - Using the lagrangian Equation to Obtain Differential Equations (Part-I)

Lecture 5 - Using the lagrangian Equation to Obtain Differential Equations (Part-II)

Lecture 6 - Using the lagrangian Equation to Obtain Differential Equations (Part-III)

Lecture 7 - Using the lagrangian Equation to Obtain Differential Equations (Part-IV)

Lecture 8 - Obtaining First Order Equations

Lecture 9 - Application of the Hamiltonian Method

Lecture 10 - Obtaining Differential Equations Using Kirchoff's Laws

Lecture 11 - The Graph Theory Approach for Electrical Circuits (Part-I)

Lecture 12 - The Graph Theory Approach for Electrical Circuits (Part-II)

Lecture 13 - The Bond Graph Approach - I

Lecture 14 - The Bond Graph Approach - II

Lecture 15 - The Bond Graph Approach - III

Lecture 16 - The Bond Graph Approach - IV

Lecture 17 - The Bond Graph Approach - V

Lecture 18 - The Bond Graph Approach - VI

Lecture 19 - The Bond Graph Approach - VII

Lecture 20 - Numerical Solution of Differential Equations

Lecture 21 - Dynamics in the State Space

Lecture 22 - Vector Field Around Equilibrium Points - I

Lecture 23 - Vector Field Around Equilibrium Points - II

Lecture 24 - Vector Field Around Equilibrium Points - III

Lecture 25 - Vector Field Around Equilibrium Points - IV

Lecture 26 - High Dimensional Linear Systems

Lecture 27 - Linear Systems with External Input - I

Lecture 28 - Linear Systems with External Input - II

Lecture 29 - Linear Systems with External Input - III

Lecture 30 - Dynamics of Nonlinear Systems - I

Lecture 31 - Dynamics of Nonlinear Systems - II

[Lecture 32 - Dynamics of Nonlinear Systems - III](#)

[Lecture 33 - Discrete-Time Dynamical Systems - I](#)

[Lecture 34 - Discrete-Time Dynamical Systems - II](#)

Lecture 1 - Thermodynamics: Fundamentals Of Energy - Energy Resources & Technology

Lecture 2 - Quality of Energy

Lecture 3 - Complete Cycle Analysis of Fossil Fuels

Lecture 4 - Energy in Transportation

Lecture 5 - Other Fossil Fuels

Lecture 6 - Energy Economics : Input-Output Analysis

Lecture 7 - Energy Economics : Input-Output Analysis

Lecture 8 - Thermal Power Plants

Lecture 9 - Thermal Power Plants

Lecture 10 - Hydroelectric Power

Lecture 11 - Hydroelectric Power

Lecture 12 - Nuclear Power Generation

Lecture 13 - Nuclear Fusion Reactors

Lecture 14 - Environmental Effects of Conventional Power

Lecture 15 - Solar Thermal Energy Conversion

Lecture 16 - Solar Concentrating Collectors

Lecture 17 - Photovoltaic Power Generation

Lecture 18 - Photovoltaic Power Generation (Continued.)

Lecture 19 - Photovoltaic Power Generation (Continued.)

Lecture 20 - Photovoltaic Power Generation (Continued.)

Lecture 21 - Wind Energy - I

Lecture 22 - Wind Energy - II

Lecture 23 - Wind Energy - III

Lecture 24 - Wind Energy - IV

Lecture 25 - Wind Energy - V

Lecture 26 - Wind Energy - VI

Lecture 27 - Wind Electrical Conversion - I

Lecture 28 - Wind Electrical Conversion - II

Lecture 29 - Wind Electrical Conversion - III

Lecture 30 - Tidal Energy

Lecture 31 - Tidal Energy

[Lecture 32 - Tidal Energy](#)

[Lecture 33 - Ocean Thermal Energy Conversion](#)

[Lecture 34 - Solar Pond and Wave Power](#)

[Lecture 35 - Geothermal Energy](#)

[Lecture 36 - Solar Distillation and Biomass Energy](#)

[Lecture 37 - Energy Storage](#)

[Lecture 38 - Magneto hydrodynamic Power Generation](#)

[Lecture 39 - Magneto hydrodynamic Power Generation](#)

[Lecture 40 - Hydrogen Economy](#)

Lecture 1 - Introduction

Lecture 2 - Probability Theory

Lecture 3 - Random Variables

Lecture 4 - Function of Random Variable Joint Density

Lecture 5 - Mean and Variance

Lecture 6 - Random Vectors Random Processes

Lecture 7 - Random Processes and Linear Systems

Lecture 8 - Some Numerical Problems

Lecture 9 - Miscellaneous Topics on Random Process

Lecture 10 - Linear Signal Models

Lecture 11 - Linear Mean Sq.Error Estimation

Lecture 12 - Auto Correlation and Power Spectrum Estimation

Lecture 13 - Z-Transform Revisited Eigen Vectors/Values

Lecture 14 - The Concept of Innovation

Lecture 15 - Last Squares Estimation Optimal IIR Filters

Lecture 16 - Introduction to Adaptive Filters

Lecture 17 - State Estimation

Lecture 18 - Kalman Filter-Model and Derivation

Lecture 19 - Kalman Filter-Derivation (Continued...)

Lecture 20 - Estimator Properties

Lecture 21 - The Time-Invariant Kalman Filter

Lecture 22 - Kalman Filter-Case Study

Lecture 23 - System identification Introductory Concepts

Lecture 24 - Linear Regression-Recursive Least Squares

Lecture 25 - Variants of LSE

Lecture 26 - Least Square Estimation

Lecture 27 - Model Order Selection Residual Tests

Lecture 28 - Practical Issues in Identification

Lecture 29 - Estimation Problems in Instrumentation and Control

Lecture 30 - Conclusion

NPTEL : Illumination Engineering (Electrical Engineering)

Co-ordinators : Prof. N.K. Kishore

- Lecture 1 - Introduction to Illumination Engineering
- Lecture 2 - Instructional Objectives
- Lecture 3 - Eye and Vision - I
- Lecture 4 - Eye and Vision - II
- Lecture 5 - Laws of Illumination
- Lecture 6 - Photometry
- Lecture 7 - Incandescent Lamps
- Lecture 8 - Discharge Lamps - I
- Lecture 9 - Discharge Lamps - II
- Lecture 10 - Discharge Lamps - III
- Lecture 11 - Illumination Systems - I
- Lecture 12 - Illumination Systems - II
- Lecture 13 - Glare
- Lecture 14 - Color
- Lecture 15 - Interior Lighting
- Lecture 16 - Sports Lighting
- Lecture 17 - Road Lighting
- Lecture 18 - Lighting Calculations
- Lecture 19 - Lighting Applications
- Lecture 20 - Conclusions on Illumination Engineering

Lecture 1 - Introduction

Lecture 2 - Architecture of Industrial Automation Systems

Lecture 3 - Measurement Systems Characteristics

Lecture 4 - Temperature Measurement

Lecture 5 - Pressure, Force and Torque Sensors

Lecture 6 - Motion Sensing

Lecture 7 - Flow Measurement

Lecture 8 - Signal Conditioning

Lecture 9 - Signal Conditioning (Continued.)

Lecture 10 - Data Acquisition Systems

Lecture 11 - Introduction to Automatic Control

Lecture 12 - P-I-D Control

Lecture 13 - PID Control Tuning

Lecture 14 - Feedforward Control Ratio Control

Lecture 15 - Time Delay Systems and Inverse Response Systems

Lecture 16 - Special Control Structures

Lecture 17 - Concluding Lesson on Process Control

Lecture 18 - Introduction to Sequence Control, PLC, RLL

Lecture 19 - Sequence Control. Scan Cycle, Simple RLL Programs

Lecture 20 - Sequence Control. More RLL Elements, RLL Syntax

Lecture 21 - A Structured Design Approach to Sequence

Lecture 22 - PLC Hardware Environment

Lecture 23 - Introduction To CNC Machines

Lecture 24 - Contour generation and Motion Control

Lecture 25 - Flow Control Valves

Lecture 26 - Hydraulic Control Systems - I

Lecture 27 - Hydraulic Control Systems - II

Lecture 28 - Industrial Hydraulic Circuit

Lecture 29 - Pneumatic Control Systems - I

Lecture 30 - Pneumatic Systems - II

Lecture 31 - Energy Savings with Variable Speed Drives

[Lecture 32 - DC Motor Drives](#)

[Lecture 33 - DC and BLDC Servo Drives](#)

[Lecture 34 - Induction Motor Drives](#)

[Lecture 35 - Step Motor Drives BLDC Drives](#)

[Lecture 36 - Embedded Systems](#)

[Lecture 37 - The Fieldbus Network - I](#)

[Lecture 38 - The Fieldbus Network - II](#)

[Lecture 39 - Higher Level Automation Systems](#)

[Lecture 40 - Course Review and Conclusion](#)

Lecture 1 - Introduction to Industrial Instrumentation

Lecture 2 - Dynamic Characteristics

Lecture 3 - Dynamic Characteristics (Continued.)

Lecture 4 - Strain gauge

Lecture 5 - Load cell

Lecture 6 - Torque Measurement

Lecture 7 - Thermistor

Lecture 8 - Thermocouples

Lecture 9 - Resistance Temperature Detector

Lecture 10 - LVDT

Lecture 11 - Capacitance Transducers

Lecture 12 - Flowmeter - I

Lecture 13 - Flowmeter - II

Lecture 14 - Flowmeter - III

Lecture 15 - Flowmeter - IV

Lecture 16 - Flowmeter - V

Lecture 17 - Problems on Temperature Sensors

Lecture 18 - Pressure Sensors

Lecture 19 - Low Pressure Measurement

Lecture 20 - pH and Viscosity Measurement

Lecture 21 - Problem and Solutions On Industrial Instrumentation

Lecture 22 - Signal Conditioning Circuits - I

Lecture 23 - Signal Conditioning Circuits - II

Lecture 24 - Piezoelectric Sensors

Lecture 25 - Ultrasonic Sensors

Lecture 26 - Nucleonic Instrumentation

Lecture 27 - Measurement Of Magnetic Field

Lecture 28 - Optoelectronic Sensor - I

Lecture 29 - Optoelectronic Sensor - II

Lecture 30 - Synchro

Lecture 31 - Dissolved Oxygen Sensors - I

[Lecture 32 - Dissolved Oxygen Sensors - II](#)

[Lecture 33 - Flapper - Nozzle](#)

[Lecture 34 - Smart Sensors](#)

[Lecture 35 - Chromatography - I](#)

[Lecture 36 - Chromatography - II](#)

[Lecture 37 - Pollution Measurement](#)

[Lecture 38 - Control Valve - I](#)

[Lecture 39 - Control Valve - II](#)

[Lecture 40 - Signal Conditioning Integrated Circuits](#)

- Lecture 1 - Introduction to Network Elements and Sources
- Lecture 2 - Introduction to Linearity and Nonlinearity
- Lecture 3 - Distributed & Lumped Parameters 2-port Networks
- Lecture 4 - Two-port Parameters Short Circuit,Open Circuit
- Lecture 5 - Tutorial
- Lecture 6 - Locus Diagram - Introduction to Signals
- Lecture 7 - Signals (Continued.) Laplace Transforms
- Lecture 8 - Laplace Transform (Continued.)
- Lecture 9 - Tutorial on Laplace Transform
- Lecture 10 - Frequency Response Bode Plot
- Lecture 11 - Bode Plot (Continued.)
- Lecture 12 - Bode Plot (Continued.) - Poles & Zeros
- Lecture 13 - Driving Point Immittance Functions - Realisability Conditions
- Lecture 14 - Two - Element Synthesis
- Lecture 15 - Two - Element Synthesis (Continued.)
- Lecture 16 - Tutorial
- Lecture 17 - Tutorial
- Lecture 18 - Graph Theory
- Lecture 19 - Graph Theory (Continued.)
- Lecture 20 - Graph Theory (Continued.)
- Lecture 21 - Graph Theory (Continued.)
- Lecture 22 - Image Impedance, Iterative Impedance
- Lecture 23 - Image Impedance, Iterative Impedance
- Lecture 24 - Characteristic Impedance and Design of Filters
- Lecture 25 - Analysis of Resistive Networks Computer Aided
- Lecture 26 - R-L-C Two-Terminal Network
- Lecture 27 - Parts of Network Functions
- Lecture 28 - Parts of Network Functions (Continued.)
- Lecture 29 - Tutorial
- Lecture 30 - Tutorial (Continued.)
- Lecture 31 - Tutorial

[Lecture 32 - Synthesis of 2-port Network](#)

[Lecture 33 - Synthesis of 2-port Network \(Continued.\)](#)

[Lecture 34 - Synthesis of 2-port Network \(Continued.\)](#)

[Lecture 35 - Fourier Series](#)

[Lecture 36 - Fourier Series \(Continued.\)](#)

- Lecture 1 - Introduction to Power system analysis
- Lecture 2 - Introduction to Single Line Diagram
- Lecture 3 - Transmission Line Parameters
- Lecture 4 - Inductance Calculation (Three Phase)
- Lecture 5 - Transmission Line Capacitance
- Lecture 6 - Transmission Line Capacitance (Continued..)
- Lecture 7 - Transmission Line Modeling
- Lecture 8 - Transmission Line Modeling Long Line
- Lecture 9 - Transmission Line Steady State Operation
- Lecture 10 - Transmission Line Steady State Control Voltage
- Lecture 11 - Transmission System A Review
- Lecture 12 - Transformer Model
- Lecture 13 - Synchronous Machine Model
- Lecture 14 - Synchronous Machine Model
- Lecture 15 - Load Model
- Lecture 16 - Power Flow - I
- Lecture 17 - Power Flow - II
- Lecture 18 - Power Flow - III
- Lecture 19 - Power Flow - IV
- Lecture 20 - Power Flow - V
- Lecture 21 - Power Flow - VI
- Lecture 22 - Power Flow - VII
- Lecture 23 - Review of Power System Component Models
- Lecture 24 - Review of Power Flow Study
- Lecture 25 - Short Circuit Analysis
- Lecture 26 - Symmetrical Component Analysis
- Lecture 27 - Sequence Networks
- Lecture 28 - Unbalanced Fault Analysis
- Lecture 29 - Unbalanced Fault Analysis
- Lecture 30 - Fault Analysis for Large power Systems
- Lecture 31 - Bus Impedance Matrix

[Lecture 32 - Asymmetrical Fault Analysis Using Z - Bus](#)

[Lecture 33 - Power System Stability - I](#)

[Lecture 34 - Power System Stability - II](#)

[Lecture 35 - Power System Stability - III](#)

[Lecture 36 - Power System Stability - IV](#)

[Lecture 37 - Power System Stability - V](#)

[Lecture 38 - Power System Stability - VI](#)

[Lecture 39 - Power System Stability - VII](#)

[Lecture 40 - Power System Stability - VIII](#)

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Architecture of Industrial Automation Systems

Lecture 4 - Architecture of Industrial Automation Systems (Continued...)

Lecture 5 - Measurement Systems Characteristics

Lecture 6 - Measurement Systems Characteristics (Continued...)

Lecture 7 - Data Acquisition Systems

Lecture 8 - Data Acquisition Systems (Continued...)

Lecture 9 - Introduction to Automatic Control

Lecture 10 - Introduction to Automatic Control (Continued...)

Lecture 11 - P-I-D Control

Lecture 12 - P-I-D Control (Continued...)

Lecture 13 - PID Controller Tuning

Lecture 14 - PID Controller Tuning (Continued...)

Lecture 15 - Feedforward Control Ratio Control

Lecture 16 - Feedforward Control Ratio Control (Continued...)

Lecture 17 - Time Delay Systems and Inverse Response Systems

Lecture 18 - Time Delay Systems and Inverse Response Systems (Continued...)

Lecture 19 - Special Control Structures

Lecture 20 - Special Control Structures (Continued...)

Lecture 21 - Concluding Lesson on Process Control (Self-study)

Lecture 22 - Introduction to Sequence Control, PLC, RLL

Lecture 23 - Introduction to Sequence Control, PLC, RLL (Continued...)

Lecture 24 - Sequence Control, Scan Cycle, Simple RLL Programs

Lecture 25 - Sequence Control, Scan Cycle, Simple RLL Programs (Continued...)

Lecture 26 - Sequence Control, More RLL Elements, RLL Syntax

Lecture 27 - Sequence Control, More RLL Elements, RLL Syntax (Continued...)

Lecture 28 - A Structured Design Approach to Sequence Control

Lecture 29 - A Structured Design Approach to Sequence Control (Continued...)

Lecture 30 - PLC Hardware Environment

Lecture 31 - PLC Hardware Environment (Continued...)

- [Lecture 32 - Flow Control Valves](#)
- [Lecture 33 - Flow Control Valves \(Continued...\)](#)
- [Lecture 34 - Hydraulic Control Systems - I](#)
- [Lecture 35 - Hydraulic Control Systems - I \(Continued...\)](#)
- [Lecture 36 - Hydraulic Control Systems - II](#)
- [Lecture 37 - Hydraulic Control Systems - II \(Continued...\)](#)
- [Lecture 38 - Industrial Hydraulic Circuit](#)
- [Lecture 39 - Industrial Hydraulic Circuit \(Continued...\)](#)
- [Lecture 40 - Pneumatic Control Systems - I](#)
- [Lecture 41 - Pneumatic Control Systems - I \(Continued...\)](#)
- [Lecture 42 - Pneumatic Systems - II](#)
- [Lecture 43 - Pneumatic Systems - II \(Continued...\)](#)
- [Lecture 44 - Energy Savings with Variable Speed Drives](#)
- [Lecture 45 - Energy Savings with Variable Speed Drives \(Continued...\)](#)
- [Lecture 46 - Introduction To CNC Machines](#)
- [Lecture 47 - Introduction To CNC Machines](#)
- [Lecture 48 - The Fieldbus Network - I](#)
- [Lecture 49 - The Fieldbus Network - I \(Continued...\)](#)
- [Lecture 50 - Higher Level Automation Systems](#)
- [Lecture 51 - Higher Level Automation Systems \(Continued...\)](#)
- [Lecture 52 - Course Review and Conclusion \(Self Study\)](#)

- Lecture 1 - Introduction to Medical Image Analysis
- Lecture 2 - X Ray and CT Imaging
- Lecture 3 - Magnetic Resonance Imaging
- Lecture 4 - Ultrasound Imaging
- Lecture 5 - Optical Microscopy and Molecular Imaging
- Lecture 6 - Texture in Medical Images
- Lecture 7 - Region Growing and Clustering
- Lecture 8 - Random Walks for Segmentation
- Lecture 9 - Active Contours for Segmentation
- Lecture 10 - Systematic Evaluation and Validation
- Lecture 11 - Decision Trees for Segmentation and Classification
- Lecture 12 - Random Forests for Segmentation and Classification
- Lecture 13 - Neural Networks for Segmentation and Classification
- Lecture 14 - Deep Learning for Medical Image Analysis
- Lecture 15 - Deep Learning for Medical Image Analysis (Continued...)
- Lecture 16 - Retinal Vessel Segmentation
- Lecture 17 - Vessel Segmentation in Computed Tomography Scan of Lungs
- Lecture 18
- Lecture 19 - Tissue Characterization in Ultrasound
- Lecture 20

[Lecture 1 - Motivation](#)

[Lecture 2 - Preliminaries](#)

[Lecture 3 - Biomedical Signal Origin and Dynamics](#)

[Lecture 4 - Biomedical Signal Origin and Dynamics \(Continued...\)](#)

[Lecture 5 - Biomedical Signal Origin and Dynamics \(Continued...\)](#)

[Lecture 6 - Biomedical Signal Origin and Dynamics \(Continued...\)](#)

[Lecture 7 - Artifact Removal](#)

[Lecture 8 - Artifact Removal \(Continued...\)](#)

[Lecture 9 - Artifact Removal \(Continued...\)](#)

[Lecture 10 - Artifact Removal \(Continued...\)](#)

[Lecture 11 - Artifact Removal \(Continued...\)](#)

[Lecture 12 - Artifact Removal \(Continued...\)](#)

[Lecture 13 - Artifact Removal \(Continued...\)](#)

[Lecture 14 - Artifact Removal \(Continued...\)](#)

[Lecture 15 - Artifact Removal \(Continued...\)](#)

[Lecture 16 - Artifact Removal \(Continued...\)](#)

[Lecture 17 - Artifact Removal \(Continued...\)](#)

[Lecture 18 - Event Detection](#)

[Lecture 19 - Event Detection \(Continued...\)](#)

[Lecture 20 - Event Detection \(Continued...\)](#)

[Lecture 21 - Event Detection \(Continued...\)](#)

[Lecture 22 - Event Detection \(Continued...\)](#)

[Lecture 23 - Event Detection \(Continued...\)](#)

[Lecture 24 - Event Detection \(Continued...\)](#)

[Lecture 25 - Homomorphic Processing](#)

[Lecture 26 - Homomorphic Processing \(Continued...\)](#)

[Lecture 27 - Waveform Analysis](#)

[Lecture 28 - Waveform Analysis \(Continued...\)](#)

[Lecture 29 - Waveform Analysis](#)

[Lecture 30 - Waveform Analysis \(Continued...\)](#)

[Lecture 31 - Waveform Analysis \(Continued...\)](#)

[Lecture 32 - Waveform Analysis \(Continued...\)](#)

[Lecture 33 - Waveform Analysis \(Continued...\)](#)

[Lecture 34 - Frequency Domain Characterisation](#)

[Lecture 35 - Frequency Domain Characterisation \(Continued...\)](#)

[Lecture 36 - Frequency Domain Characterisation \(Continued...\)](#)

[Lecture 37 - Frequency Domain Characterisation \(Continued...\)](#)

[Lecture 38 - Frequency Domain Characterisation \(Continued...\)](#)

[Lecture 39 - Frequency Domain Characterisation \(Continued...\)](#)

[Lecture 40 - Modelling of Biomedical Systems](#)

[Lecture 41 - Modelling of Biomedical Systems \(Continued...\)](#)

[Lecture 42 - Modelling of Biomedical Systems \(Continued...\)](#)

[Lecture 43 - Modelling of Biomedical Systems \(Continued...\)](#)

[Lecture 44 - Modelling of Biomedical Systems \(Continued...\)](#)

[Lecture 45 - Modelling of Biomedical Systems \(Continued...\)](#)

[Lecture 46 - Modelling of Biomedical Systems \(Continued...\)](#)

[Lecture 47 - Tutorial - I](#)

[Lecture 48 - Tutorial - I \(Continued...\)](#)

[Lecture 49 - Tutorial - I \(Continued...\)](#)

[Lecture 50 - Tutorial - II](#)

[Lecture 51 - Tutorial - II \(Continued...\)](#)

[Lecture 52 - Tutorial - II \(Continued...\)](#)

[Lecture 53 - Tutorial - III](#)

[Lecture 54 - Tutorial - III \(Continued...\)](#)

[Lecture 55 - Tutorial - III \(Continued...\)](#)

[Lecture 56 - Tutorial - III \(Continued...\)](#)

[Lecture 57 - Tutorial - IV](#)

[Lecture 58 - Tutorial - IV \(Continued...\)](#)

[Lecture 59 - Tutorial - IV \(Continued...\)](#)

[Lecture 60 - Tutorial - IV \(Continued...\)](#)

[Lecture 61 - Tutorial - IV \(Continued...\)](#)

[Lecture 62 - Tutorial - IV \(Continued...\)](#)

[Lecture 63 - Tutorial - V](#)

[Lecture 64 - Tutorial - V \(Continued...\)](#)

[Lecture 65 - Tutorial - V \(Continued...\)](#)

[Lecture 66 - Tutorial - V \(Continued...\)](#)

[Lecture 67 - Tutorial - V \(Continued...\)](#)

[Lecture 68 - Live Session](#)

[Lecture 1 - Introduction](#)

[Lecture 2 - Introduction \(Continued...\)](#)

[Lecture 3 - Introduction \(Continued...\)](#)

[Lecture 4 - Basic Computer Organization](#)

[Lecture 5 - Basic computer organization](#)

[Lecture 6 - Basic Computer Organization](#)

[Lecture 7 - 8085 Microprocessors](#)

[Lecture 8 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 9 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 10 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 11 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 12 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 13 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 14 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 15 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 16 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 17 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 18 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 19 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 20 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 21 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 22 - 8085 Microprocessors \(Continued...\)](#)

[Lecture 23 - 8051 Microcontroller](#)

[Lecture 24 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 25 - 8051Microcontroller \(Continued...\)](#)

[Lecture 26 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 27 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 28 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 29 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 30 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 31 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 32 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 33 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 34 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 35 - 8051 Microcontroller \(Continued...\)](#)

[Lecture 36 - 8051 Programming Examples](#)

[Lecture 37 - 8051 Programming Examples \(Continued...\)](#)

[Lecture 38 - 8051 Programming Examples \(Continued...\)](#)

[Lecture 39 - 8051 Programming Examples \(Continued...\)](#)

[Lecture 40 - 8051 Programming Examples \(Continued...\)](#)

[Lecture 41 - ARM](#)

[Lecture 42 - ARM \(Continued...\)](#)

[Lecture 43 - ARM \(Continued...\)](#)

[Lecture 44 - ARM \(Continued...\)](#)

[Lecture 45 - ARM \(Continued...\)](#)

[Lecture 46 - ARM \(Continued...\)](#)

[Lecture 47 - ARM \(Continued...\)](#)

[Lecture 48 - ARM \(Continued...\)](#)

[Lecture 49 - PIC](#)

[Lecture 50 - PIC, AVR](#)

[Lecture 51 - AVR \(Continued...\)](#)

[Lecture 52 - AVR \(Continued...\)](#)

[Lecture 53 - Interfacing](#)

[Lecture 54 - Interfacing \(Continued...\)](#)

[Lecture 55 - Interfacing \(Continued...\)](#)

[Lecture 56 - Interfacing \(Continued...\)](#)

[Lecture 57 - Interfacing \(Continued...\)](#)

[Lecture 58 - Interfacing \(Continued...\)](#)

[Lecture 59 - 8086](#)

[Lecture 60 - 8086 \(Continued...\)](#)

[Lecture 61 - 8086 \(Continued...\)](#)

[Lecture 62 - 8086 \(Continued...\)](#)

[Lecture 63 - 8086 \(Continued...\)](#)

[Lecture 64 - 8087](#)

- Lecture 1 - Introduction to Visual Computing
- Lecture 2 - Feature Extraction for Visual Computing
- Lecture 3 - Feature Extraction with Python
- Lecture 4 - Neural Networks for Visual Computing
- Lecture 5 - Classification with Perceptron Model
- Lecture 6 - Introduction to Deep Learning with Neural Networks
- Lecture 7 - Introduction to Deep Learning with Neural Networks
- Lecture 8 - Multilayer Perceptron and Deep Neural Networks
- Lecture 9 - Multilayer Perceptron and Deep Neural Networks
- Lecture 10 - Classification with Multilayer Perceptron
- Lecture 11 - Autoencoder for Representation Learning and MLP Initialization
- Lecture 12 - MNIST handwritten digits classification using autoencoders
- Lecture 13 - Fashion MNIST classification using autoencoders
- Lecture 14 - ALL-IDB Classification using autoencoders
- Lecture 15 - Retinal Vessel Detection using autoencoders
- Lecture 16 - Stacked Autoencoders
- Lecture 17 - MNIST and Fashion MNIST with Stacked Autoencoders
- Lecture 18 - Denoising and Sparse Autoencoders
- Lecture 19 - Sparse Autoencoders for MNIST classification
- Lecture 20 - Denoising Autoencoders for MNIST classification
- Lecture 21 - Cost Function
- Lecture 22 - Classification cost functions
- Lecture 23 - Optimization Techniques and Learning Rules
- Lecture 24 - Gradient Descent Learning Rule
- Lecture 25 - SGD and ADAM Learning Rules
- Lecture 26 - Convolutional Neural Network Building Blocks
- Lecture 27 - Simple CNN Model: LeNet
- Lecture 28 - LeNet Definition
- Lecture 29 - Training a LeNet for MNIST Classification
- Lecture 30 - Modifying a LeNet for CIFAR
- Lecture 31 - Convolutional Autoencoder and Deep CNN

[Lecture 32 - Convolutional Autoencoder for Representation Learning](#)

[Lecture 33 - AlexNet](#)

[Lecture 34 - VGGNet](#)

[Lecture 35 - Revisiting AlexNet and VGGNet for Computational Complexity](#)

[Lecture 36 - GoogLeNet - Going very deep with convolutions](#)

[Lecture 37 - GoogLeNet](#)

[Lecture 38 - ResNet - Residual Connections within Very Deep Networks and DenseNet - Densely connected networks](#)

[Lecture 39 - ResNet](#)

[Lecture 40 - DenseNet](#)

[Lecture 41 - Space and Computational Complexity in DNN](#)

[Lecture 42 - Assessing the space and computational complexity of very deep CNNs](#)

[Lecture 43 - Domain Adaptation and Transfer Learning in Deep Neural Networks](#)

[Lecture 44 - Transfer Learning a GoogLeNet](#)

[Lecture 45 - Transfer Learning a ResNet](#)

[Lecture 46 - Activation pooling for object localization](#)

[Lecture 47 - Region Proposal Networks \(rCNN and Faster rCNN\)](#)

[Lecture 48 - GAP + rCNN](#)

[Lecture 49 - Semantic Segmentation with CNN](#)

[Lecture 50 - UNet and SegNet for Semantic Segmentation](#)

[Lecture 51 - Autoencoders and Latent Spaces](#)

[Lecture 52 - Principle of Generative Modeling](#)

[Lecture 53 - Adversarial Autoencoders](#)

[Lecture 54 - Adversarial Autoencoder for Synthetic Sample Generation](#)

[Lecture 55 - Adversarial Autoencoder for Classification](#)

[Lecture 56 - Understanding Video Analysis](#)

[Lecture 57 - Recurrent Neural Networks and Long Short-Term Memory](#)

[Lecture 58 - Spatio-Temporal Deep Learning for Video Analysis](#)

[Lecture 59 - Activity recognition using 3D-CNN](#)

[Lecture 60 - Activity recognition using CNN-LSTM](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11 - Cables \(Continued...\)](#)

[Lecture 12 - Transient over voltages and Insulation coordination](#)

[Lecture 13 - Transient over voltages and Insulation coordination \(Continued...\)](#)

[Lecture 14 - Transient over voltages and Insulation coordination \(Continued...\)](#)

[Lecture 15 - Transient over voltages and Insulation coordination \(Continued...\)](#)

[Lecture 16 - Transient over voltages and Insulation coordination \(Continued...\)](#)

[Lecture 17 - Transient over voltages and Insulation coordination \(Continued...\)](#)

[Lecture 18 - Transient over voltages and Insulation coordination \(Continued...\)](#)

[Lecture 19 - Transient over voltages and Insulation coordination \(Continued...\)](#)

[Lecture 20 - Corona](#)

[Lecture 21 - Corona \(Continued...\)](#)

[Lecture 22 - Corona \(Continued...\)](#)

[Lecture 23 - Corona \(Continued...\), Sag and Tension Analysis](#)

[Lecture 24 - Sag and Tension Analysis \(Continued...\)](#)

[Lecture 25 - Sag and Tension Analysis \(Continued...\)](#)

[Lecture 26 - Sag and Tension Analysis \(Continued...\)](#)

[Lecture 27 - Sag and Tension Analysis \(Continued...\)](#)

[Lecture 28 - Sag and Tension Analysis \(Continued...\)](#)

[Lecture 29 - Load flow of radial distribution networks](#)

[Lecture 30 - Load flow of radial distribution networks \(Continued...\)](#)

[Lecture 31 - Load flow of radial distribution networks \(Continued...\)](#)

- [Lecture 32 - Load flow of radial distribution networks \(Continued...\)](#)
- [Lecture 33 - Load flow of radial distribution networks \(Continued...\)](#)
- [Lecture 34 - Load flow of radial distribution networks \(Continued...\)](#)
- [Lecture 35 - Load flow of radial distribution networks \(Continued...\)](#)
- [Lecture 36 - Load flow of radial distribution networks \(Continued...\)](#)
- [Lecture 37 - Load flow of radial distribution networks \(Continued...\), Voltage stability of distribution network](#)
- [Lecture 38 - Voltage stability of distribution network, Approximate method](#)
- [Lecture 39 - Application of capacitors in distribution system](#)
- [Lecture 40 - Application of capacitors in distribution system \(Continued...\)](#)
- [Lecture 41 - Application of capacitors in distribution system \(Continued...\)](#)
- [Lecture 42 - Application of capacitors in distribution system \(Continued...\)](#)
- [Lecture 43 - Application of capacitors in distribution system \(Continued...\)](#)
- [Lecture 44 - Application of capacitors in distribution system \(Continued...\), Load frequency control](#)
- [Lecture 45 - Load frequency control \(Continued...\)](#)
- [Lecture 46 - Load frequency control \(Continued...\)](#)
- [Lecture 47 - Load frequency control \(Continued...\)](#)
- [Lecture 48 - Load frequency control \(Continued...\)](#)
- [Lecture 49 - Load frequency control \(Continued...\)](#)
- [Lecture 50 - Load frequency control \(Continued...\)](#)
- [Lecture 51 - Load frequency control \(Continued...\)](#)
- [Lecture 52 - Load frequency control \(Continued...\)](#)
- [Lecture 53 - Load frequency control \(Continued...\)](#)
- [Lecture 54 - Load frequency control \(Continued...\)](#)
- [Lecture 55 - Load frequency control \(Continued...\)](#)
- [Lecture 56 - Load frequency control \(Continued...\)](#)
- [Lecture 57 - Automatic generation control](#)
- [Lecture 58 - Automatic generation control \(Continued...\)](#)
- [Lecture 59 - Automatic generation control \(Continued...\), Unit commitment](#)
- [Lecture 60 - Unit commitment \(Continued...\)](#)
- [Lecture 61 - Live Session](#)

Lecture 1 - Basic Concepts, Examples

Lecture 2 - Basic Concepts, Examples (Continued...)

Lecture 3 - Basic Concepts, Examples (Continued...)

Lecture 4 - Basic Concepts, Examples (Continued...)

Lecture 5 - Basic Laws

Lecture 6 - Basic Laws (Continued...)

Lecture 7 - Basic Laws (Continued...)

Lecture 8 - Basic Laws (Continued...)

Lecture 9 - Basic Laws (Continued...)

Lecture 10 - Basic Laws (Continued...)

Lecture 11 - Methods of Circuit Analysis

Lecture 12 - Methods of Circuit Analysis (Continued...)

Lecture 13 - Methods of Circuit Analysis (Continued...)

Lecture 14 - Methods of Circuit Analysis (Continued...)

Lecture 15 - Methods of Circuit Analysis (Continued...)

Lecture 16 - Methods of Circuit Analysis (Continued...)

Lecture 17 - Mesh analysis with current sources, Examples

Lecture 18 - Methods of Circuit Analysis (Continued...) and Circuit Theorems

Lecture 19 - Circuit Theorems (Continued...)

Lecture 20 - Circuit Theorems (Continued...)

Lecture 21 - Circuit Theorems (Continued...)

Lecture 22 - Circuit Theorems (Continued...)

Lecture 23 - Circuit Theorems (Continued...)

Lecture 24 - Circuit Theorems (Continued...)

Lecture 25 - Circuit Theorems (Continued...) and Capacitors and Inductors

Lecture 26 - Capacitors and Inductors (Continued...)

Lecture 27 - Capacitors and Inductors (Continued...)

Lecture 28 - Capacitors and Inductors (Continued...)

Lecture 29 - First Order Circuits

Lecture 30 - First Order Circuits (Continued...)

Lecture 31 - First Order Circuits (Continued...)

[Lecture 32 - First Order Circuits \(Continued...\)](#)

[Lecture 33 - First Order Circuits \(Continued...\)](#)

[Lecture 34 - First Order Circuits \(Continued...\)](#)

[Lecture 35 - First Order Circuits \(Continued...\)](#)

[Lecture 36 - First Order Circuits \(Continued...\)](#)

[Lecture 37 - Single phase AC circuits](#)

[Lecture 38 - Single phase AC circuits \(Continued...\)](#)

[Lecture 39 - Single phase AC circuits \(Continued...\)](#)

[Lecture 40 - Single phase AC circuits \(Continued...\)](#)

[Lecture 41 - Single phase AC circuits \(Continued...\)](#)

[Lecture 42 - Single phase AC circuits \(Continued...\)](#)

[Lecture 43 - Single phase AC circuits \(Continued...\)](#)

[Lecture 44 - Resonance and Maximum Power Transfer Theorem](#)

[Lecture 45 - Resonance and Maximum Power Transfer Theorem \(Continued...\)](#)

[Lecture 46 - Resonance and Maximum Power Transfer Theorem \(Continued...\)](#)

[Lecture 47 - Three phase circuits](#)

[Lecture 48 - Three phase circuits \(Continued...\)](#)

[Lecture 49 - Three phase circuits \(Continued...\)](#)

[Lecture 50 - Three phase circuits \(Continued...\)](#)

[Lecture 51 - Magnetic Circuits](#)

[Lecture 52 - Magnetic Circuits \(Continued...\)](#)

[Lecture 53 - Magnetic Circuits \(Continued...\)](#)

[Lecture 54 - Single Phase Transformer](#)

[Lecture 55 - Single Phase Transformer \(Continued...\)](#)

[Lecture 56 - Single Phase Transformer \(Continued...\)](#)

[Lecture 57 - Single Phase Transformer \(Continued...\)](#)

[Lecture 58 - Three phase Induction Motors](#)

[Lecture 59 - Three phase Induction Motors \(Continued...\)](#)

[Lecture 60 - Three phase Induction Motors \(Continued...\)](#)

[Lecture 61 - Three phase Induction Motors \(Continued...\)](#)

[Lecture 62 - DC Motors](#)

[Lecture 63 - DC Motors \(Continued...\)](#)

[Lecture 64 - DC Motors \(Continued...\)](#)

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Number System

Lecture 4 - Number System (Continued...)

Lecture 5 - Number System (Continued...)

Lecture 6 - Number System (Continued...)

Lecture 7 - Number System (Continued...)

Lecture 8 - Boolean Algebra

Lecture 9 - Boolean Algebra (Continued...)

Lecture 10 - Boolean Algebra (Continued...)

Lecture 11 - Boolean Algebra (Continued...)

Lecture 12 - Boolean Algebra (Continued...)

Lecture 13 - Boolean Algebra (Continued...)

Lecture 14 - Logic Gates

Lecture 15 - Logic Gates (Continued...)

Lecture 16 - Logic Gates (Continued...)

Lecture 17 - Logic Gates (Continued...)

Lecture 18 - Logic Gates (Continued...)

Lecture 19 - Logic Gates (Continued...)

Lecture 20 - Arithmetic Circuits

Lecture 21 - Arithmetic Circuits (Continued...)

Lecture 22 - Arithmetic Circuits (Continued...)

Lecture 23 - Decoders, Multiplexers, PLA

Lecture 24 - Decoders, Multiplexers, PLA (Continued...)

Lecture 25 - Decoders, Multiplexers, PLA (Continued...)

Lecture 26 - Decoders, Multiplexers, PLA (Continued...)

Lecture 27 - Decoders, Multiplexers, PLA (Continued...)

Lecture 28 - Sequential Circuits

Lecture 29 - Sequential Circuits (Continued...)

Lecture 30 - Sequential Circuits (Continued...)

Lecture 31 - Sequential Circuits (Continued...)

[Lecture 32 - Sequential Circuits \(Continued...\)](#)

[Lecture 33 - Sequential Circuits \(Continued...\)](#)

[Lecture 34 - Sequential Circuits \(Continued...\)](#)

[Lecture 35 - Finite State Machine](#)

[Lecture 36 - Finite State Machine \(Continued...\)](#)

[Lecture 37 - Data Converters](#)

[Lecture 38 - Data Converters \(Continued...\)](#)

[Lecture 39 - Data Converters \(Continued...\)](#)

[Lecture 40 - Data Converters \(Continued...\)](#)

[Lecture 41 - Memory](#)

[Lecture 42 - Memory \(Continued...\)](#)

[Lecture 43 - Memory \(Continued...\)](#)

[Lecture 44 - FPGA](#)

[Lecture 45 - FPGA \(Continued...\)](#)

[Lecture 46 - VHDL](#)

[Lecture 47 - VHDL\(Continued...\)](#)

[Lecture 48 - 8085 Microprocessor](#)

[Lecture 49 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 50 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 51 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 52 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 53 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 54 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 55 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 56 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 57 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 58 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 59 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 60 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 61 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 62 - 8085 Microprocessor \(Continued...\)](#)

[Lecture 63 - 8086 Microprocessor](#)

[Lecture 64 - 8086 Microprocessor \(Continued...\)](#)

[Lecture 65 - 8086 Microprocessor \(Continued...\)](#)

Lecture 1 - Concept of Scalar and Vector Potentials

Lecture 2 - Radiation From a Current Element (Hertzian Dipole)

Lecture 3 - Specific Properties of the Radiated Fields from a Current Element

Lecture 4 - General Properties of Radiated Fields from an Antenna

Lecture 5 - Farfield and Radiation Pattern of an Antenna

Lecture 6 - Directivity and Gain of an Antenna

Lecture 7 - Idea of Efficiency, Beamwidth, Polarisation and Bandwidth

Lecture 8 - Polarization of Antenna

Lecture 9 - Impedance of Antenna

Lecture 10 - Effective Aperture of an Antenna

Lecture 11 - Friss Transmission Equation and Antenna Temperature

Lecture 12 - Dipole And Monopole Antena

Lecture 13 - Dipole And Monopole Antena (Continued...)

Lecture 14 - BALUN

Lecture 15 - Loop Antenna

Lecture 16 - Folded Dipole Antenna

Lecture 17 - Introduction to Antenna Array

Lecture 18 - Antenna Array Theory

Lecture 19 - Broadside Uniform Linear Array

Lecture 20 - Endfire Linear Uniform Array

Lecture 21 - Parasitic Array and Log Periodic Antenna

Lecture 22 - Analysis Procedures of Aperture Antennas

Lecture 23 - Analysis Procedures of Aperture Antenna (Continued...)

Lecture 24 - Horn Antenna

Lecture 25 - Horn Antenna (Continued...)

Lecture 26 - Reflector Antennas

Lecture 27 - Paraboloid Reflector Antenna (Continued...)

Lecture 28 - Paraboloid Reflector Antenna (Continued...)

Lecture 29 - Dual Reflector Antenna

Lecture 30 - Generalised Analysis of Antenna

Lecture 31 - Solution of Wave Equation for Electric and Magnetic Current Densities

[Lecture 32 - Farfield Evaluation of Spherical Wave Radiation by Generalised Antenna](#)

[Lecture 33 - Slot Antenna](#)

[Lecture 34 - Open Ended Waveguide Antenna and Microstrip Antenna](#)

[Lecture 35 - Numerical Evaluation of Wire Antenna Currents](#)

[Lecture 36 - Solution of Intregal Equation by Moment Method](#)

[Lecture 37 - Array Pattern Synthesis](#)

[Lecture 38 - Array Pattern Synthesis \(Continued...\)](#)

[Lecture 39 - Ultra Wideband Antennas](#)

[Lecture 40 - Antenna Measurements](#)

Lecture 1 - Introduction to VLSI Design Flow

Lecture 2 - Introduction to VLSI Design Flow

Lecture 3 - Introduction to VLSI Design Flow

Lecture 4 - Algorithm to Efficient Architecture Mapping

Lecture 5 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 6 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 7 - Tutorial on Algorithm to Efficient Architecture Mapping

Lecture 8 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 9 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 10 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 11 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 12 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 13 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 14 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 15 - Efficient Adder Architecture

Lecture 16 - Efficient Adder Architecture (Continued...)

Lecture 17 - Efficient Adder Architecture (Continued...)

Lecture 18 - Efficient Adder Architecture

Lecture 19 - Efficient Adder Architecture

Lecture 20 - Efficient Adder Architecture

Lecture 21 - Efficient Adder Architecture

Lecture 22 - Efficient Adder Architecture

Lecture 23 - Efficient Adder Architecture

Lecture 24 - Efficient Adder Architecture

Lecture 25 - Pipelining and Parallel Processing

Lecture 26 - Pipelining and Parallel Processing

Lecture 27 - Multiplier Architecture

Lecture 28 - Multiplier Architecture

Lecture 29 - Multiplier Architecture

Lecture 30 - Multiplier Architecture

Lecture 31 - Multiplier Architecture

[Lecture 32 - Multiplier Architecture](#)

[Lecture 33 - Multiplier Architecture](#)

[Lecture 34 - Multiplier Architecture](#)

[Lecture 35 - Squaring Circuit Design](#)

[Lecture 36 - Reconfigurable Constant Multiplier Design](#)

[Lecture 37 - Reconfigurable Constant Multiplier Design](#)

[Lecture 38 - Reconfigurable Constant Multiplier Design](#)

[Lecture 39 - Fixed Point Number Representation](#)

[Lecture 40 - Fixed Point Number Representation](#)

[Lecture 41 - CORDIC Architecture](#)

[Lecture 42 - CORDIC Architecture](#)

[Lecture 43 - CORDIC Architecture](#)

[Lecture 44 - CORDIC Architecture](#)

[Lecture 45 - Timing Analysis](#)

[Lecture 46 - Timing Analysis](#)

[Lecture 47 - Timing Analysis](#)

[Lecture 48 - Logic Hazard](#)

[Lecture 49 - FFT Architecture](#)

[Lecture 50 - FFT Architecture \(Continued...\)](#)

[Lecture 51 - Timing analysis Basics](#)

[Lecture 52 - Timing analysis Basics \(Continued...\)](#)

[Lecture 53 - Timing analysis Basics \(Continued...\)](#)

[Lecture 54 - Timing Issuesin Digital IC Design](#)

[Lecture 55 - Timing Issuesin Digital IC Design \(Continued...\)](#)

[Lecture 56 - Timing Issuesin Digital IC Design \(Continued...\)](#)

[Lecture 57 - Timing Issuesin Digital IC Design \(Continued...\)](#)

[Lecture 58 - Architectural Design of Digital Integrated Circuits](#)

[Lecture 59 - Design Tips for Basic Circuits Design \(Continued...\)](#)

[Lecture 60 - Design Tips for Basic Circuits Design \(Continued...\)](#)

[Lecture 61 - Design Tips for Basic Circuits Design \(Continued...\)](#)

[Lecture 62 - Low Power Digital Design](#)

[Lecture 63 - Low Power Digital Design \(Continued...\)](#)

[Lecture 64 - Low Power Digital Design](#)

[Lecture 65 - Low Power Digital Design \(Continued...\)](#)

[Lecture 66 - Hardware for Machine Learning: Design Considerations Design Tips](#)

[Lecture 67 - Hardware for Machine Learning: Design Considerations Design Tips \(Continued...\)](#)

Lecture 1 - Inductance, Self and Mutual

Lecture 2 - Relationship of Inductances in Transformer

Lecture 3 - Equivalent Circuit from Circuit KVL Equations

Lecture 4 - Co-efficient of Coupling , Energy Stored in Coupled Coils

Lecture 5 - A Single Conductor Generator and Motor

Lecture 6 - Analysis of Single Conductor Generator and Motor

Lecture 7 - Analysis of Single Conductor Generator and Motor (Continued...)

Lecture 8 - Flux Density Distribution in Space and Nature emf

Lecture 9 - Flux Density Distribution in Space and Nature emf (Continued...)

Lecture 10 - From Linear to Rotating Machine

Lecture 11 - From Linear to Rotating Machine (Continued...)

Lecture 12 - Basic Underlying Principle of Operation of Rotating Machine

Lecture 13 - Basic Underlying Principle of Operation of Rotating Machine (Continued...)

Lecture 14 - Flux Density Distribution along the Air Gap

Lecture 15 - Flux Density Distribution along the Air Gap (Continued...)

Lecture 16 - Induced Voltage in a Coil in a Rotating Machine

Lecture 17 - Induced Voltage in a Coil in a Rotating Machine (Continued...)

Lecture 18 - Induced Voltage in a Coil in a Rotating Machine (Continued...)

Lecture 19 - Induced Voltage due to Fundamental and Harmonic Components of Flux Density Distribution

Lecture 20 - Distributed Coils Connected in Series Resultant Voltage

Lecture 21 - Distribution Factor

Lecture 22 - Pitch Factor and Winding Factor

Lecture 23 - How to decide about Short Pitch Angle $\hat{\mu}$

Lecture 24 - Double Layer 3-phase Winding - An Introduction

Lecture 25 - Winding Table for 3-phase Distributed Winding

Lecture 26 - Winding Table for 3-phase Distributed Winding with Examples

Lecture 27 - Winding Table for 3-phase Distributed Winding with Examples (Continued...)

Lecture 28 - 120 degree Phase Spread Winding with Examples

Lecture 29 - Winding Table of 120 degree Phase Spread Coils and Group Connection

Lecture 30 - Introduction to Rotating Magnetic Field

Lecture 31 - Rotating Magnetic Field (Continued...), Mechanical and Electrical Speed

Lecture 32 - Speed and Direction of Rotating Field

Lecture 33 - Synchronous Speed and How to Calculate Induced Voltage in a Coil

Lecture 34 - Introduction to Induction Motor

Lecture 35 - Introduction to Induction Motor (Continued...)

Lecture 36 - General Expression of Torque in Terms of Stator and Rotor Fields

Lecture 37 - Torque Angle and Torque Expression

Lecture 38 - How to Fix Up Positions of Net Field, Rotor Field and Stator Field

Lecture 39 - Slip: Its Importance and Range for Motor Operation

Lecture 40 - Equivalent Circuit of 3-Phase Induction Motor

Lecture 41 - Equivalent Circuit of 3-Phase Induction Motor (Continued...)

Lecture 42 - Equivalent Circuit of 3-Phase Induction Motor (Continued...)

Lecture 43 - Expression for Electromagnetic Torque in terms of Equivalent Circuit Parameters

Lecture 44 - Maximum Electromagnetic Torque and Slip at Which it Occurs

Lecture 45 - Typical Torque Slip Characteristic and Operating Point

Lecture 46 - Change in Torque-slip Characteristic as Supply Voltage and Rotor Resistance are Varied

Lecture 47 - Types of Induction Motor - Slip Ring Type

Lecture 48 - Introduction to Cage Induction Motor

Lecture 49 - Cage Motor Can Operate for Different Stator Poles

Lecture 50 - Core Loss in Induction Motor and Simplified Equivalent Circuit

Lecture 51 - Torque Expression from Simplified Equivalent Circuit and Introduction to Circle Diagram

Lecture 52 - Circle Diagram (Continued...)

Lecture 53 - Exact Power Flow Diagram and Circle Diagram

Lecture 54 - Circle Diagram (Continued...)

Lecture 55 - Circle Diagram: Slip Line

Lecture 56 - Circle Diagram from Test Data

Lecture 57 - Starting of 3 Phase Induction Motor - Introduction

Lecture 58 - DOL and Reactor Starting

Lecture 59 - DOL and Auto Transformer Starting

Lecture 60 - Introduction to Speed Control

Lecture 61 - Idea of VVVF Speed Control of Induction Motor

Lecture 62 - Speed Control Using Two Motors

Lecture 63 - Electrical Braking of 3 Phase Induction Motor

Lecture 64 - Braking (Continued...)

- Lecture 65 - Introduction to Single Phase Induction Motor - Sequence Currents
- Lecture 66 - Development of Equivalent Circuit
- Lecture 67 - Development of Equivalent Circuit (Continued...)
- Lecture 68 - Torque-slip Ch. of 1 ph. I-M Running on Single Winding
- Lecture 69 - Introduction to Starting of 1ph. Induction Motor
- Lecture 70 - Expression for Starting Torque and Need for Phase Splitting
- Lecture 71 - Resistor Split 1 ph. Induction Motor
- Lecture 72 - Capacitor Split 1 ph Induction Motor
- Lecture 73 - Starting of 1 ph. Induction Motor (Continued...)
- Lecture 74 - Synchronous Machine Construction
- Lecture 75 - Synchronous Generator - Introduction
- Lecture 76 - Synchronisation
- Lecture 77 - Expression for Induced Voltage and O.C. Phasor Diagram
- Lecture 78 - Loaded Synchronous Generator - Resultant Field
- Lecture 79 - Armature Reaction and Synchronous Reactance. Basic Phasor Diagram
- Lecture 80 - General Mode of Operation - Retro Field, Stator Field and Resultant Field
- Lecture 81 - Complete Phasor Diagram and Expression for Complex Power
- Lecture 82 - Synchronous Motor Operation, Phasor Diagram and Power Expression
- Lecture 83 - Effect of Variation of Field Current in Generator
- Lecture 84 - Effect of Variation Field Current in Synchronous Motor, Introduction to Salient Pole Machine
- Lecture 85 - Analysis of Salient Pole Synchronous Machine
- Lecture 86 - Phasor Diagram of Salient Pole Synchronous Machine for Generator and Motor Mode
- Lecture 87 - Expression for Load Angle and Expression for Power
- Lecture 88 - Phasor Diagrams of Salient Pole Synchronous Generator under Various Conditions
- Lecture 89 - Phasor Diagrams of Salient Pole Synchronous Motor under Various Conditions
- Lecture 90 - O.C and S.C Test on Synchronous Generator

Lecture 1 - Introduction

Lecture 2 - Transistor as a switch

Lecture 3 - Performance Issues and Introduction to TTL

Lecture 4 - Transistor Transistor Logic (TTL)

Lecture 5 - CMOS Logic

Lecture 6 - Basic Gates and their representations

Lecture 7 - Fundamentals of Boolean Algebra

Lecture 8 - Boolean Function to Truth Table and Implementaion Issues

Lecture 9 - Truth Table to Boolean Function and Implementaion Issues

Lecture 10 - Karnugh Map and Digital Circuit Realization

Lecture 11 - Karnaugh Map to Entered Variable Map

Lecture 12 - Quine - McClusky (QM) Algorithm

Lecture 13 - Cost Criteria and Minimization of Multiple Output Functions

Lecture 14 - Static 1 Hazard

Lecture 15 - Static 0 Hazard and Dynamic Hazard

Lecture 16 - Multiplexer: Part I

Lecture 17 - Multiplexer: Part II

Lecture 18 - Demultiplexer / Decoder

Lecture 19 - Decoder with BCD Input and Encoder

Lecture 20 - Parity Generator and Checker

Lecture 21 - Number System

Lecture 22 - Negative Number and 2s Complement Arithmetic

Lecture 23 - Arithmetic Building Blocks - I

Lecture 24 - Arithmetic Building Blocks - II

Lecture 25 - Overflow Detection and BCD Arithmetic

Lecture 26 - Magnitude Comparator

Lecture 27 - Arithmetic Logic Unit (ALU)

Lecture 28 - Unweighted Code

Lecture 29 - Error Detection and Correction Code

Lecture 30 - Multiplication and Division

Lecture 31 - SR Latch and Introduction to Clocked Flip-Flop

- Lecture 32 - Edge-Triggered Flip-Flop
- Lecture 33 - Representations of Flip-Flops
- Lecture 34 - Analysis of Sequential Logic Circuit
- Lecture 35 - Conversion of Flip-Flops and Flip-Flop Timing Parameters
- Lecture 36 - Register and Shift Register: PIPO and SISO
- Lecture 37 - Shift Register: SIPO, PISO and Universal Shift Register
- Lecture 38 - Application of Shift Register
- Lecture 39 - Linear Feedback Shift Register
- Lecture 40 - Serial Addition, Multiplication and Division
- Lecture 41 - Asynchronous Counter
- Lecture 42 - Decoding Logic and Synchronous Counter
- Lecture 43 - Cascading: Mod 2, 3, 5 to Mod 6, 10, 1000 Counter
- Lecture 44 - Counter Design with Asynchronous Reset and Preset
- Lecture 45 - Counter Design as Synthesis Problem and Few Other Uses of Counter
- Lecture 46 - Synthesis of Sequential Logic Circuit: Moore Model and Mealy Model
- Lecture 47 - Moore Model and Mealy Model: Realization of Digital Logic Circuit
- Lecture 48 - Algorithmic State Machine (ASM) Chart and Synthesis of Sequential Logic Circuit
- Lecture 49 - Circuit Realization from ASM Chart and State Minimization
- Lecture 50 - State Minimization by Implication Table and Partitioning Method
- Lecture 51 - Digital to Analog Conversion - I
- Lecture 52 - Digital to Analog Conversion - II
- Lecture 53 - Analog to Digital Conversion - I
- Lecture 54 - Analog to Digital Conversion - II
- Lecture 55 - Certain Performance Issue of ADC and DAC
- Lecture 56 - Introduction to Memory
- Lecture 57 - Static Random Access Memory (SRAM)
- Lecture 58 - Dynamic RAM (DRAM) and Memory Expansion
- Lecture 59 - Read Only Memory (ROM)
- Lecture 60 - PAL, PLA, CPLD, FPGA

Lecture 1 - Power System stability

Lecture 2 - Power System stability (Continued...)

Lecture 3 - Power System stability (Continued...)

Lecture 4 - Power System stability (Continued...)

Lecture 5 - Power System stability (Continued...)

Lecture 6 - Power System Stability (Continued...)

Lecture 7 - Power System Stability (Continued...)

Lecture 8 - Power System Stability (Continued...)

Lecture 9 - Power System Stability (Continued...)

Lecture 10 - Power System Stability (Continued...)

Lecture 11 - Power System Stability (Continued...)

Lecture 12 - Power System Stability (Continued...)

Lecture 13 - Power System Stability (Continued...)

Lecture 14 - Power System Stability (Continued...)

Lecture 15 - Power System Stability (Continued...)

Lecture 16 - Power System Stability (Continued...)

Lecture 17 - Power System Stability (Continued...)

Lecture 18 - Power System Stability (Continued...)

Lecture 19 - Power System Stability (Continued...)

Lecture 20 - Power System Stability (Continued...)

Lecture 21 - Power System stability (Continued...)

Lecture 22 - Power System stability, Eigen properties of the state matrix

Lecture 23 - Power System stability, Eigen properties of the state matrix (Continued...)

Lecture 24 - Power System stability, Eigen properties of the state matrix (Continued...)

Lecture 25 - Power System stability, Eigen properties of the state matrix (Continued...)

Lecture 26 - Power System stability, Eigen properties of the state matrix (Continued...)

Lecture 27 - Power System stability, Eigen properties of the state matrix, Transient stability

Lecture 28 - Transient stability

Lecture 29 - Transient stability (Continued...)

Lecture 30 - Transient stability (Continued...)

Lecture 31 - Transient stability

- Lecture 32 - Transient stability, Automatic generation control conventional scenario
- Lecture 33 - Automatic generation control conventional scenario
- Lecture 34 - Automatic generation control conventional scenario
- Lecture 35 - Automatic generation control conventional scenario
- Lecture 36 - Automatic generation control conventional scenario
- Lecture 37 - Automatic generation control conventional scenario
- Lecture 38 - Automatic generation control conventional scenario
- Lecture 39 - Automatic generation control conventional scenario
- Lecture 40 - Automatic generation control conventional scenario
- Lecture 41 - AGC in deregulated system
- Lecture 42 - AGC in deregulated system (Continued...)
- Lecture 43 - AGC in deregulated system (Continued...)
- Lecture 44 - AGC in deregulated system (Continued...)
- Lecture 45 - AGC in deregulated system (Continued...)
- Lecture 46 - AGC in deregulated system (Continued...)
- Lecture 47 - AGC in deregulated system (Continued...)
- Lecture 48 - AGC in deregulated system (Continued...)
- Lecture 49 - AGC in deregulated system, Reactive power and voltage control
- Lecture 50 - Reactive power and voltage control
- Lecture 51 - Reactive power and voltage control, State estimation in power system
- Lecture 52 - State estimation in power system
- Lecture 53 - State estimation in power system (Continued...)
- Lecture 54 - State estimation in power system (Continued...)
- Lecture 55 - State estimation in power system (Continued...)
- Lecture 56 - State estimation in power system (Continued...)
- Lecture 57 - Hydraulic turbine modelling
- Lecture 58 - Hydraulic turbine modelling (Continued...)
- Lecture 59 - Subsynchronous oscillation
- Lecture 60 - Subsynchronous oscillation, Windup and non windup limits

Lecture 1 - Evolution of wireless Communication

Lecture 2 - Evolution of wireless Communication Standards From 2G to 5G

Lecture 3 - Evolution of wireless Communication Standards From 2G to 5G (Continued...)

Lecture 4 - Evolution of wireless Communication Standards From 2G to 5G (Continued...)

Lecture 5 - Evolution of wireless Communication Standards From 2G to 5G (Continued...)

Lecture 6 - Requirements and operating scenarios of 5G

Lecture 7 - Requirements and operating scenarios of 5G (Continued....)

Lecture 8 - 5G scenarios

Lecture 9 - Ultra reliable low latency communication

Lecture 10 - Designing 5G new radio

Lecture 11 - Fundamental Framework for waveform analysis

Lecture 12 - Fundamental Framework for waveform analysis (Continued...)

Lecture 13 - Waveform Design Aspects of 2G

Lecture 14 - Waveforms in 3G

Lecture 15 - Waveforms in 3G (Continued...)

Lecture 16 - Waveform in 4G and 5G (OFDM)

Lecture 17 - Waveform in 4G and 5G (OFDM) (Continued...)

Lecture 18 - Waveform in 4G and 5G (OFDM) (Continued...)

Lecture 19 - Waveform in 4G and 5G (OFDMA)

Lecture 20 - Waveform in 4G and 5G (OFDMA, SCFDMA, SCFDE)

Lecture 21 - Waveform in 4G and 5G (SCFDMA Continued...)

Lecture 22 - Waveform in 5G

Lecture 23 - Waveform in 5G Numerology

Lecture 24 - Frame Structure in 5G NR

Lecture 25 - Numerology in 5G and adaptive subcarrier bandwidth

Lecture 26 - Numerology in 5G (Continued...)

Lecture 27 - Waveforms beyond 5G

Lecture 28 - Waveforms beyond 5G (Continued...)

Lecture 29 - Waveforms beyond 5G (Continued...)

Lecture 30 - Waveforms beyond 5G (Continued...)

Lecture 31 - Waveform beyond 5G (Precoded GFDM)

[Lecture 32 - Comparison of waveforms](#)

[Lecture 33 - Channel models for performance evaluation - Part I](#)

[Lecture 34 - Channel models for performance evaluation - Part II](#)

[Lecture 35 - Channel models for performance evaluation - Part III](#)

[Lecture 36 - MIMO Signal Processing \(Receive Diversity\)](#)

[Lecture 37 - MIMO Signal Processing](#)

[Lecture 38 - MIMO Signal Processing \(Capacity\)](#)

[Lecture 39 - MIMO Signal Processing \(Capacity and Massive MIMO\)](#)

[Lecture 40 - Hybrid beamforming \(mmWave\)](#)

Lecture 1 - PMMC Instruments

Lecture 2 - Electrodynamic Instrument

Lecture 3 - Demonstration of PMMC and Electrodynamic Instruments

Lecture 4 - Features of PMMC and Electrodynamic Instruments

Lecture 5 - Moving Iron Instruments

Lecture 6 - Demonstration of Moving Iron Instrument

Lecture 7 - Electrostatic Instrument

Lecture 8 - Derivation of Deflecting Torque in Electrodynamic, Electrostatic and Moving Iron Instrument

Lecture 9 - Damping and Eddy Current Damping

Lecture 10 - Dynamics of the Moving Coil and Damping

Lecture 11 - Dynamics of the Moving Coil and Damping (Continued...)

Lecture 12 - Ballistic Galvanometer

Lecture 13 - Ammeter - I

Lecture 14 - Ammeter - II

Lecture 15 - Voltmeter

Lecture 16 - Ohmmeters - I

Lecture 17 - Ohmmeters - II

Lecture 18 - Rectifier based Voltmeters and Ammeter - I

Lecture 19 - Rectifier based Voltmeters and Ammeter - II

Lecture 20 - Resistance measurement with a Voltmeter and an Ammeter

Lecture 21 - Four-Terminal Resistance

Lecture 22 - Problems: Four Terminal Resistance

Lecture 23 - Error Calculation

Lecture 24 - Sensitivity, Accuracy, and Resolution of Wheatstone Bridge

Lecture 25 - Kelvin Double Bridge

Lecture 26 - High Resistance Measurement

Lecture 27 - Wattmeter Connection and Compensated Wattmeter

Lecture 28 - Single Phase Energy Meter

Lecture 29 - Demonstration: 1. Eddy Current Braking 2. Creation of Magnetic Field Without Moving Objects

Lecture 30 - Single Phase Energy Meter (Continued...)

Lecture 31 - Connection of Energy Meter, Wattmeter, and Three Phase Supply

Lecture 32 - DC Potentiometer

Lecture 33 - AC Potentiometer

Lecture 34 - Polar potentiometer and phase shifter

Lecture 35 - Polar potentiometer

Lecture 36 - Co-ordinate potentiometer

Lecture 37 - Kelvin-Varley potential divider

Lecture 38 - Impedance measurement

Lecture 39 - AC bridges - I

Lecture 40 - AC bridges - II

Lecture 41 - AC bridges - III

Lecture 42 - Current transformer and potential transformer

Lecture 43 - Review of transformer and magnetic circuit

Lecture 44 - Errors in Instrument transformer

Lecture 45 - Flux density measurement with Ballistic Galvanometer

Lecture 46 - Flux density measurement with Ballistic Galvanometer (Continued...)

Lecture 47 - Background: From Flip Flop to Counters - I

Lecture 48 - Background: From Flip Flop to Counters - II

Lecture 49 - Background: Operational Amplifiers - I

Lecture 50 - Background: Operational Amplifiers - II

Lecture 51 - Background: Operational Amplifiers - III

Lecture 52 - Background: Operational Amplifiers - IV

Lecture 53 - Inverting amplifier versus Schmitt Trigger

Lecture 54 - Non-inverting amplifier versus Schmitt Trigger

Lecture 55 - Difference amplifier - I

Lecture 56 - Difference amplifier - II

Lecture 57 - Difference amplifier - III

Lecture 58 - Digital frequency meter

Lecture 59 - Digital frequency meter and Schmitt Trigger

Lecture 60 - Schmitt Trigger

Lecture 61 - Schmitt Trigger

Lecture 62 - Digital frequency meter

Lecture 63 - Linear ramp type digital voltmeter

Lecture 64 - Dual slope digital voltmeter - I

[Lecture 65 - Dual slope digital voltmeter - II](#)

[Lecture 66 - Dual slope digital voltmeter and Integrator circuit](#)

[Lecture 67 - Digital ramp type voltmeter](#)

[Lecture 68 - Digital ramp type voltmeter and Successive approximation type voltmeter](#)

[Lecture 69 - ADC and DAC - I](#)

[Lecture 70 - ADC and DAC - II](#)

[Lecture 71 - Why we need electronic Instruments](#)

[Lecture 72 - Instruments with op-amp based amplifiers - I](#)

[Lecture 73 - Instruments with op-amp based amplifiers - II](#)

[Lecture 74 - Instruments with op-amp based amplifiers - III](#)

[Lecture 75 - Instrumentation Amplifier](#)

[Lecture 76 - Function generator](#)

[Lecture 77 - 555-Timer circuit](#)

[Lecture 78 - Astable and monostable oscillator circuits](#)

[Lecture 79 - Pulse generator](#)

[Lecture 80 - Oscilloscope - I](#)

[Lecture 81 - Oscilloscope - II](#)

[Lecture 82 - Emitter follower voltmeter](#)

[Lecture 83 - Linear ohmmeter](#)

[Lecture 84 - Ramp generator](#)

- Lecture 1 - Historical Development and Application
- Lecture 2 - Radar Bands and System Modeling
- Lecture 3 - Radar Equation
- Lecture 4 - Some Basic Concepts of Pulsed Radar
- Lecture 5 - Some Basic Concepts of Pulsed Radar (Continued...)
- Lecture 6 - Some Basic Concepts of Pulsed Radar (Continued...)
- Lecture 7 - Some Basic Concepts of Pulsed Radar (Continued...)
- Lecture 8 - Tutorial Problems on Basic Concepts of Radar - Part I
- Lecture 9 - Tutorial Problems on Basic Concepts of Radar - Part II
- Lecture 10 - CW Radar
- Lecture 11 - CW Radar Mathematical Model and Applications
- Lecture 12 - FM-CW Radar
- Lecture 13 - Double Frequency CW Radar
- Lecture 14 - Pulsed Radar
- Lecture 15 - MTI Filter
- Lecture 16 - Clutter and Single DLC
- Lecture 17 - Double DLC and Recursive MTI Filter
- Lecture 18 - Multiple prf MTI Radar
- Lecture 19 - Multiple prf MTI Radar and Clutter Attenuation
- Lecture 20 - MTI Improvement Factor
- Lecture 21 - Tutorial Problems on CW and Pulsed Radar - Part I
- Lecture 22 - Tutorial Problems on CW and Pulsed Radar - Part II
- Lecture 23 - Pulsed Doppler Radar
- Lecture 24 - Pulsed Doppler Radar (Continued...) and Search Radar
- Lecture 25 - Tracking Radar
- Lecture 26 - Tracking Radar (Continued...)
- Lecture 27 - Tracking Radar (Continued...)
- Lecture 28 - Tracking Radar (Continued...)
- Lecture 29 - Tracking Radar (Continued...)
- Lecture 30 - Tracking Radar (Continued...)
- Lecture 31 - Tracking Radar (Continued...)

[Lecture 32 - Tutorial Problems on Search and Tracking Radar](#)

[Lecture 33 - Detection in Radar Receiver](#)

[Lecture 34 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 35 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 36 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 37 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 38 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 39 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 40 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 41 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 42 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 43 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 44 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 45 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 46 - Detection in Radar Receiver \(Continued...\)](#)

[Lecture 47 - Tutorial Problems on Detection in Radar Receiver](#)

[Lecture 48 - SAR Processing](#)

[Lecture 49 - SAR Processing \(Continued...\)](#)

[Lecture 50 - SAR Processing \(Continued...\)](#)

[Lecture 51 - SAR Processor](#)

[Lecture 52 - Tutorial](#)

[Lecture 53 - Statistical Detection Theory: Introduction](#)

[Lecture 54 - Statistical Detection Theory \(Continued...\)](#)

[Lecture 55 - Statistical Detection Theory \(Continued...\)](#)

[Lecture 56 - Statistical Detection Theory \(Continued...\)](#)

[Lecture 57 - Statistical Detection Theory \(Continued...\)](#)

[Lecture 58 - Tutorial](#)

[Lecture 59 - Ground Penetrating Radar](#)

[Lecture 60 - GPR Measurements and Microwave Tomography](#)

Lecture 1 - Magnetic Circuit and Transformer

Lecture 2 - Magnetising Current from B-H Curve

Lecture 3 - Ideal Transformer, Dot Convention and Phasor Diagram

Lecture 4 - Operation of Ideal Operation with Load Connected

Lecture 5 - Equivalent Circuit of Ideal Transformer

Lecture 6 - Rating of Single Phase Transformer: Rated Current and Rated Voltage with Example

Lecture 7 - Transformer with Multiple Coils

Lecture 8 - Modelling of Practical Transformer - I

Lecture 9 - Modelling of Practical Transformer - II

Lecture 10 - Modelling of Practical Transformer - III

Lecture 11 - Core Loss - Eddy Current Loss

Lecture 12 - Factors on Eddy Current Loss Depends

Lecture 13 - Hysteresis Loss

Lecture 14 - Exact Equivalent Circuit

Lecture 15 - Approximate Equivalent Circuit

Lecture 16 - Determination of Equivalent Circuit Parameters - No Load Test

Lecture 17 - Short Circuit Test

Lecture 18 - Choosing Sides to Carry Out O.C / S.C Test

Lecture 19 - Efficiency of Transformer - Losses

Lecture 20 - Efficiency (Continued...)

Lecture 21 - Condition for Maximum Efficiency When Load Power Factor Constant

Lecture 22 - Family of Efficiency Curve at Various Power Factor and Energy Efficiency

Lecture 23 - Load Description and Energy Efficiency

Lecture 24 - Regulation: its Expression

Lecture 25 - Regulation: its Expression (Continued...)

Lecture 26 - Auto Transformer - Introduction

Lecture 27 - AutoTransformer versus Two Winding Transformer

Lecture 28 - AutoTransformer versus Two Winding Transformer (Continued...)

Lecture 29 - Numerical Problems on Ideal Auto Transformer

Lecture 30 - Two Winding Transformer Connected as Auto Transformer

Lecture 31 - Practical Auto Transformer

Lecture 32 - Equivalent Circuit of an Auto Transformer

Lecture 33 - Polarity Test and Sumpner Test

Lecture 34 - 3 Phase Transformer Using 3 Single Phase Transformer

Lecture 35 - Various Connections of 3-Phase Transformer - I

Lecture 36 - Various Connections of 3-Phase Transformer - II

Lecture 37 - Vector Group of 3-Phase Transformer

Lecture 38 - Vector Group (Continued...)

Lecture 39 - Open Delta Connection

Lecture 40 - 3-Phase Core Type and Shell Type Transformer

Lecture 41 - Zig Zag Connection

Lecture 42 - Effect 3rd Harmonic Exciting Current and Flux

Lecture 43 - Choosing Transformer Connection

Lecture 44 - Choosing Transformer Connection (Continued...)

Lecture 45 - Phase Conversion using Transformer: Scott Connection

Lecture 46 - Scott Connection (Continued...)

Lecture 47 - 3 Phase to 6 Phase Conversion O.C / S.C Test on 3 Phase Transformer

Lecture 48 - Parallel Operation of Transformers - I

Lecture 49 - Parallel Operation of Transformers - II

Lecture 50 - Parallel Operation of Transformers - III

Lecture 51 - Specific Magnetic and Electric Loadings

Lecture 52 - Cooling of Transformer and Fillings of Transformer

Lecture 53 - Output Equation of 3- Phase Transformer

Lecture 54 - Introduction to D.C Machine

Lecture 55 - Single Conductor D.C Generator / Motor Operation

Lecture 56 - Homopolar D.C Generator

Lecture 57 - Homopolar D.C Motor

Lecture 58 - Introduction to Rotating D.C Machines

Lecture 59 - Armature Winding of D.C Machine - I

Lecture 60 - Armature Winding of D.C Machine - II

Lecture 61 - Armature Winding of D.C Machine - III

Lecture 62 - Generated Voltage Across the Armature

Lecture 63 - Electromagnetic Torque in D.C Machine

Lecture 64 - Generator and Motor Operation - Basics

- Lecture 65 - O.C.C and Load Characteristic of Separately Excited Generators
- Lecture 66 - Voltage Build Up in Shunt Generator
- Lecture 67 - Load Characteristic of Shunt Generator
- Lecture 68 - Qualitative Discussion on Armature Reaction
- Lecture 69 - III Effects of Armature Reaction
- Lecture 70 - Compensating and Interpoles
- Lecture 71 - Armature Reaction (Continued...)
- Lecture 72 - Field Flux Density, Armature Flux Density and Resultant Field Distribution
- Lecture 73 - Field Patterns for Both Motor and Generators
- Lecture 74 - Demagnetising and Cross Magnetising mmf for Brush Shifted Machine
- Lecture 75 - Calculation of Compensating, Interpole and Series Field Turns
- Lecture 76 - Estimating Armature and Field Resistance from its Rating
- Lecture 77 - Power Flow Diagram, Rotational Loss
- Lecture 78 - Shunt Motor: Basic Equation
- Lecture 79 - Starting of D.C Motor - 3-Point Starter
- Lecture 80 - Speed Control of Shunt Motor - I
- Lecture 81 - Speed Control of Shunt Motor - II
- Lecture 82 - Speed Control of Shunt Motor - III
- Lecture 83 - Field Control (Continued...)
- Lecture 84 - D.C Motor Braking
- Lecture 85 - Introduction to Series Motor
- Lecture 86 - Series Motor Characteristics
- Lecture 87 - Series Motor Speed Control
- Lecture 88 - Universal Motor
- Lecture 89 - Swinburne Test
- Lecture 90 - Hopkinson Test
- Lecture 91 - Efficiency Calculation
- Lecture 92 - Field Test on D.C Series Motor
- Lecture 93 - Simplex Wave winding
- Lecture 94 - Wave Winding (Continued...)

- Lecture 1 - Graphical Representation of Signals
- Lecture 2 - Signal Flow Graph
- Lecture 3 - Data Flow Graph, Critical Path
- Lecture 4 - Dependence Graph, Basics of Retiming
- Lecture 5 - Retiming Theorem
- Lecture 6 - Forward Path and Loop Retiming
- Lecture 7 - Loop Bound and Iteration Bound
- Lecture 8 - Cutset Retiming
- Lecture 9 - Retiming IIR Filters
- Lecture 10 - Adaptive Filter Basics (LMS Algorithm)
- Lecture 11 - Retiming LMS
- Lecture 12 - Retiming Delayed LMS
- Lecture 13 - Parallel Processing in DSP by Unfolding
- Lecture 14 - Basic Unfolding Relation
- Lecture 15 - Retiming for Unfolding
- Lecture 16 - Loop Unfolding
- Lecture 17 - Iteration bound for Loops
- Lecture 18 - Bitserial, Digit serial and Word serial Structures
- Lecture 19 - Unfolding a Switch
- Lecture 20 - Unfolding Bit Serial Systems
- Lecture 21 - Folding of DFG
- Lecture 22 - Folding Examples - IIR Filter
- Lecture 23 - Retiming for Folding
- Lecture 24 - Introduction to Delay Optimization by Folding
- Lecture 25 - Life Time Analysis of Storage Variables
- Lecture 26 - Forward Backward Data Allocation
- Lecture 27 - Life Time Analysis of Storage Variables in a Digital Filter
- Lecture 28 - Delay Folded Realization of a Digital Filter
- Lecture 29 - Polyphase Decomposition of Sequences
- Lecture 30 - Hardware Efficient 2 - Parallel FIR Filters
- Lecture 31 - Hardware Efficient 3 - Parallel FIR Filters

[Lecture 32 - Introduction to First Level Architectures](#)

[Lecture 33 - 2's Complement Number Systems](#)

[Lecture 34 - Multiplication of Two Binary Numbers](#)

[Lecture 35 - Carry Ripple and Carry Save Array](#)

[Lecture 36 - Bit Serial Multipliers](#)

[Lecture 37 - Bit Serial Digital Filters](#)

[Lecture 38 - Baugh Wooley Multiplier](#)

[Lecture 39 - Distributed Arithmetic](#)

- Lecture 1 - Introduction to the course
- Lecture 2 - Introduction to the constituent topics of the course and the Layout
- Lecture 3 - Revisit to pre-requisite topics
- Lecture 4 - Revisit to pre-requisite topics (Continued...)
- Lecture 5 - Analysis of Simple Non-Linear Circuit
- Lecture 6 - Analysis of Simple Non-linear Circuit (Continued...)
- Lecture 7 - Revisiting BJT Characteristic
- Lecture 8 - Revisiting BJT Characteristics (Continued...)
- Lecture 9 - Revisiting BJT Characteristics (Continued...)
- Lecture 10 - Revisiting MOSFET
- Lecture 11 - Revisiting MOSFET (Continued...)
- Lecture 12 - Revisiting MOSFET (Continued...)
- Lecture 13 - Revisiting MOSFET (Continued...)
- Lecture 14 - Analysis of simple non-linear circuit containing a BJT
- Lecture 15 - Analysis of simple non-linear circuit containing a BJT (Continued...)
- Lecture 16 - Analysis of simple non-linear circuit containing a MOSFET
- Lecture 17 - Analysis of simple non-linear circuit containing a MOSFET (Continued...)
- Lecture 18 - Linearization of non-linear circuit containing BJT
- Lecture 19 - Linearization of non-linear circuit containing BJT (Continued...)
- Lecture 20 - Linearization of non-linear circuit containing MOSFET
- Lecture 21 - Linearization of non-linear circuit containing MOSFET (Continued...)
- Lecture 22 - Linear models of Amplifiers - Part A
- Lecture 23 - Linear models of Amplifiers - Part B
- Lecture 24 - Common Emitter Amplifier - Part A
- Lecture 25 - Common Emitter Amplifier - Part B
- Lecture 26 - Common Emitter Amplifier (Continued...) - Part A
- Lecture 27 - Common Emitter Amplifier (Continued...) - Part B
- Lecture 28 - Common Emitter Amplifier (Continued...) - Numerical examples - Part A
- Lecture 29 - Common Emitter Amplifier (Continued...) - Numerical examples - Part B
- Lecture 30 - Common Emitter Amplifier (Continued...) - Design guidelines - Part A
- Lecture 31 - Common Emitter Amplifier (Continued...) - Design guidelines - Part B

[Lecture 32 - Common Source Amplifier - Part A](#)

[Lecture 33 - Common Source Amplifier - Part B](#)

[Lecture 34 - Common Source Amplifier \(Continued...\) Numerical examples and design guidelines - Part B](#)

[Lecture 35 - Frequency Response of CE and CS Amplifiers - Part A](#)

[Lecture 36 - Frequency Response of CE and CS Amplifiers - Part B](#)

[Lecture 37 - Frequency Response of CE and CS Amplifiers - Part C](#)

[Lecture 38 - Frequency Response of CE and CS Amplifiers \(Continued...\) - Part A](#)

[Lecture 39 - Frequency Response of CE And CS Amplifiers \(Continued...\) - Part B](#)

[Lecture 40 - Frequency Response of CE/CS Amplifiers Considering High Frequency Models of BJT and MOSFET - Part A](#)

[Lecture 41 - Frequency Response of CE/CS Amplifiers Considering High Frequency Models of BJT and MOSFET - Part B](#)

[Lecture 42 - Frequency Response of CE/CS Amplifiers Considering High Frequency Models of BJT And MOSFET - Part C](#)

[Lecture 43 - Limitation of CE and CS Amplifiers in Cascading](#)

[Lecture 44 - Common Collector and Common Drain Amplifiers](#)

[Lecture 45 - Common Collector and Common Drain Amplifiers \(Continued...\): Analysis - Part A](#)

[Lecture 46 - Common Collector and Common Drain Amplifiers \(Continued...\): Analysis - Part B](#)

[Lecture 47 - Common Collector and Common Drain Amplifiers \(Continued...\): Numerical Examples - Part A](#)

[Lecture 48 - Common Collector and Common Drain Amplifiers \(Continued...\): Numerical Examples - Part B](#)

[Lecture 49 - Common Base and Common Gate Amplifiers : Analysis - Part A](#)

[Lecture 50 - Common Base and Common Gate Amplifiers : Analysis - Part B](#)

[Lecture 51 - Common Base and Common Gate Amplifiers \(Continued...\) : Numerical Examples - Part A](#)

[Lecture 52 - Common Base and Common Gate Amplifiers \(Continued...\) : Numerical Examples - Part B](#)

[Lecture 53 - Common Base and Common Gate Amplifiers \(Continued...\) : Numerical Examples - Part C](#)

[Lecture 54 - Common Base and Common Gate Amplifiers \(Continued...\) : Numerical Examples - Part D](#)

[Lecture 55 - Multi-Transistor Amplifiers: Operation and Analysis - Part A](#)

[Lecture 56 - Multi-Transistor Amplifiers: Operation and Analysis - Part B](#)

[Lecture 57 - Multi-Transistor Amplifiers: Operation and Analysis - Part C](#)

[Lecture 58 - Multi-Transistor Amplifiers \(Continued...\): Numerical Examples - Part A](#)

[Lecture 59 - Multi-Transistor Amplifiers \(Continued...\): Numerical Examples - Part B](#)

[Lecture 60 - Multi-Transistor Amplifiers \(Continued...\): Numerical Examples - Part C](#)

[Lecture 61 - Multi-Transistor Amplifiers: Cascode Amplifier - Part A](#)

[Lecture 62 - Multi-Transistor Amplifiers: Cascode Amplifier - Part B](#)

[Lecture 63 - Multi-Transistor Amplifiers: Cascode Amplifier \(Continued...\) - Numerical Examples - Part A](#)

[Lecture 64 - Multi-Transistor Amplifiers: Cascode Amplifier \(Continued...\) - Numerical Examples - Part B](#)

- [Lecture 65 - Multi-Transistor Amplifiers: Cascode Amplifier \(Continued...\) - Numerical Examples - Part C](#)
- [Lecture 66 - Multi-Transistor Amplifiers: Amplifier With Active Load - Part A](#)
- [Lecture 67 - Multi-Transistor Amplifiers: Amplifier With Active Load - Part B](#)
- [Lecture 68 - Multi-Transistor Amplifiers: Amplifier With Active Load \(Continued...\) - Numerical Examples - Part A](#)
- [Lecture 69 - Multi-Transistor Amplifiers: Amplifier With Active Load \(Continued...\) - Numerical Examples - Part B](#)
- [Lecture 70 - Single-ended Vs Differential Signaling and Basic Model of a Differential Amplifier](#)
- [Lecture 71 - Single-ended Vs Differential Signaling and Basic Model of a Differential Amplifier \(Continued...\)](#)
- [Lecture 72 - Single-ended Vs Differential Signaling and Basic Model of a Differential Amplifier \(Continued...\)](#)
- [Lecture 73 - Single-ended Vs Differential Signaling and Basic Model of a Differential Amplifier \(Continued...\)](#)
- [Lecture 74 - Single-ended Vs Differential Signaling and Basic Model of a Differential Amplifier \(Continued...\)](#)
- [Lecture 75 - Differential Amplifier : Basic Structure and Principle of Operation](#)
- [Lecture 76 - Differential Amplifier : Basic Structure and Principle of Operation \(Continued...\)](#)
- [Lecture 77 - Differential Amplifier : Analysis and Numerical Examples](#)
- [Lecture 78 - Differential Amplifier : Analysis and Numerical Examples \(Continued...\)](#)
- [Lecture 79 - Differential Amplifier : Analysis and Numerical Examples \(Continued...\)](#)
- [Lecture 80 - Differential Amplifier : Analysis and Numerical Examples \(Continued...\)](#)
- [Lecture 81 - Current mirror circuits - Part A](#)
- [Lecture 82 - Current mirror circuits - Part B](#)
- [Lecture 83 - Usage of current mirror - Part A](#)
- [Lecture 84 - Usage of current mirror - Part B](#)
- [Lecture 85 - Usage of current mirror - Part C](#)
- [Lecture 86 - Numerical examples on current mirror and its applications - Part A](#)
- [Lecture 87 - Numerical examples on current mirror and its applications - Part B](#)
- [Lecture 88 - Numerical examples on current mirror and its applications - Part C](#)
- [Lecture 89 - Numerical examples on current mirror and its applications - Part D](#)
- [Lecture 90 - Feedback system - Part A](#)
- [Lecture 91 - Feedback system - Part B](#)
- [Lecture 92 - Feedback system - Part C](#)
- [Lecture 93 - Feedback system - Part D](#)
- [Lecture 94 - Feedback system - Part E](#)
- [Lecture 95 - Effect of feedback on frequency response - Part A](#)
- [Lecture 96 - Effect of feedback on frequency response - Part B](#)
- [Lecture 97 - Applications of feedback in amplifier circuits - Part A](#)

[Lecture 98 - Applications of feedback in amplifier circuits - Part B](#)

[Lecture 99 - Applications of feedback in amplifier circuits - Part C](#)

- Lecture 1 - Introduction: KVL, KCL and Power Balance
- Lecture 2 - Voltage and Current Sources
- Lecture 3 - Simple Networks with Voltage and Current Sources
- Lecture 4 - Mesh Analysis - I
- Lecture 5 - Mesh Analysis - II
- Lecture 6 - Nodal Analysis - I
- Lecture 7 - Nodal Analysis - II
- Lecture 8 - Nodal Analysis - III
- Lecture 9 - Inductor - I
- Lecture 10 - Initial Condition for Inductor
- Lecture 11 - Energy Stored in Inductor with Example
- Lecture 12 - R-L Series Circuit Analysis
- Lecture 13 - Retrieving Energy or Discharging of Inductor Energy
- Lecture 14 - Capacitor: Relationship of Voltage and Current and Initial Condition
- Lecture 15 - Charging of a Capacitor - Voltage, Current and Energy During Charging
- Lecture 16 - Discharge of a Charged Capacitor
- Lecture 17 - Linearity of R,L,C - Inductor with Initial Current and Capacitor with Initial Voltage
- Lecture 18 - General Method for Solving Linear Differential Equation - I
- Lecture 19 - General Method for Solving Linear Differential Equation - II
- Lecture 20 - General Method for Solving Linear Differential Equation - III
- Lecture 21 - Problem Solving: Application
- Lecture 22 - R-L Circuit with Sinusoidal Excitation
- Lecture 23 - R-C Circuit with Sinusoidal Exponential
- Lecture 24 - Solution Due to Exponential Forcing Function
- Lecture 25 - Mesh and Nodal Analysis with Time Varying Source
- Lecture 26 - Circuit Analysis with Phasor - I
- Lecture 27 - Circuit Analysis with Phasor - II
- Lecture 28 - Circuit Analysis with Phasor - III
- Lecture 29 - Concept of Active and Reactive Power in A.C Circuit - I
- Lecture 30 - Concept of Active and Reactive Power in A.C Circuit - II
- Lecture 31 - Expression for Complex Power in A.C Circuit

Lecture 32 - Numerical Example

Lecture 33 - Mesh and Nodal Analysis in A.C Circuit, Introduction to Impulse Function

Lecture 34 - Odd and Even Functions, Relation between Unit Step and Impulse Function

Lecture 35 - Solution of Differential Equation with Impulse Excitation

Lecture 36 - Numerical Example when Excitation is Impulse

Lecture 37 - Self and Mutual Inductances - I

Lecture 38 - Dot Convention in Mutually Coupled Coils

Lecture 39 - Mutually Coupled Coils in Series and Parallel

Lecture 40 - Energy Stored in Mutually Coupled Coils

Lecture 41 - Steady State Response with Sinusoidal Excitation when the Coils are Mutually Coupled

Lecture 42 - Basics of Signals in Brief

Lecture 43 - Laplace Transform - I

Lecture 44 - Laplace Transform - II

Lecture 45 - Laplace Transform Applied to Circuit Analysis - I

Lecture 46 - Laplace Transform Applied to Circuit Analysis - II

Lecture 47 - Numerical Examples - I

Lecture 48 - Numerical Examples - II

Lecture 49 - General Second Order Circuit Analysis with L.T - I

Lecture 50 - General Second Order Circuit Analysis with L.T - II

Lecture 51 - Network Theorem - I

Lecture 52 - Network Theorem - II

Lecture 53 - Norton's Theorem

Lecture 54 - Thevenin Theorem

Lecture 55 - Star-Delta and Delta-Star Transformation

Lecture 56 - Telligen's Theorem

Lecture 57 - Reciprocity Theorem

Lecture 58 - Maximum Power Transfer Theorem

Lecture 59 - Graph Theory Applied to Network Analysis - I

Lecture 60 - Graph Theory Applied to Network Analysis - II

Lecture 61 - Graph Theory Applied to Network Analysis - III

Lecture 62 - Graph Theory Applied to Network Analysis - IV

Lecture 63 - Graph Theory Applied to Network Analysis - V

Lecture 64 - Mesh Analysis with Graph Theory

[Lecture 65 - Nodal Analysis with Graph Theory](#)

[Lecture 66 - Cut-Set Analysis with Graph Theory](#)

[Lecture 67 - Numerical Examples of Network Analysis with Graph Theory](#)

[Lecture 68 - Circuit Analysis with Dependent Sources - I](#)

[Lecture 69 - Circuit Analysis with Dependent Sources - II](#)

[Lecture 70 - Circuit Analysis with Dependent Sources - III](#)

[Lecture 71 - Two Port Network - I](#)

[Lecture 72 - Two Port Network - II](#)

[Lecture 73 - Two Port Network - III](#)

[Lecture 74 - Two Port Network - IV](#)

[Lecture 75 - Two Port Network - V](#)

[Lecture 76 - Two Port Network - VI](#)

[Lecture 77 - Two Port Network - VII](#)

[Lecture 78 - Gyrator](#)

[Lecture 79 - Ideal Op - Amp](#)

[Lecture 80 - Examples of Ideal Op-Amp Circuits - I](#)

[Lecture 81 - Examples of Ideal Op-Amp Circuits - II](#)

[Lecture 82 - General Impedance Transfer Circuit and Concluding Remarks](#)

Lecture 1 - Faults in Power System

Lecture 2 - Elements and Features of Protection Scheme

Lecture 3 - Fault Analysis Review - Sequence Components

Lecture 4 - Fault Analysis Review - Sequence Components (Continued...)

Lecture 5 - Numerical Relaying Concept

Lecture 6 - Discrete Fourier Transform

Lecture 7 - Recursive and Half Cycle DFT and Cosine Filter

Lecture 8 - Least Square Technique

Lecture 9 - Frequency Response of Phasor Estimation techniques

Lecture 10 - In the Presence of Decaying DC

Lecture 11 - Overcurrent Relay Characteristics

Lecture 12 - Overcurrent Relay Coordination

Lecture 13 - Relay Coordination with Fuse

Lecture 14 - Introduction to Directional Relaying

Lecture 15 - Positive Sequence Directional Relay

Lecture 16 - Negative and Zero Sequence Directional Relay

Lecture 17 - Superimposed Component Based Directional Relaying

Lecture 18 - Introduction to Distance Relay

Lecture 19 - Fault Classification

Lecture 20 - Apparent Impedance Calculation

Lecture 21 - Distance Relay Implementation

Lecture 22 - Application to Double Circuit Line

Lecture 23 - Multi-terminal Lines

Lecture 24 - Protection of series compensated lines - Part I

Lecture 25 - Protection of series compensated lines - Part II

Lecture 26 - Effect of Fault Resistance

Lecture 27 - Load Encroachment

Lecture 28 - Power Swing

Lecture 29 - Power Swing Detection Techniques - Part I

Lecture 30 - Power Swing Detection Techniques - Part II

Lecture 31 - Adaptive Distance Relaying

- [Lecture 32 - Communication Assisted Relaying Scheme](#)
- [Lecture 33 - Current Transformer - Part I](#)
- [Lecture 34 - Current Transformer - Part II](#)
- [Lecture 35 - Capacitor Voltage Transformer](#)
- [Lecture 36 - Fiber Optic Sensors](#)
- [Lecture 37 - Introduction to Transformer Protection](#)
- [Lecture 38 - Differential Relay](#)
- [Lecture 39 - Steps in Differential Relay Processing](#)
- [Lecture 40 - Inrush Detection](#)
- [Lecture 41 - CT Saturation, Negative Sequence Differential and Restricted Earth Fault Relay](#)
- [Lecture 42 - Line Differential - Part I](#)
- [Lecture 43 - Line Differential - Part II](#)
- [Lecture 44 - Busbar Protection](#)
- [Lecture 45 - Fault Characteristics of Renewable Sources](#)
- [Lecture 46 - Protection Challenges of Distribution Systems with Renewables](#)
- [Lecture 47 - Protection challenges of transmission systems with renewables](#)
- [Lecture 48 - Traveling Wave Basics](#)
- [Lecture 49 - Protection using Travelling Waves](#)
- [Lecture 50 - Fault Location using Travelling Wave](#)
- [Lecture 51 - Wide Area Measurement Basics](#)
- [Lecture 52 - Wide Area Measurement for Protection](#)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Signal Processing for mm Wave communication for 5G and beyond (Electrical Engineering)

Co-ordinators : Prof. Amit Kumar Dutta

[Lecture 1 - Tx- Rx Structure](#)

[Lecture 2 - Rx -Structure](#)

[Lecture 3 - Fundamental of Ray-Tracing model](#)

[Lecture 4 - General channel model - Part I](#)

[Lecture 5 - General channel model - Part I \(Continued...\)](#)

[Lecture 6 - General channel model - Part I \(Continued...\)](#)

[Lecture 7 - General channel model - Part II](#)

[Lecture 8 - Wireless channel-A ray tracing model - Part II](#)

[Lecture 9 - Wireless channel-A ray tracing model - Part II \(Continued...\)](#)

[Lecture 10 - Wireless channel-A ray tracing model - Part II \(Continued...\)](#)

[Lecture 11 - Wireless channel-A ray tracing model - Part II \(Continued...\)](#)

[Lecture 12 - RMS Delay spread and Doppler Effect on channel](#)

[Lecture 13 - Time Varing Model](#)

[Lecture 14 - Doppler Impact on coherence BW](#)

[Lecture 15 - Introduction to time series](#)

[Lecture 16 - AR,ARMA,MA process](#)

[Lecture 17 - Doppler with AR process model](#)

[Lecture 18 - Coherence time and parameter summery](#)

[Lecture 19 - Basic ISI channel](#)

[Lecture 20 - Channel estimation and Equalizer](#)

[Lecture 21 - precoder and MIMO](#)

[Lecture 22 - precoder and MIMO \(Continued...\)](#)

[Lecture 23 - Basics of mmwave spectrum](#)

[Lecture 24 - Angle of arrival and angle of departure](#)

[Lecture 25 - 3D concepts, AoA,AoD](#)

[Lecture 26 - mmWave channel model with RX beaming](#)

[Lecture 27 - mmWave channel model with RX beaming \(Continued...\)](#)

[Lecture 28 - mmWave channel model with RX beaming \(Continued...\)](#)

[Lecture 29 - mmWave channel model with RX beaming \(Continued...\)](#)

[Lecture 30 - mmwave channel model \(Continued...\)](#)

[Lecture 31 - mmWave channel model \(Continued...\) -Tx side multiple antenna](#)

- Lecture 32 - Basics of Beamforming
- Lecture 33 - Single Antenna beamforming
- Lecture 34 - Concept of antenna many fold vector
- Lecture 35 - 3D Concept of antenna many fold vector
- Lecture 36 - Different Geometry of antenna from electrical point of view
- Lecture 37 - Basics of Beamforming pattern - Part I
- Lecture 38 - Basics of Beamforming pattern - Part II
- Lecture 39 - SISO Beamforming
- Lecture 40 - MIMO Beamforming
- Lecture 41 - Structural implementation of MIMO Beamforming
- Lecture 42 - Different Level of Beamforming
- Lecture 43 - MIMO Beamforming in Transmitter side
- Lecture 44 - MIMO Beamforming in Receiver side - Part I
- Lecture 45 - MIMO Beamforming in Receiver side - Part II
- Lecture 46 - Mathematical description of MIMO Beamforming (Continued...)
- Lecture 47 - Equalizer based detector
- Lecture 48 - Parameter to be designed in MIMO Beamforming
- Lecture 49 - OFDM Data Model
- Lecture 50 - OFDM Data model (Continued...)
- Lecture 51 - General OFDM
- Lecture 52 - OFDM spectrum and CFO
- Lecture 53 - MIMO OFDM structure
- Lecture 54 - MIMO OFDM decode and beamforming
- Lecture 55 - Design parameter estimation - Part 1
- Lecture 56 - Design parameter estimation - Part 2
- Lecture 57 - Design parameter estimation - Part 3
- Lecture 58 - Design parameter estimation - Part 4
- Lecture 59 - Design parameter estimation - Part 5
- Lecture 60 - MU System
- Lecture 61 - CFO and other impairment and their effects
- Lecture 62 - Multi User Hybrid beam and impairment and analysis - Part 3
- Lecture 63 - Multi User Hybrid beam and Impairment and analysis - Part 4
- Lecture 64 - Multi User Hybrid beam and Impairment and analysis - Part 5

- Lecture 1 - DC Power Conversion Systems - Introduction
- Lecture 2 - Overview of voltage regulators
- Lecture 3 - Switched mode power converter (SMPC)
- Lecture 4 - Model Development for MATLAB Simulation
- Lecture 5 - Demonstration of MATLAB Simulation
- Lecture 6 - Demonstration of MATLAB Simulation (Continued...)
- Lecture 7 - Power Stage Design of Basic SMPCs: Summary
- Lecture 8 - Fixed Frequency Modulation Techniques
- Lecture 9 - Variable Frequency Modulation Techniques
- Lecture 10 - Modulation in Discontinuous Conduction Mode (DCM)
- Lecture 11 - Synchronizing Simulation and Script files in MATLAB
- Lecture 12 - Interactive MATLAB Simulation and Case Studies
- Lecture 13 - Converter's Objectives and Control Implications
- Lecture 14 - Feedforward Control in SMPC
- Lecture 15 - Single and Multi Loop Feedback Control Methods
- Lecture 16 - Feedback Control of Cascaded SMPCs
- Lecture 17 - Combined feedback and feedforward control
- Lecture 18 - State feedback control
- Lecture 19 - Variable Frequency Control - Understanding Opportunities and Challenges
- Lecture 20 - Constant On-time Control Methods
- Lecture 21 - Constant Off-time Control Methods
- Lecture 22 - Hysteresis Control Methods in SMPCs
- Lecture 23 - Stability and Performance Comparison using MATLAB Simulation
- Lecture 24 - Light Load Control Methods and Interactive MATLAB Simulation
- Lecture 25 - Overview of Modeling Techniques
- Lecture 26 - State space averaging and model validation
- Lecture 27 - Circuit Averaging Techniques and Equivalent Circuit
- Lecture 28 - DC Analysis using Equivalent Circuit Model
- Lecture 29 - Derivation of Small-Signal Transfer Functions
- Lecture 30 - Small-Signal Model Validation using MATLAB and Time Domain Correlation
- Lecture 31 - Small-signal Modeling with Closed Current Loop

- Lecture 32 - Impedance Analysis and Stability
- Lecture 33 - Loop Gain Analysis and Understanding Model Limits using MATLAB
- Lecture 34 - PID Control Design and Tuning under VMC with MATLAB Case Studies
- Lecture 35 - Shaping Output Impedance of a Buck Converter under VMC
- Lecture 36 - Design of VMC Boost Converter and MATLAB Design Case Studies
- Lecture 37 - Accurate Small-signal Modelling under CMC and Verification using MATLAB
- Lecture 38 - Design CMC in a Buck Converter and MATLAB based Model Validation
- Lecture 39 - Design of CMC Boost Converter - Output and State Feedback Approaches
- Lecture 40 - Loop Interactions in CMC and Design of Average CMC
- Lecture 41 - Dynamics of SMPCs and Overview of Model-based Nonlinear Control
- Lecture 42 - Dynamics of LTIs and Vector Field with MATLAB Demonstration
- Lecture 43 - Geometric Perspectives of Eigenvalues and Eigenvectors in SMPCs
- Lecture 44 - Small-signal and Large-signal Model based Nonlinear Control
- Lecture 45 - Introduction to Sliding Mode Control in SMPCs
- Lecture 46 - Sliding Mode Control Design in a Buck Converter
- Lecture 47 - Boundary Control Techniques and Selection of Switching Surfaces
- Lecture 48 - Time Optimal Control and Identifying Physical Limits in SMPCs
- Lecture 49 - Linking Switching Boundary and PID Controller Structure in SMPCs
- Lecture 50 - Large-Signal Controller Tuning in Buck Converter: Objectives and Derivations
- Lecture 51 - Large-Signal Controller Tuning in Boost and Buck-Boost Converters
- Lecture 52 - Large-Signal Controller Tuning in Fixed- and Variable-Frequency Control
- Lecture 53 - Critical Performance Limits in Dynamic Voltage Scaling and Possible Solutions
- Lecture 54 - Nonlinear Control vs. Large-Signal Tuning: Comparative Study using MATLAB
- Lecture 55 - Small-Signal vs. Large-Signal Tuning: Comparison using MATLAB Simulation
- Lecture 56 - Performance Improvement and Size Reduction using Large-Signal based Control
- Lecture 57 - Digital Control in High Frequency SMPCs - Introduction and Motivations
- Lecture 58 - Overview of Fixed and Variable Frequency Digital Control Architectures
- Lecture 59 - Challenges and Opportunities in Digitally Controlled High Frequency SMPCs
- Lecture 60 - Course Summary, Key Takeaways, Few Emerging Applications and Future Scopes

[Lecture 1 - Scattering Matrix Concepts](#)

[Lecture 2 - Scattering Matrix Concepts \(Continued...\)](#)

[Lecture 3 - Scattering Matrix Concepts \(Continued...\)](#)

[Lecture 4 - Scattering Matrix Concepts \(Continued...\)](#)

[Lecture 5 - Scattering Matrix Concepts Tutorials](#)

[Lecture 6 - Scattering Matrix Concepts Tutorials \(Continued...\)](#)

[Lecture 7 - Scattering Matrix Concepts Tutorials \(Continued...\)](#)

[Lecture 8 - Instantaneous form of Maxwell's equations](#)

[Lecture 9 - Instantaneous form of Maxwell's equations \(Continued....\)](#)

[Lecture 10 - Instantaneous form of Maxwell's equations \(Continued...\)](#)

[Lecture 11 - Instantaneous form of Maxwell's equations \(Continued...\)](#)

[Lecture 12 - Instantaneous form of Maxwell's equations \(Continued...\)](#)

[Lecture 13 - Instantaneous form of Maxwell's equations Tutorials](#)

[Lecture 14 - Instantaneous form of Maxwell's equations Tutorials \(Continued...\)](#)

[Lecture 15 - Harmonic form of Maxwell's equations](#)

[Lecture 16 - Harmonic form of Maxwell's equations \(Continued...\)](#)

[Lecture 17 - Harmonic form of Maxwell's equations \(Continued...\)](#)

[Lecture 18 - Harmonic form of Maxwell's equations Tutorials](#)

[Lecture 19 - Wave Equation and Solution](#)

[Lecture 20 - Relation between wavenumbers](#)

[Lecture 21 - Radiation from an electric current source \(Continued...\)](#)

[Lecture 22 - Radiation from an electric current source \(Continued...\)](#)

[Lecture 23 - Radiation from an electric current source \(Continued...\)](#)

[Lecture 24 - Wave Equation and Solution Tutorials](#)

[Lecture 25 - Radiation from an electric current source Tutorials](#)

[Lecture 26 - Radiation from a magnetic current source](#)

[Lecture 27 - Radiation from a magnetic current source \(Continued...\)](#)

[Lecture 28 - Radiation from a magnetic current source \(Continued...\)](#)

[Lecture 29 - Application of the magnetic current source \(Continued...\)](#)

[Lecture 30 - Radiation from a magnetic current source Tutorials](#)

[Lecture 31 - Radiation from a magnetic current source Tutorials \(Continued....\)](#)

[Lecture 32 - Rectangular waveguide - I](#)

[Lecture 33 - Rectangular waveguide - I Tutorials](#)

[Lecture 34 - Rectangular waveguide - II](#)

[Lecture 35 - Rectangular waveguide - II \(Continued...\)](#)

[Lecture 36 - Rectangular waveguide - II Tutorials](#)

[Lecture 37 - Rectangular waveguide - II Tutorials \(Continued...\)](#)

[Lecture 38 - Rectangular cavity resonator](#)

[Lecture 39 - Rectangular cavity resonator Tutorials](#)

[Lecture 40 - Rectangular cavity resonator Tutorials \(Continued...\)](#)

[Lecture 41 - The Reciprocity Theorem, Computation of Amplitudes of Forward and Backward \(Continued...\)](#)

[Lecture 42 - The Reciprocity Theorem, Computation of Amplitudes of Forward and Backward \(Continued...\)](#)

[Lecture 43 - The Reciprocity Theorem, Computation of Amplitudes Tutorials](#)

[Lecture 44 - The Reciprocity Theorem, Computation of Amplitudes Tutorials \(Continued...\)](#)

[Lecture 45 - Analysis of Guided Structures](#)

[Lecture 46 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 47 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 48 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 49 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 50 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 51 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 52 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 53 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 54 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 55 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 56 - Analysis of Guided Structures \(Continued...\)](#)

[Lecture 57 - Analysis of Guided Structures Tutorials](#)

[Lecture 58 - Analysis of Guided Structures Tutorials \(Continued...\)](#)

[Lecture 59 - Cylindrical Wave Functions](#)

[Lecture 60 - Cylindrical Wave Functions \(Continued...\)](#)

[Lecture 61 - Cylindrical Wave Functions \(Continued...\)](#)

[Lecture 62 - Circular Waveguide](#)

[Lecture 63 - Circular Cavity](#)

[Lecture 64 - Cylindrical Wave Functions Tutorials](#)

[Lecture 65 - Cylindrical Wave Functions Tutorials \(Continued...\)](#)

[Lecture 66 - Application to the Coupling Problem : Aperture-Coupled, Probe-Coupled and Waveguide](#)

[Lecture 67 - Application to the Coupling Problem : Aperture-Coupled, Probe-Coupled and Waveguide \(Continued...\)](#)

[Lecture 68 - Application to the Coupling Problem : Aperture-Coupled, Probe-Coupled and Waveguide \(Continued...\)](#)

[Lecture 69 - Application to the Coupling Problem : Aperture-Coupled, Probe-Coupled and Waveguide \(Continued...\)](#)

Lecture 1 - Introduction

Lecture 2 - Historical Origin of Cognition Studies

Lecture 3 - The Cognitive Revolution

Lecture 4 - Anatomical Structures of the Brain

Lecture 5 - Frontal Lobes and Cognition

Lecture 6 - Neuropsychological Testing

Lecture 7 - Eye Tracking and Cognition

Lecture 8 - EEG, fMRI, MEG

Lecture 9 - Single neuron level measurements

Lecture 10 - Single Neuron Imaging and Manipulation of Neural Activity

Lecture 11 - Introduction to Computation

Lecture 12 - Currency of Computation in Neurobiology - Action Potential

Lecture 13 - Synapse and Synaptic Transmission

Lecture 14 - Synaptic Plasticity

Lecture 15 - Short Term Plasticity and STDP

Lecture 16 - Coding by neurons

Lecture 17 - Sensory Circuits: Visual - I

Lecture 18 - Sensory Circuits: Visual - II

Lecture 19 - Sensory Circuits: Auditory - I

Lecture 20 - Sensory Circuits: Auditory - II

Lecture 21 - Sensory Circuits: Somatosensory

Lecture 22 - Sensory Circuits: Olfactory and Gustatory

Lecture 23 - Motor circuits - Sensory-motor

Lecture 24 - Reward Circuits

Lecture 25 - Executive Circuits

Lecture 26 - Types of Attention, Theories Broadbent Triessman

Lecture 27 - Alerting Orientation and Executive Network

Lecture 28 - Disorders of Attention

Lecture 29 - Basics of Perception - Object, Depth and Movement

Lecture 30 - Constancy and Illusions

Lecture 31 - Neurobiology of attention, Working Memory

- Lecture 32 - Cholinergic System, Bottom up and Top down
- Lecture 33 - Object Recognition
- Lecture 34 - Visual Search and Pattern Recognition
- Lecture 35 - Auditory Scene Analysis, McGurk Effect
- Lecture 36 - Learning Processes
- Lecture 37 - Learning Processes (Continued...)
- Lecture 38 - Memory
- Lecture 39 - Learning Disorders
- Lecture 40 - Memory Failure - Forgetting
- Lecture 41 - Learning in biological neural networks
- Lecture 42 - Examples
- Lecture 43 - Different types of Plasticity
- Lecture 44 - Developmental Plasticity/Learning/Critical Period
- Lecture 45 - Examples of Disorders in Plasticity
- Lecture 46 - Introduction to speech and language (Development)
- Lecture 47 - Components of Speech, Speech Production
- Lecture 48 - Speech Perception
- Lecture 49 - Lessons from Animal Communication
- Lecture 50 - Language and Thought - Speech Language Disorders
- Lecture 51 - Theories of Emotion
- Lecture 52 - Neurophysiology of emotions - Limbic System
- Lecture 53 - Problem Solving
- Lecture 54 - Decision Making
- Lecture 55 - Frontal cortex in decision making
- Lecture 56 - Topics in current research - I
- Lecture 57 - Topics in current research - II
- Lecture 58 - Topics in current research - III
- Lecture 59 - Topics in current research - IV
- Lecture 60 - Topics in current research - V

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Digital Control in Switched Mode Power Converters and FPGA-based Prototyping (Electrical Engineering)

Co-ordinators : Prof. Santanu Kapat

Lecture 1 - Digital Control in Switched Mode Power Converters - Course Introduction

Lecture 2 - Digital Control of SMPCs - Course Instructions, Guidelines and Resources

Lecture 3 - Examples of Some Commercial Digital Control Solutions

Lecture 4 - Overview of Digital Control Implementation Platforms

Lecture 5 - Introducing Basic Digitization in Power Electronic Converters

Lecture 6 - Recap of Feedback and Feedforward Control Methods in SMPCs

Lecture 7 - Recap of Fixed and Variable Frequency Modulation Techniques

Lecture 8 - Levels of Digitization in Single-loop Feedback Control in SMPCs

Lecture 9 - Levels of Digitization in Multi-loop Feedback Control in SMPCs

Lecture 10 - SMPC Topologies and Power Stage Design for Hardware Demonstrations

Lecture 11 - Basics of Sampling under Fixed and Variable Frequency Modulation

Lecture 12 - Voltage Mode Digital Pulse Width Modulators and Sampling Methods

Lecture 13 - Overview of Digital Pulse Width Modulator Architectures

Lecture 14 - Sampling Methods under Fixed Frequency Current Mode Control

Lecture 15 - Overview of Fixed Frequency Current Mode Control Architectures

Lecture 16 - Sampling Methods under Constant On/Off - Time Digital Modulation

Lecture 17 - Constant On/Off- Time Mixed-Signal Current Mode Control Architectures

Lecture 18 - Sampling Methods under Digital Hysteresis Control Methods

Lecture 19 - Overview of Digital Hysteresis Control Architectures

Lecture 20 - Summary of Digital Current Mode Control Architectures

Lecture 21 - Recap of Voltage and Current Mode Control Implementation using MATLAB

Lecture 22 - MATLAB Model Development for Basic Digital Control Blocks

Lecture 23 - MATLAB Model Development for Fixed Frequency Digital Control

Lecture 24 - MATLAB Models for Digital Controllers using Difference Equations

Lecture 25 - MATLAB Model Development for Digital Voltage Mode Control

Lecture 26 - MATLAB Model Development for Mixed-Signal Current Mode Control

Lecture 27 - MATLAB Model Development for Fully Digital Current Mode Control

Lecture 28 - MATLAB Model Development for Constant-On Time Control

Lecture 29 - MATLAB Model Development for Constant-Off Time Control

Lecture 30 - MATLAB Model Development for Digital Current Hysteresis Control

Lecture 31 - Continuous-Time Small-Signal Modeling under Digital Control

HTML Links for 1,19,200+ NPTEL PDF Lectures, Created by Linuxpert Systems, Chennai

- Lecture 32 - Discrete Time Modeling with Closed Current Loop
- Lecture 33 - State-Space Modeling and Steps For Deriving Discrete-Time Models
- Lecture 34 - Derivation of Discrete-Time Large-Signal Models
- Lecture 35 - Validation of Discrete-Time Large-Signal Models using MATLAB - Part I
- Lecture 36 - Validation of Discrete-Time Large-Signal Models using MATLAB - Part II
- Lecture 37 - Derivation of Discrete-Time Small-Signal Models - I
- Lecture 38 - Derivation of Discrete-Time Small-Signal Models - II
- Lecture 39 - Discrete-Time Transfer Functions and Closed Loop Block Diagrams
- Lecture 40 - Model Accuracy with MATLAB Case Studies - Comparative Study
- Lecture 41 - Continuous-Time to Discrete-Time Conversion Methods - A Summary
- Lecture 42 - Recap of Frequency Domain Design of Analog VMC and CMC
- Lecture 43 - Design under Digital Voltage Mode Control - Frequency Domain Approaches
- Lecture 44 - Design under Digital Current Mode Control - Frequency Domain Approaches
- Lecture 45 - Design Case Study and MATLAB Simulation of Digital Voltage Mode Control
- Lecture 46 - Design Case Study and MATLAB Simulation of Digital Current Mode Control
- Lecture 47 - Time Optimal Control of a Buck Converter and Identifying Performance Limits
- Lecture 48 - Trajectory based CMC Design for Proximate Time Optimal Recovery
- Lecture 49 - Trajectory based Digital CMC Tuning and MATLAB Case Studies
- Lecture 50 - Digital Pulse Skipping Control and MATLAB Simulation Case Studies
- Lecture 51 - Selection of ADC and DAC in Digitally Controlled SMPCs
- Lecture 52 - High Frequency Current Sensing Techniques in Digitally Controlled SMPCs
- Lecture 53 - Current Sensing Techniques in Digitally Controlled High Power Converters
- Lecture 54 - Signal Conditioning Circuits and PCB Design for Mixed-Signal Implementation
- Lecture 55 - Reference Power Stage Design and Schematic for Buck and Boost Converters - I
- Lecture 56 - Reference Power Stage Design and Schematic for Buck and Boost Converters - II
- Lecture 57 - Step-by-Step Guidelines for Digital Control Implementation using FPGA
- Lecture 58 - Test and Measurement of a Buck Converter using Digital Storage Oscilloscope
- Lecture 59 - Functionalities in Mixed Signal Oscilloscope for Validating Digital Control
- Lecture 60 - Power Spectrum Analysis of SMPCs using Mixed-Signal Oscilloscope
- Lecture 61 - Introduction to Verilog Hardware Description Language (HDL)
- Lecture 62 - Guidelines for Verilog HDL Programming - Some Key Rules
- Lecture 63 - Structural and Dataflow Modeling in Verilog HDL for Combinational Logics
- Lecture 64 - Behavioral Modeling in Verilog HDL for Sequential Digital Circuits

- Lecture 65 - Simulation of Verilog-HDL based Design using Xilinx Webpack - I
- Lecture 66 - Simulation of Verilog-HDL based Design using Xilinx Webpack - II
- Lecture 67 - Fixed Point Implementation in Embedded Control System
- Lecture 68 - Fixed Point Arithmetic and Concept of Q Format
- Lecture 69 - Counter-based DPWM with Deadtime and Verilog HDL Programming
- Lecture 70 - Simulating Counter-based DPWM with Deadtime using Xilinx ISE Simulator
- Lecture 71 - Top Down Design Methodology in Digital Voltage Mode Control - I
- Lecture 72 - Top Down Design Methodology in Digital Voltage Mode Control - II
- Lecture 73 - Digital PID Control Implementation using Verilog HDL Programming
- Lecture 74 - Digital PID Controller - Hardware Implementation and Experimental Results
- Lecture 75 - Top Down Design Methodology in Mixed-Signal Current Mode Control
- Lecture 76 - Top Down Design Method and Verilog HDL Programming of Mixed-Signal CMC
- Lecture 77 - Verilog HDL based Digital PI Control Implementation of Mixed-Signal CMC
- Lecture 78 - Hardware Implementation of Mixed-Signal CMC and Experimental Results
- Lecture 79 - Voltage based Digital Pulse Skip Modulation and Top Down Design Method
- Lecture 80 - Implementing Digital Pulse Skip Modulation and Experimental Results
- Lecture 81 - STM32 Overview and STM32G4x ecosystem
- Lecture 82 - Getting started with STM32CubeMX - Part I
- Lecture 83 - Getting started with STM32CubeMX - Part II
- Lecture 84 - Practical implementation of LLC converters - Part I
- Lecture 85 - Practical implementation of LLC converters - Part II
- Lecture 86 - Texas Instruments C2000 Real-time Microcontroller Devices
- Lecture 87 - Getting Started with C2000 - Software and Hardware Development
- Lecture 88 - Texas Instruments C2000 key peripheral differentiations
- Lecture 89 - Texas Instruments TIDM-02008 Reference Design Overview
- Lecture 90 - Texas Instruments TIDM-02008 Reference Design Software Overview
- Lecture 91 - Steps for FPGA Implementation of Digital Voltage Mode Control
- Lecture 92 - Steps for FPGA Implementation of Mixed-Signal Current Mode Control
- Lecture 93 - Instability in Digital CMC and Ramp Compensation with Experimental Results
- Lecture 94 - Benefits of Constant Off-Time and On-Time Digital CMC Techniques
- Lecture 95 - Top Down Design Methodology of Constant On/Off-Time Control
- Lecture 96 - Verilog HDL Implementation of Voltage based Constant On-Time Control
- Lecture 97 - FPGA Implementation of Constant On/Off-Time Mixed-Signal CMC

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

[Lecture 98 - Stability Comparison of Fixed and Variable Freq. Digital CMC with Experimental Results](#)

[Lecture 99 - Assessment of Digital Control Techniques for Light Load DC-DC Converters](#)

[Lecture 100 - Adaptive On-Time Digital Control in DCM with Verilog HDL Implementation](#)

[Lecture 101 - MATLAB Simulation of a Practical Digital VMC Buck Converter in CCM](#)

[Lecture 102 - Data Acquisition and Steps for Validating Simulation and Experimental Results](#)

[Lecture 103 - Loop Shaping and Design of Digital Voltage Mode Control in a Buck Converter](#)

[Lecture 104 - Digital VMC Design for Shaping Output Impedance in a Buck Converter](#)

[Lecture 105 - Hardware Case Studies and Transient Performance in Digital VMC Buck Converter](#)

[Lecture 106 - Design and Simulation Case Studies in a Mixed-Signal CMC Buck Converter](#)

[Lecture 107 - Hardware Case Studies and Transient Performance in a Digital CMC Buck Converter](#)

[Lecture 108 - Analysis of Output Impedance in Digital CMC with Load Current Feedforward](#)

[Lecture 109 - Load Current Feedforward in Digital CMC Buck Converter: Experimental Results](#)

[Lecture 110 - Need for Multi-Mode Digital Control and Design Requirements in SMPCs](#)

[Lecture 111 - Implementing Bi-frequency Spread Spectrum in Digital VMC using Verilog HDL](#)

[Lecture 112 - Performance of Bi-frequency Spread Spectrum DPWM and Experimental Results](#)

[Lecture 113 - Top Down Design Methodology of PWM/PSM Multi-Mode Digital Control](#)

[Lecture 114 - Verilog HDL based FPGA Prototyping of PWM/PSM Multi-Mode Digital Control](#)

[Lecture 115 - FPGA Prototyping of Peak Current based PWM/PFM Multi-Mode Digital Control - I](#)

[Lecture 116 - FPGA Prototyping of Peak Current based PWM/PFM Multi-Mode Digital Control - II](#)

[Lecture 117 - Industry-Driven Architectures for Digital Control IC in High Frequency SMPC](#)

[Lecture 118 - Industry-Driven Architectures for Digital Control System Solutions in SMPCs](#)

[Lecture 119 - Exploration of Architectures, Modeling, Design, and Control - Course Summary](#)

[Lecture 120 - Key Takeaways and Course Usefulness for Skilled Manpower Development](#)

- Lecture 1 - Introduction to VLSI interconnects
- Lecture 2 - The distributed RC interconnect model
- Lecture 3 - The Elmore delay
- Lecture 4 - Elmore delay in interconnects
- Lecture 5 - Elmore delay in branched RC interconnects
- Lecture 6 - Equivalent circuit for RC interconnects
- Lecture 7 - Scaling effects in interconnects
- Lecture 8 - Delay mitigation in RC interconnects
- Lecture 9 - RC interconnect simulation
- Lecture 10 - Inductive effects in interconnects
- Lecture 11 - Distributed RLC interconnect model
- Lecture 12 - Transmission line equations
- Lecture 13 - When to consider the inductive effects?
- Lecture 14 - The transfer function of an RLC interconnect
- Lecture 15 - Time domain response of a lumped RLC circuit
- Lecture 16 - Equivalent Elmore model for RLC interconnects
- Lecture 17 - Two-pole model of RLC interconnects from ABCD parameters
- Lecture 18 - RLC interconnect simulation
- Lecture 19 - Origin of the skin effect
- Lecture 20 - Effective resistance at high frequencies
- Lecture 21 - Equivalent circuit to simulate skin effect
- Lecture 22 - Power dissipation due to interconnects
- Lecture 23 - Optimum interconnect width for minimizing total power dissipation
- Lecture 24 - Heating effects and thermal modeling
- Lecture 25 - Compact thermal modeling with equivalent electrical circuits
- Lecture 26 - Electromigration in interconnects
- Lecture 27 - Mitigation of electromigration
- Lecture 28 - Capacitive coupling in interconnects
- Lecture 29 - Cross-talk and timing jitters in two identical interconnects
- Lecture 30 - Coupling effects and mitigation techniques
- Lecture 31 - Matrix formulation of coupled interconnects

[Lecture 32 - Coupled RLC interconnects](#)

[Lecture 33 - Decoupling of interconnects by diagonalization of matrix](#)

[Lecture 34 - Analysis of coupled interconnects: Examples - 1](#)

[Lecture 35 - Analysis of coupled interconnects: Examples - 2](#)

[Lecture 36 - Simulation of RC coupled interconnects](#)

[Lecture 37 - Extraction of capacitance - Part 1](#)

[Lecture 38 - Extraction of capacitance - Part 2](#)

[Lecture 39 - Extraction of inductance - Part 1](#)

[Lecture 40 - Extraction of inductance - Part 2](#)

[Lecture 41 - Estimation of interconnect parameters from S-parameters](#)

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Crystal Concept

Lecture 4 - Crystal Concept

Lecture 5 - Crystal Concept

Lecture 6 - Reciprocal Space

Lecture 7 - Problem Session - 1

Lecture 8 - Doping In Semiconductors

Lecture 9 - Bandstructure

Lecture 10 - Effective Mass

Lecture 11 - Density of States

Lecture 12 - Mobility

Lecture 13 - Problem Session - 2

Lecture 14 - Semiconductor statistics

Lecture 15 - Semiconductor statistics (Continued...)

Lecture 16 - P-N Junction

Lecture 17 - P-N Junction (Continued...)

Lecture 18 - P-N Junction (Continued...)

Lecture 19 - Problem Session - 3

Lecture 20 - BJT

Lecture 21 - Bipolar Junction Transistor

Lecture 22 - Bipolar Junction Transistor (Continued...)

Lecture 23 - Bipolar Junction Transistor (Continued...)

Lecture 24 - Problem Session - 4

Lecture 25 - Metal- Semiconductor Interface

Lecture 26 - Schottky junction

Lecture 27 - Field Effect Transistor

Lecture 28 - MOS Capacitor

Lecture 29 - MOS-CV

Lecture 30 - REAL MOS (Continued...)

Lecture 31 - MOSFET

[Lecture 32 - MOSFET \(Continued...\)](#)

[Lecture 33 - Problem Session - 5](#)

[Lecture 34 - Semiclassical Transport](#)

[Lecture 35 - Semiclassical Transport \(Continued...\)](#)

[Lecture 36 - Semiclassical Transport \(Continued...\)](#)

[Lecture 37 - Semiclassical Transport \(Continued...\)](#)

[Lecture 38 - Semiclassical Transport \(Continued...\)](#)

[Lecture 39 - Problem Session - 6](#)

[Lecture 40 - Drift-diffusion model](#)

[Lecture 41 - Drift-diffusion model \(Continued...\)](#)

[Lecture 42 - Drift-diffusion model \(Continued...\)](#)

[Lecture 43 - Drift-diffusion model \(Continued...\)](#)

[Lecture 44 - Generation-Recombination](#)

[Lecture 45 - Generation-Recombination \(Continued...\)](#)

[Lecture 46 - Solving DD Equations \(Continued...\)](#)

[Lecture 47 - Solving DD Equations \(Continued...\)](#)

[Lecture 48 - Problem Session - 7](#)

[Lecture 49 - Hydrodynamic Model](#)

[Lecture 50 - Hydrodynamic Model \(Continued...\)](#)

[Lecture 51 - Hydrodynamic Model \(Continued...\)](#)

[Lecture 52 - Monte Carlo simulations](#)

[Lecture 53 - Problem Session - 8](#)

[Lecture 54 - Quantum Mechanics](#)

[Lecture 55 - Solving Schrodinger Equation](#)

[Lecture 56 - Quantum Correction Models](#)

[Lecture 57 - Quantum Transport](#)

[Lecture 58 - Transfer Matrix Approach](#)

[Lecture 59 - TCAD Tools](#)

[Lecture 60 - ATLAS SILVACO](#)

[Lecture 61 - Simulating Junctions](#)

[Lecture 62 - Models and Simulation Concepts](#)

[Lecture 63 - Mixed-mode Simulation](#)

Lecture 1 - The network concept

Lecture 2 - One-port network

Lecture 3 - One-port network, Two-port network

Lecture 4 - Two-port network, Signal flow graph

Lecture 5 - Tutorial - 1

Lecture 6 - General analysis of cylindrical waveguides

Lecture 7 - TE to z mode analysis of cylindrical waveguides

Lecture 8 - TE to z mode analysis of cylindrical waveguides (Continued...), TM to z mode analysis

Lecture 9 - Normalization of mode vectors, Characteristics of eigen values and eigen functions

Lecture 10 - Wave impedance for TE and TM to z modes, Transmission line analogy for mode voltage

Lecture 11 - Transmission line equivalence for TE and TM modes, Power calculation using

Lecture 12 - Tutorial - 2

Lecture 13 - Modal expansion in cylindrical waveguides, Concept of mode orthogonality

Lecture 14 - Concept of mode orthogonality (continued), Determination of arbitrary mode

Lecture 15 - Power orthogonality in cylindrical waveguides

Lecture 16 - Tutorial - 3

Lecture 17 - Modal expansion of fields in rectangular waveguides

Lecture 18 - Modal expansion of fields in rectangular waveguides (Continued), Capacitive rectangular

Lecture 19 - Capacitive rectangular waveguide junction (Continued...)

Lecture 20 - Inductive rectangular waveguide junction (Continued...)

Lecture 21 - Inductive rectangular waveguide junction (Continued...), Construction of solutions

Lecture 22 - Cylindrical waveguide junctions (Continued...)

Lecture 23 - Cylindrical waveguide junctions (Continued...)

Lecture 24 - Cylindrical waveguide junctions (Continued...), Example of capacitive rectangular

Lecture 25 - Cylindrical waveguide junctions (Continued...), Example of capacitive rectangular

Lecture 26 - Example of inductive waveguide junction (Continued...), Alternative equivalent circuit

Lecture 27 - Tutorial - 4

Lecture 28 - Obstacles in waveguides

Lecture 29 - Obstacles in waveguides (Continued...)

Lecture 30 - Obstacles in waveguides (Continued...)

Lecture 31 - Small obstacles in waveguides

- [Lecture 32 - Small obstacles in waveguides \(Continued...\)](#)
- [Lecture 33 - Small obstacles in waveguides, Reciprocity](#)
- [Lecture 34 - Reciprocity](#)
- [Lecture 35 - Reciprocity \(Continued...\)](#)
- [Lecture 36 - Tutorial - 5](#)
- [Lecture 37 - Posts in rectangular waveguide](#)
- [Lecture 38 - Posts in rectangular waveguide \(Continued...\)](#)
- [Lecture 39 - Posts in rectangular waveguide \(Continued...\)](#)
- [Lecture 40 - Posts in rectangular waveguide \(Continued...\)](#)
- [Lecture 41 - Diaphragms in waveguide](#)
- [Lecture 42 - Diaphragms in waveguide \(Continued...\)](#)
- [Lecture 43 - Diaphragms in waveguide \(Continued...\)](#)
- [Lecture 44 - Diaphragms in waveguide \(Continued...\)](#)
- [Lecture 45 - Tutorial - 6](#)
- [Lecture 46 - Currents in Waveguides](#)
- [Lecture 47 - Currents in Waveguides \(Continued...\)](#)
- [Lecture 48 - Coaxial to waveguide junction with matched termination](#)
- [Lecture 49 - Coaxial to waveguide feeds with arbitrary termination](#)
- [Lecture 50 - Coaxial to waveguide feeds with arbitrary termination \(Continued...\)](#)
- [Lecture 51 - Coaxial to waveguide feeds with arbitrary termination \(Continued...\)](#)
- [Lecture 52 - Coaxial to waveguide feeds with arbitrary termination \(Continued...\)](#)
- [Lecture 53 - Tutorial - 7](#)
- [Lecture 54 - Apertures in the ground plane](#)
- [Lecture 55 - Apertures in the ground plane \(Continued...\)](#)
- [Lecture 56 - Apertures in the ground plane \(Continued...\)](#)
- [Lecture 57 - Apertures in the ground plane \(Continued...\), Plane current sheets](#)
- [Lecture 58 - Plane current sheets \(Continued...\)](#)
- [Lecture 59 - Tutorial - 8](#)
- [Lecture 60 - Excitation of Apertures](#)
- [Lecture 61 - Tutorial - 9](#)
- [Lecture 62 - Modal expansion in cavities](#)
- [Lecture 63 - Probes in cavities](#)
- [Lecture 64 - Tutorial - 10](#)

[Lecture 65 - Aperture coupling to cavities](#)

[Lecture 66 - Aperture coupling to cavities \(Continued...\)](#)

[Lecture 67 - Wave interaction with cylindrical structures](#)

[Lecture 68 - Wave interaction with cylindrical structures \(Continued...\)](#)

[Lecture 69 - Wave interaction with cylindrical structures \(Continued...\)](#)

[Lecture 70 - Wave interaction with cylindrical structures \(Continued...\)](#)

[Lecture 71 - Wave interaction with cylindrical structures \(Continued...\)](#)

[Lecture 72 - Wave interaction with cylindrical structures \(Continued...\)](#)

[Lecture 73 - Wave interaction with cylindrical structures \(Continued...\)](#)

[Lecture 74 - Wave interaction with cylindrical structures \(Continued...\)](#)

[Lecture 75 - Tutorial - 12](#)

Lecture 1 - Introduction to Adaptive Filters

Lecture 2 - Probability and Random Variables

Lecture 3 - General Set of Random Variables

Lecture 4 - Statistical Impedance, Covariance Matrices

Lecture 5 - Multivariate Gaussian Density

Lecture 6 - Complex Random Variables

Lecture 7 - Introduction to Hermitian Matrices

Lecture 8 - Eigenvalues and eigenvectors of Hermitian Matrices

Lecture 9 - Spectral Decomposition of Hermitian Matrices

Lecture 10 - Positive Definite and Semidefinite Matrices

Lecture 11 - Introduction to Discrete Time Random Processes

Lecture 12 - Power Spectral Density (PSD)

Lecture 13 - PSD and Linear Time Invariant Systems

Lecture 14 - Optimal FIR Filter

Lecture 15 - Optimal FIR Filter (Continued...)

Lecture 16 - LMS Algorithm

Lecture 17 - Convergence Proof of LMS Algorithm

Lecture 18 - Convergence Proof of LMS Algorithm (Continued...)

Lecture 19 - Application of Adaptive Filter

Lecture 20 - Application of Adaptive Filter (Continued...)

Lecture 21 - Application of Adaptive Filter (Continued...)

Lecture 22 - Applications of Adaptive Filter

Lecture 23 - Applications of Adaptive Filter

Lecture 24 - Second Order Analysis of LMS Algorithm

Lecture 25 - Second Order Analysis of LMS Algorithm (Continued...)

Lecture 26 - Second Order Analysis of LMS Algorithm (Continued...)

Lecture 27 - Second Order Analysis of LMS Algorithm (Continued...)

Lecture 28 - NLMS Algorithm

Lecture 29 - NLMS Algorithm

Lecture 30 - Affine Projection Algorithm (APA)

Lecture 31 - Affine Projection Algorithm (APA)

[Lecture 32 - Introduction to RLS Algorithm](#)

[Lecture 33 - Introduction to RLS Algorithm \(Continued...\)](#)

[Lecture 34 - Introduction to RLS Algorithm \(Continued...\)](#)

[Lecture 35 - Formulation of the RLS Algorithm](#)

[Lecture 36 - Introduction to RLS Algorithm](#)

[Lecture 37 - Introduction to RLS Algorithm](#)

[Lecture 38 - Formulation of the RLS Algorithm](#)

[Lecture 39 - Derivation of the RLS transversal adaptive filter](#)

[Lecture 40 - Derivation of the RLS transversal adaptive filter](#)

[Lecture 41 - Derivation of the RLS transversal adaptive filter](#)

Lecture 1 - What is Nano Bio Photonics?

Lecture 2 - Why is Nano Bio Photonics?

Lecture 3 - Why do this?

Lecture 4 - Why Photonics?

Lecture 5 - Why Biology?

Lecture 6 - Nature of Light

Lecture 7 - Light-Matter Interactions

Lecture 8 - Introduction to Fluorescence

Lecture 9 - The Cell

Lecture 10 - The Central Dogma

Lecture 11 - Facts of Matter

Lecture 12 - Introduction to Nanotechnology

Lecture 13 - Nanotechnology: The art of small

Lecture 14 - Synthesis of Nanomaterials : Top-Down Approach

Lecture 15 - Applications of Nanomaterials in Photonics

Lecture 16 - Interaction of Light with Cells

Lecture 17 - Light-matter interactions in molecules (Basic of Spectroscopy)

Lecture 18 - Imaging for Biological Matters

Lecture 19 - Fluorophores and Fluorescence Microscopy Techniques

Lecture 20 - Primary Examples

Lecture 21 - Basics of Flow Cytometry - Part 1

Lecture 22 - Basics of Flow Cytometry - Part 2

Lecture 23 - Data manipulation and presentation

Lecture 24 - Application of Flow cytometry in Biology

Lecture 25 - Raman Assisted Flow cytometry

Lecture 26 - Genetic Code

Lecture 27 - Biosensing Background

Lecture 28 - Basics of Microarray Technology

Lecture 29 - DNA Microarray Technology

Lecture 30 - Protein Microarray Technology

Lecture 31 - Laser Principles and Operation

- Lecture 32 - Nonlinear Optical Processes
- Lecture 33 - In Vivo Photoexcitation
- Lecture 34 - Light/Laser Activated Therapy
- Lecture 35 - Laser Tissue Contouring
- Lecture 36 - Metamaterials
- Lecture 37 - Metamaterials as Biosensors
- Lecture 38 - Biosensing with Optical Nano-Antennas
- Lecture 39 - Nanoscale Chemical Imaging
- Lecture 40 - Optical Tweezers
- Lecture 41 - Introduction to Optogenetics
- Lecture 42 - Controlling the Brain with Light
- Lecture 43 - The Nervous System
- Lecture 44 - The Neural Circuits
- Lecture 45 - Optical Neuroimaging and Tomography
- Lecture 46 - Functional Near-Infrared Spectroscopy (fNIRS) of the Brain
- Lecture 47 - Neuro imaging with Light-Sheet Microscopy
- Lecture 48 - Brain imaging with Two Photon Microscopy
- Lecture 49 - Brain imaging with functional optoacoustic Imaging
- Lecture 50 - Tomographic technique for Brain imaging
- Lecture 51 - Optogenetic Modulation of Neural Circuits
- Lecture 52 - Nanoparticles for Optical Modulation of Neuronal Behavior
- Lecture 53 - Optical Stimulation of Neural Circuits in Freely Moving Animals
- Lecture 54 - Higher Harmonic Generation Imaging for Neuropathology
- Lecture 55 - Multi-Photon Nanosurgery
- Lecture 56 - Bioinspired materials for photonics
- Lecture 57 - Bioderived Materials
- Lecture 58 - Bioinspired Materials
- Lecture 59 - Biotemplates
- Lecture 60 - Summary and Revisiting Few Topics

- Lecture 1 - Introduction to Electromagnetic Environment
- Lecture 2 - Introduction to Electromagnetic Compatibility
- Lecture 3 - EMC Standards
- Lecture 4 - EMC Units and Signal Spectrum
- Lecture 5 - Single Sided Spectrum
- Lecture 6 - Response of Linear Systems to Periodic Input Signals
- Lecture 7 - Important Computational Techniques
- Lecture 8 - Fourier Coefficient for Piecewise Linear Periodic Waveforms
- Lecture 9 - Fourier Coefficient for Piecewise Linear Periodic Waveforms (Continued...)
- Lecture 10 - Trapezoidal Clock
- Lecture 11 - Spectral Bounds for Trapezoidal Clock
- Lecture 12 - Spectral estimation of trapezoidal clock
- Lecture 13 - Effect of Rise/Fall Time on Spectral Bound of a Clock
- Lecture 14 - Effect of Ringing on Spectral Bounds
- Lecture 15 - Spectral Bounds for Linear System Output
- Lecture 16 - Resolution Bandwidth of a Spectrum Analyser
- Lecture 17 - Detector of Spectrum Analyser
- Lecture 18 - Radiated Emission Model Subproblem - I
- Lecture 19 - Farfield Characteristics of Current Element: Some Discussion
- Lecture 20 - Farfield of Dipole Antena
- Lecture 21 - Farfield models of wire antenna and current models
- Lecture 22 - Differential mode current emission model
- Lecture 23 - Differential mode current emission model (Continued...)
- Lecture 24 - Common Mode Current Emission Model
- Lecture 25 - Current Measurement
- Lecture 26 - Radiated Susceptibility Models
- Lecture 27 - Determination of Per Unit Length Inductance (Continued...)
- Lecture 28 - Per Unit Length Parameters of Various Two Wire Lines
- Lecture 29 - Radiated Susceptibility Model
- Lecture 30 - Radiated Susceptibility Model (Continued...)
- Lecture 31 - Radiated Susceptibility Model (Continued...)

[Lecture 32 - Crosstalk](#)

[Lecture 33 - Development of Multi Conductor Transmission Line Equation](#)

[Lecture 34 - Per Unit Length Parameter of a Three Conductor System](#)

[Lecture 35 - Parameters of Three Conductor Systems \(Continued...\)](#)

[Lecture 36 - Parameters of Three Conductor Systems \(Continued...\)](#)

[Lecture 37 - Development of crosstalk model infrequency domain](#)

[Lecture 38 - Determination of Terminal Currents of a three conductor system](#)

[Lecture 39 - Derivation of Chain Parameter Matrix](#)

[Lecture 40 - Determination of Crosstalk in a Lossless Line Immersed in Homogeneous Medium](#)

[Lecture 41 - Determination of Crosstalk \(Continued...\)](#)

[Lecture 42 - Determination of Crosstalk \(Continued...\)](#)

[Lecture 43 - Determination of Crosstalk \(Continued...\)](#)

[Lecture 44 - Inductive and Capacitive coupling](#)

[Lecture 45 - Time Domain Crosstalk](#)

[Lecture 46 - Time Domain Crosstalk \(Continued...\)](#)

[Lecture 47 - Inclusion of Losses in Transient Crosstalk](#)

[Lecture 48 - Conducted emission and susceptibility](#)

[Lecture 49 - Shielding](#)

[Lecture 50 - Shielding Effectiveness for Farfield Source](#)

[Lecture 51 - Shielding Effectiveness Due to Farfield Source \(Continued...\)](#)

[Lecture 52 - SE Due to Farfield Sources \(Continued...\) and Free Space Impedance Ar Nearfield](#)

[Lecture 53 - Shielding for Nearfield Source](#)

[Lecture 54 - EMC System Aspect for Shielding](#)

[Lecture 55 - Grounding](#)

[Lecture 56 - Grounding \(Continued...\)](#)

[Lecture 57 - Bonds and Joints](#)

[Lecture 58 - EMC Case Studies](#)

[Lecture 59 - Electrostatic Discharge \(ESD\)](#)

Lecture 1 - Introduction

Lecture 2 - Real-life Examples Illustration

Lecture 3 - Sensor Structure and Characteristics

Lecture 4 - Sensor and Actuator Characteristics and Numerical Problem

Lecture 5 - Temperature Sensors and its Signal Conditioning Circuits

Lecture 6 - Motion Sensors and its Interfacing Aspects

Lecture 7 - Gyroscope and Strain Gauge

Lecture 8 - Strain Gauge and Optical Sensor

Lecture 9 - Optical Encoder, Gas Sensor and Chemical Sensor

Lecture 10 - Magnetic Sensor and Actuator

Lecture 11 - Electrical Actuator

Lecture 12 - Electrical Actuator: Stepper Motor and Heater

Lecture 13 - Smart Material Actuator

Lecture 14 - Metamaterial and Other Actuators

Lecture 15 - Op-amp based circuits and amplifier

Lecture 16 - Various Op-amp Configurations

Lecture 17 - Instrumentation Amplifier and Filter

Lecture 18 - Passive and Active Filters

Lecture 19 - Universal Filter and Data Converter

Lecture 20 - ADC and DAC

Lecture 21 - Sampling Issue and Communication Protocol

Lecture 22 - Bridge Circuits and their Linearity Improvement

Lecture 23 - Linearization and error reduction schemes

Lecture 24 - Principle of Direct Interfacing Scheme

Lecture 25 - Various Aspects of Direct Interfacing

Lecture 26 - Direct Interfacing for Differential and Bridge Type Resistive Sensor

Lecture 27 - Measurement Uncertainties and Interface of Sensor Array

Lecture 28 - Various Configurations of Capacitive Sensors

Lecture 29 - Analog Interface Circuit and Direct Interfacing Scheme

Lecture 30 - Direct Interfacing Scheme for Differential Capacitive Sensor

Lecture 31 - Lossy Capacitive Sensor and its Interfacing Aspect

- Lecture 32 - Advanced Interfacing Circuits for Lossy Capacitive Sensor
- Lecture 33 - Autobalance Active Bridge Interfacing Circuit
- Lecture 34 - Background of Miniaturization
- Lecture 35 - Micromachining Technology for MEMS Devices
- Lecture 36 - Bulk and Surface Micromachining and Fabrication Steps
- Lecture 37 - MEMS Fabrication Process - Part 1
- Lecture 38 - MEMS Fabrication Process - Part 2
- Lecture 39 - MEMS Fabrication Process - Part 3
- Lecture 40 - MEMS Fabrication Process - Part 4
- Lecture 41 - MEMS-IC Integration Aspects and Miniaturized Sensor
- Lecture 42 - MEMS Pressure Sensor and Interfacing Electronics
- Lecture 43 - MEMS Accelerometer
- Lecture 44 - MEMS Capacitive Accelerometer and Interfacing Electronics
- Lecture 45 - Interfacing Electronics Details for MEMS Accelerometer
- Lecture 46 - MEMS Gyroscope and Flow sensor
- Lecture 47 - MEMS Actuator
- Lecture 48 - MEMS Electrostatic Actuator Analysis
- Lecture 49 - Background of Renewable Energy Harvesting
- Lecture 50 - Various Transduction Mechanisms for Energy Harvester
- Lecture 51 - Vibration Energy Harvester and its Interfacing Aspects
- Lecture 52 - Interfacing Power Management Circuit for Vibration Energy Harvester
- Lecture 53 - Demonstration of Energy Harvester Set-up and Self-powered Embedded System
- Lecture 54 - Background of Embedded Sensors and Actuators in Automotives
- Lecture 55 - Applications in Safety System of Automotive
- Lecture 56 - Applications in Safety System and Engine Control System
- Lecture 57 - Application in Cardiovascular Measurements
- Lecture 58 - Applications in Remote Healthcare and Smart Medical Devices
- Lecture 59 - Electronic Nose and its Applications in Disease Detection
- Lecture 60 - Virtual Sensing, Research Scopes, Summary and Key Takeaways of the Course

Lecture 1 - Electric systems

Lecture 2 - Resistive circuit connections

Lecture 3 - Nodal analysis

Lecture 4 - Mesh Analysis / Loop Analysis

Lecture 5 - Mixed sources - Mesh and Nodal analysis

Lecture 6 - Superposition Theorem

Lecture 7 - Thevenin's Theorem and its applications

Lecture 8 - Norton's theorem and Maximum power transfer theorem

Lecture 9 - Review problems on DC circuits

Lecture 10 - Average and RMS values Phasor representation of sinusoids Reactance

Lecture 11 - Series AC circuits, R-L, R-C, R-L-C

Lecture 12 - KVL and KCL Series and parallel combination of impedance Star - delta transformations

Lecture 13 - Power Curves for AC circuits

Lecture 14 - Real and Reactive Power

Lecture 15 - Loop current method, nodal analysis and theorems

Lecture 16 - Theorem-examples, maximum power transfer theorem

Lecture 17 - Resonance

Lecture 18 - Power Factor Improvement

Lecture 19 - Review problems on AC circuits

Lecture 20 - Capacitor - properties series - parallel combinations

Lecture 21 - Inductor - properties series - parallel combinations

Lecture 22 - Source free RC and RL circuits

Lecture 23 - Step response of RC and RL circuits

Lecture 24 - Review Problems on RL and RC transients

Lecture 25 - Basics on three phase systems

Lecture 26 - Line and phase currents and voltages in star connected systems

Lecture 27 - Line and phase voltages and currents in delta connected systems

Lecture 28 - Three phase power

Lecture 29 - Three phase power and Power factor

Lecture 30 - Measurement of 3 - phase power

Lecture 31 - Magnetic flux, flux density, magnetic field strength

[Lecture 32 - Reluctance Equivalent magnetic circuit Solving Magnetic Circuits](#)

[Lecture 33 - Solving Magnetic Circuits](#)

[Lecture 34 - Hysteresis loop Hysteresis and Eddy Current loss](#)

[Lecture 35 - Self and Mutual inductances Dot Convention](#)

[Lecture 36 - Solving Magnetic Coupled Circuits](#)

[Lecture 37 - Magnetic Circuit applications](#)

[Lecture 38 - Transformer Basics, The emf equation](#)

[Lecture 39 - Ideal transformer, Impedance referred to primary](#)

[Lecture 40 - Practical transformer, Transformer equivalent circuit diagram](#)

[Lecture 41 - Voltage Drop and Voltage Regulation Calculation](#)

[Lecture 42 - Efficiency of Transformer](#)

[Lecture 43 - Transformer Tests, Transformer Applications](#)

Lecture 1 - Introduction

Lecture 2 - Magnetic Fields

Lecture 3 - Magnetic Circuit

Lecture 4 - Singly Excited Linear Motion System

Lecture 5 - Linear and Cylindrical Motion Systems

Lecture 6 - Systems with Multiple Excitations

Lecture 7 - Non-linear Magnetic Systems

Lecture 8 - Inductances in Constant Air gap Machines

Lecture 9 - Inductance in Salient Pole Machine - I

Lecture 10 - Inductance in Salient Pole Machine - II

Lecture 11 - Inductance in Salient Pole Machine - III

Lecture 12 - Inductance in Salient Pole Machine - IV

Lecture 13 - Inductance in Salient Pole Machine - V

Lecture 14 - Inductances of Distributed Winding - I

Lecture 15 - Inductances of Distributed Winding - II

Lecture 16 - Inductances of Distributed Winding - III

Lecture 17 - Dynamic Equations of Induction Machines

Lecture 18 - Dynamic Equations of Salient Pole Synchronous Machine

Lecture 19 - Three-to-Two Phase Transformation

Lecture 20 - Induction Machine in Two-Phase Reference Frame

Lecture 21 - The Pseudo-Stationary Reference Frame

Lecture 22 - Induction Machine in Pseudo-Stationary Reference Frame

Lecture 23 - The Primitive Machine Equations

Lecture 24 - Dynamic Equations of DC Machines

Lecture 25 - Small Signal Model of DC Machine

Lecture 26 - Small Signal Behaviour of DC Machine

Lecture 27 - The Arbitrary Reference Frame

Lecture 28 - Induction Machine Equations in Arbitrary, Synchronous Reference Frames and Small Signal Modelling

Lecture 29 - Introduction to Field Oriented Control of Induction Machines

Lecture 30 - Space Vector Formulation of Induction Machine Equations

Lecture 31 - Modelling of Salient Pole Synchronous Machines - I

[Lecture 32 - Modelling of Salient Pole Synchronous Machines - II](#)

[Lecture 33 - Modelling of Salient Pole Synchronous Machines - III](#)

[Lecture 34 - Steady State Models - Induction Machine](#)

[Lecture 35 - Steady State Models - Salient Pole Synchronous Machine](#)

[Lecture 36 - Solution of Dynamic Equations of Induction Machine - I](#)

[Lecture 37 - Solution of Dynamic Equations of Induction Machine - II](#)

[Lecture 38 - Reactances of Salient Pole Synchronous Machines - I](#)

[Lecture 39 - Reactances of Salient Pole Synchronous Machines - II](#)

[Lecture 40 - Reactances of Salient Pole Synchronous Machines - III](#)

[Lecture 41 - Sudden Short Circuit of Three Phase Alternator - Analytical Solution](#)

[Lecture 42 - Sudden Short Circuit of Three Phase Alternator - Numerical Simulation](#)

[Lecture 43 - Course Recapitulation and Assignments](#)

- Lecture 1 - Basic Building Blocks In Analog ICs
- Lecture 2 - Current Mirrors
- Lecture 3 - Translinear Networks
- Lecture 4 - Differential Amplifier
- Lecture 5 - Differential Amplifier Characteristics
- Lecture 6 - Video Amplifier and RF/IF Amplifiers
- Lecture 7 - Cascade Amplifier
- Lecture 8 - IC Negative Feedback Wide Band Amplifiers
- Lecture 9 - IC Negative Feedback Amplifiers
- Lecture 10 - Voltage Sources And References
- Lecture 11 - IC Voltage Regulator
- Lecture 12 - Characteristics and Parameters Of Voltage
- Lecture 13 - Protection Circuitry For Voltage Regulator
- Lecture 14 - Switched Mode Regulator And Operational
- Lecture 15 - IC Operational Voltage Amplifier
- Lecture 16 - General Purpose Operational Amplifier-747
- Lecture 17 - Transconductance Operational Amplifier
- Lecture 18 - Audio Power Amplifier and Norton's Amplifier
- Lecture 19 - Analog Multipliers
- Lecture 20 - Analog Multipliers
- Lecture 21 - Voltage Controlled Oscillator
- Lecture 22 - Voltage Controlled Oscillator
- Lecture 23 - Self Tuned Filter
- Lecture 24 - Phase Locked Loop24 Phase Locked Loop
- Lecture 25 - Phase Locked Loop
- Lecture 26 - Phase Locked Loop
- Lecture 27 - Phase Locked Loop
- Lecture 28 - Current Mode ICs

NPTEL : Digital Integrated Circuits (Electrical Engineering)

Co-ordinators : Prof. Amitava Dasgupta

Lecture 1 - Semiconductors

Lecture 2 - Modelling of PN Junction Diodes

Lecture 3 - Modelling of BJTs

Lecture 4 - Diode and BJT Model Parameter Extraction

Lecture 5 - BJT Inverters DC and Switching Characteristics

Lecture 6 - Schottky Transistor

Lecture 7 - Specifications of Logic Circuits

Lecture 8 - Qualitative discussion on TTL Circuits

Lecture 9 - Standard TTL Circuits

Lecture 10 - Schottky (74s..) and Low power Schottky (74ls)

Lecture 11 - Advanced TTL Circuits

Lecture 12 - I²L Technology

Lecture 13 - Edge triggered D-F/F

Lecture 14 - I²L - Condition for Proper Operation

Lecture 15 - I²L - Propagation delay Self aligned

Lecture 16 - Schottky Transistor Logic

Lecture 17 - Stacked I²L

Lecture 18 - ECL Basic Operation

Lecture 19 - Quantitative analysis of ECL 10k Series gates

Lecture 20 - ECL 100k series; Stacked ECL gates; D-F/F

Lecture 21 - Emitter Function Logic;Low Power ECL

Lecture 22 - Polyemitter Bipolar Transistor In ECL;Propagation

Lecture 23 - Heterojunction Bipolar Transistor Based ECL;ECL

Lecture 24 - nMOS Logic Circuits

Lecture 25 - nMOS Logic Circuits(contd); CMOS :Introduction

Lecture 26 - CMOS Inverter

Lecture 27 - CMOS NAND,NOR and Other Gates: Clocked CMOS

Lecture 28 - Dynamic CMOS ;Transmission Gates;Realization Of MUX,decoder, D-F/F

Lecture 29 - BiCMOS Gates

Lecture 30 - BiCMOS Driver;BiCMOS 32-bit Adder

Lecture 31 - Digital Integrated Circuits

[Lecture 32 - Digital Integrated Circuits](#)

[Lecture 33 - CMOS SRAM](#)

[Lecture 34 - BiCMOS SRAM](#)

[Lecture 35 - DRAM-CMOS and BiCMOS](#)

[Lecture 36 - ROM-EPROM,EEPROM and Flash EPROM](#)

[Lecture 37 - GaAs MESFET Characteristics and Equivalent Circuits](#)

[Lecture 38 - Direct Coupled FET Logic; Superbuffer FET Logic](#)

[Lecture 39 - Buffered FET Logic; Schottky Diode FET Logic](#)

[Lecture 40 - Transmission Line Effects](#)

NPTEL : Electromagnetic Fields (Electrical Engineering)

Co-ordinators : Prof. Harishankar Ramachandran

Lecture 1 - Introduction To Vector

Lecture 2 - Introduction To Vector (Continued...)

Lecture 3 - Coulomb's Law

Lecture 4 - Electric Field

Lecture 5 - Electro Static Potential

Lecture 6 - The Gradient

Lecture 7 - Gauss's Law

Lecture 8 - Poisson's Equation

Lecture 9 - Energy In The Field

Lecture 10 - Sample Problems In Electrostatics

Lecture 11 - Fields In Materials

Lecture 12 - Fields In Material Bodies

Lecture 13 - Displacement Vectors

Lecture 14 - Capacitors

Lecture 15 - Method Of Images

Lecture 16 - Poisson's Equation 2 Dimensions

Lecture 17 - Field Near Sharp Edges And Points

Lecture 18 - Magnetic Field 1

Lecture 19 - Magnetic Field 2

Lecture 20 - Stokes Theorems

Lecture 21 - The curl

Lecture 22 - Field due to current loop

Lecture 23 - Ampere's law

Lecture 24 - Examples of Ampere's law

Lecture 25 - Inductance

Lecture 26 - Mutual Inductance

Lecture 27 - Faraday's law

Lecture 28 - Magnetic Energy

Lecture 29 - Magnetic Energy (Continued...)

Lecture 30 - Magnetic Energy (Continued...)

Lecture 31 - Generalised Ampere's Law

[Lecture 32 - The Wave Equation](#)

[Lecture 33 - The Wave Equation](#)

[Lecture 34 - Poynting Theorem](#)

[Lecture 35 - Skin Effect](#)

[Lecture 36 - Skin Effect \(Continued...\)](#)

[Lecture 37 - Radiation And Circuits](#)

[Lecture 38 - Phasor Form Of Poynting Theorem](#)

[Lecture 39 - Reflection At Dielectric Boundaries](#)

[Lecture 40 - Reflection At Dielectric Boundaries \(Continued...\)](#)

[Lecture 41 - Transmission Lines](#)

[Lecture 42 - Transmission Lines \(Continued...\) and Conclusion](#)

Lecture 1 - Introductory Concepts - 1

Lecture 2 - Introductory Concepts - 2

Lecture 3 - Introductory Concepts - 3

Lecture 4 - Introductory Concepts - 4

Lecture 5 - Introductory Concepts - 5

Lecture 6 - Introductory Concepts - 6

Lecture 7 - Fourier Series - 1

Lecture 8 - Fourier Series - 2

Lecture 9 - Fourier Series - 3

Lecture 10 - Fourier Series - 4

Lecture 11 - Fourier Series - 5

Lecture 12 - Fourier Series - 6

Lecture 13 - Fourier Transforms - 1

Lecture 14 - Fourier Transforms - 2

Lecture 15 - Fourier Transforms - 3

Lecture 16 - Fourier Transforms - 4

Lecture 17 - Fourier Transforms - 5

Lecture 18 - Fourier Transforms - 6

Lecture 19 - Fourier Transforms - 7

Lecture 20 - Laplace Transforms - 1

Lecture 21 - Laplace Transforms - 2

Lecture 22 - Laplace Transforms - 3

Lecture 23 - Laplace Transforms - 4

Lecture 24 - Laplace Transforms - 5

Lecture 25 - Laplace Transforms - 6

Lecture 26 - Application of Laplace Transforms - 1

Lecture 27 - Application of Laplace Transforms - 2

Lecture 28 - Application of Laplace Transforms - 3

Lecture 29 - Application of Laplace Transforms - 4

Lecture 30 - Network Functions - 1

Lecture 31 - Network Functions - 2

[Lecture 32 - Network Functions - 3](#)

[Lecture 33 - Network Functions - 4](#)

[Lecture 34 - Network Theorems - 1](#)

[Lecture 35 - Network Theorems - 2](#)

[Lecture 36 - Network Theorems - 3](#)

[Lecture 37 - Network Theorems - 4](#)

[Lecture 38 - Discrete - Time Systems - 1](#)

[Lecture 39 - Discrete - Time Systems - 2](#)

[Lecture 40 - Discrete - Time Systems - 3](#)

[Lecture 41 - Discrete - Time Systems - 4](#)

[Lecture 42 - Discrete - Time Systems - 5](#)

[Lecture 43 - Discrete - Time Systems - 6](#)

[Lecture 44 - Discrete - Time Systems - 7](#)

[Lecture 45 - State-Variable Methods - 1](#)

[Lecture 46 - State-Variable Methods - 2](#)

[Lecture 47 - State Variable Methods - 3](#)

[Lecture 48 - State Variable Methods - 4](#)

[Lecture 49 - State Variable Methods - 5](#)

[Lecture 50 - State Variable Methods - 6](#)

Lecture 1 - Introduction

Lecture 2 - Cardinality

Lecture 3 - Countability

Lecture 4 - Uncountable sets - 1

Lecture 5 - Uncountable sets - 2

Lecture 6 - Probability spaces - Introduction

Lecture 7 - Probability spaces - Algebra

Lecture 8 - Probability spaces - σ -algebra

Lecture 9 - Probability spaces - Measurable space

Lecture 10 - Properties of probability measures

Lecture 11 - Continuity of probability measure

Lecture 12 - Discrete probability space - finite and countably infinite sample space

Lecture 13 - Discrete probability space - Uncountable sample space

Lecture 14 - Generated σ -algebra, Borel Sets

Lecture 15 - Borel sets

Lecture 16 - Uniform probability measure on Borel sets-Lebesgue measure

Lecture 17 - Carathéodory's extension theorem

Lecture 18 - Lebesgue measure (Continued...)

Lecture 19 - Infinite coin toss model

Lecture 20 - Infinite coin toss model (Continued...)

Lecture 21 - Conditional probability

Lecture 22 - Properties of conditional probability

Lecture 23 - Independence of events

Lecture 24 - Independence of σ -algebras

Lecture 25 - Borel-Cantelli Lemma - 1

Lecture 26 - Borel-Cantelli Lemma - 2

Lecture 27 - Random Variables

Lecture 28 - Random Variables (Continued...)

Lecture 29 - Cumulative Distribution Function

Lecture 30 - Properties of CDF

Lecture 31 - Types of Random Variables

[Lecture 32 - Examples of Random Variables](#)

[Lecture 33 - Continuous Random Variables - 1](#)

[Lecture 34 - Examples of Continuous Random Variables - 1](#)

[Lecture 35 - Continuous Random Variables - 2, Examples of Continuous Random Variables - 2](#)

[Lecture 36 - Singular Random Variables](#)

[Lecture 37 - Several Random Variables - 1](#)

[Lecture 38 - Several Random Variables - 2](#)

[Lecture 39 - Independent Random Variables - 1](#)

[Lecture 40 - Independent Random Variables - 2](#)

[Lecture 41 - Conditional PMF, Jointly Continuous Random Variables - 1](#)

[Lecture 42 - Jointly Continuous Random Variables - 2](#)

[Lecture 43 - Jointly Continuous Random Variables - 3](#)

[Lecture 44 - Conditional CDF](#)

[Lecture 45 - Transformation of Random Variables - 1](#)

[Lecture 46 - Transformation of Random Variables - 2; Independent Random Variables](#)

[Lecture 47 - Sums of Discrete Random Variables](#)

[Lecture 48 - Sums of Jointly Continuous Random Variables](#)

[Lecture 49 - Sums of Random Number of Random Variables](#)

[Lecture 50 - General Transformations of Random Variables](#)

[Lecture 51 - Jacobian Formula](#)

[Lecture 52 - Examples Illustrating the use of Jacobian Formula](#)

[Lecture 53 - Introduction Integral and Expectation](#)

[Lecture 54 - Definition of the Abstract Integral](#)

[Lecture 55 - Simple Functions](#)

[Lecture 56 - Computing Expectation using Simple Functions, Properties of Integrals](#)

[Lecture 57 - Properties of Integrals \(Continued....\)](#)

[Lecture 58 - Inclusion Exclusion Formula using Indicator RVs and Expectation](#)

[Lecture 59 - Monotone Convergence Theorem - 1](#)

[Lecture 60 - Monotone Convergence Theorem - 2](#)

[Lecture 61 - Expectation of a Discrete Random Variable](#)

[Lecture 62 - Examples of Expectation of Discrete Random Variables](#)

[Lecture 63 - Expectation of Function of Random Variable](#)

[Lecture 64 - Some Examples of Computing Expectation](#)

- [Lecture 65 - Fatou's Lemma](#)
- [Lecture 66 - Dominated Convergence Theorem](#)
- [Lecture 67 - Variance](#)
- [Lecture 68 - Covariance](#)
- [Lecture 69 - Covariance Correlation Coefficient - 1](#)
- [Lecture 70 - Covariance Correlation Coefficient - 2](#)
- [Lecture 71 - Conditional Expectation](#)
- [Lecture 72 - Properties of Conditional Expectation](#)
- [Lecture 73 - MMSE Estimator](#)
- [Lecture 74 - Transforms](#)
- [Lecture 75 - Moment Generating Function - 1](#)
- [Lecture 76 - Moment Generating Function - 2](#)
- [Lecture 77 - Characteristic Function - 1](#)
- [Lecture 78 - Characteristic Function - 2](#)
- [Lecture 79 - Characteristic Function - 3](#)
- [Lecture 80 - Characteristic Function - 4](#)
- [Lecture 81 - Concentration Inequalities - 1](#)
- [Lecture 82 - Concentration Inequalities - 2](#)
- [Lecture 83 - Convergence of Random Variables - 1](#)
- [Lecture 84 - Convergence of Random Variables - 2](#)
- [Lecture 85 - Convergence of Random Variables - 3](#)
- [Lecture 86 - Convergence of Random Variables - 4](#)
- [Lecture 87 - Convergence of Random Variables - 5](#)
- [Lecture 88 - Convergence of Random Variables - 6](#)
- [Lecture 89 - Convergence Of Characteristic Functions](#)
- [Lecture 90 - Limit Theorems](#)
- [Lecture 91 - The Law of Large Numbers - 1](#)
- [Lecture 92 - The Law of Large Numbers - 2](#)
- [Lecture 93 - The Central Limit Theorem - 1](#)
- [Lecture 94 - The Central Limit Theorem - 2](#)
- [Lecture 95 - A Brief Overview of Multivariate Gaussians - 1](#)
- [Lecture 96 - A Brief Overview of Multivariate Gaussians - 2](#)

- Lecture 1 - Introduction to the course
- Lecture 2 - Obtaining power gain
- Lecture 3 - Obtaining power gain using a linear two port?
- Lecture 4 - One port (two terminal) nonlinear element
- Lecture 5 - Nonlinear circuit analysis
- Lecture 6 - Small signal incremental analysis - graphical view
- Lecture 7 - Small signal incremental analysis
- Lecture 8 - Incremental equivalent circuit
- Lecture 9 - Large signal characteristics of a diode
- Lecture 10 - Analysis of diode circuits
- Lecture 11 - Small signal model of a diode
- Lecture 12 - Two port nonlinearity
- Lecture 13 - Small signal equivalent of a two port network
- Lecture 14 - Small signal equivalent circuit of a two port network
- Lecture 15 - Gain of a two port network
- Lecture 16 - Constraints on small signal parameters to maximize the gain
- Lecture 17 - Constraints on large signal characteristics to maximize the gain
- Lecture 18 - Implications of constraints in terms of the circuit equivalent
- Lecture 19 - MOS transistor-description
- Lecture 20 - MOS transistor large signal characteristics
- Lecture 21 - MOS transistor large signal characteristics - graphical view
- Lecture 22 - MOS transistor small signal characteristics
- Lecture 23 - Linear (Triode) region of the MOS transistor
- Lecture 24 - Small signal amplifier using the MOS transistor
- Lecture 25 - Basic amplifier structure
- Lecture 26 - Problems with the basic structure
- Lecture 27 - Adding bias and signal-ac coupling
- Lecture 28 - Common source amplifier with biasing
- Lecture 29 - Common source amplifier: Small signal equivalent circuit
- Lecture 30 - Common source amplifier analysis: Effect of biasing components
- Lecture 31 - Constraint on the input coupling capacitor

- Lecture 32 - Constraint on the output coupling capacitor
- Lecture 33 - Dependence of I_D on V_{DS}
- Lecture 34 - Small signal output conductance of a MOS transistor
- Lecture 35 - Effect of g_{ds} on a common source amplifier; Inherent gain limit of a transistor
- Lecture 36 - Variation g_m with transistor parameters
- Lecture 37 - Variation of g_m with constant V_{GS} and constant drain current bias
- Lecture 38 - Negative feedback control for constant drain current bias
- Lecture 39 - Types of feedback for constant drain current bias
- Lecture 40 - Sense at the drain and feedback to the gate-Drain feedback
- Lecture 41 - Intuitive explanation of low sensitivity with drain feedback
- Lecture 42 - Common source amplifier with drain feedback bias
- Lecture 43 - Constraint on the gate bias resistor
- Lecture 44 - Constraint on the input coupling capacitor
- Lecture 45 - Constraint on the output coupling capacitor
- Lecture 46 - Input and output resistances of the common source amplifier with constant V_{GS} bias
- Lecture 47 - Current mirror
- Lecture 48 - Common source amplifier with current mirror bias
- Lecture 49 - Constraint on coupling capacitors and bias resistance
- Lecture 50 - Diode connected transistor
- Lecture 51 - Source feedback biasing
- Lecture 52 - Common source amplifier with source feedback bias
- Lecture 53 - Constraints on capacitor values
- Lecture 54 - Sensing at the drain and feeding back to the source
- Lecture 55 - Sensing at the source and feeding back to the gate
- Lecture 56 - Ensuring that transistor is in saturation
- Lecture 57 - Using a resistor instead of current source for biasing
- Lecture 58 - Controlled sources using a MOS transistor-Introduction
- Lecture 59 - Voltage controlled voltage source
- Lecture 60 - VCVS using a MOS transistor
- Lecture 61 - VCVS using a MOS transistor - Small signal picture
- Lecture 62 - VCVS using a MOS transistor - Complete circuit
- Lecture 63 - Source follower: Effect of output conductance; Constraints on coupling capacitors
- Lecture 64 - VCCS using a MOS transistor

- Lecture 65 - VCCS using a MOS transistor: Small signal picture
- Lecture 66 - VCCS using a MOS transistor: Complete circuit
- Lecture 67 - VCCS using a MOS transistor: AC coupling the output
- Lecture 68 - Source degenerated CS amplifier
- Lecture 69 - CCCS using a MOS transistor
- Lecture 70 - CCCS using a MOS transistor: Small signal picture
- Lecture 71 - CCCS using a MOS transistor: Complete circuit
- Lecture 72 - CCVS using a MOS transistor
- Lecture 73 - CCVS using a MOS transistor: Gain
- Lecture 74 - CCVS using a MOS transistor: Input and output resistances
- Lecture 75 - CCVS using a MOS transistor: Complete circuit
- Lecture 76 - VCVS using an opamp
- Lecture 77 - CCVS using an opamp
- Lecture 78 - Negative feedback and virtual short in an opamp
- Lecture 79 - Negative feedback and virtual short in a transistor
- Lecture 80 - Constraints on controlled sources using opamps and transistors
- Lecture 81 - Quick tour of amplifying devices
- Lecture 82 - Signal swing limits in amplifiers
- Lecture 83 - Swing limit due to transistor entering triode region
- Lecture 84 - Swing limit due to transistor entering cutoff region
- Lecture 85 - Swing limit calculation example
- Lecture 86 - Swing limits-more calculations
- Lecture 87 - pMOS transistor
- Lecture 88 - Small signal model of the pMOS transistor
- Lecture 89 - Common source amplifier using the pMOS transistor
- Lecture 90 - Swing limits of the pMOS common source amplifier
- Lecture 91 - Biasing a pMOS transistor at a constant current; pMOS current mirror
- Lecture 92 - Converting nMOS transistor circuits to pMOS
- Lecture 93 - Bias current generation
- Lecture 94 - Examples of more than one transistor in feedback
- Lecture 95 - Gain limitation in a common source amplifier with resistive load
- Lecture 96 - nMOS active load for pMOS common source amplifier
- Lecture 97 - CMOS inverter

Lecture 98 - Large signal characteristics of pMOS CS amplifier with nMOS active load

Lecture 99 - Large signal characteristics of nMOS CS amplifier with pMOS active load

Lecture 100 - Large signal characteristics of a CMOS inverter

Lecture 101 - Active load amplifiers as digital gates

Lecture 102 - Sensitivity of output bias to input bias in a CMOS inverter

Lecture 103 - Self biasing a CMOS inverter

Lecture 104 - An application of self biased inverters

Lecture 105 - Current consumption of a self-biased inverter; Current biasing

Lecture 106 - Amplifying a difference signal; Differential pair

Lecture 107 - Differential pair-small signal basics

Lecture 108 - Biasing a differential pair

Lecture 109 - Differential pair with differential excitation

Lecture 110 - Differential pair with a current mirror load

Lecture 111 - Differential pair with a current mirror load - operating point

Lecture 112 - Differential pair with a current mirror load - Norton equivalent current

Lecture 113 - Differential pair with a current mirror load - Norton equivalent resistance

Lecture 114 - Common mode gain

Lecture 115 - Single stage opamp

Lecture 116 - Single stage opamp: Input common mode swing limits

Lecture 117 - Single stage opamp: Output swing limits

Lecture 118 - Which transistor type to use for the second stage?

Lecture 119 - Small signal gain

Lecture 120 - DC negative feedback biasing of all stages

Lecture 121 - DC negative feedback biasing of all stages (Continued...)

Lecture 122 - Small signal model

Lecture 123 - Swing limits

Lecture 124 - Systematic offset; How to eliminate it

Lecture 125 - Bipolar junction transistor(BJT): Large signal model

Lecture 126 - BJT model for calculating operating points

Lecture 127 - BJT small signal model

Lecture 128 - Biasing a BJT

Lecture 129 - Biasing a BJT, (Continued...)

Lecture 130 - Amplifiers using BJTs

Lecture 1 - A brief introduction to modelling

Lecture 2 - Dynamics and Nonlinear systems: getting started

Lecture 3 - 1-Dimensional Flows, Flows on the Line, Lecture 1

Lecture 4 - 1-Dimensional Flows, Flows on the Line, Lecture 2

Lecture 5 - 1-Dimensional Flows, Flows on the Line, Lecture 3

Lecture 6 - 1-Dimensional Flows, Flows on the Line, Lecture 4

Lecture 7 - 1-Dimensional Flows, Flows on the Line, Lecture 5

Lecture 8 - 1-Dimensional Flows, Flows on the Line, Lecture 6

Lecture 9 - 1-Dimensional Flows, Bifurcations, Lecture 1

Lecture 10 - 1-Dimensional Flows, Bifurcations, Lecture 2

Lecture 11 - 1-Dimensional Flows, Bifurcations, Lecture 3

Lecture 12 - 1-Dimensional Flows, Bifurcations, Lecture 4

Lecture 13 - 1-Dimensional Flows, Bifurcations, Lecture 5

Lecture 14 - 1-Dimensional Flows, Bifurcations, Lecture 6

Lecture 15 - 1-Dimensional Flows, Flows on the Circle, Lecture 1

Lecture 16 - 1-Dimensional Flows, Flows on the Circle, Lecture 2

Lecture 17 - 2-Dimensional Flows, Linear Systems, Lecture 1

Lecture 18 - 2-Dimensional Flows, Linear Systems, Lecture 2

Lecture 19 - 2-Dimensional Flows, Linear Systems, Lecture 3

Lecture 20 - 2-Dimensional Flows, Linear Systems, Lecture 4

Lecture 21 - 2-Dimensional Flows, Phase Plane, Lecture 1

Lecture 22 - 2-Dimensional Flows, Phase Plane, Lecture 2

Lecture 23 - 2-Dimensional Flows, Phase Plane, Lecture 3

Lecture 24 - 2-Dimensional Flows, Limit Cycles, Lecture 1

Lecture 25 - 2-Dimensional Flows, Limit Cycles, Lecture 2

Lecture 26 - 2-Dimensional Flows, Limit Cycles, Lecture 3

Lecture 27 - 2-Dimensional Flows, Bifurcations, Lecture 1

Lecture 28 - 2-Dimensional Flows, Bifurcations, Lecture 2

Lecture 29 - 2-Dimensional Flows, Bifurcations, Lecture 3

Lecture 1 - Introduction to Systems and Control

Lecture 2 - Modelling of Systems

Lecture 3 - Elements of Modelling

Lecture 4 - Examples of Modelling

Lecture 5 - Solving Problems in Modelling of Systems

Lecture 6 - Laplace Transforms

Lecture 7 - Inverse Laplace Transforms

Lecture 8 - Transfer Function of Modelling Block Diagram Representation

Lecture 9 - Solving Problems on Laplace Transforms and Transfer Functions

Lecture 10 - Block Diagram Reduction, Signal Flow Graphs

Lecture 11 - Solving Problems on Block Diagram Reduction, Signal Flow Graphs

Lecture 12 - Time Response Analysis of systems

Lecture 13 - Time Response specifications

Lecture 14 - Solving Problems on Time Response Analysis and specifications

Lecture 15 - Stability

Lecture 16 - Routh Hurwitz Criterion

Lecture 17 - Routh Hurwitz Criterion T 1

Lecture 18 - Closed loop System and Stability

Lecture 19 - Root Locus Technique

Lecture 20 - Root Locus Plots

Lecture 21 - Root Locus Plots (Continued...)

Lecture 22 - Root Locus Plots (Continued...)

Lecture 23 - Root Locus Plots (Continued...)

Lecture 24 - Introduction to Frequency Response

Lecture 25 - Frequency Response Plots

Lecture 26 - Relative Stability

Lecture 27 - Bode plots

Lecture 28 - Basics of Control design Proportional, Integral and Derivative Actions

Lecture 29 - Basics of Control design Proportional, Integral and Derivative Actions

Lecture 30 - Problems on PID Controllers

Lecture 31 - Basics of Control design Proportional, Integral and Derivative Actions

Lecture 32 - Control design in time domain and discusses the lead compensator

Lecture 33 - Improvement of the Transient Response using lead compensation

Lecture 34 - Design of control using lag compensators

Lecture 35 - The design of Lead-Lag compensators using root locus

Lecture 36 - Introduction design of control in frequency domain

Lecture 37 - Design of Lead Compensator using Bode Plots

Lecture 38 - Design of Lag Compensators using Bode Plots

Lecture 39 - Design of Lead-Lag Compensators using Bode plots

Lecture 40 - Experimental Determination of Transfer Function

Lecture 41 - Effect of Zeros on System Response

Lecture 42 - Navigation - Stories and Some Basics

Lecture 43 - Navigation - Dead Reckoning and Reference Frames

Lecture 44 - Inertial Sensors and Their Characteristics

Lecture 45 - Filter Design to Attenuate Inertial Sensor Noise

Lecture 46 - Complementary Filter

Lecture 47 - Complementary Filter - 1

Lecture 48 - Introduction to State Space Systems

Lecture 49 - Linearization of State Space Dynamics

Lecture 50 - Linearization of State Space Dynamics - 1

Lecture 51 - Controllability and Observability

Lecture 52 - State Space Canonical Forms

Lecture 53 - State Space Solution and Matrix Exponential

Lecture 54 - Controllability and Pole Placement

Lecture 55 - Controllable Decomposition and Observability

Lecture 1 - Introduction to MOSFETs

Lecture 2 - Simple MOSFET Circuits

Lecture 3 - MOSFET Current Mirrors

Lecture 4 - Cascode Amplifiers

Lecture 5 - MOSFET in Integrated Circuits

Lecture 6 - MOSFET Capacitances

Lecture 7 - Noise

Lecture 8 - Noise of Simple Circuits

Lecture 9 - Systematic Mismatch

Lecture 10 - Random Mismatch

Lecture 11 - Differential Amplifiers

Lecture 12 - Negative Feedback

Lecture 13 - Stability of Negative Feedback Systems

Lecture 14 - Dominant Pole Compensation

Lecture 15 - Active Load

Lecture 16 - One Stage OpAmps - 1

Lecture 17 - One Stage OpAmps - 2

Lecture 18 - One Stage OpAmps - 3

Lecture 19 - Differential Amplifiers Offset

Lecture 20 - One Stage OpAmps - Noise and Offset

Lecture 21 - One Stage OpAmps - Slew Rate

Lecture 22 - One Stage OpAmps - Datasheet

Lecture 23 - One Stage OpAmps - Example 1

Lecture 24 - One Stage OpAmps - Example 2

Lecture 25 - Telescopic OpAmp - 1

Lecture 26 - Telescopic OpAmp - 2

Lecture 27 - Telescopic OpAmp - 3

Lecture 28 - Telescopic OpAmp - 4

Lecture 29 - Telescopic OpAmp - 5

Lecture 30 - Telescopic OpAmp - Datasheet

Lecture 31 - Telescopic OpAmp - Design Example

- Lecture 32 - Folded-Cascode OpAmp - 1
- Lecture 33 - Folded-Cascode OpAmp - 2
- Lecture 34 - Folded-Cascode OpAmp - 3
- Lecture 35 - Folded-Cascode OpAmp - 4
- Lecture 36 - Folded-Cascode OpAmp - 5
- Lecture 37 - Negative feedback amplifier
- Lecture 38 - Step response, sinusoidal steady state response
- Lecture 39 - Loop gain and unity loop gain frequency; Opamp
- Lecture 40 - Opamp realization using controlled sources; Delay in the loop
- Lecture 41 - Negative feedback amplifier with ideal delay-small delays
- Lecture 42 - Negative feedback amplifier with ideal delay-large delays
- Lecture 43 - Negative feedback amplifier with parasitic poles and zeros
- Lecture 44 - Negative feedback amplifier with parasitic poles and zeros; Nyquist criterion
- Lecture 45 - Nyquist criterion; Phase margin
- Lecture 46 - Phase margin
- Lecture 47 - Single stage opamp realization
- Lecture 48 - Two stage miller compensated opamp
- Lecture 49 - Two stage miller compensated opamp.
- Lecture 50 - Two and three stage miller compensated opamps; Feedforward compensated opamp
- Lecture 51 - Two Stage Opamp
- Lecture 52 - Two Stage Opamp ; Three Stage and Triple Cascade Opamps
- Lecture 53 - Common Mode Rejection Ratio ; Example
- Lecture 54 - Fully differential single stage opamp
- Lecture 55 - Common mode feedback
- Lecture 56 - Fully differential single stage opamp-2
- Lecture 57 - Fully differential two stage opamp; Fully differential versus pseudo-differential

Lecture 1 - Experiments, Outcomes and Events

Lecture 2 - Examples: Experiments and sample spaces

Lecture 3 - Operations on Events

Lecture 4 - Examples: Sample spaces and events

Lecture 5 - Sigma Fields and Probability

Lecture 6 - Discrete Sample Spaces

Lecture 7 - Union and Partition

Lecture 8 - Examples: Probability Calculation for Equally likely Outcomes

Lecture 9 - Definition and Basic Properties

Lecture 10 - Bayes' Rule for Partitions

Lecture 11 - Examples: Conditional probability

Lecture 12 - Example of Detection

Lecture 13 - Example: Coloured Cards from a Box

Lecture 14 - Independence of Events

Lecture 15 - Examples: Independence

Lecture 16 - Combining Independent Experiments

Lecture 17 - Conditional Independence

Lecture 18 - Examples and Computations with Conditional Independence

Lecture 19 - Binomial and Geometric Models

Lecture 20 - Examples: Binomial and Geometric Model

Lecture 21 - Definition and Discrete Setting

Lecture 22 - Random Variables and Events

Lecture 23 - Examples: Discrete random variables

Lecture 24 - Important distributions

Lecture 25 - Examples: Discrete PMFs

Lecture 26 - Real-life modeling example

Lecture 27 - More Distributions

Lecture 28 - Conditional PMFs, Conditioning on an event, Indicator random variables

Lecture 29 - Example: Conditioning on an event, Indicator random variables

Lecture 30 - Multiple random variables and joint distribution

Lecture 31 - Example: Two random variables

Lecture 32 - Marginal PMF

Lecture 33 - Trinomial joint PMF

Lecture 34 - Events and Conditioning with Two Random Variables

Lecture 35 - Example: compute marginal and conditional PMFs, probability of events

Lecture 36 - Independent random variables

Lecture 37 - More on independence

Lecture 38 - Example: IID Repetitions

Lecture 39 - Addition of Random Variables

Lecture 40 - Sum, Difference and Max of Two Random Variables

Lecture 41 - More Computations: Min of Two Random Variables

Lecture 42 - Example: $X+Y$, $X-Y$, $\min(X,Y)$, $\max(X,Y)$

Lecture 43 - Real line as sample space

Lecture 44 - Probability density function (pdf)

Lecture 45 - Cumulative distribution function (CDF)

Lecture 46 - Continuous random variables

Lecture 47 - pdf and CDF of continuous random variables

Lecture 48 - Spinning pointer example

Lecture 49 - Important continuous distributions

Lecture 50 - More continuous distributions

Lecture 51 - Two-dimensional real sample space

Lecture 52 - Joint pdf and joint CDF

Lecture 53 - More on assigning probability to regions of x-y plain

Lecture 54 - Darts example and marginal pdfs

Lecture 55 - Independence to two continuous random variables

Lecture 56 - Examples: two independent continuous random variables

Lecture 57 - $\text{Prob}[X > Y]$: computation of probability of a non-rectangular region

Lecture 58 - Transformations of random variables

Lecture 59 - CDF method

Lecture 60 - pdf method

Lecture 61 - Examples

Lecture 62 - One-to-one transformations

Lecture 63 - Expected Value or Mean of a Random Variable

Lecture 64 - Properties of Expectation

[Lecture 65 - Expectation Computations for Important Distributions](#)

[Lecture 66 - Variance](#)

[Lecture 67 - Examples of Variance](#)

[Lecture 68 - Expectations with Two Random Variables](#)

[Lecture 69 - Correlation and Covariance](#)

[Lecture 70 - Examples: Continuous Distributions](#)

[Lecture 71 - Examples: Symmetry](#)

[Lecture 72 - Examples: Discrete Distributions](#)

[Lecture 73 - Live Session](#)

Lecture 1 - Introduction to Photonics

Lecture 2 - Diffraction and Interference

Lecture 3 - Tutorial on Ray Optics and Wave Optics

Lecture 4 - Lab Demonstration : Diffractions and Interference

Lecture 5 - Interferometers

Lecture 6 - Coherence

Lecture 7 - Spatial and Temporal Coherence

Lecture 8 - Tutorial on Wave Optics

Lecture 9 - Lab Demonstration: Michelson Interferometer

Lecture 10 - Electromagnetic Optics

Lecture 11 - Fiber Optics

Lecture 12 - Photon Properties

Lecture 13 - Lab Demonstration: Fiber modes, NA and MFD

Lecture 14 - Photon Optics

Lecture 15 - Tutorial on Photon optics

Lecture 16 - Photon interaction - 1

Lecture 17 - Photon interaction - 2

Lecture 18 - Lab Demonstration: Interaction of light with matter

Lecture 19 - Optical Amplification

Lecture 20 - Three Level systems

Lecture 21 - Four Level Systems

Lecture 22 - EDFA Introduction

Lecture 23 - EDFA Tutorial

Lecture 24 - Lasers Part - 1

Lecture 25 - Lab Demonstration: EDFA Characterization

Lecture 26 - Lasers part- 2

Lecture 27 - Lasers part- 3

Lecture 28 - Lasers part- 4

Lecture 29 - Lab Demonstration: Fiber Laser

Lecture 30 - Semiconductor light Source and detector - Band structure

Lecture 31 - Semiconductor light Source and detector - Light emission

[Lecture 32 - Semiconductor light Source and detector LED Characteristics](#)

[Lecture 33 - Lab Demonstration: Semiconductor Sources](#)

[Lecture 34 - Semiconductor light Source and detector Laser Characteristics](#)

[Lecture 35 - Semiconductor Detectors - 1](#)

[Lecture 36 - Semiconductor Detectors - 2](#)

[Lecture 37 - Semiconductor Detectors - 3](#)

[Lecture 38 - Lab Demonstration: Semiconductor Detectors](#)

[Lecture 39 - Semiconductor Detectors - 4](#)

[Lecture 40 - Light manipulation-Mallus' Law](#)

[Lecture 41 - Light manipulation-Birefringence](#)

[Lecture 42 - Light manipulation-Faraday Rotation](#)

[Lecture 43 - Lab Demonstration: Manipulation of Light Intensity and Polarization](#)

[Lecture 44 - Non-linear optics-Pockels effect](#)

[Lecture 45 - Non-linear optics-Kerr Effect](#)

[Lecture 46 - Lab Demonstration: Manipulation of Light Electro Optic Modulator \(EOM\)](#)

[Lecture 47 - Non-linear optics-stimulated Brillouin scattering](#)

[Lecture 48 - Non-linear optics-stimulated Raman scattering](#)

- Lecture 1 - Introduction to Multirate DSP - Part 1
- Lecture 2 - Introduction to Multirate DSP - Part 2
- Lecture 3 - Sampling and Nyquist criterion - Part 1
- Lecture 4 - Sampling and Nyquist criterion - Part 2
- Lecture 5 - Signal Reconstruction - Part 1
- Lecture 6 - Signal Reconstruction - Part 2
- Lecture 7 - Reconstruction filter - Part 1
- Lecture 8 - Reconstruction filter - Part 2
- Lecture 9 - Discrete time processing of continuous time signal - Part 1
- Lecture 10 - Discrete time processing of continuous time signal - Part 2
- Lecture 11 - DT processing of CT signal example
- Lecture 12 - Time scaling- upsampler and downsampler - Part 1
- Lecture 13 - Time scaling- upsampler and downsampler - Part 2
- Lecture 14 - Upsampler and downsampler- continued - Part 1
- Lecture 15 - Upsampler and downsampler- continued - Part 2
- Lecture 16 - Decimator properties
- Lecture 17 - Properties of Upsampler and Downsampler
- Lecture 18 - Fractional sampling rate change - Part 1
- Lecture 19 - Fractional sampling rate change - Part 2
- Lecture 20 - Multiplexer/ demultiplexer interpretation
- Lecture 21 - Noble identities and polyphase decomposition - Part 1
- Lecture 22 - Noble identities and polyphase decomposition - Part 2
- Lecture 23 - Polyphase decomposition continued - Part 1
- Lecture 24 - Polyphase decomposition continued - Part 2
- Lecture 25 - Introduction to Multirate Filter Banks
- Lecture 26 - Applications of Multirate - Part 1
- Lecture 27 - Applications of Multirate - Part 2
- Lecture 28 - Spectral Analysis of Filter Bank - Part 1
- Lecture 29 - Spectral Analysis of Filter Bank - Part 2
- Lecture 30 - DFT and High Resolution Spectral Analysis - Part 1
- Lecture 31 - DFT and High Resolution Spectral Analysis - Part 2

- [Lecture 32 - Transmultiplexer and Maximally Decimated Filterbanks - Part 1](#)
- [Lecture 33 - Transmultiplexer and Maximally Decimated Filterbanks - Part 2](#)
- [Lecture 34 - Maximally Decimated Filterbanks 2 - Part 1](#)
- [Lecture 35 - Maximally Decimated Filterbanks 2 - Part 2](#)
- [Lecture 36 - Study of Two-channel filter bank](#)
- [Lecture 37 - Introduction to Quadrature Mirror Filters \(QMF\)](#)
- [Lecture 38 - 2-channel QMF Filter Bank Design](#)
- [Lecture 39 - Study of All-pass filters](#)
- [Lecture 40 - Study of All-pass lattice](#)
- [Lecture 41 - All-pass decomposition, the study of Mth band and Nyquist filters](#)
- [Lecture 42 - Study of two-channel filter bank with perfect reconstruction](#)
- [Lecture 43 - First part name : Perfect Reconstruction Final Overview. Second part name : Introduction to OFDM- Motivation - Part 1](#)
- [Lecture 44 - First part name : Perfect Reconstruction Final Overview. Second part name : Introduction to OFDM- Motivation - Part 2](#)
- [Lecture 45 - Capacity of wireless channels - CSIR - Part 1](#)
- [Lecture 46 - Capacity of wireless channels - CSIT - Part 2](#)
- [Lecture 47 - Capacity of wireless channels - Formulation of capacity calculation - Part 3](#)
- [Lecture 48 - Capacity of wireless channels - Formulation of capacity calculation \(Continued...\) - Part 1](#)
- [Lecture 49 - Capacity of wireless channels - Formulation of capacity calculation \(Continued...\) - Part 2](#)
- [Lecture 50 - Capacity of wireless channels - Time-invariant Frequency selective channel - Part 3](#)
- [Lecture 51 - Capacity of wireless channels - Time varying Frequency selective channels - Part 1](#)
- [Lecture 52 - Multi-rate DSP framework for Multi-carrier Modulation - Part 2](#)
- [Lecture 53 - MCM with overlapping spectra - Part 1](#)
- [Lecture 54 - Recap of multirate DSP concepts for building OFDM - Part 2](#)
- [Lecture 55 - Introduction to Redundancy and it's implementation in multi-rate framework - Part 3](#)
- [Lecture 56 - M-channel multicarrier Transceiver - Part 1](#)
- [Lecture 57 - M-channel multicarrier Transceiver - Part 2](#)
- [Lecture 58 - M-channel multicarrier Transceiver - Part 3](#)
- [Lecture 59 - Pseudo -circulant structure - Part 1](#)
- [Lecture 60 - Pseudo -circulant structure - Part 2](#)
- [Lecture 61 - MCM impairments and CP - Part 1](#)
- [Lecture 62 - MCM impairments and CP - Part 2](#)
- [Lecture 63 - Orthogonal Frequency Division Multiplexing - Part 1](#)
- [Lecture 64 - Orthogonal Frequency Division Multiplexing - Part 2](#)

[Lecture 65 - Review of OFDM with CP](#)

[Lecture 66 - Review of Lec 1-28](#)

[Lecture 67 - OFDM applications - Quantization - Part 1](#)

[Lecture 68 - OFDM applications - Quantization - Part 2](#)

[Lecture 69 - Some more applications of MDSP](#)

Lecture 1 - Additive White Gaussian Noise (AWGN) Channel and BPSK

Lecture 2 - Bit Error Rate (BER) and Signal to Noise Ratio (SNR)

Lecture 3 - Error Correction Coding in a Digital Communication System

Lecture 4 - Complementary Error Function

Lecture 5 - Simulation of Uncoded BPSK and BER v/s E_b/N_0 plot Generation in MATLAB/Octave

Lecture 6 - $n = 3$ Repetition Code

Lecture 7 - Implementation of $n = 3$ Repetition Code in MATLAB

Lecture 8 - (7,4) Hamming Code

Lecture 9 - A Brief Introduction to Linear Block Codes

Lecture 10 - Simulation of (7,4) Hamming Code in MATLAB

Lecture 11 - Low Density Parity Check Codes: definition, properties and introduction to protograph construction

Lecture 12 - LDPC Codes in 5G: protograph, base matrix, expansion

Lecture 13 - Encoding LDPC codes in 5G

Lecture 14 - MATLAB programs for encoding LDPC codes

Lecture 15 - Log-Likelihood Ratio and Soft Input and Soft Output (SISO) Decoder for the Repetition Code

Lecture 16 - Soft Input and Soft Output (SISO) Decoder for the Single Parity Check (SPC) Code

Lecture 17 - Illustration of SISO decoder for (3,2) SPC code and min-sum approximation

Lecture 18 - SISO decoder for a general $(n,n-1)$ SPC code

Lecture 19 - Soft-Input Soft-Output Iterative Message Passing Decoder for LDPC Codes

Lecture 20 - A Toy Example Illustration of the SISO Minsum Iterative Message Passing Decoder

Lecture 21 - Modifications to the Decoder: Layered Decoding and Offset

Lecture 22 - Implementation of SISO Layered Minsum Iterative Message Passing Decoder in MATLAB

Lecture 23 - Debugging and Improvements to the MATLAB Implementation

Lecture 24 - Rate Matching in LDPC Codes using Puncturing and Shortening

Lecture 25 - Implementation of Fixed Point Quantization and Offset Minsum in the Decoder

Lecture 26 - Introduction to Polar Codes: Polar Transform

Lecture 27 - Channel Polarization, Definition of (N,K) Polar Code and Encoding

Lecture 28 - MATLAB Implementation for Encoding Polar Codes

Lecture 29 - Successive Cancellation (SC) Decoder for Polar Codes: Illustration of its Building Blocks with $N=2,4$

Lecture 30 - Successive Cancellation (SC) Decoder for a General (N,K) Polar Code

Lecture 31 - MATLAB Implementation of Successive Cancellation Decoder - Part 1

[Lecture 32 - MATLAB Implementation of Successive Cancellation Decoder - Part 2](#)

[Lecture 33 - Successive Cancellation List Decoding](#)

[Lecture 34 - Fixed Point Quantization for SC Decoder and LDPC Decoder](#)

[Lecture 35 - MATLAB Implementation of Successive Cancellation List Decoding](#)

[Lecture 36 - Rate Matching for LDPC codes](#)

[Lecture 37 - Performance Comparison of LDPC codes and Polar Codes in 5G](#)

Lecture 1 - Introduction to EMC - Definitions

Lecture 2 - Introduction to EMC - Sources, units etc

Lecture 3 - Electromagnetic principles - Faraday's and Ampere's equations

Lecture 4 - Electromagnetic principles - Gauss's equation, boundary conditions

Lecture 5 - Electromagnetic principles - Uniform plane wave

Lecture 6 - Electromagnetic principles - Transmission lines

Lecture 7 - Electromagnetic principles - Dipoles

Lecture 8 - High-frequency behaviour of components - Conductors

Lecture 9 - High-frequency behaviour of components - Capacitors, inductors, resistors

Lecture 10 - High-frequency behaviour of components - Mechanical switches and transformers

Lecture 11 - Crosstalk or near-field coupling - Capacitive coupling, inductive coupling, common-impedance coupling

Lecture 12 - Crosstalk or near-field coupling - Crosstalk combinations

Lecture 13 - Crosstalk or near-field coupling - Coupling to shielded cables

Lecture 14 - Electromagnetic coupling in the far-field

Lecture 15 - Field Coupling - Exercises

Lecture 16 - Solutions to EMC problems - Lay out and control of interfaces

Lecture 17 - Solutions to EMC problems - Grounding or earthing

Lecture 18 - Solutions to EMC problems - Electromagnetic Shielding

Lecture 19 - Solutions to EMC problems - Electromagnetic Shielding (Continued...)

Lecture 20 - Solutions to EMC problems - Shielded cables

Lecture 21 - Solutions to EMC problems - Filters and Surge protectors

Lecture 22 - Lightning Protection - Introduction

Lecture 23 - Lightning protection - Currents, charges and fields

Lecture 24 - Lightning Protection - Buildings

Lecture 25 - Lightning Protection - Towers, Lightning safety

Lecture 26 - EMC Requirements and Standard, Testing and Difficulties - 1

Lecture 27 - EMC Requirements and Standard, Testing and Difficulties - 2

Lecture 28 - Intentional Electromagnetic Interference or IEMI - 1

Lecture 29 - Intentional Electromagnetic Interference or IEMI - 2

Lecture 1 - Introduction: Objectives and Pre-requisites

Lecture 2 - Review of digital logic

Lecture 3 - Timing and Power in digital circuits

Lecture 4 - Implementation Costs and Metrics

Lecture 5 - Example: Audio processing

Lecture 6 - Example: AlexNet

Lecture 7 - Architecture cost components

Lecture 8 - Examples of Architectures

Lecture 9 - Multi-objective Optimization

Lecture 10 - Number representation

Lecture 11 - Scientific notation and Floating point

Lecture 12 - Basic FIR filter

Lecture 13 - Serial FIR filter architectures

Lecture 14 - Simple programmable architecture

Lecture 15 - Block diagrams and SFGs

Lecture 16 - Dataflow Graphs

Lecture 17 - Iteration period

Lecture 18 - FIR filter iteration period

Lecture 19 - IIR filter iteration period

Lecture 20 - Computation Model

Lecture 21 - Constraint analysis for IPB computation

Lecture 22 - Motivational examples for IPB

Lecture 23 - General IPB computation

Lecture 24 - Sample period calculation

Lecture 25 - Parallel architecture

Lecture 26 - Odd-even register reuse

Lecture 27 - Power consumption

Lecture 28 - Pipelining

Lecture 29 - Time-invariant systems

Lecture 30 - Valid pipelining examples

Lecture 31 - Feedforward cutsets

- Lecture 32 - Balanced pipeline
- Lecture 33 - Retiming basic concept
- Lecture 34 - Retiming basic concept
- Lecture 35 - Example and uses of retiming
- Lecture 36 - Resource sharing: adder example
- Lecture 37 - Changing iteration period
- Lecture 38 - Hardware assumptions and constraint analysis
- Lecture 39 - Mathematical formulation
- Lecture 40 - Examples with formulation
- Lecture 41 - Example: Biquad filter
- Lecture 42 - Hardware architecture
- Lecture 43 - Review biquad folding sets
- Lecture 44 - Complete biquad hardware
- Lecture 45 - DEMO: FFT in Vivado HLS
- Lecture 46 - DEMO: FFT synthesis
- Lecture 47 - Obtaining a folding schedule
- Lecture 48 - ASAP schedule
- Lecture 49 - Utilization Efficiency
- Lecture 50 - ALAP schedule
- Lecture 51 - Iteration period bound and scheduling
- Lecture 52 - Retiming for scheduling
- Lecture 53 - Blocked schedules
- Lecture 54 - Overlapped schedules
- Lecture 55 - Improved blocked schedule
- Lecture 56 - Allocation, Binding and Scheduling
- Lecture 57 - DEMO: Analyze FFT implementation
- Lecture 58 - DEMO: FFT interface
- Lecture 59 - Scheduling: problem formulation
- Lecture 60 - Example: differential equation solver
- Lecture 61 - Heuristic approaches to scheduling
- Lecture 62 - Mathematical formulation
- Lecture 63 - ILP formulation
- Lecture 64 - List scheduling

- Lecture 65 - Hardware model
- Lecture 66 - Force Directed Scheduling
- Lecture 67 - DEMO: HLS on FFT
- Lecture 68 - DEMO: FFT Simulation and Optimization
- Lecture 69 - DEMO: CPU interfacing
- Lecture 70 - Software Compilation
- Lecture 71 - Optimization Examples
- Lecture 72 - Loop optimizations - 1
- Lecture 73 - Loop optimizations - 2
- Lecture 74 - Loop optimizations - 3
- Lecture 75 - Software pipelining - 1
- Lecture 76 - Software pipelining - 2
- Lecture 77 - FFT Optimization
- Lecture 78 - Demo: Vivado setup
- Lecture 79 - Background: CPUs and FPGAs
- Lecture 80 - Demo: Vivado HLS FFT IP Export
- Lecture 81 - Demo: Vivado ILA and VIO on hardware
- Lecture 82 - Demo: FFT on FPGA board
- Lecture 83 - Demo: Simulating SoC and SDK
- Lecture 84 - Background: Understanding ELF files
- Lecture 85 - On-chip communication basics
- Lecture 86 - Many-to-Many communication
- Lecture 87 - AXI bus handshaking
- Lecture 88 - AXI bus (Continued...)
- Lecture 89 - Demo: Microblaze processor on FPGA
- Lecture 90 - Demo: Performance counter AXI peripheral
- Lecture 91 - Demo: HW accelerator for FPGA
- Lecture 92 - DMA and arbitration
- Lecture 93 - Network-on-chip basics
- Lecture 94 - NoC - Topologies and metrics
- Lecture 95 - NoC - Routing
- Lecture 96 - NoC - Switching and flow control
- Lecture 97 - Systolic Arrays - Background

[Lecture 98 - Systolic Arrays - Examples](#)

[Lecture 99 - CORDIC algorithm](#)

[Lecture 100 - Parallel implementation of FIR filters](#)

[Lecture 101 - Unfolding Transformation](#)

[Lecture 102 - Lookahead Transformation](#)

[Lecture 103 - Introduction to GPUs and Matrix multiplication](#)

Lecture 1 - Introduction to Linear Systems

Lecture 2 - System Models

Lecture 3 - System Models - Part 1

Lecture 4 - System Models - Part 2

Lecture 5 - General Representation

Lecture 6 - Sets, Functions and Fields

Lecture 7 - Linear Algebra - Vector Spaces and Metric Spaces

Lecture 8 - Linear Algebra - Span, Basis and Subspaces

Lecture 9 - Linear Algebra - Linear Maps and Matrices

Lecture 10 - Linear Algebra - Fundamental Subspaces and Rank-Nullity

Lecture 11 - Tutorial 1 on Linear Algebra

Lecture 12 - Linear Algebra - Change of Basis and Similarity Transformation

Lecture 13 - Linear Algebra - Invariant Subspaces, Eigen Values and Eigen Vectors

Lecture 14 - Linear Algebra - Diagonalization and Jordan Forms

Lecture 15 - Linear Algebra - Eigen Decomposition and Singular Value Decomposition

Lecture 16 - Tutorial 2 on Linear Algebra

Lecture 17 - Solutions to LTI Systems

Lecture 18 - State Transition Matrix for LTI systems

Lecture 19 - Forced Reponse of Continuous and Discrete LTI system

Lecture 20 - State Transition Matrix and Solutions to LTV systems

Lecture 21 - Equilibrium Points

Lecture 22 - Limit Cycles and Linearisation

Lecture 23 - Stability Analysis and Types of Stability

Lecture 24 - Lyapunov Stability

Lecture 25 - Stability of Discrete Time Systems

Lecture 27 - Controllability and Reachability

Lecture 28 - Controllability Matrix and Controllable Systems

Lecture 29 - Controllability Tests

Lecture 30 - Controllability of Discrete Time Systems

Lecture 31 - Controllable Decomposition

Lecture 32 - Stabilizability

[Lecture 33 - Observability](#)

[Lecture 34 - Gramians and Duality](#)

[Lecture 35 - Observability for Discrete Time Systems and Observability Tests](#)

[Lecture 36 - Observable Decomposition and Detectability](#)

[Lecture 37 - Kalman Decomposition and Minimal Realisation](#)

[Lecture 38 - Canonical Forms and State Feedback Control](#)

[Lecture 39 - Control Design using Pole Placement](#)

[Lecture 40 - Tutorial for Modules 9 and 10](#)

[Lecture 41 - State Estimation and Output Feedback](#)

[Lecture 42 - Design of Observer and Observer based Controller](#)

[Lecture 43 - Optimal Control and Linear Quadratic Regulator \(LQR\)](#)

[Lecture 44 - Feedback Invariant and Algebraic Riccati Equation](#)

[Lecture 45 - Tutorial for Module 11](#)

[Lecture 46 - Linear Matrix Inequalities](#)

[Lecture 47 - Properties of LMIs and Delay LMIs](#)

Lecture 1 - Signal Definition and Classification

Lecture 2 - Affine Transform

Lecture 3 - Recap of Affine Transform

Lecture 4 - Even and Odd Parts of a Signal

Lecture 5 - The Unit Step Sequence

Lecture 6 - The Unit Impulse

Lecture 7 - The Unit Impulse (Continued...)

Lecture 8 - Exponential Signals and Sinusoids

Lecture 9 - Sinusoids (Continued...)

Lecture 10 - When are two sinusoids independent?

Lecture 11 - Another Difference Between CT and DT Sinusoids

Lecture 12 - System definition and properties (linearity)

Lecture 13 - Time-invariance, memory, causality, and stability

Lecture 14 - LTI systems, impulse response, and convolution

Lecture 15 - Properties of convolution, system interconnections

Lecture 16 - Java applet demo of convolution

Lecture 17 - Systems governed by LCCDE

Lecture 18 - FIR and IIR systems

Lecture 19 - Karplus-Strong algorithm

Lecture 20 - Z-transform definition and RoC

Lecture 21 - Z-transform (Continued...)

Lecture 22 - Poles and zeros

Lecture 23 - Recursive implementation of FIR filters

Lecture 24 - Convergence criterion

Lecture 25 - Properties of the RoC

Lecture 26 - DTFT definition and absolute summability

Lecture 27 - Linearity

Lecture 28 - Delay

Lecture 29 - Exponential multiplication

Lecture 30 - Complex conjugation

Lecture 31 - Time reversal

Lecture 32 - Differentiation in the Z-domain

Lecture 33 - Convolution in the time domain

Lecture 34 - Relationship between $x[n]$ and $X(z)$

Lecture 35 - Initial Value Theorem

Lecture 36 - Final Value Theorem

Lecture 37 - Multiplication in the time domain

Lecture 38 - Parseval's Theorem

Lecture 39 - Partial Fractions Method

Lecture 40 - Power series method

Lecture 41 - Contour Integral Method

Lecture 42 - Contour Integral Method (Continued...)

Lecture 43 - Inverse DTFT

Lecture 44 - DTFT of Sequences that are not absolutely summable

Lecture 45 - Response to $\cos(\omega_0 n)$

Lecture 46 - Causality and Stability

Lecture 47 - Response to suddenly applied inputs

Lecture 48 - Introduction to frequency response

Lecture 49 - Magnitude response and its geometric interpretation

Lecture 50 - Magnitude Response (Continued...)

Lecture 51 - Response of a single complex zero/pole

Lecture 52 - Resonator and Improved Resonator

Lecture 53 - Notch filter

Lecture 54 - Moving Average Filter

Lecture 55 - Comb filter

Lecture 56 - Phase response of a single complex zero

Lecture 57 - Effect of crossing a unit circle zero, wrapped and unwrapped phase, resonator phase response

Lecture 58 - Allpass Filter

Lecture 59 - Group delay and its physical interpretation

Lecture 60 - Zero-phase filtering, effect on nonlinear phase on waveshape

Lecture 61 - Zero-Phase Filtering, Linear Phase - 1

Lecture 62 - Linear Phase - 2

Lecture 63 - Linear Phase - 3

Lecture 64 - Linear Phase - 3

[Lecture 65 - Linear Phase - 3](#)

[Lecture 66 - Linear Phase - 4, Sampling - 1](#)

[Lecture 67 - Linear Phase - 4, Sampling - 1](#)

[Lecture 68 - Linear Phase - 4, Sampling - 1](#)

[Lecture 69 - Sampling - 2](#)

[Lecture 70 - Sampling - 3](#)

[Lecture 71 - Sampling - 4](#)

[Lecture 72 - Sampling - 4](#)

[Lecture 73 - Sampling - 4](#)

[Lecture 74 - The Discrete Fourier Transform - 1](#)

[Lecture 75 - The Discrete Fourier Transform - 1](#)

[Lecture 76 - The Discrete Fourier Transform - 2](#)

[Lecture 77 - The Discrete Fourier Transform - 3](#)

[Lecture 78 - The Discrete Fourier Transform - 3](#)

[Lecture 79 - The Discrete Fourier Transform - 3](#)

[Lecture 80 - The Discrete Fourier Transform - 4](#)

[Lecture 81 - The Discrete Fourier Transform - 4](#)

[Lecture 82 - The Discrete Fourier Transform - 4](#)

- Lecture 1 - Chain rule of differentiation
- Lecture 2 - Gradient, Divergence, and Curl operators
- Lecture 3 - Common theorems in vector calculus
- Lecture 4 - Corollaries of these theorems
- Lecture 5 - Mathematical History
- Lecture 6 - Different regimes of Maxwell's equations
- Lecture 7 - Different ways of solving them
- Lecture 8 - Maxwell's Equations
- Lecture 9 - Boundary Conditions
- Lecture 10 - Uniqueness Theorem
- Lecture 11 - Equivalence Theorem
- Lecture 12 - Simple Numerical Integration
- Lecture 13 - Interpolating a Function
- Lecture 14 - Gauss Quadrature
- Lecture 15 - Line Charge Problem
- Lecture 16 - Solving the Integral Equation
- Lecture 17 - Basis Functions
- Lecture 18 - Helmholtz Equation
- Lecture 19 - Solving Helmholtz Equation
- Lecture 20 - Huygen's principle and the Extinction theorem
- Lecture 21 - Formulating the integral equations
- Lecture 22 - Conclusions of surface integral equations
- Lecture 23 - Motivations for Green's functions
- Lecture 24 - A one-dimensional example
- Lecture 25 - 1-D example: alternate representation
- Lecture 26 - 2-D wave example : finding solution
- Lecture 27 - 2-D wave example : boundary conds
- Lecture 28 - 2-D example : Evaluating Constants - Part 1
- Lecture 29 - 2-D example : Evaluating Constants - Part 2
- Lecture 30 - 3-D example
- Lecture 31 - Motivation for MoM

[Lecture 32 - Linear Vector Spaces](#)

[Lecture 33 - Formulating Method of Moments](#)

[Lecture 34 - Surface Integral Equations: Recap](#)

[Lecture 35 - Surface Integral Equations: Evaluating the Integrals - Part 1](#)

[Lecture 36 - Surface Integral Equations: Evaluating the Integrals - Part 2](#)

[Lecture 37 - Surface Integral Equations: Conclusion](#)

[Lecture 38 - Volume Integral Equations:Setting Up](#)

[Lecture 39 - Volume Integral Equations:Solving - Part 1](#)

[Lecture 40 - Volume Integral Equations:Solving - Part 2](#)

[Lecture 41 - Volume Integral Equations:Summary](#)

[Lecture 42 - Surface integral equations for PEC](#)

[Lecture 43 - Surface v/s volume integral equations](#)

[Lecture 44 - Definition of radar cross-section](#)

[Lecture 45 - Computational Considerations](#)

[Lecture 46 - History and Overview of the FEM](#)

[Lecture 47 - Basic framework of FEM](#)

[Lecture 48 - 1D Basis Functions](#)

[Lecture 49 - 2D Basis Functions](#)

[Lecture 50 - Weak form of 1D-FEM - Part 1](#)

[Lecture 51 - Weak form of 1D-FEM - Part 2](#)

[Lecture 52 - Generating System of Equations for 1D FEM](#)

[Lecture 53 - 1D wave equation: Formulation](#)

[Lecture 54 - 1D Wave Equation: Boundary Conditions](#)

[Lecture 55 - 1D Wave Equation: Basis and testing functions](#)

[Lecture 56 - 1D Wave Equation: Matrix assembly](#)

[Lecture 57 - 2D FEM Shape Functions](#)

[Lecture 58 - Converting to Weak Form \(2D FEM\)](#)

[Lecture 59 - Radiation Boundary Condition](#)

[Lecture 60 - Total field formulation](#)

[Lecture 61 - Scattered field formulation](#)

[Lecture 62 - Comparing total and scattered field formulation](#)

[Lecture 63 - Matrix assembly - Part 1](#)

[Lecture 64 - Matrix assembly - Part 2](#)

- Lecture 65 - Computing Far Field
- Lecture 66 - Numerical Aspects of 2D FEM
- Lecture 67 - Summary of FEM Procedure
- Lecture 68 - Introduction to FDTD
- Lecture 69 - 2D FDTD Formulation : Stencil
- Lecture 70 - 2D FDTD Formulation : Time Stepping
- Lecture 71 - 2D FDTD Formulation : Divergence Conditions
- Lecture 72 - Stability Criteria - Part 1
- Lecture 73 - Stability Criteria - Part 2
- Lecture 74 - Stability Criteria - Higher Dimensions
- Lecture 75 - Accuracy Considerations - 1D
- Lecture 76 - Accuracy Considerations - Higher Dimensions
- Lecture 77 - Dealing with non-dispersive dielectric media
- Lecture 78 - Dealing with dispersive dielectric media
- Lecture 79 - Debye Model - Part 1
- Lecture 80 - Debye Model - Part 2
- Lecture 81 - Absorbing Boundary Conditions - 1D
- Lecture 82 - Absorbing Boundary Conditions - 2D
- Lecture 83 - Implementing ABC in FDTD
- Lecture 84 - Failure of ABC
- Lecture 85 - Perfectly Matched Layers (PML) - Introduction
- Lecture 86 - Implementing PML using Coordinate Stretching
- Lecture 87 - PML - Phase Matching
- Lecture 88 - PML - Tangential Boundary Conditions
- Lecture 89 - Perfectly Matched Interface
- Lecture 90 - PML theory - Summary
- Lecture 91 - Implementing PML into FDTD - Part 1
- Lecture 92 - Implementing PML into FDTD - Part 2
- Lecture 93 - Sources in FDTD - Currents
- Lecture 94 - Sources in FDTD - Part 2
- Lecture 95 - Summary of FDTD
- Lecture 96 - MEEP : FDTD in action
- Lecture 97 - Inverse Problems - Introduction

[Lecture 98 - Inverse Problems - Mathematical Formulation](#)

[Lecture 99 - Inverse Problems - Challenges](#)

[Lecture 100 - Inverse Problems - Non-Linearity](#)

[Lecture 101 - Inverse Problems - Summary](#)

[Lecture 102 - Antennas - Potential formulation](#)

[Lecture 103 - Antennas - Hertz Dipole - Part 1](#)

[Lecture 104 - Antennas - Hertz Dipole - Part 2](#)

[Lecture 105 - Antennas - Radiation Patterns](#)

[Lecture 106 - Antennas - Motivation for CEM](#)

[Lecture 107 - Antennas - Pocklington's Integral Equation - Part 1](#)

[Lecture 108 - Antennas - Pocklington's Integral Equation - Part 2](#)

[Lecture 109 - Antennas - Source Modeling](#)

[Lecture 110 - Antennas - Circuit Model](#)

[Lecture 111 - Antennas - MoM details](#)

[Lecture 112 - Antennas - Mutual Coupling - Part 1](#)

[Lecture 113 - Antennas - Mutual Coupling - Part 2](#)

[Lecture 114 - Hybrid Methods - Motivation](#)

[Lecture 115 - Finite Element-Boundary Integral - Part 1](#)

[Lecture 116 - Finite Element-Boundary Integral - Part 2](#)

[Lecture 117 - Finite Element-Boundary Integral - Part 3](#)

Lecture 1 - Transmission lines

Lecture 2 - Lossless Transmission lines: Wave Equations

Lecture 3 - Introduction to finite difference method

Lecture 4 - Octave simulation of wave equation

Lecture 5 - Octave simulation of Telegrapher's equation

Lecture 6 - Reflections and reflection coefficient

Lecture 7 - AC signals in loss-less transmission lines

Lecture 8 - Transmission lines with losses

Lecture 9 - Octave simulation of Transmission lines with losses

Lecture 10 - Voltage reflection coefficient and standing wave ratio

Lecture 11 - Graphical representation of reflection coefficient

Lecture 12 - Impedance matching using Smith chart

Lecture 13 - Demonstration of Impedance matching using VNA

Lecture 14 - Transmission Line Limitations and Maxwell's Equation

Lecture 15 - Maxwell's Curl Equation

Lecture 16 - Octave simulation of an Electromagnetic Wave Equation

Lecture 17 - Polarisation of an Electromagnetic Wave

Lecture 18 - Octave Simulation of different types of Polarisation

Lecture 19 - Electromagnetic Waves in a conductive Medium

Lecture 20 - Plane Waves

Lecture 21 - Plane Waves at normal incidence

Lecture 22 - Plane waves at Oblique Incidence - I

Lecture 23 - Plane waves at Oblique Incidence - II

Lecture 24 - Plane waves at Oblique Incidence - III

Lecture 25 - Octave simulation of perpendicular polarisation

Lecture 26 - Octave simulation of perpendicular polarisation (Continued...)

Lecture 27 - Dielectric-ideal conductor interface

Lecture 28 - Parallel plate waveguide

Lecture 29 - Rectangular Waveguide

Lecture 30 - Octave simulation of modes of a Rectangular Waveguide

Lecture 31 - Phase Velocity and Group velocity

[Lecture 32 - Octave simulation of Field pattern of a parallel plate waveguide](#)

[Lecture 33 - Cavity resonator and Real life applications of waveguides and cavity](#)

Lecture 1 - Introduction - Digital IC Design

Lecture 2 - PN Junction

Lecture 3 - MOS Capacitor Threshold Voltage

Lecture 4 - MOS Transistor Current Expression

Lecture 5 - Body Effect and I-V Plots

Lecture 6 - Short Channel Transistors - Channel Length Modulation

Lecture 7 - Velocity Saturation and Level-1 SPICE Model

Lecture 8 - Drain Induced Barrier Lowering

Lecture 9 - Sub-Threshold Leakage

Lecture 10 - Substrate and Gate Leakage

Lecture 11 - The PMOS Transistor

Lecture 12 - Transistor Capacitance - 1

Lecture 13 - Transistor Capacitance - 2

Lecture 14 - CMOS Inverter Construction

Lecture 15 - Voltage Transfer Characteristics

Lecture 16 - Load Line Analysis

Lecture 17 - Trip Point for Short Channel Device Inverter

Lecture 18 - Trip Point for Long Channel Device Inverter

Lecture 19 - Noise Margin Analysis - 1

Lecture 20 - Noise Margin Analysis - 2

Lecture 21 - Noise Margin Analysis - 3

Lecture 22 - Noise Margin Analysis-Long Channel Device Inverter - 1

Lecture 23 - Noise Margin Analysis-Long Channel Device Inverter - 2

Lecture 24 - Pass Transistors

Lecture 25 - NMOS Transistor ON Resistance and Fall Delay

Lecture 26 - Elmore Delay Model

Lecture 27 - Inverter: Transient Response

Lecture 28 - Inverter: Dynamic Power

Lecture 29 - Inverter: Short Circuit Power

Lecture 30 - Inverter: Leakage Power and Transistor Stacks

Lecture 31 - Stacking Effect and Sleep Transistors

- Lecture 32 - Ring Oscillators and Process Variations
- Lecture 33 - Implementing Any Boolean Logic Function
- Lecture 34 - Implementing Any Boolean Logic Function: Examples. Gate sizing
- Lecture 35 - Gate Sizing
- Lecture 36 - Logic Gate Capacitance
- Lecture 37 - Gate Delay
- Lecture 38 - Parasitic Delay
- Lecture 39 - Gate Delay with a Load Capacitance
- Lecture 40 - Logical Effort
- Lecture 41 - Gate Delay
- Lecture 42 - Path Delay Calculation and Optimization Formulation
- Lecture 43 - Path Delay Optimization: Intuition
- Lecture 44 - Path Delay Optimization: Example
- Lecture 45 - Buffer Insertion
- Lecture 46 - Input Ordering and Asymmetric Gates
- Lecture 47 - Skewed Gates
- Lecture 48 - Special Functions
- Lecture 49 - Pseudo NMOS Logic
- Lecture 50 - Pseudo NMOS Inverter
- Lecture 51 - Pseudo NMOS Logical Effort and CVSL
- Lecture 52 - Dynamic Circuits and Input Monotonicity
- Lecture 53 - Domino Logic and Weak Keepers
- Lecture 54 - Transmission Gate Logic
- Lecture 55 - Gate Sizing for Large Circuits
- Lecture 56 - Ripple Adder Introduction
- Lecture 57 - Full Adder Circuit Implementation
- Lecture 58 - Full Adder Optimization
- Lecture 59 - Carry Skip Adder
- Lecture 60 - Carry Select Adder
- Lecture 61 - Linear and Square Root Carry Select Adder
- Lecture 62 - Two's Complement Arithmetic
- Lecture 63 - Two's Complement Sign Extension
- Lecture 64 - Array Multiplier

[Lecture 65 - Array Multiplier - Timing Analysis](#)

[Lecture 66 - Carry Save Multiplier](#)

[Lecture 67 - Carry Save Multiplier - Signed Multiplication](#)

[Lecture 68 - Introduction to Pipelining](#)

[Lecture 69 - Time Borrowing](#)

[Lecture 70 - Master Slave Flip Flop](#)

[Lecture 71 - Flop Timing Parameters](#)

[Lecture 72 - Alternate Circuit Implementations](#)

[Lecture 73 - Clock Overlap](#)

[Lecture 74 - C2MOS Flop](#)

[Lecture 75 - Flop Characterization](#)

[Lecture 76 - Max and Min Delay of Flop Based Systems](#)

[Lecture 77 - Flop Min Delay Constraint](#)

[Lecture 78 - Latch - Max and Min Delay Constraints](#)

[Lecture 79 - Latch - Timing Analysis with Skew](#)

[Lecture 80 - Time Borrowing](#)

Lecture 1 - Introduction to PMIC - Part 1

Lecture 2 - Introduction to PMIC - Part 2

Lecture 3 - Linear versus Switching Regulators

Lecture 4 - Performance Parameters of Regulators

Lecture 5 - Local vs Remote Feedback, Point of Load Regulators

Lecture 6 - Kelvin Sensing, Droop Compensation

Lecture 7 - Current Regulator Applications, Introduction to Bandgap Voltage References, PTAT and CTAT voltage

Lecture 8 - Adding PTAT and CTAT Voltages

Lecture 9 - Bandgap Voltage Reference Circuit, Brokaw Bandgap Circuit

Lecture 10 - Sub-1-volt Bandgap Circuit

Lecture 11 - Generating Multiple Reference Voltages; Applications of Linear Regulators

Lecture 12 - Designing a Linear Regulator, Negative and Positive Feedback

Lecture 13 - First-Order Systems, Phase Margin

Lecture 14 - Closed-Loop Response of Second-Order Systems

Lecture 15 - Relationship between Damping Factor and Phase Margin, Frequency Compensation, MOS Parasitic Capacitances

Lecture 16 - Finding the Poles of the Error Amplifier - Part 1

Lecture 17 - Finding the Poles of the Error Amplifier - Part 2

Lecture 18 - Dominant Pole Frequency Compensation

Lecture 19 - Dominant Pole Compensation at No-Load

Lecture 20 - Dominant Pole Compensation using Miller Effect, RHP zero due to Miller Capacitor

Lecture 21 - Intuitive Method of Finding the Poles, Pole Splitting after Miller Compensation

Lecture 22 - Effect of RHP zero on Stability, Mitigating the Effect of RHP zero, LDO with NMOS Pass Element

Lecture 23 - Output Impedance of PMOS LDO

Lecture 24 - Line Regulation and PSRR of PMOS LDO

Lecture 25 - PSRR of PMOS versus PSRR of NMOS LDO

Lecture 26 - Sources of Error in Linear and Switching Regulators

Lecture 27 - Offset in Amplifiers; Real Life Analogy; Static Offset Cancellation

Lecture 28 - Dynamic Offset Cancellation Techniques (Chopping, Auto-zeroing)

Lecture 29 - Digital LDO, Technique to Avoid Limit Cycle Oscillations in Digital LDO

Lecture 30 - Hybrid LDO, Short-Circuit Protection

Lecture 31 - Hiccup Mode and Foldback Current Limit

Lecture 32 - Introduction to Switching Regulators

Lecture 33 - volt-second Balance, Non-Idealities in the Power Stage of a Buck Converter

Lecture 34 - Transformer Model of a Buck Converter, Conduction Efficiency, Efficiency of an LDO versus Efficiency of a Switching Regulator

Lecture 35 - Synchronous versus Non-Synchronous Switching Regulators, PWM Control Techniques

Lecture 36 - Losses in Switching Regulators (Conduction Loss, Gate-Driver Switching Loss)

Lecture 37 - Dead-Time Switching Loss in DC-DC Converters

Lecture 38 - Hard Switching Loss in DC DC Converters

Lecture 39 - Magnetic Loss in DC-DC Converters, Relative Significance of Losses as a Function of the Load Current

Lecture 40 - Output Voltage Ripple of a Buck Converter

Lecture 41 - Choosing the Inductor and Capacitor for a Buck Converter

Lecture 42 - CCM Vs DCM Operation in DC DC Converters

Lecture 43 - CCM DCM Boundary Condition, Voltage Conversion Ratio in DCM

Lecture 44 - Concept of Pulse Frequency Modulation PFM

Lecture 45 - Classification of Pulse Width Modulators

Lecture 46 - DC - DC Converter Control Techniques, Stability Analysis of Voltage Mode Buck Converter - Part 1

Lecture 47 - Stability Analysis of Voltage Mode Buck Converter - Part 2

Lecture 48 - Stability Analysis of Voltage Mode Buck Converter - Part 3

Lecture 49 - Dominant Pole Compensation (Type-I with Gm-C Architecture)

Lecture 50 - Dominant Pole Compensation (Type-I with Op Amp-RC Architecture)

Lecture 51 - Introduction to Type-II Compensation

Lecture 52 - Type-II Compensator using Gm-C Architecture - Part 1

Lecture 53 - Type-II Compensator using Gm-C Architecture - Part 2

Lecture 54 - Type-II Compensator using Gm-C Architecture - Part 3

Lecture 55 - Type-II Compensator using Op Amp-RC Architecture

Lecture 56 - Introduction to Type-III Compensator

Lecture 57 - Type-III Compensator using Op Amp-RC Architecture

Lecture 58 - Simulation of DC-DC Converter with Type-III Compensator

Lecture 59 - Type-III Compensator using Gm-C Architecture

Lecture 60 - Feed-Forward Line Compensation, Loop Gain Compensation by Modulating Gm

Lecture 61 - Designing a Buck Converter, Power Loss Budgeting

Lecture 62 - Sizing Power MOSFETs

Lecture 63 - Estimating Switching Losses and Choosing the Switching Frequency

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

Lecture 64 - Choosing Inductance and Capacitance Values

Lecture 65 - Choosing 'C' Depending on Factors that Limit the Load Transient Response

Lecture 66 - Inductor and Capacitor Characteristics, Reducing the Effect of Capacitor ESL

Lecture 67 - Gate Buffer and Non-Overlap Clock Generator in Gate-Driver Circuit

Lecture 68 - Pulse-Width Modulator- Trailing Edge, Leading Edge and Dual Edge; Triangle Wave Generator

Lecture 69 - Average Ramp Voltage of Single-Edge PW Modulator, Design Considerations of EA

Lecture 70 - Delays Associated with PW Modulator, PFM and PSM Operation, DCM Operation using NMOS

Lecture 71 - Designing a Zero-Cross Comparator, Inverter-Based Auto-Zeroed Comparator, Simulation Demo

Lecture 72 - Current Mode Control- Peak, Valley, Emulated; VMC versus CMC; Sub-Harmonic Oscillation

Lecture 73 - Ramp-Adaptive Slope Compensation to Avoid Current Loop Instability

Lecture 74 - Non-Linear Control of DC-DC Converters, Phase-Shift between i_L and v_C

Lecture 75 - Stabilising a Voltage-Mode Hysteretic Converter using R_{esr} , Relation between F_{sw} and the Hysteresis Window

Lecture 76 - Hysteretic Converter - Simulation Demo

Lecture 77 - Current-Mode Hysteretic Converter, Using R-C as Ripple Generator

Lecture 78 - Controlling the Switching Frequency of a Hysteretic Converter, Delay in the Hysteretic Comparator

Lecture 79 - Frequency and Voltage Regulation Loops in a Fixed-Frequency Hysteretic Converter

Lecture 80 - Resetting the Capacitor Voltage in a Hysteretic Converter, Constant ON-Time Control

Lecture 81 - Introduction to Boost Converter, RHP Zero in a Boost Converter

Lecture 82 - Introduction to Buck-Boost Converter

Lecture 83 - Tri-Mode Buck-Boost Converter (Buck, Buck-Boost and Boost)

Lecture 84 - Boundary Conditions for Mode Transition in a Tri-Mode Buck-Boost Converter

Lecture 85 - Generating Buck and Boost Duty Cycles in a Tri-Mode Buck-Boost Converter

Lecture 86 - Introduction to Switched-Capacitor DC-DC Converters, Switched-Capacitor DC-DC Converter with $V_o = 2*V_{DD}$

Lecture 87 - Applications of Switched-Capacitor DC-DC Converters in Open-Loop, Regulating the Output using Feedback Control

Lecture 88 - H-Bridge Switched-Capacitor DC-DC Converter, SC DC-DC converter with Multiple Gain Settings

Lecture 89 - Current Sensing Techniques in DC-DC Converters

Lecture 90 - Analog Layout Techniques - Part 1

Lecture 91 - Analog Layout Techniques - Part 2

Lecture 92 - Digital Control of DC-DC Converters, ADC Architectures

Lecture 93 - Digital Pulse-Width Modulator Architectures, Adaptive Compensation

Lecture 94 - Limitations of Analog and Digital Controllers, Time-Based Controller for Buck Converter

Lecture 95 - Time-Based Controller for Buck Converter and for LDO, Issues with Time-Based Control

Lecture 96 - Multi-Phase DC-DC Converters

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

[Lecture 97 - Dynamic Voltage and Frequency Scaling, Single Inductor Multiple Output \(SIMO\) DC-DC Converter](#)

[Lecture 98 - LCD/AMOLED Display Drivers - Part 1](#)

[Lecture 99 - LCD/AMOLED Display Drivers - Part 2](#)

[Lecture 100 - LCD/AMOLED Display Drivers - Part 3](#)

[Lecture 101 - LED Drivers for Camera Flash](#)

[Lecture 102 - Li-Ion Battery and its Charging Phases](#)

[Lecture 103 - Battery Charger IC](#)

Lecture 1 - Course contents

Lecture 2 - Introduction

Lecture 3 - Historical developments

Lecture 4 - Power semiconductor devices

Lecture 5 - General converter configuration

Lecture 6 - Choice of converter configuration: Valve utilization factor

Lecture 7 - Choice of converter configuration: Transformer utilization factor

Lecture 8 - Converter configuration for pulse number equal to 6

Lecture 9 - Analysis of 6 pulse LCC neglecting inductance

Lecture 10 - Analysis of 6 pulse LCC neglecting inductance: Jumps in voltage across a valve

Lecture 11 - Analysis of 6 pulse LCC neglecting inductance: Average DC side voltage

Lecture 12 - Fourier series - Part 1

Lecture 13 - Fourier series - Part 2

Lecture 14 - Analysis of 6 pulse LCC neglecting inductance: DC side voltage harmonics

Lecture 15 - Analysis of 6 pulse LCC neglecting inductance: Fundamental and harmonic components of AC side current

Lecture 16 - Definitions: Delay angle, angle of advance, commutation margin angle

Lecture 17 - Commutation margin angle in a 6 pulse LCC neglecting inductance - Part 1

Lecture 18 - Commutation margin angle in a 6 pulse LCC neglecting inductance - Part 2

Lecture 19 - Instantaneous power on AC and DC sides in a 6 pulse LCC neglecting inductance

Lecture 20 - Average power on AC and DC sides in a 6 pulse LCC neglecting inductance

Lecture 21 - 6 pulse LCC with inductance

Lecture 22 - 2 and 3 valve conduction mode of 6 pulse LCC

Lecture 23 - 2 and 3 valve conduction mode of 6 pulse LCC: DC side voltage harmonics

Lecture 24 - 2 and 3 valve conduction mode of 6 pulse LCC: DC side voltage and voltage across a valve

Lecture 25 - 2 and 3 valve conduction mode of 6 pulse LCC: Fundamental and harmonic components of AC side current

Lecture 26 - Extinction angle

Lecture 27 - Extinction angle: Commutation margin angle for normal inverter operation of 6 pulse LCC

Lecture 28 - 3 and 4 valve conduction mode of 6 pulse LCC

Lecture 29 - Analysis of 3 and 4 valve conduction mode of 6 pulse LCC - Part 1

Lecture 30 - Analysis of 3 and 4 valve conduction mode of 6 pulse LCC - Part 2

Lecture 31 - Analysis of 3 and 4 valve conduction mode of 6 pulse LCC - Part 3

- Lecture 32 - 3 valve conduction mode of 6 pulse LCC
- Lecture 33 - Commutation margin angle
- Lecture 34 - Normalization
- Lecture 35 - Characteristics of 6 pulse LCC - Part 1
- Lecture 36 - Characteristics of 6 pulse LCC - Part 2
- Lecture 37 - Steady state analysis of a general LCC - Part 1
- Lecture 38 - Steady state analysis of a general LCC - Part 2
- Lecture 39 - Steady state analysis of a general LCC - Application to 6 pulse LCC
- Lecture 40 - 6 pulse LCC with resistance included on the AC side
- Lecture 41 - 6 pulse LCC with resistance, inductance and voltage source on the DC side - Part 1
- Lecture 42 - 6 pulse LCC with resistance, inductance and voltage source on the DC side - Part 2
- Lecture 43 - Power factor
- Lecture 44 - Capacitor commutated converter - Part 1
- Lecture 45 - Capacitor commutated converter - Part 2
- Lecture 46 - 12 pulse LCC - Part 1
- Lecture 47 - 12 pulse LCC - Part 2
- Lecture 48 - Modes of operation of 12 pulse LCC
- Lecture 49 - Purposes of transformer
- Lecture 50 - Applications of DC transmission
- Lecture 51 - Types of DC link: Monopolar
- Lecture 52 - Types of DC link: Bipolar and homopolar
- Lecture 53 - DC link control
- Lecture 54 - DC link control: Control variables
- Lecture 55 - Considerations that influence selection of control
- Lecture 56 - Converter control characteristics
- Lecture 57 - MTDC systems: Applications
- Lecture 58 - Types of MTDC systems
- Lecture 59 - Non-characteristic harmonics
- Lecture 60 - Effect of firing angle errors
- Lecture 61 - Problems with harmonics
- Lecture 62 - Single tuned filter
- Lecture 63 - Design of single tuned filter - Part 1
- Lecture 64 - Design of single tuned filter - Part 2

[Lecture 65 - Double tuned and damped filters](#)

[Lecture 66 - Reactive power requirement](#)

[Lecture 67 - Comparison of AC and DC transmission](#)

- Lecture 1 - Introduction to Optical Engineering
- Lecture 2 - Geometric Optics Basics
- Lecture 3 - Refraction at a single surface
- Lecture 4 - Lab 1 Introduction to OSLO
- Lecture 5 - Stops and Rays
- Lecture 6 - Aperture stop - Part 1
- Lecture 7 - Aperture stop - Part 2
- Lecture 8 - Lab 2 OSLO
- Lecture 9 - Imaging equation for thick lens using ABCD matrix
- Lecture 10 - Ray Tracing Matrix - Part 1
- Lecture 11 - Ray Tracing Matrix - Part 2
- Lecture 12 - Principal Planes
- Lecture 13 - Lab 3 OSLO
- Lecture 14 - Tracing rays through optical pupils - Part 1
- Lecture 15 - Tracing rays through optical pupils - Part 2
- Lecture 16 - Aberrations
- Lecture 17 - Monochromatic Aberrations - Part 1
- Lecture 18 - Monochromatic Aberrations - Part 2
- Lecture 19 - Lab 4 - OSLO
- Lecture 20 - Chromatic Aberrations and Aberration correction
- Lecture 21 - Aberration correction
- Lecture 22 - Revisiting Ray intercept curves
- Lecture 23 - Lab 5 - OSLO
- Lecture 24 - Interesting Geometric phenomena and applications
- Lecture 25 - Gaussian beams introduction
- Lecture 26 - Gaussian beams
- Lecture 27 - Lab 6 - OSLO
- Lecture 28 - Transformation of a Gaussian beam
- Lecture 29 - Transformation of a Gaussian beam due to a lens and a mirror
- Lecture 30 - Application of Gaussian beam equations
- Lecture 31 - Interferometry basics

[Lecture 32 - Interferometry basics - Part 1](#)

[Lecture 33 - Introduction to Python](#)

[Lecture 34 - Python - Part 2](#)

[Lecture 35 - Introduction to Matlab](#)

[Lecture 36 - Interferometry basics - Part 2](#)

[Lecture 37 - Python - Part 3](#)

[Lecture 38 - Matlab tutorial on interference](#)

[Lecture 39 - Applications of interference - Part 1](#)

[Lecture 40 - Holography](#)

[Lecture 41 - Applications of interference](#)

[Lecture 42 - Applications of Optical Engineering](#)

[Lecture 43 - Diffractive Optics](#)

[Lecture 44 - Diffraction Grating](#)

- Lecture 1 - Examples of Nonlinear Physical Systems
- Lecture 2 - Math Preliminaries - Part 1
- Lecture 3 - Math Preliminaries - Part 2
- Lecture 4 - Math Preliminaries - Part 3
- Lecture 5 - Lipschitz Continuity and Contraction Mapping Theorem - Part 1
- Lecture 6 - Lipschitz Continuity and Contraction Mapping Theorem - Part 2
- Lecture 7 - Lipschitz Continuity and Contraction Mapping Theorem - Part 3
- Lecture 8 - Existence and Uniqueness Theorem of ODE - Part 1
- Lecture 9 - Existence and Uniqueness Theorem of ODE - Part 2
- Lecture 10 - Existence and Uniqueness Theorem of ODE - Part 3
- Lecture 11 - Existence and Uniqueness Theorem of ODE - Part 4
- Lecture 12 - Equilibrium Points
- Lecture 13 - Phase Portrait - Part 1
- Lecture 14 - Phase Portrait - Part 2
- Lecture 15 - Phase Portrait - Part 3
- Lecture 16 - Phase portrait of Nonlinear Systems: Examples
- Lecture 17 - Limit Cycles
- Lecture 18 - Limit Cycles - Examples - Part 1
- Lecture 19 - Limit Cycles - Examples - Part 2
- Lecture 20 - Introduction to Bifurcation Theory - 1
- Lecture 21 - Introduction to Bifurcation Theory - 2
- Lecture 22 - Necessary and Sufficient Conditions for Local Bifurcation
- Lecture 23 - Problems on Bifurcation Theory.
- Lecture 24 - Stability Notions: Lyapunov and LaSalle's theorem - Part 1
- Lecture 25 - Stability Notions: Lyapunov and LaSalle's theorem - Part 2
- Lecture 26 - Stability Notions: Lyapunov and LaSalle's theorem - Part 3
- Lecture 27 - Stability Notions: Lyapunov and LaSalle's theorem - Part 4
- Lecture 28 - Stability Analysis and types of stability
- Lecture 29 - Lyapunov Stability
- Lecture 30 - Supplementary lecture: Comparison Lemma and Lyapunov Stability
- Lecture 31 - Center Manifold Theorem

[Lecture 32 - Interconnection between non linearity and a linear system - Sector Nonlinearities And Aizermann's conjecture](#)

[Lecture 33 - Counter example for Aizermann's conjecture](#)

[Lecture 34 - Passivity inspiration - passive circuits - dissipation equality](#)

[Lecture 35 - Dissipative Equality for circuit \(Continued...\)](#)

[Lecture 36 - PR condition for passivity of SISO system](#)

[Lecture 37 - Examples of PR transfer functions](#)

[Lecture 38 - Relation between storage function and Lyapunov function - PR Lemma](#)

[Lecture 39 - Proof of PR Lemma](#)

[Lecture 40 - Proof \(Continued...\) using spectral factorization theorem](#)

[Lecture 41 - PR definition for MIMO case](#)

[Lecture 42 - PSD Storage function in PR Lemma and how to make it PD \(strictly PR\)](#)

[Lecture 43 - KYP Theorem](#)

[Lecture 44 - Passivity preservation under interconnection](#)

[Lecture 45 - Aizermann's conjecture under passivity assumption is true](#)

[Lecture 46 - Sector Nonlinearities and need for generalizing KYP Lemma](#)

[Lecture 47 - Need for Loop transformations](#)

[Lecture 48 - Loop Transformations - Part 1](#)

[Lecture 49 - Loop Transformations - Part 2](#)

[Lecture 50 - Circle criterion for PR](#)

[Lecture 51 - Examples based on circle criterion and stability under circle transformations](#)

- Lecture 1 - Real and Complex Number
- Lecture 2 - Sinusoid and Phasor
- Lecture 3 - Limits and Continuity
- Lecture 4 - Differentiation and Integration
- Lecture 5 - L'Hôpital's Rule
- Lecture 6 - LTI System Examples; Impedance
- Lecture 7 - Dirac Delta function; Impulse
- Lecture 8 - Continuous and Discrete Time Systems
- Lecture 9 - Even Signal; Odd Signal
- Lecture 10 - Orthogonality of Signals
- Lecture 11 - Shifting and Scaling in Continuous Time - I
- Lecture 12 - Shifting and Scaling in Continuous Time - II
- Lecture 13 - Shifting and Scaling in Discrete Time
- Lecture 14 - Signal and Noise
- Lecture 15 - Signals in the Physical World
- Lecture 16 - Signals and Sensory Perception
- Lecture 17 - Frequency Domain Representation
- Lecture 18 - Definition of Fourier Transform
- Lecture 19 - Fourier Transform : Examples I
- Lecture 20 - Dirichlet Conditions
- Lecture 21 - Inverse Fourier Transform
- Lecture 22 - Fourier Transform : Examples II
- Lecture 23 - Frequency-Time Uncertainty Relation
- Lecture 24 - Fourier Transform : Linearity, Time Shifting and Time Scaling
- Lecture 25 - Fourier Transform : Derivative Property
- Lecture 26 - Fourier Transform : Multiplication and Convolution Property
- Lecture 27 - Fourier Transform : Integral Property
- Lecture 28 - Fourier Transform : Example III
- Lecture 29 - Fourier Transform : Example IV
- Lecture 30 - Fourier Transform of Noise
- Lecture 31 - Types of Noise

- Lecture 32 - Overview of Systems and General Properties
- Lecture 33 - Linearity and Time Invariance
- Lecture 34 - LTI System Examples
- Lecture 35 - Frequency Response of RLC circuits - I
- Lecture 36 - Frequency Response of RLC circuits - II
- Lecture 37 - LCCDE Representation of Continuous-Time LTI Systems
- Lecture 38 - Frequency Domain Representation of LCCDE Systems
- Lecture 39 - Time Domain Representation of LTI Systems
- Lecture 40 - Continuous-Time Convolution Integral
- Lecture 41 - Continuous-Time Convolution : Example I
- Lecture 42 - Continuous-Time Convolution : Example II
- Lecture 43 - Continuous-Time Convolution : Example III
- Lecture 44 - LTI Systems : Commutative, Distributive and Associative
- Lecture 45 - LTI Systems : Memorylessness and Invertibility
- Lecture 46 - LTI Systems : Causality and Stability
- Lecture 47 - Fourier Transform in Complex Frequency Domain
- Lecture 48 - Laplace Transform : Poles and Zeros
- Lecture 49 - Laplace Transform : Region of Convergence [ROC]
- Lecture 50 - Laplace Transform : Examples I
- Lecture 51 - Laplace Transform : Examples II
- Lecture 52 - Laplace Analysis of LTI Systems
- Lecture 53 - Laplace Analysis of RLC Circuits - I
- Lecture 54 - Laplace Transform : Linearity, Shifting and Scaling
- Lecture 55 - Laplace Transform : Derivative and Integral
- Lecture 56 - Laplace Transform : Causality and Stability
- Lecture 57 - Laplace Analysis of LTI Systems : Example I
- Lecture 58 - Laplace Analysis of LTI Systems : Example II
- Lecture 59 - Laplace Analysis of First Order RLC Circuits
- Lecture 60 - Laplace Analysis of Second Order RLC Circuits
- Lecture 61 - Fourier Transform of Periodic Signals
- Lecture 62 - Fourier Series Representation in Continuous-Time
- Lecture 63 - Fourier Series Properties - I
- Lecture 64 - Fourier Series Properties - II

[Lecture 65 - LTI System Response for Periodic Input Signal](#)

[Lecture 66 - Fourier Series in Continuous-Time : Examples I](#)

[Lecture 67 - Fourier Series in Continuous-Time : Examples II](#)

[Lecture 68 - Discrete-Time Convolution Sum](#)

[Lecture 69 - Discrete-Time Convolution Sum Examples and Properties](#)

[Lecture 70 - LCCDE Representation of Discrete-Time LTI Systems](#)

[Lecture 71 - Impulse Train Sampling](#)

[Lecture 72 - Reconstruction of Continuous-Time Signal](#)

[Lecture 73 - Nyquist Sampling Theorem and Aliasing](#)

[Lecture 74 - Fourier Transform of Sampled Signals](#)

[Lecture 75 - DTFT : Examples I](#)

[Lecture 76 - DTFT Properties I: Periodicity, Linearity, Time/Frequency shifting, and Conjugation](#)

[Lecture 77 - DTFT Properties II: Differencing and Accumulation in Time Domain, Differentiation in Frequency Domain](#)

[Lecture 78 - DTFT Properties III: Time Reversal, Time Expansion, Convolution and Parseval's Relation](#)

[Lecture 79 - DTFT : Examples II](#)

[Lecture 80 - DTFT in Complex Frequency Domain](#)

[Lecture 81 - Z-Transform : Properties of ROC](#)

[Lecture 82 - Z-Transform Properties I: Linearity, Time-Shifting, Time-Expansion, Time-Reversal, and Z-Scaling](#)

[Lecture 83 - Z-Transform Properties II: Conjugation and Convolution](#)

[Lecture 84 - Z-Transform Properties III: Causality and Stability](#)

[Lecture 85 - Z-Transform : Examples I](#)

[Lecture 86 - Z-Transform : Examples II](#)

[Lecture 87 - Block Diagram Representation](#)

- Lecture 1 - Response and state-space solution of Linear systems
- Lecture 2 - Solution of LTV systems
- Lecture 3 - Solution of LTI systems
- Lecture 4 - Equivalent State Equations
- Lecture 5 - Realization of LTI and LTV Systems
- Lecture 6 - Tutorial - 1
- Lecture 7 - Introduction to Stability Analysis
- Lecture 8 - Lyapunov Stability - Part I
- Lecture 9 - Lyapunov Stability - Part II
- Lecture 10 - Proof of Lyapunov stability theorem
- Lecture 11 - BIBO vs Lyapunov Stability
- Lecture 12 - BIBO vs Lyapunov Stability
- Lecture 13 - Tutorial - 2
- Lecture 14 - Introduction to Controllability
- Lecture 15 - Reachability and Controllability Gramians
- Lecture 16 - Controllability Matrix
- Lecture 17 - Discrete-time Reachability and Controllability Gramians
- Lecture 18 - Tests for controllability - I
- Lecture 19 - Tests for controllability - II
- Lecture 20 - Tutorial - 3
- Lecture 21 - Tests for controllability - III
- Lecture 22 - Tests for controllability - IV
- Lecture 23 - Controllable Decomposition - I
- Lecture 24 - Stabilizable Systems
- Lecture 25 - Tests for Stabilizability
- Lecture 26 - Tutorial - 4
- Lecture 27 - State Feedback - I
- Lecture 28 - State Feedback - II
- Lecture 29 - Lyapunov Method of State Feedback Design
- Lecture 30 - Regulation and Tracking
- Lecture 31 - Tutorial - 5

[Lecture 32 - Robust Tracking and Disturbance Rejection](#)

[Lecture 33 - State Feedback design for Multi-input systems](#)

[Lecture 34 - Linear Quadratic Regulator](#)

[Lecture 35 - Tutorial - 6](#)

[Lecture 36 - Output feedback and observability](#)

[Lecture 37 - Duality and Observability tests](#)

[Lecture 38 - Decompositions and Detectability](#)

[Lecture 39 - Minimal Realisations](#)

[Lecture 40 - Observer Design and Output Feedback](#)

[Lecture 41 - Observer Design and Output Feedback](#)

[Lecture 42 - UIO](#)

[Lecture 43 - Tutorial - 7 and 8 \(combined\)](#)

Lecture 1 - Introduction to Microscale Sensors or MEMS

Lecture 2 - Scaling effect

Lecture 3 - Some Simple Mechanics

Lecture 4 - Basic Mechanics - Part 1

Lecture 5 - Basic Mechanics - Part 2

Lecture 6 - Basic Mechanics - Part 3

Lecture 7 - Electrostatics

Lecture 8 - Electrostatic force

Lecture 9 - Coupled electromechanics

Lecture 10 - Stiction

Lecture 11 - Si crystal structure

Lecture 12 - Si etching

Lecture 13 - KOH etching

Lecture 14 - TMAH etching

Lecture 15 - Deposition and Lithography

Lecture 16 - Lithography

Lecture 17 - Pressure sensor types, membrane, Piezoelectric sensing, capacitive sensing

Lecture 18 - Pressure Sensor - II

Lecture 19 - Pressure Sensor - III

Lecture 20 - Accelerometer - I

Lecture 21 - Accelerometer - II

Lecture 22 - Assignment 1

Lecture 23 - Assignment 2

Lecture 1 - Introduction to FOCT: Prerequisites, Course Content and Learning Outcomes

Lecture 2 - Communication through the ages

Lecture 3 - Communication: Basics - 1

Lecture 4 - Communication: Basics - 2

Lecture 5 - Digital Communication for Optical Communication

Lecture 6 - Digital modulation: Basics - 2

Lecture 7 - Digital modulation: Basics - 3

Lecture 8 - Optical communication system

Lecture 9 - Assignment Discussion - Week 1

Lecture 10 - Optical Sources

Lecture 11 - Semiconductor gain media- structure, spectrum

Lecture 12 - Optical sources: LED

Lecture 13 - External Quantum Efficiency

Lecture 14 - Modulation Bandwidth of LED

Lecture 15 - Optical and Electrical Bandwidth of LED

Lecture 16 - Emission Pattern of LED

Lecture 17 - Optical Sources: Laser Diodes over LEDs

Lecture 18 - Laser Diodes: Resonator Concepts 1a

Lecture 19 - Laser Diodes: Resonator Concepts 1b

Lecture 20 - Laser Diodes: Resonator Concepts 1c

Lecture 21 - Assignment Discussion - Week 2

Lecture 22 - Laser Diodes: Gain Coefficient

Lecture 23 - Laser Diodes: Photon life time

Lecture 24 - Laser rate equation: Steady State solution1

Lecture 25 - Laser rate equation: LI Chara

Lecture 26 - Laser power derivation

Lecture 27 - Modulation Response of Laser - 1

Lecture 28 - Modulation Response of Laser - 2

Lecture 29 - Modulation Response of Laser - 3

Lecture 30 - Setbacks of direct modulation of laser: Modulation Chirp

Lecture 31 - Setbacks of direct modulation of laser: Transcient Chirp

[Lecture 32 - Assignment Discussion - Week 3](#)

[Lecture 33 - Recap of direction modulation consequences](#)

[Lecture 34 - Noise in Lasers](#)

[Lecture 35 - Relative Intensity Noise](#)

[Lecture 36 - Laser Phase Noise - 1](#)

[Lecture 37 - Laser Phase Noise - 2](#)

[Lecture 38 - Effect of Laser Phase Noise: A case study](#)

[Lecture 39 - Electro-optic phase modulation](#)

[Lecture 40 - Electro-optic intensity modulator](#)

[Lecture 41 - Biasing of MZM: BPSK Generation](#)

[Lecture 42 - Biasing of MZM: QPSK and 16 QAM Generation](#)

[Lecture 43 - Line coding schemes and their bandwidth requirements](#)

[Lecture 44 - Assignment Discussion - Week 4](#)

[Lecture 45 - Introduction to optical Fiber](#)

[Lecture 46 - Attenuation in optical fibers](#)

[Lecture 47 - Fiber Modes](#)

[Lecture 48 - Modes of a step index fiber - 1](#)

[Lecture 49 - Modes of a step index fiber - 2](#)

[Lecture 50 - Modes of a step index fiber - 3](#)

[Lecture 51 - Modes of a step index fiber - 4](#)

[Lecture 52 - Modes of a step index fiber - 5](#)

[Lecture 53 - Modes and Cut-off conditions](#)

[Lecture 54 - Universal b-V curves](#)

[Lecture 55 - Modal Profiles in step index fiber](#)

[Lecture 56 - Mode Field Diameter](#)

[Lecture 57 - Dispersion- Intermodal dispersion derivation](#)

[Lecture 58 - Dispersion-Bit rate distance Product](#)

[Lecture 59 - Phase Velocity and Group Velocity - 1](#)

[Lecture 60 - Phase Velocity and Group Velocity - 2](#)

[Lecture 61 - Material dispersion](#)

[Lecture 62 - Waveguide dispersion](#)

[Lecture 63 - Total Dispersion in optical fiber](#)

[Lecture 64 - Polarization mode dispersion](#)

- Lecture 65 - Photodetectors concepts
- Lecture 66 - p-n and p-i-n Photodetectors
- Lecture 67 - Avalance Photodetector
- Lecture 68 - Direct detection receiver and sources of noise
- Lecture 69 - Quantifying noises in direct detection receivers
- Lecture 70 - SNR and Operation Regimes
- Lecture 71 - Noise Equivalent power and SNR in APDs
- Lecture 72 - Coherent Receivers
- Lecture 73 - SNR analysis of coherent receivers
- Lecture 74 - Performance Evaluation - 1
- Lecture 75 - Performance Evaluation - 2
- Lecture 76 - Performance Metrics: BER,Q, and Receiver Sensitivity
- Lecture 77 - Performance Metrics:Q and SNR
- Lecture 78 - Quantum limit of photodetection
- Lecture 79 - Optical Amplifier
- Lecture 80 - Erbium doped fiber amplifier - 1
- Lecture 81 - Erbium doped fiber amplifier - 2
- Lecture 82 - Erbium doped fiber amplifier - 3
- Lecture 83 - Erbium doped fiber amplifier - 4
- Lecture 84 - Link Design - Rise Time Budget
- Lecture 85 - Link Design - Case Study
- Lecture 86 - Link Design - Passive Optical Network and long haul link
- Lecture 87 - Dispersion - Recap
- Lecture 88 - Dispersion Compensation - Pulse Propagation with disperison
- Lecture 89 - Pulse propagation - 2
- Lecture 90 - Dispersion Compensation - Dispersion Transfer Function
- Lecture 91 - Dispersion Compensation - Case Study
- Lecture 92 - Dispersion CCompensation - WDM and DSP
- Lecture 93 - Nonlinear Effects- Nonlinear refractive Index
- Lecture 94 - Self Phase Modulation
- Lecture 95 - Cross Phase Modulation
- Lecture 96 - Scattering Processes in optical fibers
- Lecture 97 - Stimulated Brillouin Scattering

- [Lecture 98 - Stimulated Raman Scattering](#)
- [Lecture 99 - Components - Directional Couplers](#)
- [Lecture 100 - Components - VOA, Polariser, Polarisation Controllers](#)
- [Lecture 101 - Components - Isolator](#)
- [Lecture 102 - Components - Circulator, Definitions](#)
- [Lecture 103 - Components - Wavelength filters](#)
- [Lecture 104 - Components - Arrayed Waveguide Gratings, WSS](#)
- [Lecture 105 - Balanced Detection](#)
- [Lecture 106 - Polarisation Diverse Coherent Receiver](#)
- [Lecture 107 - Phase and Polarisation Diverse Coherent Receiver](#)
- [Lecture 108 - Overview of impairments in coherent optical communication](#)
- [Lecture 109 - Transceiver impairments - Generation and Compensation](#)
- [Lecture 110 - Channel Impairments - Generation and Compensation](#)
- [Lecture 111 - Demo video](#)
- [Lecture 112 - Introduction to Optical Networks](#)
- [Lecture 113 - Layers of Optical Network](#)
- [Lecture 114 - SDH/SONET Layering, Frame Structure](#)
- [Lecture 115 - Physical Networks Topologies](#)
- [Lecture 116 - Topology specific Link Design](#)
- [Lecture 117 - Network Protection](#)
- [Lecture 118 - Access Networks- PON](#)
- [Lecture 119 - Optical Interconnects, Data Centers](#)
- [Lecture 120 - Optical communication for Wireless Fronthauling](#)

[Lecture 1 - Course Introduction](#)

[Lecture 2 - Applications of Image processing](#)

[Lecture 3 - Applications of Image processing \(Continued...\)](#)

[Lecture 4 - Basics of Images](#)

[Lecture 5 - Shot Noise](#)

[Lecture 6 - Geometric Transformations](#)

[Lecture 7 - Geometric Transformations \(Continued...\)](#)

[Lecture 8 - Bilinear Interpolation](#)

[Lecture 9 - Geometric Transformations \(Continued...\)](#)

[Lecture 10 - Projective Transformation](#)

[Lecture 11 - Homography](#)

[Lecture 12 - Homography - Special cases](#)

[Lecture 13 - Computing Homography](#)

[Lecture 14 - RANSAC](#)

[Lecture 15 - Rotational Homography](#)

[Lecture 16 - Research Challenges](#)

[Lecture 17 - Real Aperture Camera](#)

[Lecture 18 - Real aperture camera - Introduction](#)

[Lecture 19 - Circle of confusion](#)

[Lecture 20 - Depth of field, Linearity](#)

[Lecture 21 - Space-Invariance](#)

[Lecture 22 - 2D Convolution](#)

[Lecture 23 - 2D Convolution](#)

[Lecture 24 - Blur Models](#)

[Lecture 25 - Space-variant Blurring](#)

[Lecture 26 - Shape from X - Introduction](#)

[Lecture 27 - 2-View Stereo](#)

[Lecture 28 - Introduction to Shape from Focus](#)

[Lecture 29 - SFF Principle](#)

[Lecture 30 - Shape from focus - Gaussian fitting](#)

[Lecture 31 - Shape from focus - Focus operators](#)

- Lecture 32 - Shape from Focus - Examples
- Lecture 33 - Shape from Focus - Tensor Voting
- Lecture 34 - DFD Principle
- Lecture 35 - Motion Blur
- Lecture 36 - Image Transforms - Introduction
- Lecture 37 - Image Transforms - Motivation
- Lecture 38 - 1D Unitary Transforms - Introduction
- Lecture 39 - Extending 1D Unitary Transform to 2D - Motivation
- Lecture 40 - Extending 1D Unitary Transform to 2D - Example
- Lecture 41 - Alternative Forms of 2D
- Lecture 42 - Kronecker Product
- Lecture 43 - Kronecker Product - (Example Revisited)
- Lecture 44 - Extending 1D Unitary Transform to 2D - Summary
- Lecture 45 - 1D DFT to 2D DFT
- Lecture 46 - 2D DFT Visualization
- Lecture 47 - 2D DFT - Computation
- Lecture 48 - 1D DCT - Definition, Motivation
- Lecture 49 - Relation to DFT
- Lecture 50 - 2D DCT and Walsh-Hadamard Transform
- Lecture 51 - Data Dependent Transforms, Karhunen Loeve Transform
- Lecture 52 - Karhunen-Loeve Transform (KLT) - Concept
- Lecture 53 - Karhunen-Loeve Transform (KLT) - Applications
- Lecture 54 - Karhunen-Loeve Transform (KLT) - Applications
- Lecture 55 - Singular Value Decomposition (SVD)
- Lecture 56 - Applications of SVD
- Lecture 57 - Change detection
- Lecture 58 - Image Thresholding
- Lecture 59 - Adaptive Local thresholding - Motivation
- Lecture 60 - Chow-Kaneko Local thresholding
- Lecture 61 - K-Means Method
- Lecture 62 - ISODATA Method
- Lecture 63 - Theory of Histogram Equalization and Modification
- Lecture 64 - Histogram Equalization example

[Lecture 65 - Image sequence and Single image filtering in Gaussian noise](#)

[Lecture 66 - Non-local Means Method](#)

[Lecture 67 - Non-local Means Filtering \(Examples\)](#)

[Lecture 68 - Impulse Noise Generator](#)

[Lecture 69 - Impulse noise filtering](#)

[Lecture 70 - Transform Domain Filtering](#)

[Lecture 71 - Illumination Handling](#)

[Lecture 72 - Applications of Restoration, and Image Deblurring](#)

[Lecture 73 - Haddamard's conditions and Least squares solution](#)

[Lecture 74 - Min-norm solution and Norm of Linear operator](#)

[Lecture 75 - Numerical stability analysis](#)

[Lecture 76 - Image Deblurring](#)

[Lecture 77 - Tikhonov-Miller Regularization](#)

[Lecture 78 - Conditional Mean as an Estimator](#)

[Lecture 79 - Linear Estimator](#)

[Lecture 80 - Wiener Filter](#)

[Lecture 81 - Fourier Wiener Filter](#)

[Lecture 82 - 1D Superresolution](#)

[Lecture 83 - Superresolution Examples](#)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Fundamentals of Electric Vehicles: Technology and Economics (Electrical Engineering)

Co-ordinators : Prof. Ashok Jhunjunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha, Prof. L Kannan

Lecture 1 - Overview of Electric Vehicles in India

Lecture 2 - Can India Drive its EV program Innovatively and Differently and scale? - Part 1

Lecture 3 - Can India Drive its EV program Innovatively and Differently and scale? - Part 2

Lecture 4 - A bit about batteries

Lecture 5 - Charging and Swapping Infrastructure

Lecture 6 - Where will we get Lithium for batteries?

Lecture 7 - EV Subsystems

Lecture 8 - Forces acting when a vehicle move

Lecture 9 - Aerodynamic drag, Rolling Resistance and Uphill Resistance

Lecture 10 - Power and Torque to accelerate

Lecture 11 - Putting it all together - 1

Lecture 12 - Putting it all together - 2

Lecture 13 - Concept of Drive Cycle - 1

Lecture 14 - Concept of Drive Cycle - 2

Lecture 15 - Drive Cycles and Energy used per km - Part 1

Lecture 16 - Drive Cycles and Energy used per km - Part 2

Lecture 17 - EV Subsystem: Design of EV Drive Train - Part 1

Lecture 18 - EV Subsystem: Design of EV Drive Train - Part 2

Lecture 19 - Introduction to Battery Parameters - Part 1

Lecture 20 - Introduction to Battery Parameters - Part 2

Lecture 21 - Why Lithium Ion Battery? - Part 1

Lecture 22 - Why Lithium Ion Battery? - Part 2

Lecture 23 - Batteries in Future

Lecture 24 - Li-Ion Battery Cells

Lecture 25 - SoH and SoC estimation and Self Discharge - Part 1

Lecture 26 - SoH and SoC estimation and Self Discharge - Part 2

Lecture 27 - Battery Pack Development - Part 1

Lecture 28 - Battery Pack Development - Part 2

Lecture 29 - Computation of Effective cost of battery - Part 1

Lecture 30 - Computation of Effective cost of battery - Part 2

Lecture 31 - Charging Batteries

- [Lecture 32 - Fundamentals of Battery Pack Design](#)
- [Lecture 33 - Mechanical Design - Part 1](#)
- [Lecture 34 - Mechanical Design - Part 2](#)
- [Lecture 35 - Mechanical Design - Part 3](#)
- [Lecture 36 - Mechanical Design - Part 4](#)
- [Lecture 37 - Thermal Design - Part 1](#)
- [Lecture 38 - Thermal Design - Part 2](#)
- [Lecture 39 - Thermal Design - Part 3](#)
- [Lecture 40 - Thermal Design - Part 4](#)
- [Lecture 41 - Electrical Design - Part 1](#)
- [Lecture 42 - Electrical Design - Part 2](#)
- [Lecture 43 - Electrical Design - Part 3](#)
- [Lecture 44 - BMS Design of Electric Vehicle - Part 1](#)
- [Lecture 45 - BMS Design of Electric Vehicle - Part 2](#)
- [Lecture 46 - BMS Design of Electric Vehicle - Part 3](#)
- [Lecture 47 - EV Motors and Controllers - Understanding Flow - Part 1](#)
- [Lecture 48 - EV Motors and Controllers - Understanding Flow - Part 2](#)
- [Lecture 49 - Power and Efficiency](#)
- [Lecture 50 - Torque Production - Part 1](#)
- [Lecture 51 - Torque Production - Part 2](#)
- [Lecture 52 - Torque Production - Part 3](#)
- [Lecture 53 - Speed and Back EMF](#)
- [Lecture 54 - The d-q Equivalent circuit - Part 1](#)
- [Lecture 55 - The d-q Equivalent circuit - Part 2](#)
- [Lecture 56 - Field-oriented Control](#)
- [Lecture 57 - Three phase AC - Part 1](#)
- [Lecture 58 - Three phase AC - Part 2](#)
- [Lecture 59 - Thermal Design - Part 1](#)
- [Lecture 60 - Thermal Design - Part 2](#)
- [Lecture 61 - Engineering Considerations - Part 1](#)
- [Lecture 62 - Engineering Considerations - Part 2](#)
- [Lecture 63 - Future Frontiers](#)
- [Lecture 64 - EV Chargers: Introduction](#)

[Lecture 65 - EV Chargers: Slow or Fast - Part 1](#)

[Lecture 66 - EV Chargers: Slow or Fast - Part 2](#)

[Lecture 67 - Battery Swapping](#)

[Lecture 68 - Standardization and On board Chargers](#)

[Lecture 69 - Public Chargers - Part 1](#)

[Lecture 70 - Public Chargers - Part 2](#)

[Lecture 71 - Bulk Chargers/Swap Stations - Part 1](#)

[Lecture 72 - Bulk Chargers/Swap Stations - Part 2](#)

[Lecture 73 - Economics of Public Chargers in context](#)

[Lecture 74 - Analytics - Part 1](#)

[Lecture 75 - Analytics - Part 2](#)

[Lecture 76 - Course Summary](#)

Lecture 1 - Introduction to the Course

Lecture 2 - Vector Spaces: Introduction

Lecture 3 - Linear Combinations and Span

Lecture 4 - Subspaces, Linear Dependence and Independence

Lecture 5 - Basis and Dimension

Lecture 6 - Sums, Direct Sums and Gaussian Elimination

Lecture 7 - Linear Maps and Matrices

Lecture 8 - Null space, Range, Fundamental theorem of linear maps

Lecture 9 - Column space, null space and rank of a matrix

Lecture 10 - Algebraic operations on linear maps

Lecture 11 - Invertible maps, Isomorphism, Operators

Lecture 12 - Solving Linear Equations

Lecture 13 - Elementary Row Operations

Lecture 14 - Translates of a subspace, Quotient Spaces

Lecture 15 - Row space and rank of a matrix

Lecture 16 - Determinants

Lecture 17 - Coordinates and linear maps under a change of basis

Lecture 18 - Simplifying matrices of linear maps by choice of basis

Lecture 19 - Polynomials and Roots

Lecture 20 - Invariant subspaces, Eigenvalues, Eigenvectors

Lecture 21 - More on Eigenvalues, Eigenvectors, Diagonalization

Lecture 22 - Eigenvalues, Eigenvectors and Upper Triangularization

Lecture 23 - Properties of Eigenvalues

Lecture 24 - Linear state space equations and system stability

Lecture 25 - Discrete-time Linear Systems and Discrete Fourier Transforms

Lecture 26 - Sequences and counting paths in graphs

Lecture 27 - PageRank Algorithm

Lecture 28 - Dot product and length in C^n , Inner product and norm in V over F

Lecture 29 - Orthonormal basis and Gram-Schmidt orthogonalisation

Lecture 30 - Linear Functionals, Orthogonal Complements

Lecture 31 - Orthogonal Projection

- Lecture 32 - Projection and distance from a subspace
- Lecture 33 - Linear equations, Least squares solutions and Linear regression
- Lecture 34 - Minimum Mean Squared Error Estimation
- Lecture 35 - Adjoint of a linear map
- Lecture 36 - Properties of Adjoint of a Linear Map
- Lecture 37 - Adjoint of an Operator and Operator-Adjoint Product
- Lecture 38 - Self-adjoint Operator
- Lecture 39 - Normal Operators
- Lecture 40 - Complex Spectral Theorem
- Lecture 41 - Real Spectral Theorem
- Lecture 42 - Positive Operators
- Lecture 43 - Quadratic Forms, Matrix Norms and Optimization
- Lecture 44 - Isometries
- Lecture 45 - Classification of Operators
- Lecture 46 - Singular Values and Vectors of a Linear Map
- Lecture 47 - Singular Value Decomposition
- Lecture 48 - Polar decomposition and some applications of SVD

Lecture 1 - Preliminaries

Lecture 2 - Current

Lecture 3 - Voltage

Lecture 4 - Electrical elements and circuits

Lecture 5 - Kirchhoff's current law (KCL)

Lecture 6 - Kirchhoff's voltage law (KVL)

Lecture 7 - Voltage source

Lecture 8 - Current source

Lecture 9 - Resistor

Lecture 10 - Capacitor

Lecture 11 - Inductor

Lecture 12 - Mutual inductor

Lecture 13 - Linearity of elements

Lecture 14 - Series connection-Voltage sources in series

Lecture 15 - Series connection of R, L, C, current source

Lecture 16 - Elements in parallel

Lecture 17 - Current source in series with an element; Voltage source in parallel with an element

Lecture 18 - Extreme cases: Open and short circuits

Lecture 19 - Summary

Lecture 20 - Voltage controlled voltage source (VCVS)

Lecture 21 - Voltage controlled current source (VCCS)

Lecture 22 - Current controlled voltage source (CCVS)

Lecture 23 - Current controlled current source (CCCS)

Lecture 24 - Realizing a resistance using a VCCS or CCCS

Lecture 25 - Scaling an element's value using controlled sources

Lecture 26 - Example calculation

Lecture 27 - Power and energy absorbed by electrical elements

Lecture 28 - Power and energy in a resistor

Lecture 29 - Power and energy in a capacitor

Lecture 30 - Power and energy in an inductor

Lecture 31 - Power and energy in a voltage source

Lecture 32 - Power and energy in a current source

Lecture 33 - Goals of circuit analysis

Lecture 34 - Number of independent KCL equations

Lecture 35 - Number of independent KVL equations and branch relationships

Lecture 36 - Analysis of circuits with a single independent source

Lecture 37 - Analysis of circuits with multiple independent sources using superposition

Lecture 38 - Superposition: Example

Lecture 39 - What is nodal analysis

Lecture 40 - Setting up nodal analysis equations

Lecture 41 - Structure of the conductance matrix

Lecture 42 - How do elements circuit appear in the nodal analysis formulation

Lecture 43 - Completely solving the circuit starting from nodal analysis

Lecture 44 - Nodal analysis example

Lecture 45 - Matrix inversion basics

Lecture 46 - Nodal analysis with independent voltage sources

Lecture 47 - Supernode for nodal analysis with independent voltage sources

Lecture 48 - Nodal analysis with VCCS

Lecture 49 - Nodal analysis with VCVS

Lecture 50 - Nodal analysis with CCVS

Lecture 51 - Nodal analysis with CCCS

Lecture 52 - Nodal analysis summary

Lecture 53 - Planar circuits

Lecture 54 - Mesh currents and their relationship to branch currents

Lecture 55 - Mesh analysis

Lecture 56 - Mesh analysis with independent current sources-Supermesh

Lecture 57 - Mesh analysis with current controlled voltage sources

Lecture 58 - Mesh analysis with current controlled current sources

Lecture 59 - Mesh analysis using voltage controlled sources

Lecture 60 - Nodal analysis versus Mesh analysis

Lecture 61 - Superposition theorem

Lecture 62 - Pushing a voltage source through a node

Lecture 63 - Splitting a current source

Lecture 64 - Substitution theorem: Current source

- Lecture 65 - Substitution theorem: Voltage source
- Lecture 66 - Substituting a voltage or current source with a resistor
- Lecture 67 - Extensions to Superposition and Substitution theorem
- Lecture 68 - Thevenin's theorem
- Lecture 69 - Worked out example: Thevenin's theorem
- Lecture 70 - Norton's theorem
- Lecture 71 - Worked out example: Norton's theorem
- Lecture 72 - Maximum power transfer theorem
- Lecture 73 - Preliminaries
- Lecture 74 - Two port parameters
- Lecture 75 - y parameters
- Lecture 76 - y parameters: Examples
- Lecture 77 - z parameters
- Lecture 78 - z parameters: Examples
- Lecture 79 - h parameters
- Lecture 80 - h parameters: Examples
- Lecture 81 - g parameters
- Lecture 82 - g parameters: Examples
- Lecture 83 - Calculations with a two-port element
- Lecture 84 - Calculations with a two-port element
- Lecture 85 - Degenerate cases
- Lecture 86 - Relationships between different two-port parameters
- Lecture 87 - Equivalent circuit representation of two-ports
- Lecture 88 - Reciprocity
- Lecture 89 - Proof of reciprocity of resistive two-ports
- Lecture 90 - Proof for 4-terminal two-ports
- Lecture 91 - Reciprocity in terms of different two-port parameters
- Lecture 92 - Reciprocity in circuits containing controlled sources
- Lecture 93 - Examples
- Lecture 94 - Feedback amplifier using an opamp
- Lecture 95 - Ideal opamp
- Lecture 96 - Negative feedback around the opamp
- Lecture 97 - Finding opamp sign for negative feedback

- Lecture 98 - Example: Determining opamp sign for negative feedback
- Lecture 99 - Analysis of circuits with opamps
- Lecture 100 - More on opamps: Example circuits and additional topics
- Lecture 101 - Inverting amplifier
- Lecture 102 - Summing amplifier
- Lecture 103 - Instrumentation amplifier
- Lecture 104 - Negative resistance
- Lecture 105 - Finding opamp signs for negative feedback-circuits with multiple opamps
- Lecture 106 - Opamp supply voltages and saturation
- Lecture 107 - KCL with an opamp and supply currents
- Lecture 108 - Circuits with storage elements (capacitors and inductors)
- Lecture 109 - First order circuit with zero input-natural response
- Lecture 110 - First order RC circuit with zero input-Example
- Lecture 111 - First order circuit with a constant input
- Lecture 112 - General form of the first order circuit response
- Lecture 113 - First order RC circuit with a constant input-Example
- Lecture 114 - First order circuit with piecewise constant input
- Lecture 115 - First order circuit with piecewise constant input-Example
- Lecture 116 - First order circuit-Response of arbitrary circuit variables
- Lecture 117 - Summary: Computing first order circuit response
- Lecture 118 - Does a capacitor block DC?
- Lecture 119 - Finding the order of a circuit
- Lecture 120 - First order RC circuits with discontinuous capacitor voltages
- Lecture 121 - Summary: Computing first order circuit response with discontinuities
- Lecture 122 - First order RL circuits
- Lecture 123 - First order RL circuit with discontinuous inductor current-Example
- Lecture 124 - First order RC circuit with an exponential input
- Lecture 125 - First order RC response to its own natural response
- Lecture 126 - First order RC response to a sinusoidal input
- Lecture 127 - First order RC response to a sinusoidal input-via the complex exponential
- Lecture 128 - Summary: Linear circuit response to sinusoidal input via the complex exponential
- Lecture 129 - Three methods of calculating the sinusoidal steady state response
- Lecture 130 - Calculating the total response including initial conditions

[Lecture 131 - Why are sinusoids used in measurement?](#)

[Lecture 132 - Second order system natural response](#)

[Lecture 133 - Second order system as a cascade of two first order systems](#)

[Lecture 134 - Second order system natural response-critically damped and underdamped](#)

[Lecture 135 - Generalized form of a second order system](#)

[Lecture 136 - Numerical example](#)

[Lecture 137 - Series and parallel RLC circuits](#)

[Lecture 138 - Forced response of a second order system](#)

[Lecture 139 - Steady state response calculation and Phasors](#)

[Lecture 140 - Phasors \(Continued...\)](#)

[Lecture 141 - Magnitude and Phase plots](#)

[Lecture 142 - Magnitude and phase plots of a second order system](#)

[Lecture 143 - Maximum power transfer and Conjugate matching](#)

Lecture 1 - Introduction to optical sensors

Lecture 2 - Different types of optical sensors

Lecture 3 - Overview of distributed sensors

Lecture 4 - Optical sensors system

Lecture 5 - Optical sources

Lecture 6 - Optical receivers - 1

Lecture 7 - Optical receivers - 2

Lecture 8 - Optical receivers - 3

Lecture 9 - Optical receiver design

Lecture 10 - Noise Analysis

Lecture 11 - Sensor Performance characteristics

Lecture 12 - Noise Mitigation Techniques

Lecture 13 - Lock in detection

Lecture 14 - Amplitude modulated sensors - 1

Lecture 15 - Gas absorption spectroscopy

Lecture 16 - Amplitude modulated sensors - 2

Lecture 17 - Amplitude modulated sensors - 3

Lecture 18 - Amplitude modulated sensors - 4

Lecture 19 - Problem Discussion

Lecture 20 - Pulse-oximeter

Lecture 21 - Phase modulated sensors - 1

Lecture 22 - Phase modulated sensors - 2

Lecture 23 - Phase modulated Sensors - 3

Lecture 24 - Phase modulated sensors - 4

Lecture 25 - Phase modulated sensors - 5

Lecture 26 - Phase modulated sensors - 6

Lecture 27 - Phase modulated sensors - 7

Lecture 28 - Phase modulated sensors - 8

Lecture 29 - Phase modulated sensors - 9

Lecture 30 - Phase modulated sensors - 10

Lecture 31 - Phase modulated Sensors - 11

[Lecture 32 - Wavelength modulated sensors - 1](#)

[Lecture 33 - Wavelength modulated sensors - 2](#)

[Lecture 34 - Wavelength modulated sensors - 3](#)

[Lecture 35 - Wavelength modulated sensors - 4](#)

[Lecture 36 - Wavelength modulated sensors - 5](#)

[Lecture 37 - Wavelength modulated sensors - 6](#)

[Lecture 38 - Wavelength modulated sensors - 7](#)

[Lecture 39 - Wavelength modulated sensors - 8](#)

[Lecture 40 - Polarization modulated sensors - 1](#)

[Lecture 41 - Polarization modulated sensors - 2](#)

[Lecture 42 - Polarization modulated sensors - 3](#)

- Lecture 1 - Course Introduction and Motivation
- Lecture 2 - Kirchoff's Current and Voltage Laws, and the Incidence Matrix
- Lecture 3 - Power Conservation and Tellegen's Theorem
- Lecture 4 - Intuition behind Tellegen's Theorem
- Lecture 5 - Tellegen's Theorem and reciprocity in linear resistive networks
- Lecture 6 - Why is reciprocity useful in practice?
- Lecture 7 - Inter-reciprocity in linear time-invariant networks
- Lecture 8 - Inter-reciprocity in linear time-invariant networks (Continued...)
- Lecture 9 - Inter-reciprocity in networks with ideal operational amplifiers
- Lecture 10 - Review of Modified Nodal Analysis (MNA) of linear networks
- Lecture 11 - MNA stamps of controlled sources - the VCCS and VCVS
- Lecture 12 - MNA stamps of controlled sources - the CCCS and CCVS
- Lecture 13 - Inter-reciprocity in linear networks - using the MNA stamp approach
- Lecture 14 - The Adjoint Network
- Lecture 15 - MNA stamp of an ideal opamp
- Lecture 16 - Properties of circuits with multiple ideal opamps
- Lecture 17 - Introduction to noise in electrical networks
- Lecture 18 - Noise processed by a linear time-invariant system
- Lecture 19 - kT/C noise in a sample-and-hold circuit
- Lecture 20 - Noise in RLC networks
- Lecture 21 - Total integrated noise in RLC Networks
- Lecture 22 - Bode's Noise Theorem - Frequency domain
- Lecture 23 - Input referred noise in electrical networks - Part 1
- Lecture 24 - Input referred noise in electrical networks - Part 2
- Lecture 25 - Input referred noise and the noise factor
- Lecture 26 - Noise Factor Examples
- Lecture 27 - Motivation to learn about time-varying circuits and systems - Part 1
- Lecture 28 - Motivation to learn about time-varying circuits and systems - Part 2
- Lecture 29 - Convolution integral for LTV systems
- Lecture 30 - Frequency response of an LTV system
- Lecture 31 - LTV system example : Time-varying RC filter

- Lecture 32 - Linear Periodically Time-Varying Systems (LPTV)
- Lecture 33 - Response of an LPTV system to a complex exponential input
- Lecture 34 - Harmonic Transfer Functions
- Lecture 35 - Zadeh expansion of an LPTV system
- Lecture 36 - MNA analysis of LPTV networks
- Lecture 37 - MNA stamp of a periodically time varying conductance
- Lecture 38 - MNA stamp of a capacitor and a voltage source in an LPTV network
- Lecture 39 - Analysis of an example LPTV network - Part 1
- Lecture 40 - Analysis of an example LPTV network - Part 2
- Lecture 41 - LPTV network analysis, RC filter, time-varying
- Lecture 42 - Impedance and admittance in LTI and LPTV networks
- Lecture 43 - Thevenin and Norton's Theorems for LPTV networks
- Lecture 44 - The N-path principle
- Lecture 45 - N-path example
- Lecture 46 - Time-domain intuition of the N-path principle
- Lecture 47 - N-path example: Time-Interleaved ADCs
- Lecture 48 - Dc-dc converter as an LPTV system
- Lecture 49 - N-path principle: Multiphase dc-dc converter
- Lecture 50 - The N-path filter
- Lecture 51 - Computing $H_0(j2\pi f_s)$ for a 4-path filter
- Lecture 52 - Input impedance of the 4-path filter at f_s
- Lecture 53 - Computing $H_0(j2\pi^2 f_s)$ for a 4-path filter
- Lecture 54 - Determining H_0 for input frequency deviations from f_s
- Lecture 55 - Reciprocity and Inter-reciprocity in LPTV networks : Part 1
- Lecture 56 - Reciprocity and Inter-reciprocity in LPTV networks : Part 2, the transfer-function theorem
- Lecture 57 - Why is the transfer-function theorem important?
- Lecture 58 - The frequency-reversal theorem for inter-reciprocal (adjoint) LPTV networks : introduction
- Lecture 59 - The frequency-reversal theorem for inter-reciprocal (adjoint) LPTV networks : derivation
- Lecture 60 - Why is the frequency-reversal theorem important?
- Lecture 61 - Inter-reciprocity in signal-flow graphs
- Lecture 62 - Applications of inter-reciprocity: analysis of chopped amplifiers
- Lecture 63 - Applications of inter-reciprocity: analysis of chopped amplifiers (Continued...)
- Lecture 64 - Applications of inter-reciprocity: chopping with square-wave modulation

[Lecture 65 - Applications of inter-reciprocity: the switched-RC network](#)

[Lecture 66 - Time-domain implications of inter-reciprocity and the adjoint network](#)

[Lecture 67 - Time-domain implications of inter-reciprocity and the adjoint network : Example calculation](#)

[Lecture 68 - LPTV networks with sampled outputs: Switched capacitor circuits](#)

[Lecture 69 - LPTV networks with sampled outputs: A continuous-time delta-sigma data converter](#)

[Lecture 70 - LPTV networks with sampled outputs: The equivalent LTI filter](#)

[Lecture 71 - Finding the equivalent LTI filter of a sampled LPTV system : example](#)

[Lecture 72 - Equivalent LTI filter for a switched-RC network](#)

[Lecture 73 - Finding the equivalent LTI filter of a sampled LPTV system : example of a continuous-time delta-sigma modulator](#)

[Lecture 74 - Finding the equivalent LTI filter of a sampled LPTV system with offset sampling](#)

[Lecture 75 - LPTV networks driven by modulated inputs](#)

[Lecture 76 - Introduction to noise in LPTV Networks](#)

[Lecture 77 - Noise in LPTV networks with sampled outputs](#)

[Lecture 78 - Total integrated noise in networks with R,L,C and periodically operated switches](#)

Lecture 1 - Introduction

Lecture 2 - Analog vs Digital

Lecture 3 - Binary number system - 1

Lecture 4 - Binary number system - 2

Lecture 5 - Negative number representation - 1

Lecture 6 - Negative number representation - 2

Lecture 7 - Other number systems

Lecture 8 - Floating point numbers - 1

Lecture 9 - Floating point numbers - 2

Lecture 10 - Floating point numbers - 3

Lecture 11 - Floating point numbers - 4

Lecture 12 - Floating point numbers - 5

Lecture 13 - Boolean functions

Lecture 14 - Boolean Algebra

Lecture 15 - SOP and POS Representation

Lecture 16 - Algebraic simplifications

Lecture 17 - Canonical form

Lecture 18 - Boolean minimization using K-Maps

Lecture 19 - More Logic gates

Lecture 20 - Hardware description language:Verilog

Lecture 21 - Verilog simulation demo

Lecture 22 - K-maps

Lecture 23 - QM-method

Lecture 24 - Area delay model

Lecture 25 - Multi-level logic

Lecture 26 - Multiplexer

Lecture 27 - Four state logic

Lecture 28 - Decoders - 1

Lecture 29 - Decoders - 2

Lecture 30 - Encoders

Lecture 31 - Programmable hardware

Lecture 32 - Ripple carry adder

Lecture 33 - Carry look ahead adder

Lecture 34 - Modeling BUS in Verilog

Lecture 35 - Fast adder: Carry select adder

Lecture 36 - Multiple operand adder

Lecture 37 - Multiplication

Lecture 38 - Iterative circuits - 1

Lecture 39 - Iterative circuits - 2

Lecture 40 - Introduction to sequential circuits

Lecture 41 - Latches

Lecture 42 - D-Flip-flops

Lecture 43 - More Flip-flops

Lecture 44 - Counters

Lecture 45 - Verilog-Behavior model - 1

Lecture 46 - Verilog-Behavior model - 2

Lecture 47 - Registers - 1

Lecture 48 - Registers - 2

Lecture 49 - Memory

Lecture 50 - Sequential circuit analysis

Lecture 51 - Derivation state graph

Lecture 52 - Sequence detector: Example 1

Lecture 53 - Sequence detector: Example 2

Lecture 54 - State machine reduction

Lecture 55 - State encoding

Lecture 56 - Multi-cycle adder design

Lecture 57 - Pipelined adder design

Lecture 58 - Multiplication design

Lecture 59 - Division hardware design

Lecture 60 - Interacting state machines

Lecture 61 - Register Transfer Level design

Lecture 62 - GCD computer at RTL Level

Lecture 63 - RTL Design - Bubble sort

Lecture 64 - RTL Design - Traffic light controller

[Lecture 65 - FPGA](#)

[Lecture 66 - Xilinx CLB](#)

[Lecture 67 - FPGA - Design flow](#)

[Lecture 68 - FPGA design demo](#)

[Lecture 69 - Introduction to ASIC design flow - Part 1](#)

[Lecture 70 - Introduction to ASIC design flow - Part 2](#)

[Lecture 71 - Future directions](#)

- Lecture 1 - Review of Probability Theory: Random Variable
- Lecture 2 - Sequence of Random Variables
- Lecture 3 - Laws of Large Numbers and Central Limit Theorem
- Lecture 4 - What is a stochastic process?
- Lecture 5 - Counting Process
- Lecture 6 - Poisson Process - Introduction
- Lecture 7 - Poisson Process - Memorylessness
- Lecture 8 - Poisson Process - Increment properties
- Lecture 9 - Distribution of arrival epoch S_n and $N(t)$ for a Poisson Process
- Lecture 10 - Alternate definitions of a Poisson Process
- Lecture 11 - Merging of Poisson Processes - Part 1
- Lecture 12 - Merging of Poisson Processes - Part 2
- Lecture 13 - Splitting of Poisson Process - Part 1
- Lecture 14 - Splitting of Poisson Process - Part 2
- Lecture 15 - Example: Poisson Splitting
- Lecture 16 - Conditional arrival density and order statistics - Part 1
- Lecture 17 - Conditional arrival density and order statistics - Part 2
- Lecture 18 - Non Homogeneous Poisson Process
- Lecture 19 - Introduction to Queueing (with examples)
- Lecture 20 - Examples: Non homogeneous Poisson process
- Lecture 21 - Examples: Competing Poisson processes
- Lecture 22 - Introduction to Renewal Processes
- Lecture 23 - Strong law for renewal processes
- Lecture 24 - Strong law for renewal processes - Proof
- Lecture 25 - Residual life, age and duration (Time average) - Part 1
- Lecture 26 - Residual life, age and duration (Time average) - Part 2
- Lecture 27 - Renewal Reward Theorem (Time average) - Part 1
- Lecture 28 - Renewal Reward Theorem (Time average) - Part 2
- Lecture 29 - Stopping time
- Lecture 30 - Wald's Equality
- Lecture 31 - Wald's Equality (Continued...)

[Lecture 32 - Elementary Renewal Theorem](#)

[Lecture 33 - The Renewal Equation](#)

[Lecture 34 - The Renewal Equation \(Continued...\)](#)

[Lecture 35 - G/G/1 Queue and Little's theorem](#)

[Lecture 36 - Little's theorem](#)

[Lecture 37 - M/G/1 Queue](#)

[Lecture 38 - M/G/1 Queue and PK Formula](#)

[Lecture 39 - M/G/1 Queue and PK Formula \(Continued...\)](#)

[Lecture 40 - Ensemble rewards - Age and Duration](#)

[Lecture 41 - Ensemble rewards - Age and Duration \(Continued...\)](#)

[Lecture 42 - Key Renewal Theorem and Ensemble rewards](#)

[Lecture 43 - Introduction to finite state Discrete Time Markov Chains](#)

[Lecture 44 - Class and Types of Classes in a DTMC](#)

[Lecture 45 - Periodicity in a DTMC](#)

[Lecture 46 - Matrix Representation of a DTMC](#)

[Lecture 47 - The long term behaviour of a DTMC](#)

[Lecture 48 - Stationary Distribution and Long term behaviour of a DTMC - Part 1](#)

[Lecture 49 - Stationary Distribution and Long term behaviour of a DTMC - Part 2](#)

[Lecture 50 - Stationary Distribution and Long term behaviour of a DTMC - Part 3](#)

[Lecture 51 - Spectral Properties of Stochastic Matrices - Part 1](#)

[Lecture 52 - Spectral Properties of Stochastic Matrices - Part 2](#)

[Lecture 53 - The Short-term Behaviour of a DTMC](#)

[Lecture 54 - Introduction to Countable-state DTMC](#)

[Lecture 55 - Introduction to Countable-state DTMC \(Continued...\)](#)

[Lecture 56 - The Strong Markov Property](#)

[Lecture 57 - Renewal Theory applied to DTMC's](#)

[Lecture 58 - Stationary Distribution of a Countable State Space DTMC and Renewal Theory](#)

[Lecture 59 - Stationary Distribution of a Countable State Space DTMC and Renewal Theory \(Continued...\)](#)

[Lecture 60 - Stationary Distribution and The Steady State Behaviour of a Countable-state DTMC - Part 1](#)

[Lecture 61 - Stationary Distribution and The Steady State Behaviour of a Countable-state DTMC - Part 2](#)

[Lecture 62 - Convergence to Steady State of a Countable-state DTMC \(Stochastic Coupling\)](#)

[Lecture 63 - The Birth-Death Markov Chains](#)

[Lecture 64 - The Reversibility Markov Chains](#)

[Lecture 65 - The Reversibility Markov Chains \(Continued...\)](#)

[Lecture 66 - Time Sampled M/M/1 Queue and The Burke's Theorem](#)

[Lecture 67 - Introduction to Continuous Time Markov Chains](#)

[Lecture 68 - Introduction to CTMC \(Continued...\)](#)

[Lecture 69 - The Steady State Behaviour of CTMC - Part 1](#)

[Lecture 70 - The Steady State Behaviour of CTMC - Part 2](#)

[Lecture 71 - The Steady State Behaviour of CTMC - Part 3](#)

[Lecture 72 - The Steady State Behaviour of CTMC - Part 4](#)

[Lecture 73 - The chapman-kolmogrov equations for CTMC's](#)

[Lecture 74 - The Birth-Death Continuous time Markov Chains](#)

[Lecture 75 - The Reversibility of Continuous time Markov Chains](#)

[Lecture 76 - Burke's Theorem and the Tandem Queues - Part 1](#)

[Lecture 77 - Burke's Theorem and the Tandem Queues - Part 2](#)

[Lecture 78 - The Jackson Networks - Part 1](#)

[Lecture 79 - The Jackson Networks - Part 2](#)

[Lecture 80 - Semi Markov Processes - Part 1](#)

[Lecture 81 - Semi Markov Processes - Part 2](#)

- Lecture 1 - Course Background and Learning Outcome
- Lecture 2 - Moore's Law and Interconnect Bottleneck
- Lecture 3 - Progress in Optical Interconnect Technology and Beyond
- Lecture 4 - Evolution of Silicon Photonics Platform
- Lecture 5 - Fundamentals of Lightwaves: EM Waves: Maxwell Equations and Plane Wave Solutions
- Lecture 6 - Fundamentals of Lightwaves: EM Waves: Wave Propagation in Lossy Dielectric Medium
- Lecture 7 - Fundamentals of Lightwaves: EM Waves in Metals and Semiconductors
- Lecture 8 - Fundamentals of Lightwaves: EM Waves: Plasma Dispersion
- Lecture 9 - Fundamentals of Lightwaves: EM Waves Principle of Optical Waveguiding
- Lecture 10 - Fundamentals of Lightwaves: 1-D Optical Waveguide: Ray Optics Model
- Lecture 11 - Optical Waveguides: Theory and Design: TIR Based Eigen Mode Solutions for Slab Waveguides
- Lecture 12 - Optical Waveguides: Theory and Design: TIR Based Design Solutions for Slab Waveguides
- Lecture 13 - Optical Waveguides: Theory and Design: Guided Mode Solutions for Slab Waveguides
- Lecture 14 - Optical Waveguides: Theory and Design: Guided Mode Solutions for Slab Waveguides cont
- Lecture 15 - Optical Waveguides: Theory and Design: Guided Mode Dispersion and Power in Slab Waveguides
- Lecture 16 - Optical Waveguides: Theory and Design: Optical Waveguide with 2D confinement
- Lecture 17 - Optical Waveguides: Theory and Design: Dispersion and Polarization of Guided Modes
- Lecture 18 - Optical Waveguides: Theory and Design: Orthogonality of Guided Modes
- Lecture 19 - Optical Waveguides: Theory and Design: Coupled Mode Theory of Guided Modes
- Lecture 20 - Optical Waveguides: Theory and Design: Coupled Mode Theory (Continued...)
- Lecture 21 - Optical Waveguides: Theory and Design: Coupled Mode Theory (Continued...)
- Lecture 22 - Integrated Optical Components: Y-Junction Power Splitter/Combiner and Mach-Zehnder Interferometer
- Lecture 23 - Integrated Optical Components: Directional Coupler: Coupled Waveguides
- Lecture 24 - Integrated Optical Components: Directional Coupler: Coupled Waveguides (Continued...)
- Lecture 25 - Integrated Optical Components: Directional Coupler: Design and Modelling
- Lecture 26 - Integrated Optical Components: DC based MZI and Microring Resonator (MRR)
- Lecture 27 - Integrated Optical Components: Microring Resonator (MRR): Passive Characteristics
- Lecture 28 - Integrated Optical Components: Distributed Bragg Reflector (DBR)
- Lecture 29 - Integrated Optical Components: Distributed Bragg Reflector (DBR): Device Design - Part 1
- Lecture 30 - Integrated Optical Components: Distributed Bragg Reflector (DBR): Device Design - Part 2
- Lecture 31 - Tunable Devices and Reconfigurable Circuits: Phase Error Interference

[Lecture 32 - Tunable Devices and Reconfigurable Circuits: Post Fabrication Phase Error Corrections](#)

[Lecture 33 - Tunable Devices and Reconfigurable Circuits: Thermo-Optic Switching and Tuning](#)

[Lecture 34 - Tunable Devices and Reconfigurable Circuits: Programmable Silicon Photonics](#)

[Lecture 35 - Electro-Optic Modulators for Integrated Photonics: Basic Design and Working Principle](#)

[Lecture 36 - Electro-Optic Modulators for Integrated Photonics: Various Physical Mechanisms](#)

[Lecture 37 - Electro-Optic Modulators for Integrated Photonics: FCCE Based Silicon Photonics Modulator](#)

[Lecture 38 - Light Sources and Photodetectors for Integrated Photonics: Integrated Photonic light Sources - Part 1](#)

[Lecture 39 - Light Sources and Photodetectors for Integrated Photonics: Integrated Photonic light Sources - Part 2](#)

[Lecture 40 - Light Sources and Photodetectors for Integrated Photonics: Photodetectors for Silicon Photonics](#)

- Lecture 1 - Types of Semiconductors
- Lecture 2 - Classical Vs Quantum Mechanics
- Lecture 3 - Electrons in infinite and finite 1D potential well
- Lecture 4 - 3D potential well model of atom and Bohr's model
- Lecture 5 - Covalent bonds and inter-atomic interactions in Silicon
- Lecture 6 - Energy band formation
- Lecture 7 - Electron hole pair generation
- Lecture 8 - Direct and Indirect bandgap semiconductors
- Lecture 9 - Energy levels in infinite and finite potential wells (short demo)
- Lecture 10 - Effective mass in Semiconductors
- Lecture 11 - Intrinsic carrier density
- Lecture 12 - Doping and extrinsic semiconductors
- Lecture 13 - Fermi level in extrinsic semiconductors
- Lecture 14 - Temperature dependence of Fermi level
- Lecture 15 - Temperature dependence of Fermi level
- Lecture 16 - Charge neutrality relationship
- Lecture 17 - Drift current and energy band representation of kinetic energy of carriers
- Lecture 18 - Semiconductor bands in a electric field
- Lecture 19 - Diffusion current
- Lecture 20 - Non-uniform doping
- Lecture 21 - Equilibrium Vs Nonequilibrium carrier response
- Lecture 22 - Minority carrier diffusion equation (MCDE) - Example problems
- Lecture 23 - Quasi Fermi level in nonequilibrium conditions
- Lecture 24 - Quasi Fermi level and minority carrier diffusion length
- Lecture 25 - Semiconductor device fabrication
- Lecture 26 - PN Junctions - An introduction
- Lecture 27 - PN Junction electrostatics
- Lecture 28 - Energy band diagram of PN junction
- Lecture 29 - Depletion width and peak electric field
- Lecture 30 - PN junction electrostatics - examples
- Lecture 31 - Demo of PN Junction Lab on Nanohub

- Lecture 32 - Forward and reverse biased PN junctions
- Lecture 33 - Minority carrier injection in PN junctions
- Lecture 34 - Current in forward biased PN junction
- Lecture 35 - Current in reverse biased PN junction
- Lecture 36 - Depletion capacitance in PN junction
- Lecture 37 - Non-idealities in PN junction diode
- Lecture 38 - Nanohub Demo - PN Junction with applied bias
- Lecture 39 - Schottky barrier in metal-semiconductor junction
- Lecture 40 - Current flow across a Schottky barrier
- Lecture 41 - Ohmic vs rectifying contacts
- Lecture 42 - An Ideal MOS Capacitor
- Lecture 43 - Operating regimes of a MOSCAP
- Lecture 44 - Simplified band diagrams of accumulation and depletion in MOSCAP
- Lecture 45 - Inversion in a MOSCAP
- Lecture 46 - NMOSCAP in accumulation mode
- Lecture 47 - NMOSCAP in depletion mode
- Lecture 48 - NMOSCAP in inversion mode
- Lecture 49 - Exact solution vs delta-depletion approximation
- Lecture 50 - Threshold voltage in a MOSCAP
- Lecture 51 - Nanohub Demo - MOSCAP tool
- Lecture 52 - Non-ideal MOS Capacitor
- Lecture 53 - MOSCAP Capacitance-Voltage (CV) Characteristics
- Lecture 54 - Example problems with MOSCAPs
- Lecture 55 - Impact of doping, oxide thickness and temperature on CV
- Lecture 56 - Nanohub Demo - MOS CV
- Lecture 57 - Introduction to MOSFET
- Lecture 58 - Operating modes of a MOSFET
- Lecture 59 - IV Characteristics of a long channel MOSFET
- Lecture 60 - Example problems with MOSFETs
- Lecture 61 - MOSFET device metrics
- Lecture 62 - CMOS Technology
- Lecture 63 - MOSFET Scaling and technology nodes
- Lecture 64 - Limits of scaling

[Lecture 65 - Current characteristics of a short channel MOSFET](#)

[Lecture 66 - Threshold voltage characteristics of short channel MOSFET](#)

[Lecture 67 - MOSFETs in the 21st century](#)

[Lecture 68 - Optical absorption and bandgap](#)

[Lecture 69 - Introduction to solar cells](#)

[Lecture 70 - Efficiency of a solar cell](#)

[Lecture 71 - Types of photodetectors](#)

[Lecture 72 - PIN and avalanche Photodetectors](#)

[Lecture 73 - Photodetector metrics](#)

[Lecture 74 - Radiative absorption and emission processes](#)

[Lecture 75 - Materials for optoelectronic devices](#)

[Lecture 76 - Operation of a light emitting diode \(LED\)](#)

[Lecture 77 - LED emission spectrum](#)

[Lecture 78 - Stimulated emission and lasing](#)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Electric Vehicles and Renewable Energy (Electrical Engineering)

Co-ordinators : Prof. Ashok Jhunjunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha, Prof. L Kannan

Lecture 1 - Electric Vehicle Introduction

Lecture 2 - The drive Torque, Power, Speed and Energy

Lecture 3 - Energy Source

Lecture 4 - Vehicle Auxillary, Petrol pumps and Charging stations

Lecture 5 - Introduction to Electric Vehicles in India

Lecture 6 - Can India Drive its EV program Innovatively and Differently and scale

Lecture 7 - Battery Cost reduction strategy

Lecture 8 - A bit about Batteries, Charging and Swapping Infrastructure

Lecture 9 - Where will we get Lithium for batteries and EV Subsystems

Lecture 10 - Forces acting when a vehicle move

Lecture 11 - Aerodynamic drag, Rolling Resistance and Uphill Resistance

Lecture 12 - Power and torque to accelerate

Lecture 13 - Putting it all together - 1

Lecture 14 - Putting it all together - 2

Lecture 15 - Concept of drive cycle - 1

Lecture 16 - Concept of drive cycle - 2

Lecture 17 - Drive Cycles and Energy used per km - Part 1

Lecture 18 - Drive Cycles and Energy used per km - Part 2

Lecture 19 - EV Subsystem: Design of EV Drive Train - Part 1

Lecture 20 - EV Subsystem: Design of EV Drive Train - Part 2

Lecture 21 - Introduction to Battery Parameters - Part 1

Lecture 22 - Introduction to Battery Parameters - Part 2

Lecture 23 - Why Lithium Ion Battery? - Part 1

Lecture 24 - Why Lithium Ion Battery? - Part 2

Lecture 25 - Batteries in Future

Lecture 26 - Li-Ion Battery Cells

Lecture 27 - SoH and SoC estimation and Self Discharge - Part 1

Lecture 28 - SoH and SoC estimation and Self Discharge - Part 2

Lecture 29 - Battery Pack Development - Part 1

Lecture 30 - Battery Pack Development - Part 2

Lecture 31 - Computation of Effective cost of battery - Part 1

- Lecture 32 - Computation of Effective cost of battery - Part 2
- Lecture 33 - Charging Batteries
- Lecture 34 - Fundamentals of Battery Pack Design
- Lecture 35 - Electrical Design of Battery Pack - Part 1
- Lecture 36 - Electrical Design of Battery Pack - Part 2
- Lecture 37 - Electrical Design of Battery Pack - Part 3
- Lecture 38 - Mechanical Design of Battery Pack - Part 1
- Lecture 39 - Mechanical Design of Battery Pack - Part 2
- Lecture 40 - Mechanical Design of Battery Pack - Part 3
- Lecture 41 - Mechanical Design of Battery Pack - Part 4
- Lecture 42 - Thermal Design of Battery Pack - Part 1
- Lecture 43 - Thermal Design of Battery Pack - Part 2
- Lecture 44 - Thermal Design of Battery Pack - Part 3
- Lecture 45 - Thermal Design of Battery Pack - Part 4
- Lecture 46 - BMS Design and Embedded System - Part 1
- Lecture 47 - BMS Design and Embedded System - Part 2
- Lecture 48 - BMS Design and Embedded System - Part 3
- Lecture 49 - BMS Design and Embedded System - Part 4
- Lecture 50 - BMS Design and Embedded System - Part 5
- Lecture 51 - Cell Testing and Characterization - Part 1
- Lecture 52 - Cell Testing and Characterization - Part 2
- Lecture 53 - EV Motors and Controllers - Vehicle Dynamics - Part 1
- Lecture 54 - EV Motors and Controllers - Vehicle Dynamics - Part 2
- Lecture 55 - EV Motors and Controllers - Understanding Flow - Part 1
- Lecture 56 - EV Motors and Controllers - Understanding Flow - Part 2
- Lecture 57 - Power and Efficiency
- Lecture 58 - Torque Production - Part 1
- Lecture 59 - Torque Production - Part 2
- Lecture 60 - Torque Production - Part 3
- Lecture 61 - Speed and Back EMF
- Lecture 62 - The d-q Equivalent circuit - Part 1
- Lecture 63 - The d-q Equivalent circuit - Part 2
- Lecture 64 - Field-oriented Control

- Lecture 65 - Three phase AC - Part 1
- Lecture 66 - Three phase AC - Part 2
- Lecture 67 - Thermal Design - Part 1
- Lecture 68 - Thermal Design - Part 2
- Lecture 69 - Thermal Design - Part 3
- Lecture 70 - Engineering Considerations - Part 1
- Lecture 71 - Engineering Considerations - Part 2
- Lecture 72 - Engineering Considerations - Part 3 and Future Frontiers
- Lecture 73 - EV Charger Introduction
- Lecture 74 - Charger Parameters and Types
- Lecture 75 - Slow Fast chargers and Swapping
- Lecture 76 - Swapping
- Lecture 77 - Standardization and on board chargers
- Lecture 78 - Public chargers
- Lecture 79 - Public charger economics in Indian Context
- Lecture 80 - Bulk Chargers, Swapping stations and data analytics
- Lecture 81 - Introduction to Energy Scenario in India - Part 1
- Lecture 82 - Introduction to Energy Scenario in India - Part 2
- Lecture 83 - A novel Approach towards 100% RE in India - Part 1
- Lecture 84 - A novel Approach towards 100% RE in India - Part 2
- Lecture 85 - Going Beyond solar, wind, Li Ion and chilled water storage
- Lecture 86 - Solar Photovoltaic
- Lecture 87 - Solar Cell and its Characteristics
- Lecture 88 - Solar Cells to Modules
- Lecture 89 - Wind Energy
- Lecture 90 - The War of Currents
- Lecture 91 - The Birth of Solar - DC
- Lecture 92 - Storage Options for Energy - Part 1
- Lecture 93 - Storage Options for Energy - Part 2
- Lecture 94 - Storage Options for Energy - Part 3
- Lecture 95 - Storage Options for Energy - Part 4
- Lecture 96 - The EV Ecosystem - Part 1
- Lecture 97 - The EV Ecosystem - Part 2

NPTEL : Phase-locked loops (Electrical Engineering)

Co-ordinators : Dr. Saurabh Saxena

Lecture 1 - Course Introduction and Motivation - Part I

Lecture 2 - Course Introduction and Motivation - Part II

Lecture 3 - Basic Operation of a Phase Locked Loop

Lecture 4 - Simple Implementation of a Phase Locked Loop

Lecture 5 - Input Output Characteristics of Basic PLL Blocks

Lecture 6 - Time Domain Analysis of a Simple PLL

Lecture 7 - Time Domain Versus Small Signal Analysis of a Simple PLL

Lecture 8 - Type and Order of PLL

Lecture 9 - Small Signal Analysis of Type-I/II/III PLLs for Phase Step, Frequency Step and Frequency Ramp

Lecture 10 - Frequency Acquisition Range for PLLs

Lecture 11 - Frequency Acquisition in Type-I PLLs

Lecture 12 - Frequency Acquisition Limits in Type-I PLLs

Lecture 13 - Frequency Acquisition in Type II PLLs

Lecture 14 - Frequency Acquisition Ranges in Type II PLLs with Ideal and Non Ideal Integrator

Lecture 15 - Frequency Domain Insight in Frequency Acquisition for Type II PLLs

Lecture 16 - Introduction to Clock Multipliers

Lecture 17 - Analog Phase Error Detectors - Part I

Lecture 18 - Analog Phase Error Detectors - Part II

Lecture 19 - Digital Phase Error Detectors - Part I

Lecture 20 - Digital Phase Error Detectors - Part II

Lecture 21 - Range Extension for Phase Error Detectors

Lecture 22 - Phase Frequency Detector

Lecture 23 - Digital Frequency Detector

Lecture 24 - Charge Pump PLL

Lecture 25 - Small Signal and Stability Analysis of Type II Order 2 Charge Pump PLL

Lecture 26 - Problems in Charge Pump PLL - Dead Zone in PFD

Lecture 27 - Problems in Charge Pump PLL - Reference Spur

Lecture 28 - Design Procedure for Type-II Order 3 Charge Pump PLL

Lecture 29 - Design Procedure for Charge Pump Clock Multiplier

Lecture 30 - Sources of Non-Linearities in CP-PLL - Part I

Lecture 31 - Sources of Non-Linearities in CP-PLL - Part II

- Lecture 32 - Noise Analysis in CP-PLL - Part I
- Lecture 33 - Noise Analysis in CP PLL - Part II
- Lecture 34 - Noise Analysis in CP-PLL - Part III
- Lecture 35 - Noise Simulations for CP-PLL Blocks
- Lecture 36 - Introduction to Oscillators
- Lecture 37 - Low Swing Ring Oscillator - Part I
- Lecture 38 - Low-Swing Ring Oscillator - Part II
- Lecture 39 - Large-Swing Ring Oscillator - Part I
- Lecture 40 - Large-Swing Ring Oscillator - Part II
- Lecture 41 - Large-Swing Ring Oscillator - Part III
- Lecture 42 - Large-Swing Ring Oscillator - Part IV
- Lecture 43 - Large-Swing Ring Oscillator - Part V
- Lecture 44 - Supply Regulated VCO - Part I
- Lecture 45 - Supply Regulated VCO - Part II
- Lecture 46 - Supply Regulated VCO - Part III
- Lecture 47 - Phase Noise in Ring Oscillators
- Lecture 48 - Circuit level Design of PFD - Part I
- Lecture 49 - Circuit level Design of PFD - Part II
- Lecture 50 - Circuit level Design of PFD - Part III
- Lecture 51 - Circuit level Design of Charge Pump - Part I
- Lecture 52 - Circuit-level Design of Charge Pump - Part II
- Lecture 53 - Circuit-level Design of Charge Pump - Part III
- Lecture 54 - Circuit-level Design of Charge Pump - Part IV
- Lecture 55 - Circuit-level Design of Charge Pump - Part V
- Lecture 56 - Circuit-level Design of Charge Pump - Part VI
- Lecture 57 - Circuit-level Design of Clock Frequency Divider
- Lecture 58 - Techniques for Wide Frequency Range Clock Multiplier
- Lecture 59 - Introduction to Digital PLL
- Lecture 60 - Design of Time-to-Digital Converter
- Lecture 61 - Small Signal Analysis of Digital PLL
- Lecture 62 - Noise Analysis in Digital PLL
- Lecture 63 - Analog/Digital Hybrid PLL - Part I
- Lecture 64 - Analog/Digital Hybrid PLL - Part II

Lecture 1 - Review of Maxwell's Equations

Lecture 2 - Wave Equation

Lecture 3 - Dispersion Relation

Lecture 4 - Propagating and Evanescent Waves

Lecture 5 - Diffraction Limit and Spatial Frequencies

Lecture 6 - Plane Waves

Lecture 7 - Optical Response of Materials

Lecture 8 - Lorentz Model

Lecture 9 - Properties of Lorentz Oscillator Model

Lecture 10 - Drude-Lorentz Model for Metals

Lecture 11 - Kramers-Kronig Relation

Lecture 12 - Engineering Optical Response of Materials

Lecture 13 - Low dimensional systems

Lecture 14 - Absorption in Semiconductors

Lecture 15 - Optical gain in semiconductors

Lecture 16 - Absorption in low-dimensional semiconductors

Lecture 17 - Selection rules for optical processes

Lecture 18 - Scattering of EM radiation

Lecture 19 - LSPR: Quasi-static approximation

Lecture 20 - Size dependence of Plasmon Resonance

Lecture 21 - Tuning Plasmonic Resonances

Lecture 22 - Surface Plasmon Polariton(SPP)

Lecture 23 - Understanding SPP Dispersion Diagram

Lecture 24 - Exciting Surface Plasmon Polaritons

Lecture 25 - Analytical Calculation of Scattering Coefficients - IPython code overview

Lecture 26 - EM Waves in Multilayer Stack - T Matrix formulation

Lecture 27 - Photonic Bandgap in 1D

Lecture 28 - EM Waves in 1D Photonic Crystal

Lecture 29 - Diffracton Grating

Lecture 30 - Applications of Photonic Crystals

Lecture 31 - PhC in 1D - T-matrix examples

- Lecture 32 - Introduction to Metamaterials
- Lecture 33 - Metamaterials at GHz and THz frequencies
- Lecture 34 - Negative index materials at optical frequencies
- Lecture 35 - Plasmonic Metasurfaces
- Lecture 36 - Dielectric Metasurfaces
- Lecture 37 - Tunable and Active Metamaterials
- Lecture 38 - Radiative Absorption and Emission
- Lecture 39 - Miniaturization of Integrated Photonic Devices
- Lecture 40 - Recent trends in nanoscale lasers
- Lecture 41 - Non-Hermitian Systems
- Lecture 42 - Resonant light-atom interactions
- Lecture 43 - Experimental observation of Rabi oscillations
- Lecture 44 - Atom-Cavity Interaction - Weak and strong coupling regimes
- Lecture 45 - Experimental observation of weak and strong coupling
- Lecture 46 - Fabrication of nanophotonic structures - 1
- Lecture 47 - Fabrication of nanophotonic structures - 2
- Lecture 48 - Measuring light quanta
- Lecture 49 - Photon Statistics
- Lecture 50 - Photodetection and shot noise limit
- Lecture 51 - Second order correlation function
- Lecture 52 - Hanbury Brown-Twiss Experiment with Photons
- Lecture 53 - EM Waves as harmonic oscillator
- Lecture 54 - Vacuum fluctuations
- Lecture 55 - Coherent and squeezed states
- Lecture 56 - Squeezed and photon number states
- Lecture 57 - Application of squeezed states
- Lecture 58 - Preliminaries for quantum theory of light
- Lecture 59 - Quantum theory of light
- Lecture 60 - Operator solution of quantum harmonic oscillator
- Lecture 61 - Photon number states
- Lecture 62 - Field quadratures and operators
- Lecture 63 - Uncertainty relations for quantum light
- Lecture 64 - Applications of quantum light - Quantum Key Distribution

Lecture 1 - Introduction Linear and Nonlinear Network

Lecture 2 - Small Signal Analysis of Nonlinear Networks

Lecture 3 - Small Signal Analysis

Lecture 4 - Incremental Model for Common Two Terminal Element Passive Two Terminal Elements

Lecture 5 - Linear and Nonlinear Two Ports and the Incremental Y Matrix

Lecture 6 - Graphical Representation of the Y Matrix

Lecture 7 - Nonlinear Two Ports With Incremental Gain

Lecture 8 - IV Characteristic of a Nonlinear 2 port with Incremental Gain

Lecture 9 - The MOSFET and its Characteristics

Lecture 10 - Deriving the Common V Source Amplifier - Part 1

Lecture 11 - The Common Source Amplifier

Lecture 12 - Large Signal Behaviour of the Common Source Amplifier

Lecture 13 - The Common Source Amplifier Swing Limits

Lecture 14 - Introduction to Robust Biasing

Lecture 15 - Robust Biasing Part 1 Common Source Amplifier with DC Drain Feedback

Lecture 16 - Robust Biasing with the Current Mirror and Drain Gate Resistor

Lecture 17 - Robust Biasing With Source Feedback - Part 1

Lecture 18 - Robust Biasing with Source Feedback - Part 2

Lecture 19 - Robust Biasing with Source Degeneration

Lecture 20 - Introduction to Negative Feedback

Lecture 21 - The Ideal Operational Amplifier

Lecture 22 - Negative Feedback (Continued...)

Lecture 23 - Robust Biasing with Drain Measurement and Source Feedback

Lecture 24 - Robust biasing with source measurement and gate feedback

Lecture 25 - The Incremental Voltage Controlled Voltage Source The Common drain Amplifier Incremental Picture

Lecture 26 - Biasing of the Common Drain Amplifier and Signal Swings

Lecture 27 - The VCVS Continued, the Incremental

Lecture 28 - Introducing the Current Controlled Voltage Source

Lecture 29 - The Incremental Current Controlled Voltage Source Transimpedance Amplifier

Lecture 30 - The Transimpedance amplifier (Continued...)

Lecture 31 - The Incremental current controlled current source, the common gate amplifier

Lecture 32 - Summary of controlled Sources and finite output Impedance of the Transistor

Lecture 33 - Effect of Finite Output Resistance on the Basic Building Blocks - Part 1

Lecture 34 - Effect of Finite Output Resistance on the Basic Building Blocks - Part 2

Lecture 35 - Effect of Finite Output Resistance on the Basic Building Blocks - Part 3

Lecture 36 - Finite output Effect in current Mirrors the Cascode Current Mirror

Lecture 37 - Comparison of Current Mirrors The High Swing Cascode

Lecture 38 - Precision High Swing Cascode

Lecture 39 - The PMOS transistor

Lecture 40 - Small Signal Model and Bias Stabilization

Lecture 41 - Basic Building Blocks with PMOS Devices

Lecture 42 - Fixed Transconductance Bias Circuits from First Principles

Lecture 43 - Limitation of a Resistive Load

Lecture 44 - The Active Load

Lecture 45 - The Active Load (Continued...)

Lecture 46 - The CMOS Inverter

Lecture 47 - The CMOS Inverter (Continued...)

Lecture 48 - The Differential Amplifier

Lecture 49 - Half - Circuit Analysis

Lecture 50 - The Different Amplifier with Active Load - Part 1

Lecture 51 - The Different Amplifier with Active Load - Part 2

Lecture 52 - Large Signal Behaviour of the Different Pair

Lecture 53 - The two Stage Opamp and Single Supply Operation

Lecture 54 - The two Stage Opamp (Continued...)

Lecture 55 - The Two Stage Opamp (Continued...)

Lecture 56 - Swing Limits of the Two Stage OTA

Lecture 57 - The Two-Stage Opamp

Lecture 58 - The Bandgap Reference Principle

Lecture 59 - The Bandgap Reference - Part 1

Lecture 60 - The Bandgap Reference - Part 2

Lecture 61 - Memory Effects in MOS Transistors

Lecture 62 - The Common Source Amplifier with Parasitic Capacitances

Lecture 63 - The Common Source Amplifier with Parasitic Capacitances

Lecture 64 - Frequency Response of the Common Drain Amplifier

- [Lecture 65 - Frequency Response of the Common Gate Amplifier](#)
- [Lecture 66 - Stability of Negative Feedback System The First Order Forward Amplifier](#)
- [Lecture 67 - Stability of Second Order Feedback System](#)
- [Lecture 68 - Stability of Third Order Negative Feedback System](#)
- [Lecture 69 - Dominant Pole Compensation - Part 1](#)
- [Lecture 70 - Dominant Pole Compensation - Part 2](#)
- [Lecture 71 - Phase Margin](#)
- [Lecture 72 - Example Phase Margin Calculations](#)
- [Lecture 73 - Dominant Pole Compensation Summary](#)
- [Lecture 74 - Phase Margin Example](#)
- [Lecture 75 - The 2 Stage Miller Compensated Amplifier](#)
- [Lecture 76 - 2 Stage Operational Amplifier and Miller Compensation \(Continued...\)](#)
- [Lecture 77 - Intuition Behind the Dominant and Second Poles in a Miller Compensated OTA](#)
- [Lecture 78 - 2 Stage Operational Amplifier and Miller Compensation Cancelling the RHP Zero](#)
- [Lecture 79 - Miller Compensation OTA Schematic](#)
- [Lecture 80 - Bipolar Junction Transistor Circuits-Device Equations and Small Signal Model](#)
- [Lecture 81 - BJT Biasing and Basic Building Blocks](#)
- [Lecture 82 - Bipolar Junction Transistor Circuits Swing Limits and Two Stage Opamp](#)
- [Lecture 83 - Input Stage of the 741 Opamp](#)
- [Lecture 84 - Basic Analysis of the 741](#)

Lecture 1 - Course introduction - 1

Lecture 2 - Course introduction - 2

Lecture 3 - Introduction to Deep Learning - 1

Lecture 4 - Introduction to Deep Learning - 2

Lecture 5 - Introduction to Deep Learning - 3

Lecture 6 - Introduction to Neuron - 1

Lecture 7 - Introduction to Neuron - 2

Lecture 8 - Introduction to Neuron - 3

Lecture 9 - Multilayer Perceptron

Lecture 10 - Regression and classification losses

Lecture 11 - Training a neural network

Lecture 12 - Gradient descent

Lecture 13 - Activation function

Lecture 14 - Backpropagation in MLP - 1

Lecture 15 - Backpropagation in MLP - 2

Lecture 16 - Optimization and Regularization - 1

Lecture 17 - Optimization and Regularization - 2

Lecture 18 - Regularization

Lecture 19 - Dropout

Lecture 20 - Pre-processing

Lecture 21 - Convolutional Neural Networks - 1

Lecture 22 - Convolutional Neural Networks - 2

Lecture 23 - Convolutional Neural Networks - 3

Lecture 24 - CNN Properties

Lecture 25 - Alexnet

Lecture 26 - CNN Architectures - 1

Lecture 27 - CNN Architectures - 2

Lecture 28 - CNN Architectures - 3

Lecture 29 - Introduction to RNN - 1

Lecture 30 - Introduction to RNN - 2

Lecture 31 - Encoder-Decoder models in RNN

[Lecture 32 - LSTM](#)

[Lecture 33 - Low-level vision - 1](#)

[Lecture 34 - Low-level vision - 2](#)

[Lecture 35 - Low-level vision - 3](#)

[Lecture 36 - Spatial Domain Filtering](#)

[Lecture 37 - Frequency Domain Filtering](#)

[Lecture 38 - Edge Detection - 1](#)

[Lecture 39 - Edge Detection - 2](#)

[Lecture 40 - DeepNets for Edge Detection](#)

[Lecture 41 - Line detection](#)

[Lecture 42 - Feature detectors](#)

[Lecture 43 - Harris Corner Detector - 1](#)

[Lecture 44 - Harris Corner Detector - 2](#)

[Lecture 45 - Harris Corner Detector - 3](#)

[Lecture 46 - Blob detection - 1](#)

[Lecture 47 - Blob detection - 2](#)

[Lecture 48 - Blob detection - 3](#)

[Lecture 49 - SIFT - 1](#)

[Lecture 50 - SIFT - 2](#)

[Lecture 51 - Feature descriptors - 1](#)

[Lecture 52 - Feature descriptors - 2](#)

[Lecture 53 - SURF - 1](#)

[Lecture 54 - SURF - 2](#)

[Lecture 55 - Single-View Geometry - 1](#)

[Lecture 56 - Single-View Geometry - 2](#)

[Lecture 57 - 2D Geometric transformations - 1](#)

[Lecture 58 - 2D Geometric transformations - 2](#)

[Lecture 59 - Camera intrinsics and extrinsics - 1](#)

[Lecture 60 - Camera intrinsics and extrinsics - 2](#)

[Lecture 61 - Two-view stereo - 1](#)

[Lecture 62 - Two-view stereo - 2](#)

[Lecture 63 - Two-view stereo - 3](#)

[Lecture 64 - Algebraic representation of epipolar geometry - 1](#)

[Lecture 65 - Algebraic representation of epipolar geometry - 2](#)

[Lecture 66 - Fundamental matrix computation - 1](#)

[Lecture 67 - Fundamental matrix computation - 2](#)

[Lecture 68 - Structure from Motion - 1](#)

[Lecture 69 - Structure from Motion - 2](#)

[Lecture 70 - Structure from Motion - 3](#)

[Lecture 71 - Batch processing in SFM](#)

[Lecture 72 - Multi-view SFM](#)

[Lecture 73 - Factorization methods in SFM](#)

[Lecture 74 - Bundle adjustment](#)

[Lecture 75 - Dense 3D reconstruction](#)

[Lecture 76 - Some results in Stereo and SFM](#)

[Lecture 77 - Deepnets for stereo and SFM - 1](#)

[Lecture 78 - Deepnets for stereo and SFM - 2](#)

[Lecture 79 - Mid-level vision - 1](#)

[Lecture 80 - Mid-level vision - 2](#)

[Lecture 81 - Lucas-Kanade method for OF](#)

[Lecture 82 - Handling large motion in optical flow](#)

[Lecture 83 - Image segmentation](#)

[Lecture 84 - GMM for clustering](#)

[Lecture 85 - Deepnets for Segmentation and OF -1](#)

[Lecture 86 - Deepnets for Segmentation and OF -2](#)

[Lecture 87 - Deepnets for Segmentation and OF -3](#)

[Lecture 88 - Deepnets for Object Detection - 1](#)

[Lecture 89 - Deepnets for Object Detection - 2](#)

[Lecture 90 - Vision and Language](#)

Lecture 1 - Introduction to Optical Wireless Communications (OWC)

Lecture 2 - Basics of Lighting System

Lecture 3 - Optical Sources (LED)

Lecture 4 - Optical Sources (LASER)

Lecture 5 - Photodetectors

Lecture 6 - Photodetectors (Continued...)

Lecture 7 - SNR for PIN and APD

Lecture 8 - Indoor OWC channel modelling

Lecture 9 - Indoor OWC channel modelling (Continued...)

Lecture 10 - Channel model for single source

Lecture 11 - Channel model for multiple sources

Lecture 12 - MIMO channel

Lecture 13 - MIMO channel (Continued...)

Lecture 14 - Outdoor Optical Channel Modelling

Lecture 15 - Range equation of FSO link

Lecture 16 - Range equation of FSO link (Continued...)

Lecture 17 - Atmospheric Turbulence

Lecture 18 - Atmospheric Turbulence (Continued...)

Lecture 19 - Turbulence Mitigation techniques

Lecture 20 - Underwater OWC Channel Model

Lecture 21 - Underwater OWC Channel Model (Continued...)

Lecture 22 - Modulation Schemes for OWC, BER for OOK

Lecture 23 - BER of M-PPM, BER of L-PPM

Lecture 24 - Differential Pulse Interval Modulation (DPIM) and (DAPPM)

Lecture 25 - Variable Pulse Position Modulation (VPPM)

Lecture 26 - OFDM Basics

Lecture 27 - Cyclic Prefix (CP), OFDM with CP, BER of OFDM System

Lecture 28 - Frequency Offset in OFDM, PAPR in OFDM

Lecture 29 - OFDM in VLC, DCO-OFDM

Lecture 30 - ACO-OFDM

Lecture 31 - Color Shift Keying (CSK)

[Lecture 32 - Higher order CSK](#)

[Lecture 33 - NOMA](#)

[Lecture 34 - NOMA VLC](#)

[Lecture 35 - MIMO](#)

[Lecture 36 - VLC based MIMO NOMA](#)

[Lecture 37 - Power allocation in VLC based MIMO NOMA](#)

[Lecture 38 - Hybrid Network LiFi and WiFi Coexistence](#)

[Lecture 39 - Vehicle to Vehicle communication using Visible light](#)

[Lecture 40 - Anand Singh Part - 1](#)

[Lecture 41 - Anand Singh Part - 2](#)

[Lecture 42 - Dilnashin lecture - 1](#)

[Lecture 43 - Saswati Paramita](#)

[Lecture 44 - Dilnashin Tutorial - 2](#)

[Lecture 45 - Guriendar Prof Anand 001](#)

[Lecture 46 - Rehana Prof Anand](#)

Lecture 1 - Basic Concepts of Integrated Circuit - I

Lecture 2 - Basic Concepts of Integrated Circuit - II

Lecture 3 - Overview of VLSI Design Flow - I

Lecture 4 - Overview of VLSI Design Flow - II

Lecture 5 - Tutorial 1

Lecture 6 - Overview of VLSI Design Flow - III

Lecture 7 - Overview of VLSI Design Flow - IV

Lecture 8 - Overview of VLSI Design Flow - V

Lecture 9 - Overview of VLSI Design Flow - VI

Lecture 10 - Introduction to TCL

Lecture 11 - Hardware Modeling: Introduction to Verilog - I

Lecture 12 - Hardware Modeling: Introduction to Verilog - II

Lecture 13 - Functional Verification using Simulation

Lecture 14 - High-level synthesis using Bambu - Tutorial 3

Lecture 15 - RTL Synthesis - Part I

Lecture 16 - RTL Synthesis - Part II

Lecture 17 - Logic Optimization - Part I

Lecture 18 - Simulation-based Verification using Icarus

Lecture 19 - Logic Optimization - Part II

Lecture 20 - Logic Optimization - Part III

Lecture 21 - Formal Verification - I

Lecture 22 - Logic Synthesis using Yosys

Lecture 23 - Formal Verification - II

Lecture 24 - Formal Verification - III

Lecture 25 - Formal Verification - IV

Lecture 26 - Technology Library

Lecture 27 - Logic Optimization using Yosys

Lecture 28 - Static Timing Analysis - I

Lecture 29 - Static Timing Analysis - II

Lecture 30 - Static Timing Analysis - III

Lecture 31 - Static Timing Analysis using OpenSTA

[Lecture 32 - Constraints - I](#)

[Lecture 33 - Constraints - II](#)

[Lecture 34 - Technology Mapping](#)

[Lecture 35 - Timing-driven Optimization](#)

[Lecture 36 - Technology Library and Constraints](#)

[Lecture 37 - Power Analysis](#)

[Lecture 38 - Power Optimization](#)

[Lecture 39 - Basic Concepts of DFT](#)

[Lecture 40 - Scan Design Flow](#)

[Lecture 41 - Power Analysis using OpenSTA](#)

[Lecture 42 - Automatic Test Pattern Generation \(ATPG\)](#)

[Lecture 43 - Built-in Self Test \(BIST\)](#)

[Lecture 44 - Basic Concepts for Physical Design - I](#)

[Lecture 45 - Basic Concepts for Physical Design - II](#)

[Lecture 46 - Installation of OpenRoad](#)

[Lecture 47 - Chip Planning - I](#)

[Lecture 48 - Chip Planning - II](#)

[Lecture 49 - Placement](#)

[Lecture 50 - Chip Planning and Placement](#)

[Lecture 51 - Clock Tree Synthesis \(CTS\)](#)

[Lecture 52 - Routing](#)

[Lecture 53 - Post-layout Verification and Signoff](#)

[Lecture 54 - Clock Tree Synthesis \(CTS\) and Routing](#)

- Lecture 1 - Introduction to the Course
- Lecture 2 - Basics of Wireless Communication Systems
- Lecture 3 - Path-Loss Models for a Wireless Channel
- Lecture 4 - Log-Normal Shadowing
- Lecture 5 - Small-Scale Fading
- Lecture 6 - Statistical Multipath Channel Models
- Lecture 7 - MATLAB programming for Path Loss Models
- Lecture 8 - Statistical Multipath Channel Models - Part 1
- Lecture 9 - Statistical Multipath Channel Models - Part 2
- Lecture 10 - Digital Modulation and Detection (Binary Modulations) - Part 1
- Lecture 11 - Digital Modulation and Detection (Binary Modulations) - Part 2
- Lecture 12 - Digital Modulation and Detection (Binary Modulations) - Part 3
- Lecture 13 - MATLAB programming for Wireless Fading Channels
- Lecture 14 - Digital Modulation and Detection (Binary Modulations) - Part 1
- Lecture 15 - Digital Modulation and Detection (Binary Modulations) - Part 2
- Lecture 16 - Digital Modulation and Detection (M-ary Modulation) - Part 1
- Lecture 17 - Digital Modulation and Detection (M-ary Modulation) - Part 2
- Lecture 18 - Digital Modulation and Detection (M-ary Modulation) - Part 3
- Lecture 19 - MATLAB programming for Modulation Schemes
- Lecture 20 - Digital Modulation and Detection (GMSK)
- Lecture 21 - Performance of Digital Modulation over Wireless Channels
- Lecture 22 - Performance of Digital Modulation over Wireless Channels
- Lecture 23 - MATLAB programaming: Error performance in AWGN channel
- Lecture 24 - Receiver Diversity Techniques - Part 1
- Lecture 25 - Receiver Diversity Techniques - Part 2
- Lecture 26 - Receiver Diversity Techniques - Part 3
- Lecture 27 - Error performance in Fading Channel Part 1
- Lecture 28 - Error performance in Fading Channel Part 2
- Lecture 29 - Multi-Carrier Modulation and OFDM - Part 1
- Lecture 30 - Multi-Carrier Modulation and OFDM - Part 2
- Lecture 31 - Multi-Carrier Modulation and OFDM - Part 3

[Lecture 32 - Multi-Carrier Modulation and OFDM - Part 4](#)

[Lecture 33 - Numerical on OFDM](#)

[Lecture 34 - Programming for OFDM](#)

[Lecture 35 - OFDM System with Cyclic Prefix](#)

[Lecture 36 - OFDM Signal Transmission and OFDM System Design](#)

[Lecture 37 - Advantages and Drawbacks of OFDM System](#)

[Lecture 38 - OFDM Standards](#)

[Lecture 39 - Multiple Access Schemes](#)

[Lecture 40 - Technologies for Wireless Cellular Standards](#)

Lecture 1 - Sensors and Transducers - Basics

Lecture 2 - Introduction to Sensors

Lecture 3 - Materials for sensors

Lecture 4 - Multidisciplinary Aspects of Sensors

Lecture 5 - Introduction to Sensor Parameters

Lecture 6 - Sensor Parameters - II

Lecture 7 - Sensor Parameters - III

Lecture 8 - Sensor Parameters - IV

Lecture 9 - Sensor Parameters - V

Lecture 10 - Numerical Examples

Lecture 11 - Introduction: Physics of Sensors

Lecture 12 - Capacitive Sensor Architecture

Lecture 13 - Different Types of Capacitive Sensors

Lecture 14 - Thermal Sensors Basics

Lecture 15 - Dynamic Condition of Thermal Sensors

Lecture 16 - Classification of Thermal Sensors

Lecture 17 - Chemical Sensor Basics

Lecture 18 - Electrochemical Sensors

Lecture 19 - Impedimetric Sensors

Lecture 20 - Numerical Examples

Lecture 21 - Physics of Optical Sensors

Lecture 22 - Physics of Magnetic Sensors

Lecture 23 - Physics of Acoustic Sensors

Lecture 24 - Physics of Microfluidic Sensors

Lecture 25 - Various Sensor Geometries and Examples

Lecture 26 - Microfabrication Technologies

Lecture 27 - Deposition Techniques

Lecture 28 - Physical Vapor Deposition

Lecture 29 - Chemical Vapor Deposition

Lecture 30 - Patterning Techniques

Lecture 31 - Lithography Techniques

[Lecture 32 - Basics of Etching Techniques](#)

[Lecture 33 - Dry Etching Techniques](#)

[Lecture 34 - Optical and Electron Microscopy](#)

[Lecture 35 - Other Microscopy Techniques](#)

[Lecture 36 - Sensor System: Basic Circuits](#)

[Lecture 37 - Amplifier Circuits](#)

[Lecture 38 - Instrumentation Amplifier](#)

[Lecture 39 - Filter Circuits](#)

[Lecture 40 - Sensor System: Experimental Demonstration](#)

Lecture 1 - Overview of Advanced Topics in Wireless Communication System - Part A

Lecture 2 - Overview of Advanced Topics in Wireless Communication System - Part B

Lecture 3 - Revision of Wireless Fundamentals - Part A

Lecture 4 - Revision of Wireless Fundamentals - Part B

Lecture 5 - Revision of Wireless Fundamentals - Part C

Lecture 6 - Revision of Wireless Fundamentals - Part D

Lecture 7 - Revision of Wireless Fundamentals - Part E

Lecture 8 - Channel Capacity in AWGN channel

Lecture 9 - Channel Capacity in flat fading channel

Lecture 10 - Channel Capacity with Optimal Power Adaptation

Lecture 11 - Tutorial 1 - MATLAB Tutorial: Channel Capacity

Lecture 12 - Introduction to Channel Coding

Lecture 13 - Channel Coding: Uncoded and Coded Performance

Lecture 14 - Introduction to Linear Block Codes

Lecture 15 - Tutorial 2 - MATLAB Tutorial: Linear Block Codes

Lecture 16 - Linear Block Codes: Error Detection

Lecture 17 - Linear Block Codes: Error Correction

Lecture 18 - Examples of Linear Block Codes

Lecture 19 - Introduction to Convolution Codes

Lecture 20 - Convolution Code: Decoder-Viterbi Algorithm

Lecture 21 - Tutorial 3 - MATLAB Tutorial: Syndrome Identification and Correction

Lecture 22 - Convolution Codes: State Diagram and Transfer Function

Lecture 23 - Turbo codes

Lecture 24 - Low Density Parity Check (LDPC) Codes: Encoding

Lecture 25 - Low Density Parity Check (LDPC) Codes: Decoding

Lecture 26 - Introduction to Polar Codes

Lecture 27 - Polar Codes: Encoding and Decoding

Lecture 28 - Introduction to MIMO systems

Lecture 29 - Spatial Diversity Techniques

Lecture 30 - Introduction to Space Time Block Codes

Lecture 31 - Tutorial 4 - Convolution Codes: Hard and Soft Decoding

[Lecture 32 - MIMO Zero-Forcing Receiver](#)

[Lecture 33 - MIMO MMSE Receiver](#)

[Lecture 34 - Introduction to MIMO SVD](#)

[Lecture 35 - Diagonalization of MIMO channel](#)

[Lecture 36 - Optimal Capacity of MIMO channel and MIMO Beamforming](#)

[Lecture 37 - Tutorial 5 - Random Access Technoques: ALOHA and CSMA](#)

[Lecture 38 - MIMO V-BLAST Receivers](#)

[Lecture 39 - Introduction to Adaptive Modulation and Coding](#)

[Lecture 40 - Modulation and Coding with Variable MQAM](#)

[Lecture 41 - Conventional Multiple Access Schemes](#)

[Lecture 42 - Next generation Multiple Access Schemes and Multi-User Channels](#)

[Lecture 43 - Overview of Cellular and Wi-Fi Standards](#)

[Lecture 44 - Evolution of Cellular and Wi-Fi Standards](#)

[Lecture 45 - Tutorial 6 - MIMO SVD Example](#)

[Lecture 46 - Tutorial 7 - Rate Splitting Multiple Access](#)

Lecture 1 - Introduction

Lecture 2 - Standard State-space Representation of Physical Systems

Lecture 3 - Mathematical Modeling from First Principles

Lecture 4 - Mathematical Modeling from First Principles

Lecture 5 - State-space Representation of Transfer Functions

Lecture 6 - State-space Representation of Transfer Functions (Continued...)

Lecture 7 - Equivalent Dynamical Equations

Lecture 8 - Transformation of State Equations into Canonical forms

Lecture 9 - Solution of State Equations

Lecture 10 - Solution of State Equations: Methods to determine the STM

Lecture 11 - Simulation: An Overview

Lecture 12 - Numerical Solution of State Equations

Lecture 13 - Controllability

Lecture 14 - Controllability

Lecture 15 - Controllability

Lecture 16 - Observability

Lecture 17 - Lypunov's Stability - 1

Lecture 18 - Lypunov's Stability - 2

Lecture 19 - Lypunov's Stability - 3

Lecture 20 - Pole Placement Design-I: Concept of State feedback

Lecture 21 - Pole Placement Design-II: Properties of State Feedback

Lecture 22 - Pole Placement Design-III: Pole placement formulae, Selection of Closed loop pole locations

Lecture 23 - Linear Quadratic Optimal Control - Part 1

Lecture 24 - Linear Quadratic Optimal Control - Part 2

Lecture 25 - Linear Observers-Full Order Observer

Lecture 26 - Linear Observers-Reduced Order Observer

Lecture 27 - Separation Principle

Lecture 28 - Multirate Sampling Controllers-Relationship between System state, multirate output samples and inputs

Lecture 29 - Multirate Output Controller (MROC)

Lecture 30 - Fast Output Sampling (FOS) Controller

Lecture 31 - Periodic Output Feedback (POF) Controller

[Lecture 32 - Continuous-Time Kalman Filter](#)

[Lecture 33 - Discrete-Time Kalman Filter](#)

[Lecture 34 - Case Study of Nuclear Reactor: Nonlinear Model Development](#)

[Lecture 35 - Case Study of Nuclear Reactor: Model Linearization](#)

[Lecture 36 - Case Study of Nuclear Reactor: Output Feedback Control Design](#)

[Lecture 37 - Case Study of Nuclear Reactor: Periodic Output Feedback Design](#)

[Lecture 38 - Case Study of Nuclear Reactor: Fast Output Sampling based Control Design](#)

[Lecture 39 - Case Study of Nuclear Reactor: Application of Kalman Filtering to Response Improvement of Vanadium SPND](#)

- Lecture 1 - Introduction to the course - 1 - Prerequisites, key elements
- Lecture 2 - Introduction to the course - 2 - Types of problems
- Lecture 3 - Introduction to the course - 3 - An optimization example to live longer
- Lecture 4 - Summary of background material - Linear Algebra - I
- Lecture 5 - Summary of background material - Linear Algebra - II
- Lecture 6 - Summary of background material - Analysis - I
- Lecture 7 - Summary of background material - Analysis - II
- Lecture 8 - Summary of background material - Analysis - III
- Lecture 9 - Summary of background material - Calculus - I
- Lecture 10 - Summary of background material - Calculus - II
- Lecture 11 - Summary of background material - Calculus - III
- Lecture 12 - Example of Multivariate Differentiation
- Lecture 13 - Gradient of Quadratic form and product rule
- Lecture 14 - Directional derivative, hessian, and mean value theorem
- Lecture 15 - Unconstrained optimization - 1 - Roadmap of the course and Taylor's theorem
- Lecture 16 - Unconstrained optimization - 2 - Identifying a local minima - 1st and 2nd order conditions
- Lecture 17 - Unconstrained optimization - 3 - Proof of 1st Order Condition
- Lecture 18 - Unconstrained optimization - 4 - overview of algorithms and choosing a descent direction
- Lecture 19 - Unconstrained optimization - 5 - properties of descent directions steepest descent direction
- Lecture 20 - Unconstrained optimization - 6 - properties of descent directions newton direction
- Lecture 21 - Unconstrained optimization - 7 - Trust Region Methods
- Lecture 22 - A MATLAB session
- Lecture 23 - Introduction to Line Search
- Lecture 24 - Wolfe Conditions
- Lecture 25 - Strong Wolfe Conditions
- Lecture 26 - Backtracking Line Search
- Lecture 27 - Line Search - Analysis
- Lecture 28 - Line Search - Convergence and Rate - 1
- Lecture 29 - Line Search - Convergence and Rate - 2
- Lecture 30 - Convergence analysis of a descent algorithm - 1
- Lecture 31 - Convergence analysis of a descent algorithm - 2

Lecture 32 - Implementation of an optimization algorithm in MATLAB

Lecture 33 - Conjugate Gradient Methods - Introduction and Proof

Lecture 34 - Visualizing Quadratic Forms

Lecture 35 - Orthogonality and Conjugacy

Lecture 36 - Conjugate Directions Method - Introduction and Proof

Lecture 37 - Discussion on doubts

Lecture 38 - More on Conjugate Directions Method

Lecture 39 - Ways of Generating Conjugate Directions

Lecture 40 - Expanding Subspace Theorem

Lecture 41 - Discussion on doubts

Lecture 42 - Conjugate Gradient Method

Lecture 43 - MATLAB implementation on CGM

Lecture 44 - Discussion on doubts

Lecture 45 - Preconditioned Conjugate Gradient - Part 1

Lecture 46 - Preconditioned Conjugate Gradient - Part 2

Lecture 47 - Preconditioned Conjugate Gradient - Part 3

Lecture 48 - Non Linear Conjugate Gradient method

Lecture 49 - Intro to Newton methods

Lecture 50 - Newton methods and convergence

Lecture 51 - Checks for positive definite matrices

Lecture 52 - Hessian Modification

Lecture 53 - Quasi newton methods

Lecture 54 - BFGS method

Lecture 55 - Least squares problems

Lecture 56 - Linear least squares - Part 1

Lecture 57 - Linear least squares - Part 2

Lecture 58 - Solving least squares using SVD

Lecture 59 - Non linear least squares

Lecture 60 - Constrained Optimisation

Lecture 61 - Single equality constraint

Lecture 62 - Single inequality constraint - Part 1

Lecture 63 - Single inequality constraint - Part 2

Lecture 64 - Two inequality constraints example

[Lecture 65 - Linearised feasible directions](#)

[Lecture 66 - Feasible sequences and tangent cone](#)

[Lecture 67 - LICQ conditions](#)

[Lecture 68 - KKT conditions \(First order necessary conditions\)](#)

[Lecture 69 - Proof sketch for KKT conditions - Part 1](#)

[Lecture 70 - Proof sketch for KKT conditions - Part 2](#)

[Lecture 71 - Introduction to Projected gradient descent](#)

[Lecture 72 - Projected gradient descent and proof of convergence](#)

[Lecture 73 - Proof of convergence - Part 2](#)

[Lecture 74 - Subgradients and Subdifferential](#)

[Lecture 75 - Projection onto \$l_1\$ ball](#)

[Lecture 76 - Soft thresholding example](#)

[Lecture 77 - Recap of Projection onto \$l_1\$ ball](#)

[Lecture 78 - KKT and duality introduction](#)

[Lecture 79 - Intuition of duality and dual problem](#)

[Lecture 80 - Proof of concavity of the dual problem - Part 1](#)

[Lecture 81 - Proof of concavity of the dual problem - Part 2](#)

[Lecture 82 - Proof of concavity of the dual problem - Part 3](#)

- Lecture 1 - Introduction Wide Bandgap Devices
- Lecture 2 - Characterization Of Wide Bandgap Devices
- Lecture 3 - Static Characterization Of Power Devices
- Lecture 4 - Junction Capacitance Characterization Of Power Devices
- Lecture 5 - Fundamentals Of Dynamic Characterization
- Lecture 6 - Fundamentals Of Dynamic Characterization (Continued...)
- Lecture 7 - Gate Drive For Dynamic Characterization
- Lecture 8 - Gate Drive For Dynamic Characterization (Continued...)
- Lecture 9 - Gate Drive For Dynamic Characterization (Continued...)
- Lecture 10 - Gate Driver Protection
- Lecture 11 - Dpt-Protection
- Lecture 12 - Protection-Dpt
- Lecture 13 - Cross Talk Consideration
- Lecture 14 - Cross Talk Consideration (Continued...)
- Lecture 15 - Layout Design And Parasitic Management
- Lecture 16 - Layout Design And Parasitic Management (Continued...)
- Lecture 17 - Layout
- Lecture 18 - Heat Sink
- Lecture 19 - Heat Sink (Continued...)
- Lecture 20 - Electromagnetic Interference (EMI) - Part 1
- Lecture 21 - Electromagnetic Interference (EMI) - Part 2
- Lecture 22 - Electromagnetic Interference (EMI) - Part 3
- Lecture 23 - Electromagnetic Interference (EMI) - Passive Filter
- Lecture 24 - Electromagnetic Interference (EMI) - Active Filter
- Lecture 25 - Getting Started With Ltspice
- Lecture 26 - Getting Started With Ltspice - Part 1
- Lecture 27 - Getting Started With Ltspice - Part 2
- Lecture 28 - EMI Simulation with LTspice - Part 1
- Lecture 29 - EMI Simulation with LTspice - Part 2
- Lecture 30 - Power Density - Part 1
- Lecture 31 - Power Density - Part 2

[Lecture 32 - Introduction to PCB Design](#)

[Lecture 33 - PCB Design](#)

[Lecture 34 - WBG Applications - IMD](#)

[Lecture 35 - WBG Applications - Renewable Energy Sources](#)

[Lecture 36 - WBG Applications - Reliability Analysis](#)

Lecture 1 - Introduction and Performance Index

Lecture 2 - Basic Concepts of Calculus of Variation

Lecture 3 - The Basic Variational Problem

Lecture 4 - Fixed End Point Problem

Lecture 5 - Free End Point Problem

Lecture 6 - Free End Point Problem (Continued...)

Lecture 7 - Free End Point Problem (Continued...)

Lecture 8 - Free End Point Problem (Continued...)

Lecture 9 - Optimum of Functions with Conditions

Lecture 10 - Optimum of Functions with Conditions (Lagrange Multiplier Method)

Lecture 11 - Optimum of Functional with Conditions

Lecture 12 - Variational Approach to Optimal Control Systems

Lecture 13 - Variational Approach to Optimal Control Systems (Continued...)

Lecture 14 - Linear Quadratic Optimal Control Systems

Lecture 15 - Linear Quadratic Optimal Control Systems (Continued...)

Lecture 16 - Linear Quadratic Optimal Control Systems (Continued...)

Lecture 17 - Linear Quadratic Optimal Control Systems (Continued...)

Lecture 18 - Linear Quadratic Optimal Control Systems (Continued...)

Lecture 19 - Linear Quadratic Optimal Control Systems (Optimal Value of Performance Index)

Lecture 20 - Infinite Horizon Regulator Problem

Lecture 21 - Infinite Horizon Regulator Problem (Continued...)

Lecture 22 - Analytical Solution of MDRE - State Transition Matrix Approach

Lecture 23 - Analytical Solution of MDRE - Similarity Transformation Approach

Lecture 24 - Analytical Solution of MDRE - Similarity Transformation Approach (Continued...)

Lecture 25 - Frequency Domain Interpretation of LQR - Linear Time Invariant System

Lecture 26 - Frequency Domain Interpretation of LQR - Linear Time Invariant System (Continued...)

Lecture 27 - LQR with a Specified Degree of Stability

Lecture 28 - Inverse Matrix Riccati Equation

Lecture 29 - Linear Quadratic Tracking System

Lecture 30 - Discrete-Time Optimal Control Systems

Lecture 31 - Discrete-Time Optimal Control Systems (Continued...)

[Lecture 32 - Discrete-Time Optimal Control Systems \(Continued...\)](#)

[Lecture 33 - Matrix Discrete Riccati Equation](#)

[Lecture 34 - Analytical Solution of Matrix Difference Riccati Equation](#)

[Lecture 35 - Analytical Solution of Matrix Difference Riccati Equation \(Continued...\)](#)

[Lecture 36 - Optimal Control using Dynamic Programming](#)

[Lecture 37 - The Hamilton-Jacobi-Bellman \(HJB\) Equation](#)

[Lecture 38 - LQR System Using HJB Equation](#)

[Lecture 39 - Time Optimal Control System - Constrained Input](#)

[Lecture 40 - Time Optimal Control System \(Continued...\)](#)

Lecture 1 - Foundation for software defined radio

Lecture 2 - Components of a software defined radio

Lecture 3 - Software defined radio architectures - Part I

Lecture 4 - Software defined radio architectures - Part II

Lecture 5 - Software defined radio architectures - Part III

Lecture 6 - Software defined radio architectures - Part IV

Lecture 7 - Distortion Parameters - Part I

Lecture 8 - Distortion Parameters - Part II

Lecture 9 - Distortion Parameters: Nonlinear Distortion

Lecture 10 - Distortion Parameters: Nonlinearity Specifications

Lecture 11 - Power Amplifiers: Nonlinear Distortion in Transmitted Signals

Lecture 12 - Power Amplifiers: Useful Definitions

Lecture 13 - Case study-I: Power amplifier Line-up for achieving linearity and power requirement example

Lecture 14 - Case study-II: Power amplifier Line-up for linearity and power requirement: Need for linearization techniques

Lecture 15 - Behavioral models for representing nonlinear distortions

Lecture 16 - Linearization Techniques for nonlinear distortion

Lecture 17 - Predistortion Techniques for nonlinearity distortion in SDR

Lecture 18 - Basic Digital Predistortion Techniques for nonlinear distortion in SDR

Lecture 19 - State-of-the-art Digital Predistortion Techniques for Nonlinear Distortion in SDR

Lecture 20 - Digital Predistortion Techniques for Linear as well as Nonlinear Distortion in SDR

- Lecture 1 - Introduction to Electrical Distribution System
- Lecture 2 - Components of Distribution System Substation and Busbar Layouts
- Lecture 3 - Components of Distribution System and Feeder Configurations
- Lecture 4 - Nature of Loads in a Distribution System
- Lecture 5 - Load Allocation in a Distribution System
- Lecture 6 - K Factors and Their Applications
- Lecture 7 - Analysis of Uniformly Distributed Loads
- Lecture 8 - Lumping Loads in Geometric Configurations: Rectangular
- Lecture 9 - Lumping Loads in Geometric Configurations: Triangular
- Lecture 10 - Impedance of Distribution Lines and Feeders - Part I
- Lecture 11 - Series Impedance of Distribution Lines and Feeders - Part II
- Lecture 12 - Models of Distribution Lines and Cables
- Lecture 13 - Modelling of Single-Phase and Three-Phase Transformers
- Lecture 14 - Modelling of Three-Phase Transformers - Part I
- Lecture 15 - Modelling of Three-Phase Transformers - Part II
- Lecture 16 - Modelling of Three-Phase Transformers - Part III
- Lecture 17 - Modelling of Three-Phase Transformers - Part IV
- Lecture 18 - Modelling of Step Voltage Regulators - Part I
- Lecture 19 - Modelling of Step Voltage Regulators - Part II
- Lecture 20 - Modelling of Step Voltage Regulators - Part III
- Lecture 21 - Modelling of Step Voltage Regulators - Part IV
- Lecture 22 - Load Models in Distribution System - Part I
- Lecture 23 - Load Models in Distribution System - Part II
- Lecture 24 - Modelling of Distributed Generation
- Lecture 25 - Applications and Modeling of Capacitor Banks
- Lecture 26 - Summary of Modelling of Distribution System Components
- Lecture 27 - Backward/Forward Sweep Load Flow Analysis - Part I
- Lecture 28 - Backward/Forward Sweep Load Flow Analysis - Part II
- Lecture 29 - Direct Approach Based Load Flow Analysis - Part I
- Lecture 30 - Direct Approach Based Load Flow Analysis - Part II
- Lecture 31 - Direct Approach Based Load Flow Analysis - Part III

- Lecture 32 - Direct Approach Based Load Flow Analysis: Weakly Meshed System
- Lecture 33 - Gauss Implicit Z-matrix Method
- Lecture 34 - Sequence Component Based Short Circuit Analysis
- Lecture 35 - Thevenin's Equivalent and Phase Variable Based Short Circuit Analysis
- Lecture 36 - Direct Approach for Short-Circuit Analysis: Introduction and LG Fault
- Lecture 37 - Direct Approach for Short-Circuit Analysis: LLG and LLLG Fault
- Lecture 38 - Direct Approach for Short-Circuit Analysis: LL Fault and Examples
- Lecture 39 - Direct Approach for Short-Circuit Analysis: Weakly Meshed System
- Lecture 40 - Applications of Distribution System Analysis
- Lecture 41 - Distributed Generation Integration Issues in Distribution System
- Lecture 42 - Distribution System Protection Issues
- Lecture 43 - Power Quality, Reliability and Availability
- Lecture 44 - Design and Operation - Part I
- Lecture 45 - Design and Operation - Part II
- Lecture 46 - Definition and objective of Volt-var control (VVC)
- Lecture 47 - Traditional approaches of VVC
- Lecture 48 - Distribution Automation
- Lecture 49 - SCADA-Based VVC and Integrated VVC
- Lecture 50 - Advanced technologies for VVC - Part I
- Lecture 51 - Advanced technologies for VVC - Part II
- Lecture 52 - System Planning - Part I
- Lecture 53 - System Planning - Part II
- Lecture 54 - Electricity Forecasting
- Lecture 55 - Case study: IIT Roorkee distribution system
- Lecture 56 - Optimization techniques
- Lecture 57 - Optimal location and sizing battery energy storage system (BESS)
- Lecture 58 - Practical Insights into Electrical Distribution Systems
- Lecture 59 - Field Deployment of BESS
- Lecture 60 - Emerging Technologies and Future Trends

Lecture 1 - Introduction to Smart Grid - I

Lecture 2 - Introduction to Smart Grid - II

Lecture 3 - Architecture of smart grid system

Lecture 4 - Standards for smart grid system

Lecture 5 - Elements and Technologies of smart grid system - I

Lecture 6 - Elements and Technologies of smart grid system - II

Lecture 7 - Distributed Generation Resources - I

Lecture 8 - Distributed Generation Resources - II

Lecture 9 - Distributed Generation Resources - III

Lecture 10 - Distributed Generation Resources - IV

Lecture 11 - Wide Area Monitoring System - I

Lecture 12 - Wide Area Monitoring System - II

Lecture 13 - Phasor Estimation - I

Lecture 14 - Phasor Estimation - II

Lecture 15 - Digital Relays for Smart Grid Protection

Lecture 16 - Islanding Detection Techniques - I

Lecture 17 - Islanding Detection Techniques - II

Lecture 18 - Islanding Detection Techniques - III

Lecture 19 - Smart Grid Protection - I

Lecture 20 - Smart Grid Protection - II

Lecture 21 - Smart Grid Protection - III

Lecture 22 - Smart Grid Protection - IV

Lecture 23 - Modelling of Storage Devices

Lecture 24 - Modelling of DC Smart Grid Components

Lecture 25 - Operation and Control of AC Microgrid - I

Lecture 26 - Operation and Control of AC Microgrid - II

Lecture 27 - Operation and Control of DC Microgrid - I

Lecture 28 - Operation and Control of DC Microgrid - II

Lecture 29 - Operation and Control of AC-DC hybrid Microgrid - I

Lecture 30 - Operation and Control of AC-DC hybrid Microgrid - II

Lecture 31 - Simulation and Case Study of AC Microgrid

[Lecture 32 - Simulation and Case Study of DC Microgrid](#)

[Lecture 33 - Simulation and Case Study of AC-DC Hybrid Microgrid](#)

[Lecture 34 - Demand Side Management in Smart Grid](#)

[Lecture 35 - Demand Response Analysis of Smart Grid](#)

[Lecture 36 - Energy Management](#)

[Lecture 37 - Design of Smart Grid and Practical Smart Grid Case Study - I](#)

[Lecture 38 - Design of Smart Grid and Practical Smart Grid Case Study - II](#)

[Lecture 39 - System Analysis of AC/DC Smart Grid](#)

[Lecture 40 - Conclusions](#)

Lecture 1 - Introduction - I

Lecture 2 - Introduction - II

Lecture 3 - Switch Realization

Lecture 4 - PWM - I

Lecture 5 - PWM - II

Lecture 6 - Closed Loop Control

Lecture 7 - Multi Level Inverter - I

Lecture 8 - Multi Level Inverter - II

Lecture 9 - Multi Level Inverter - III

Lecture 10 - Shunt Compensator Analysis

Lecture 11 - Shunt Compensator TCR and TSC - I

Lecture 12 - Shunt Compensator TCR and TSC - II

Lecture 13 - Static Var Compensator - I

Lecture 14 - Static Var Compensator - II

Lecture 15 - STATCOM - I

Lecture 16 - STATCOM - II

Lecture 17 - STATCOM/SVC Comparisons

Lecture 18 - External Control Design of Static Var Compensator

Lecture 19 - DSTATCOM

Lecture 20 - Design of DSTATCOM

Lecture 21 - Series Compensator - I

Lecture 22 - Series Compensator - II

Lecture 23 - GCSC and SSSC

Lecture 24 - SSSC - II

Lecture 25 - SSSC - III and TSSC

Lecture 26 - TSSC - II and TCSC

Lecture 27 - TCSC Characteristics and Control

Lecture 28 - Voltage and Phase Angle Regulation

Lecture 29 - Voltage and Phase Angle Regulator Device - I

Lecture 30 - Voltage and Phase Angle Regulator Device - II

Lecture 31 - UPQC Introduction and Classification

[Lecture 32 - UPQC Classification - I](#)

[Lecture 33 - Operation and Control of UPQC - II](#)

[Lecture 34 - Operation and Control of UPQC - III](#)

[Lecture 35 - UPFC](#)

[Lecture 36 - Control Structure of UPFC](#)

[Lecture 37 - Comparison of UPFC with PAR and Series Compensators](#)

[Lecture 38 - Interline Power Flow Controller \(IPFC\) - I](#)

[Lecture 39 - Interline Power Flow Controller \(IPFC\) - II](#)

[Lecture 40 - Practical Application and Conclusion](#)

Lecture 1 - Introduction to State Space

Lecture 2 - State Space Representation

Lecture 3 - State Space Representation: Companion Form (Controllable Canonical Form)

Lecture 4 - State Space Representation: Extended Controllable Canonical Form

Lecture 5 - State Space Representation: Observable Canonical Form

Lecture 6 - State Space Representation: Diagonal Canonical Form - Part I

Lecture 7 - State Space Representation: Diagonal Canonical Form - Part II

Lecture 8 - State Space Representation: Jordan Canonical Form

Lecture 9 - State Space Representation: Numerical Examples on State space Modelling - Part I

Lecture 10 - State Space Representation: Numerical Examples on State space Modelling - Part II

Lecture 11 - Modelling of Mechanical Systems in State Space

Lecture 12 - Modelling of DC Servo Motor - Part I

Lecture 13 - Modelling of DC Servo Motor - Part II

Lecture 14 - Determination of Transfer Function from State Space Model - Part I

Lecture 15 - Determination of Transfer Function from State Space Model - Part II

Lecture 16 - Stability Analysis in State Space: Concept of Eigenvalues and Eigenvectors - Part I

Lecture 17 - Stability Analysis in State Space - Part II

Lecture 18 - Stability Analysis in State Space: Lyapunov Stability Analysis (Sylvester's Criterion) - Part III

Lecture 19 - Stability Analysis in State Space: Lyapunov Stability Analysis (Stability Criterion) - Part IV

Lecture 20 - Stability Analysis in State Space: Lyapunov Stability Analysis (Direct Method) - Part V

Lecture 21 - Concept of Diagonalization

Lecture 22 - Solution of State Equation

Lecture 23 - Solution of State Equation (Forced System)

Lecture 24 - Steady State Error for State Space System

Lecture 25 - State Transition Matrix - Part I

Lecture 26 - State Transition Matrix - Part II

Lecture 27 - State Transition Matrix using Cayley-Hamilton Theorem - Part III

Lecture 28 - MATLAB Programming with State Space

Lecture 29 - Controllability in State Space - Part I

Lecture 30 - Controllability in State Space - Part II

[Lecture 31 - Observability in State Space - Part I](#)

[Lecture 32 - Observability in State Space - Part II](#)

[Lecture 33 - Pole Placement by State Feedback - Part I](#)

[Lecture 34 - Pole Placement by State Feedback - Part II](#)

[Lecture 35 - Pole Placement by State Feedback - Part III](#)

[Lecture 36 - Tracking Problem in State Feedback Design - Part I](#)

[Lecture 37 - Tracking Problem in State Feedback Design - Part II](#)

[Lecture 38 - State Observer Design - Part I](#)

[Lecture 39 - State Observer Design - Part II](#)

[Lecture 40 - State Observer Design - Part III](#)

- Lecture 1 - Modeling of Power System Components
- Lecture 2 - Modeling of Power System Components (Continued...)
- Lecture 3 - Bus Admittance Matrix
- Lecture 4 - Bus Admittance Matrix with Mutual Impedance
- Lecture 5 - Bus Admittance Matrix with mutual impedance (Continued...)
- Lecture 6 - Power flow equations and classification of buses
- Lecture 7 - Basic Gauss - Seidel Numerical Method
- Lecture 8 - Gauss - Seidel Load Flow (GSLF)
- Lecture 9 - GSLF with Multiple Generators
- Lecture 10 - Example of GSLF
- Lecture 11 - Basics of Newton Raphson Numerical Method
- Lecture 12 - Newton - Raphson Load Flow (NRLF) in Polar Co-Ordinate
- Lecture 13 - NRLF in polar co-ordinate (Continued...)
- Lecture 14 - NRLF in polar co-ordinate (Continued...)
- Lecture 15 - NRLF (Polar) Algorithm and Example
- Lecture 16 - NRLF in rectangular coordinate
- Lecture 17 - NRLF in rectangular coordinate (Continued...)
- Lecture 18 - NRLF in rectangular coordinate (Continued...)
- Lecture 19 - Example of NRLF (Rectangular) Method
- Lecture 20 - Fast decoupled load flow (FDLF)
- Lecture 21 - FDLF (Continued...)
- Lecture 22 - FDLF (Continued...)
- Lecture 23 - AC- DC Load Flow
- Lecture 24 - AC- DC Load Flow (Continued...)
- Lecture 25 - AC- DC Load Flow (Continued...)
- Lecture 26 - Sparsity and Gaussian Elimination
- Lecture 27 - Gaussian Elimination Method
- Lecture 28 - Example of Gaussian Elimination Method
- Lecture 29 - Gaussian Elimination and Optimal Ordering
- Lecture 30 - Triangular Factorization
- Lecture 31 - LU Decomposition

- [Lecture 32 - Introduction to Contingency Analysis](#)
- [Lecture 33 - Linear Sensitivity Factor](#)
- [Lecture 34 - Linear Sensitivity Factors \(Continued...\)](#)
- [Lecture 35 - Line outage sensitivity factor](#)
- [Lecture 36 - Line outage sensitivity factor \(Continued...\)](#)
- [Lecture 37 - Line outage sensitivity factor \(Continued...\)](#)
- [Lecture 38 - State Estimation Technique](#)
- [Lecture 39 - Weighted Least Square \(WLS\) Method](#)
- [Lecture 40 - WLS \(Continued...\)](#)
- [Lecture 41 - WLS Examples](#)
- [Lecture 42 - Error Analysis](#)
- [Lecture 43 - Error Analysis \(Continued...\)](#)
- [Lecture 44 - Bad Data Detection](#)
- [Lecture 45 - Power system state estimation](#)
- [Lecture 46 - Power system state estimation \(Continued...\)](#)
- [Lecture 47 - Power system state estimation \(Continued...\)](#)
- [Lecture 48 - Power system state estimation \(Continued...\)](#)
- [Lecture 49 - Fault Analysis](#)
- [Lecture 50 - Fault Analysis \(Continued...\)](#)
- [Lecture 51 - Fault Analysis \(Continued...\)](#)
- [Lecture 52 - Fault Analysis \(Continued...\)](#)
- [Lecture 53 - Fault Analysis \(Continued...\)](#)
- [Lecture 54 - Fault Analysis \(Continued...\)](#)
- [Lecture 55 - Fault Analysis \(Continued...\)](#)
- [Lecture 56 - Fault Analysis \(Continued...\)](#)
- [Lecture 57 - Fault Analysis \(Continued...\)](#)
- [Lecture 58 - Fault Analysis \(Continued...\)](#)
- [Lecture 59 - Fault Analysis \(Continued...\)](#)
- [Lecture 60 - Fault Analysis \(Continued...\)](#)

Lecture 1 - Introduction

Lecture 2 - Basic Concept of Switches

Lecture 3 - Device Physics - I

Lecture 4 - Device Physics - II

Lecture 5 - Device Physics - III

Lecture 6 - Device Physics - IV

Lecture 7 - Application and Analysis of Switches - I

Lecture 8 - Application and Analysis of Switches - II

Lecture 9 - Single Phase Converter

Lecture 10 - Single Phase Converters - II

Lecture 11 - Single Phase Converters - III

Lecture 12 - Three Phase Converters - I

Lecture 13 - Three Phase Converters - II

Lecture 14 - Multipulse Converters II

Lecture 15 - Effect of Source Inductance and PWM Rectifiers

Lecture 16 - PWM Rectifiers - II

Lecture 17 - PWM Rectifiers - III and Power Factor Improvement Techniques

Lecture 18 - PWM Rectifiers - IV and Power Factor Improvement Techniques - II

Lecture 19 - Power Factor Improvement Techniques III and Non Isolated DC- DC Converters

Lecture 20 - Non Isolated DC- DC Converters - II

Lecture 21 - Non Isolated and Isolated DC- DC Converters and Choppers

Lecture 22 - Isolated DC-DC Converters and Choppers

Lecture 23 - Isolated DC-DC Converters - II

Lecture 24 - Isolated DC-DC Converters - III

Lecture 25 - Isolated DC-DC Converters - IV and VSI and CSI

Lecture 26 - VSI and CSI

Lecture 27 - VSI and CSI II and MLI

Lecture 28 - PWM Techniques II and MLI

Lecture 29 - MLI II and ZSI

Lecture 30 - ZSI II and Space Vector Modulation (SVM)

Lecture 31 - SVM II and AC to AC Converters

[Lecture 32 - SVM III and AC to AC Converters](#)

[Lecture 33 - Cycloconverters and Matrix Converters](#)

[Lecture 34 - Matrix Converter - II](#)

[Lecture 35 - Matrix Converter - III and Power Quality Mitigation Devices](#)

[Lecture 36 - Power Quality Mitigation Devices - II](#)

[Lecture 37 - Linear and Non Linear Control in Power Electronics - I](#)

[Lecture 38 - Linear and Non Linear Control in Power Electronics - II](#)

[Lecture 39 - Non-Linear Control in Power Electronics](#)

[Lecture 40 - Application and Conclusion](#)

Lecture 1 - MOS Transistor Basics - I

Lecture 2 - MOS Transistor Basics - II

Lecture 3 - MOS Transistor Basics - III

Lecture 4 - MOS Parasitics and SPICE Model

Lecture 5 - CMOS Inverter Basics - I

Lecture 6 - CMOS Inverter Basics - II

Lecture 7 - CMOS Inverter Basics - III

Lecture 8 - Power Analysis - I

Lecture 9 - Power Analysis - II

Lecture 10 - SPICE Simulation - I

Lecture 11 - SPICE Simulation - II

Lecture 12 - Combinational Logic Design - I

Lecture 13 - Combinational Logic Design - II

Lecture 14 - Combinational Logic Design - III

Lecture 15 - Combinational Logic Design - IV

Lecture 16 - Combinational Logic Design - V

Lecture 17 - Combinational Logic Design - VI

Lecture 18 - Combinational Logic Design - VII

Lecture 19 - Combinational Logic Design - VIII

Lecture 20 - Combinational Logic Design - IX

Lecture 21 - Combinational Logic Design - X

Lecture 22 - Logical Efforts - I

Lecture 23 - Logical Efforts - II

Lecture 24 - Logical Efforts - III

Lecture 25 - Sequential Logic Design - I

Lecture 26 - Sequential Logic Design - II

Lecture 27 - Sequential Logic Design - III

Lecture 28 - Sequential Logic Design - IV

Lecture 29 - Sequential Logic Design - V

Lecture 30 - Sequential Logic Design - VI

Lecture 31 - Sequential Logic Design - VII

[Lecture 32 - Sequential Logic Design - VIII](#)

[Lecture 33 - Clocking Strategies for Sequential Design - I](#)

[Lecture 34 - Clocking Strategies for Sequential Design - II](#)

[Lecture 35 - Clocking Strategies for Sequential Design - III](#)

[Lecture 36 - Clocking Strategies for Sequential Design - IV](#)

[Lecture 37 - Sequential Logic Design - IX](#)

[Lecture 38 - Clocking Strategies for Sequential Design - V](#)

[Lecture 39 - Concept of Memory and its Designing - I](#)

[Lecture 40 - Concept of Memory and its Designing - II](#)

Lecture 1 - Bipolar Junction Transistor : Physical structure and Modes of Operation

Lecture 2 - Bipolar Junction Transistor : Modes of operation - I

Lecture 3 - Bipolar Junction Transistor : Modes of operation - II

Lecture 4 - BJT Operation in active mode Circuit symbol and conventions - I

Lecture 5 - BJT Operation in active mode Circuit symbol and conventions - II

Lecture 6 - BJT as an amplifier small circuit model - I

Lecture 7 - BJT as an amplifier small circuit model - II

Lecture 8 - BJT Small Signal Circuit Model - I

Lecture 9 - BJT Small Signal Circuit Model - II

Lecture 10 - BJT as a switch and Ebers Moll Model

Lecture 11 - Simple BJT Inverter and second order effects

Lecture 12 - BJT Second order effects - I

Lecture 13 - BJT Second order effects - II

Lecture 14 - MOS Transistor basics - I

Lecture 15 - MOS Transistor basics - II

Lecture 16 - MOS Transistor basics - III

Lecture 17 - MOS Parasitic and SPICE Model

Lecture 18 - CMOS Inverter Basics - I

Lecture 19 - CMOS Inverter Basics - II

Lecture 20 - CMOS Inverter Basics - III

Lecture 21 - Power Analysis - I

Lecture 22 - Logical Efforts - I

Lecture 23 - Fabrication-Process - I

Lecture 24 - Fabrication-Process - II

Lecture 25 - Biasing of Amplifier and its behaviour as an Analog switch - I

Lecture 26 - Biasing of Amplifier and its behaviour as an Analog switch - II

Lecture 27 - Biasing of Amplifier and its behaviour as an Analog switch - III

Lecture 28 - CMOS CS/CG/CD Amplifier Configuration

Lecture 29 - CMOS CG/CD Amplifier Configuration

Lecture 30 - Internal CAP Models and high frequency Modelling - I

Lecture 31 - Internal CAP Models and high frequency Modelling - II

- Lecture 32 - JFET, Structure and Operation
- Lecture 33 - Multistage and Differential Amplifier - I
- Lecture 34 - Multistage and Differential Amplifier - II
- Lecture 35 - MOS Differential Amplifier - I
- Lecture 36 - MOS Differential Amplifier - II
- Lecture 37 - Small signal operation and Differential Amplifiers - I
- Lecture 38 - Small signal operation and Differential Amplifiers - II
- Lecture 39 - Multistage Amplifier with SPICE Simulation
- Lecture 40 - S-Domain Analysis, Transfer Function, Poles and Zeros - I
- Lecture 41 - S-Domain Analysis, Transfer Function, Poles and Zeros - II
- Lecture 42 - High Frequency response of CS and CE Amplifier
- Lecture 43 - High Frequency response of CC and SF Configuration
- Lecture 44 - Frequency response of Differential Amplifier
- Lecture 45 - General Feedback Structure and properties of negative Feedback
- Lecture 46 - Basic Feedback Topologies
- Lecture 47 - Design of feedback amplifier for all configuration
- Lecture 48 - Stability and amplifier poles
- Lecture 49 - Bode plots and Frequency Plot
- Lecture 50 - Ideal Operational Amplifier and its terminal
- Lecture 51 - Op-amp as a Integrator and Differentiator
- Lecture 52 - Large Signal Operation of Op-amp and second order effects
- Lecture 53 - Combinational logic design - I
- Lecture 54 - Combinational logic design - II
- Lecture 55 - Combinational logic design - III
- Lecture 56 - Combinational logic design - IV
- Lecture 57 - Sequential logic design - I
- Lecture 58 - Clocking strategies For Sequential design - I
- Lecture 59 - Clocking strategies For Sequential design - II
- Lecture 60 - Memory Design

NPTEL : NOC:DC Microgrid (Electrical Engineering)

Co-ordinators : Prof. Avik Bhattacharya

Lecture 1 - Overview of Microgrids

Lecture 2 - Concept of Microgrids

Lecture 3 - Microgrid and distributed generation

Lecture 4 - Microgrid vs Conventional Power System

Lecture 5 - AC and DC Microgrid with Distributed Energy Resources (AC Microgrid Part)

Lecture 6 - AC and DC Microgrid with Distributed Energy Resources (AC Microgrid Part) (Continued...)

Lecture 7 - Power Electronics for Microgrid

Lecture 8 - Power Electronic Converters in Microgrid Applications

Lecture 9 - Power Electronic Converters in Microgrid Applications (Power Electronic for Interfacing)

Lecture 10 - Power Electronic Converters in Microgrid Applications (Converter Modulation Techniques)

Lecture 11 - Modeling of converters in microgrid power system (AC/DC and DC/AC Converters Modeling)

Lecture 12 - Modeling of Power Converters in Microgrid Power System (DC/DC Converter Modeling and Control)

Lecture 13 - Modeling of Renewable Energy Resources (Modeling of Wind Energy System)

Lecture 14 - Modeling of Renewable Energy Resources (Modeling of Photovoltaic System)

Lecture 15 - Modeling of Energy Storage System

Lecture 16 - Microgrid Dynamics and Modeling

Lecture 17 - Microgrid Dynamics and Modeling (Continued...)

Lecture 18 - Microgrid Operation Modes and Standards - Part I

Lecture 19 - Microgrid Operation Modes and Standards - Part II

Lecture 20 - Microgrid Control Architectures

Lecture 21 - Microgrid Control Architectures (Continued...)

Lecture 22 - Intelligent Microgrid Operation and Control

Lecture 23 - Intelligent Microgrid Operation and Control (Continued...)

Lecture 24 - Intelligent Microgrid Operation and Control (Continued...)

Lecture 25 - Energy Management in Microgrid System (Continued...)

Lecture 26 - DC Microgrid System Architecture and AC Interface

Lecture 27 - DC Microgrid System Architecture and AC Interface (Continued...)

Lecture 28 - DC Microgrid System Architecture and AC Interface (Continued...)

Lecture 29 - DC Microgrid Dynamics and Modeling

Lecture 30 - DC Microgrid Dynamics and Modeling (Continued...)

Lecture 31 - Control of DC Microgrid System

[Lecture 32 - Control of DC Microgrid System \(Continued...\)](#)

[Lecture 33 - Applications of DC Microgrids](#)

[Lecture 34 - Stability in Microgrid](#)

[Lecture 35 - Stability Analysis of DC Microgrid](#)

[Lecture 36 - Stability Analysis of DC Microgrid \(Continued...\)](#)

[Lecture 37 - DC Microgrid stabilization strategies \(Passive damping method\)](#)

[Lecture 38 - DC Microgrid Stabilization Strategies \(Impedance/Admittance stability criteria\)](#)

[Lecture 39 - DC microgrid stabilization using nonlinear Techniques](#)

[Lecture 40 - General Summary of DC Microgrids](#)

Lecture 1 - Introduction

Lecture 2 - Overview - I

Lecture 3 - Overview - II

Lecture 4 - Overview - III

Lecture 5 - Source of Poor Power Quality - I

Lecture 6 - Source of Poor Power Quality - II

Lecture 7 - AC Power Quality Standard

Lecture 8 - Improvement of Power Factor by Capacitor

Lecture 9 - Passive Filter - I

Lecture 10 - Passive Filter - II

Lecture 11 - Passive Filter Design - I

Lecture 12 - Passive Filter Design - II

Lecture 13 - PWM Rectifier - I

Lecture 14 - PWM Rectifier - II

Lecture 15 - PWM Rectifier - III

Lecture 16 - Three phase converters - I

Lecture 17 - Three Phase Converters - II and multi pulse Converters

Lecture 18 - Three Phase Converters - III and multi-pulse Converters

Lecture 19 - VSI and CSI

Lecture 20 - Multilevel Inverter - I

Lecture 21 - Multilevel Inverter - II

Lecture 22 - Multilevel Inverter - III

Lecture 23 - PWM for Voltage Source Inverter - I

Lecture 24 - PWM for Voltage Source Inverter - II

Lecture 25 - PWM for Voltage Source inverter - III

Lecture 26 - PWM for Voltage Source Inverter - IV

Lecture 27 - Operation and Control of Grid-Connected VSC

Lecture 28 - Grid Connected VSC with inner Current Control

Lecture 29 - Shunt Active Power Filter - I

Lecture 30 - Shunt Active Power Filter - II

Lecture 31 - Shunt Active Power Filter - III

[Lecture 32 - Shunt Active Power Filter - IV](#)

[Lecture 33 - Hybrid Active Power Filter - I](#)

[Lecture 34 - Hybrid Active power Filter - II](#)

[Lecture 35 - Hybrid Shunt Active Power Filter](#)

[Lecture 36 - UPQC Introduction and classification](#)

[Lecture 37 - UPQC Classification](#)

[Lecture 38 - Operation and Control of UPQC](#)

[Lecture 39 - Control of UPQC](#)

[Lecture 40 - Conclusion](#)

- Lecture 1 - Fundamentals of Protective Relaying - I
- Lecture 2 - Fundamentals of Protective Relaying - II
- Lecture 3 - Fundamentals of Protective Relaying - III
- Lecture 4 - Fundamentals of Protective Relaying - IV
- Lecture 5 - Fundamentals of Protective Relaying - V
- Lecture 6 - Current based Relaying Scheme - I
- Lecture 7 - Current based Relaying Scheme - II
- Lecture 8 - Current based Relaying Scheme - III
- Lecture 9 - Current based Relaying Scheme - IV
- Lecture 10 - Current based Relaying Scheme - V
- Lecture 11 - Current based Relaying Scheme - VI
- Lecture 12 - Current based Relaying Scheme - VII
- Lecture 13 - Current based Relaying Scheme - VIII
- Lecture 14 - Protection of Transmission Lines using Distance Relays - I
- Lecture 15 - Protection of Transmission Lines using Distance Relays - II
- Lecture 16 - Protection of Transmission Lines using Distance Relays - III
- Lecture 17 - Protection of Transmission Lines using Distance Relays - IV
- Lecture 18 - Protection of Transmission Lines using Distance Relays - V
- Lecture 19 - Carrier Aided Schemes for Transmission Lines - I
- Lecture 20 - Carrier Aided Schemes for Transmission Lines - II
- Lecture 21 - Carrier Aided Schemes for Transmission Lines - III
- Lecture 22 - Carrier Aided Schemes for Transmission Lines - IV
- Lecture 23 - Auto-reclosing and Synchronizing - I
- Lecture 24 - Auto-reclosing and Synchronizing - II
- Lecture 25 - Auto-reclosing and Synchronizing - III
- Lecture 26 - Protection of Transformers - I
- Lecture 27 - Protection of Transformers - II
- Lecture 28 - Protection of Generators - I
- Lecture 29 - Protection of Generators - II
- Lecture 30 - Protection of Induction Motors
- Lecture 31 - Protection of Busbars

[Lecture 32 - Protection against Transients and Surges along with System Response to Severe Upsets - I](#)

[Lecture 33 - Protection against Transients and Surges along with System Response to Severe Upsets - II](#)

[Lecture 34 - Arc Interruption Theory in Circuit Breaker - I](#)

[Lecture 35 - Arc Interruption Theory in Circuit Breaker - II](#)

[Lecture 36 - Arc Interruption Theory in Circuit Breaker - III](#)

[Lecture 37 - Arc Interruption Theory in Circuit Breaker - IV](#)

[Lecture 38 - Types of Circuit Breakers](#)

[Lecture 39 - Testing, Commissioning and Maintenance of Relays - I](#)

[Lecture 40 - Testing, Commissioning and Maintenance of Relays - II](#)

Lecture 1 - Basic of Wireless Communication - I

Lecture 2 - Basic of Wireless Communication - II

Lecture 3 - Basic of Wireless Communication - III

Lecture 4 - Basic of Wireless Communication - IV

Lecture 5 - Basic of Wireless Communication - V

Lecture 6 - Basic of Wireless Communication - VI

Lecture 7 - Noise in RF Systems - I

Lecture 8 - Noise in RF Systems - II

Lecture 9 - Noise in RF Systems - III

Lecture 10 - Noise in RF Systems - IV

Lecture 11 - Non-Linearity in RF Systems - I

Lecture 12 - Non-Linearity in RF Systems - II

Lecture 13 - Non-Linearity in RF Systems - III

Lecture 14 - Transceiver Architecture - I

Lecture 15 - Transceiver Architecture - II

Lecture 16 - Transceiver Architecture - III

Lecture 17 - Transceiver Architecture - IV

Lecture 18 - Transceiver Architecture - V

Lecture 19 - Transceiver Architecture - VI

Lecture 20 - Transceiver Architecture - VII

Lecture 21 - Active Devices - I

Lecture 22 - Active Devices - II

Lecture 23 - Active Devices - III

Lecture 24 - Active Devices - IV

Lecture 25 - Passive Components and Impedance Matching - I

Lecture 26 - Passive Components and Impedance Matching - II

Lecture 27 - Passive Components and Impedance Matching - III

Lecture 28 - Passive Components and Impedance Matching - IV

Lecture 29 - Passive Components and Impedance Matching - V

Lecture 30 - Passive Components and Impedance Matching - VI

Lecture 31 - Passive Components and Impedance Matching - VII

Lecture 32 - Stability and Amplifier Design - I
Lecture 33 - Stability and Amplifier Design - II
Lecture 34 - Stability and Amplifier Design - III
Lecture 35 - Stability and Amplifier Design - IV
Lecture 36 - Low Noise Amplifier Design - I
Lecture 37 - Low Noise Amplifier Design - II
Lecture 38 - Low Noise Amplifier Design - III
Lecture 39 - Low Noise Amplifier Design - IV
Lecture 40 - Low Noise Amplifier Design - V
Lecture 41 - Low Noise Amplifier Design - VI
Lecture 42 - Mixer Design - I
Lecture 43 - Mixer Design - II
Lecture 44 - Mixer Design - III
Lecture 45 - Mixer Design - IV
Lecture 46 - Mixer Design - V
Lecture 47 - Mixer Design - VI
Lecture 48 - Mixer Design - VII
Lecture 49 - Mixer Design - VIII
Lecture 50 - Mixer Design - IX
Lecture 51 - Oscillator Design - I
Lecture 52 - Oscillator Design - II
Lecture 53 - Oscillator Design - III
Lecture 54 - Oscillator Design - IV
Lecture 55 - Power Amplifier Design - I
Lecture 56 - Power Amplifier Design - II
Lecture 57 - Power Amplifier Design - III
Lecture 58 - Basics of Phase Locked Loop - I
Lecture 59 - Basics of Phase Locked Loop - II
Lecture 60 - System Level Considerations
Lecture 61 - RF Testing and Measurement Techniques

- Lecture 1 - Introduction to VLSI Design
- Lecture 2 - Introduction to VLSI Physical Design
- Lecture 3 - Complexity Analysis for Algorithms
- Lecture 4 - Graphs for Physical Design
- Lecture 5 - Graph searching Algorithms
- Lecture 6 - Spanning Tree and Shortest Path Algorithms
- Lecture 7 - Overview of Timing Analysis
- Lecture 8 - Timing Arcs and Unateness
- Lecture 9 - Delay Parameters of a Combinational Circuit
- Lecture 10 - Delay Parameters of a Sequential Circuit
- Lecture 11 - Timing Analysis in a Sequential Circuit
- Lecture 12 - STA in Sequential Circuit with Clock Skew - I
- Lecture 13 - STA in Sequential Circuit with Clock Skew - II
- Lecture 14 - STA in Sequential Circuit with Clock Jitter
- Lecture 15 - STA considering OCV and CRPR (Setup check)
- Lecture 16 - STA considering OCV and CRPR (Hold check)
- Lecture 17 - STA for Combinational Circuits - I
- Lecture 18 - STA for Combinational Circuits - II
- Lecture 19 - Introduction to Partitioning - I
- Lecture 20 - Introduction to Partitioning - II
- Lecture 21 - Partitioning Algorithms
- Lecture 22 - Kernighan-Lin (KL) Algorithm
- Lecture 23 - Fiduccia-Mattheyses (FM) Algorithm
- Lecture 24 - Introduction to Floorplanning
- Lecture 25 - Floorplanning Representations
- Lecture 26 - Floorplanning Algorithms - 1
- Lecture 27 - Floorplanning Algorithms - 2
- Lecture 28 - Pin Assignment and Power - Ground Routing
- Lecture 29 - Introduction to Placement
- Lecture 30 - Wirelength estimation techniques
- Lecture 31 - Min-cut placement

- Lecture 32 - Placement Algorithms
- Lecture 33 - Placement algorithms and legalization
- Lecture 34 - Introduction to Clock Tree Synthesis
- Lecture 35 - Clock Routing Algorithms - I
- Lecture 36 - Clock Routing Algorithms - II
- Lecture 37 - Clock Routing Algorithms - III
- Lecture 38 - Introduction and Optimization Goals - Global Routing
- Lecture 39 - Single net routing (Rectilinear routing)
- Lecture 40 - Global Routing in the connectivity graph
- Lecture 41 - Finding Shortest Paths with Dijkstra's Algorithm
- Lecture 42 - Full-Netlist Routing
- Lecture 43 - Introduction: Detailed Routing
- Lecture 44 - Channel Routing Algorithms - I
- Lecture 45 - Channel Routing Algorithms - II
- Lecture 46 - Switchbox and Over the cell routing
- Lecture 47 - Timing Constraints in latch based system
- Lecture 48 - Timing Constraints in Pulsed Latch-based System
- Lecture 49 - Time Borrowing in Latch
- Lecture 50 - Crosstalk Analysis
- Lecture 51 - Standard Cell Library
- Lecture 52 - Low Power Cells in Standard Cell Library
- Lecture 53 - Sub-threshold Standard Cell Library
- Lecture 54 - Timing Library for Standard Cells
- Lecture 55 - PDK and Other files
- Lecture 56 - Open-Source Tool Installation and Qflow
- Lecture 57 - Open-Source tool - YOSYS
- Lecture 58 - OpenSTA Static Timing Analyzer
- Lecture 59 - OpenROAD Physical Synthesis Flow - I
- Lecture 60 - OpenROAD Physical Synthesis Flow - II

Lecture 1 - Introduction

Lecture 2 - Carson's Line

Lecture 3 - Carson's Line (Continued...)

Lecture 4 - Three-phase Transmission Line - 1

Lecture 5 - Three-phase Transmission Line - 2

Lecture 6 - Three-phase Transmission Line (Continued...)

Lecture 7 - Three-phase Transmission Line (Continued...)

Lecture 8 - Three-phase Transmission Line (Continued...)

Lecture 9 - Transposition of Transmission Line

Lecture 10 - Transposition of Transmission Line (Continued...)

Lecture 11 - Sequence impedance of Transmission Line

Lecture 12 - Sequence impedance of Transmission Line (Continued...)

Lecture 13 - Impedance of Transmission Line

Lecture 14 - Impedance of Transmission Line (Continued...)

Lecture 15 - Impedance of Transmission Line (Continued...)

Lecture 16 - Impedance of Transmission Line (Continued...)

Lecture 17 - Impedance of Transmission Line (Continued...)

Lecture 18 - Impedance of Transmission Line (Continued...)

Lecture 19 - Impedance of Transmission Line (Continued...)

Lecture 20 - Impedance of Transmission Line (Continued...)

Lecture 21 - Capacitance of Transmission Line

Lecture 22 - Capacitance of Transmission Line (Continued...)

Lecture 23 - Capacitance of Transmission Line (Continued...)

Lecture 24 - Capacitance of Transmission Line (Continued...)

Lecture 25 - Transformer Modeling (Introduction, $Y_g Y_{g0}$)

Lecture 26 - Transformer Modeling ($Y_g Y_{g0}$, $Y_g Y_{g4}$)

Lecture 27 - Transformer Modeling ($Y_g D1$)

Lecture 28 - Transformer Modeling ($Y_g D1$, Y_{D1})

Lecture 29 - Transformer Modeling (Y_{D1}) (Continued...)

Lecture 30 - Transformer Modeling (Y_{D1}) (Continued...)

Lecture 31 - Transformer Modeling (Y_{Yg0} , D_{d0})

- [Lecture 32 - Transformer Modeling \(Dd0, Overall Summary\)](#)
- [Lecture 33 - Three-Phase Load Flow \(Network Modelling\)](#)
- [Lecture 34 - Three-Phase Load Flow \(Formation of bus admittance matrix\)](#)
- [Lecture 35 - Three-Phase Load Flow \(Formation of bus admittance matrix\) \(Continued...\)](#)
- [Lecture 36 - Three-Phase Load Flow \(Formation of bus admittance matrix\) \(Continued...\)](#)
- [Lecture 37 - Three-Phase Load Flow \(General expression of bus admittance matrix\)](#)
- [Lecture 38 - Three-Phase Load Flow \(General expression of bus injected current\)](#)
- [Lecture 39 - Three-Phase Load Flow \(Derivation of power flow equations\)](#)
- [Lecture 40 - Three-Phase Load Flow \(Concept of Generator Internal Bus\)](#)
- [Lecture 41 - Three-Phase Load Flow \(Unknown Quantities\)](#)
- [Lecture 42 - Three-Phase Load Flow \(Classification of Unknown Quantities\)](#)
- [Lecture 43 - Three-Phase Load Flow \(Classification of Known Quantities\)](#)
- [Lecture 44 - Three-Phase Load Flow \(Equations Relating Known and Unknown Quantities\)](#)
- [Lecture 45 - Three-Phase Load Flow \(NRLF Polar Method\)](#)
- [Lecture 46 - Three-Phase Load Flow \(General Definitions and Dimensions of Jacobian Submatrices\)](#)
- [Lecture 47 - Three-Phase Load Flow \(Derivation of J1\)](#)
- [Lecture 48 - Three-Phase Load Flow \(Derivation of J1\) \(Continued...\)](#)
- [Lecture 49 - Three-Phase Load Flow \(Derivation of J2\)](#)
- [Lecture 50 - Three-Phase Load Flow \(Derivation of J3\)](#)
- [Lecture 51 - Three-Phase Load Flow \(Derivation of J3\) \(Continued...\)](#)
- [Lecture 52 - Three-Phase Load Flow \(Derivation of J4, J5, J6, J7, J8\)](#)
- [Lecture 53 - Three-Phase Load Flow \(Derivation of J9\)](#)
- [Lecture 54 - Three-Phase Load Flow \(Derivation of J9, J10\)](#)
- [Lecture 55 - Three-Phase Load Flow \(Derivation of J11, J12\)](#)
- [Lecture 56 - Three-Phase Load Flow \(Derivation of J13, J14, J15 and J16, Algorithm and Example\)](#)
- [Lecture 57 - Three-Phase State Estimation \(Revision of WLS State Estimation Method for Balanced Systems\)](#)
- [Lecture 58 - Three-Phase State Estimation \(Derivation of Measurement Functions for Unbalanced Systems\)](#)
- [Lecture 59 - Three-Phase State Estimation \(Derivation of Measurement Functions for Unbalanced Systems\)](#)
- [Lecture 60 - Three-Phase State Estimation \(General Structure of Jacobian Matrix, Example\)](#)

Lecture 1 - Introduction and Objectives of the course

Lecture 2 - Definition of a system and history of semiconductors

Lecture 3 - Products and levels of packaging

Lecture 4 - Packaging aspects of handheld products; Case studies in applications

Lecture 5 - Case Study (continued); Definition of PWB, summary and Questions for review

Lecture 6 - Basics of Semiconductor and Process flowchart; Video on "Sand-to-Silicon"

Lecture 7 - Wafer fabrication, inspection and testing

Lecture 8 - Wafer packaging; Packaging evolution; Chip connection choices

Lecture 9 - Wire bonding, TAB and flipchip-1

Lecture 10 - Wire bonding, TAB and flipchip-2; Tutorials

Lecture 11 - Why packaging? & Single chip packages or modules (SCM)

Lecture 12 - Commonly used packages and advanced packages; Materials in packages

Lecture 13 - Advances packages (continued); Thermal mismatch in packages; Current trends in packaging

Lecture 14 - Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits; Quiz on packages

Lecture 15 - Electrical Issues " I; Resistive Parasitic

Lecture 16 - Electrical Issues " II; Capacitive and Inductive Parasitic

Lecture 17 - Electrical Issues " III; Layout guidelines and the Reflection problem

Lecture 18 - Electrical Issues " IV; Interconnection

Lecture 19 - Quick Tutorial on packages; Benefits from CAD; Introduction to DFM, DFR & DFT

Lecture 20 - Components of a CAD package and its highlights

Lecture 21 - Design Flow considerations; Beginning a circuit design with schematic work and component layout

Lecture 22 - Demo and examples of layout and routing; Technology file generation from CAD; DFM check list and design rules; Design for Reliability

Lecture 23 - Review of CAD output files for PCB fabrication; Photo plotting and mask generation

Lecture 24 - Process flow-chart; Vias; PWB substrates

Lecture 25 - Substrates continued; Video highlights; Surface preparation

Lecture 26 - Photoresist and application methods; UV exposure and developing; Printing technologies for PWBs

Lecture 27 - PWB etching; Resist stripping; Screen-printing technology

Lecture 28 - Through-hole manufacture process steps; Panel and pattern plating methods

Lecture 29 - Video highlights on manufacturing; Solder mask for PWBs; Multilayer PWBs; Introduction to microvias

Lecture 30 - Microvia technology and Sequential build-up technology process flow for high-density interconnects

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

Lecture 31 - Conventional Vs HDI technologies; Flexible circuits; Tutorial session

Lecture 32 - SMD benefits; Design issues; Introduction to soldering

Lecture 33 - Reflow and Wave Soldering methods to attach SMDs

Lecture 34 - Solders; Wetting of solders; Flux and its properties; Defects in wave soldering

Lecture 35 - Vapour phase soldering, BGA soldering and Desoldering/Repair; SMT failures

Lecture 36 - SMT failure library and Tin Whiskers

Lecture 37 - Tin-lead and lead-free solders; Phase diagrams; Thermal profiles for reflow soldering; Lead-free alloys

Lecture 38 - Lead-free solder considerations; Green electronics; RoHS compliance and e-waste recycling issues

Lecture 39 - Thermal Design considerations in systems packaging

Lecture 40 - Introduction to embedded passives; Need for embedded passives; Design Library; Embedded resistor processes

Lecture 41 - Embedded capacitors; Processes for embedding capacitors; Case study examples; Summary of materials in packaging

Lecture 42 - Chapter-wise summary

Lecture 1 - Course introduction and overview

Lecture 2 - Distributed generation technologies

Lecture 3 - Distributed storage technologies

Lecture 4 - Distribution system protection

Lecture 5 - Circuit breaker coordination

Lecture 6 - Symmetrical component analysis and sequence excitation

Lecture 7 - Modeling of distribution system components

Lecture 8 - Protection components

Lecture 9 - Impact of distributed generation of distribution protection

Lecture 10 - Consumption and distribution grounding

Lecture 11 - Islanding of distribution systems

Lecture 12 - Modeling of islanded distribution systems

Lecture 13 - Distribution system problems and examples

Lecture 14 - Distribution system problems and examples continued

Lecture 15 - Anti-islanding methods

Lecture 16 - Solid state circuit switching

Lecture 17 - Relaying for distributed generation

Lecture 18 - Feeder voltage regulation

Lecture 19 - Grounding, distribution protection coordination problems and examples

Lecture 20 - Ring and network distribution

Lecture 21 - Economic evaluation of DG systems

Lecture 22 - Design for effective initial cost

Lecture 23 - Single phase inverters

Lecture 24 - DC bus design in voltage source inverter

Lecture 25 - Electrolytic capacitor reliability and lifetime

Lecture 26 - Inverter switching and average model

Lecture 27 - Common mode and differential mode model of inverters

Lecture 28 - Two leg single phase inverter

Lecture 29 - Distribution system problems, and examples

Lecture 30 - DG evaluation problems and examples

Lecture 31 - Switch selection in two level voltage source inverters and loss evaluation

[Lecture 32 - Thermal model, management and cycling failure of IGBT modules](#)

[Lecture 33 - Semiconductor switch design reliability considerations](#)

[Lecture 34 - AC filters for grid connected inverters](#)

[Lecture 35 - AC inductor design and need for LCL filter](#)

[Lecture 36 - LCL filter design](#)

[Lecture 37 - Examples in power electronic design for DG systems](#)

[Lecture 38 - Examples in power electronic design for DG systems continued](#)

[Lecture 39 - Higher order passive damping design for LCL filters](#)

[Lecture 40 - Balance of hardware component for inverters in DG systems](#)

Lecture 1 - Electronic switches

Lecture 2 - DC - DC converters

Lecture 3 - DC - AC converters

Lecture 4 - Multilevel converters - I

Lecture 5 - Multilevel converters - II

Lecture 6 - Applications of voltage source converter - I

Lecture 7 - Applications of voltage source converter - II

Lecture 8 - Applications of voltage source converter - III

Lecture 9 - Purpose of PWM - I

Lecture 10 - Purpose of PWM - II

Lecture 11 - Low switching frequency PWM - I

Lecture 12 - Low switching frequency PWM - II

Lecture 13 - Selective harmonic elimination

Lecture 14 - Off-line optimized pulsewidth modulation

Lecture 15 - Sine-triangle pulsewidth modulation

Lecture 16 - Harmonic injection pulsewidth modulation

Lecture 17 - Bus-clamping pulsewidth modulation

Lecture 18 - Triangle-comparison based PWM for three-phase inverter

Lecture 19 - Concept of space vector

Lecture 20 - Conventional space vector PWM

Lecture 21 - Space vector based bus-clamping PWM

Lecture 22 - Space vector based advanced bus-clamping PWM

Lecture 23 - Harmonic analysis of PWM techniques

Lecture 24 - Analysis of RMS line current ripple using the notion of stator flux ripple

Lecture 25 - Evaluation of RMS line current ripple using the notion of stator flux ripple

Lecture 26 - Analysis and design of PWM techniques from line current ripple perspective

Lecture 27 - Instantaneous and average dc link current in a voltage source inverter

Lecture 28 - DC link current and DC capacitor current in a voltage source inverter

Lecture 29 - Analysis of torque ripple in induction motor drives - I

Lecture 30 - Analysis of torque ripple in induction motor drives - II

Lecture 31 - Evaluation of conduction loss in three-phase inverter

[Lecture 32 - Evaluation of switching loss in three-phase inverter](#)

[Lecture 33 - Design of PWM for reduced switching loss in three-phase inverter](#)

[Lecture 34 - Effect of dead-time on inverter output voltage for continuous PWM schemes](#)

[Lecture 35 - Effect of dead-time on inverter output voltage for bus-clamping PWM schemes](#)

[Lecture 36 - Analysis of overmodulation in sine-triangle PWM from space vector perspective](#)

[Lecture 37 - Overmodulation in space vector modulated inverter](#)

[Lecture 38 - PWM for three-level neutral-point-clamped inverter - I](#)

[Lecture 39 - PWM for three-level neutral-point-clamped inverter - II](#)

[Lecture 40 - PWM for three-level neutral-point-clamped inverter - III](#)

Lecture 1 - Introduction to DC-DC converter

Lecture 2 - Diode

Lecture 3 - Controlled Switches

Lecture 4 - Prior Art

Lecture 5 - Inductor

Lecture 6 - Transformer

Lecture 7 - Capacitor

Lecture 8 - Issues related to switches

Lecture 9 - Energy storage - Capacitor

Lecture 10 - Energy storage - Inductor

Lecture 11 - Primitive Converter

Lecture 12 - Non-Isolated converter - I

Lecture 13 - Non-Isolated converter - II

Lecture 14 - Isolated Converters - I

Lecture 15 - Isolated Converters - II

Lecture 16 - Conduction Mode

Lecture 17 - Problem set - I

Lecture 18 - Problem set - II

Lecture 19 - Modeling DC-DC converters

Lecture 20 - State space representation - I

Lecture 21 - State Space representation - II

Lecture 22 - Circuit Averaging - I

Lecture 23 - Circuit Averaging - II

Lecture 24 - State Space Model of Boost Converter

Lecture 25 - DC-DC converter controller

Lecture 26 - Controller Structure

Lecture 27 - PID Controller - I

Lecture 28 - PID Controller - II

Lecture 29 - PID Controller - III

Lecture 30 - Implementation of PID controller

Lecture 31 - Pulse Width Modulator

[Lecture 32 - Controller Design - I](#)

[Lecture 33 - Controller Design - II](#)

[Lecture 34 - Controllers and Sensing Circuit](#)

[Lecture 35 - Regulation of Multiple outputs - I](#)

[Lecture 36 - Regulation of Multiple outputs - II](#)

[Lecture 37 - Current Control](#)

[Lecture 38 - Unity Power Factor Converter](#)

[Lecture 39 - Magnetic Design](#)

[Lecture 40 - DC-DC Converter Design](#)

Lecture 1 - Basic Electrical Technology

Lecture 2 - Passive Components

Lecture 3 - Sources

Lecture 4 - Kirchoff's Law

Lecture 5 - Modelling of Circuit - Part 1

Lecture 6 - Modelling of Circuit - Part 2

Lecture 7 - Analysis Using MatLab

Lecture 8 - Sinusoidal steady state

Lecture 9 - Transfer Function and Pole Zero domain

Lecture 10 - Transfer function & pole zero

Lecture 11 - The Sinusoid

Lecture 12 - Phasor Analysis - Part 1

Lecture 13 - Phasor Analysis - Part 2

Lecture 14 - Power Factor

Lecture 15 - Power ports

Lecture 16 - Transformer Basics - Part 1

Lecture 17 - Transformer Basics - Part 2

Lecture 18 - Transformer Basics - Part 3

Lecture 19 - The Practical Transformer - Part 1

Lecture 20 - The Practical Transformer - Part 2

Lecture 21 - The Practical Transformer - Part 3

Lecture 22 - DC Machines - Part 1

Lecture 23 - DC Machines - Part 2

Lecture 24 - DC Generators - Part 1

Lecture 25 - DC Generators - Part 2

Lecture 26 - DC Motors - Part 1

Lecture 27 - DC Motors - Part 2

Lecture 28 - DC Motors - Part 3

Lecture 29 - Three Phase System - Part 1

Lecture 30 - Three Phase System - Part 2

Lecture 31 - Three Phase System - Part 3

[Lecture 32 - Three Phase System - Part 4](#)

[Lecture 33 - Three Phase Transformer - Part 1](#)

[Lecture 34 - Three Phase Transformer - Part 2](#)

[Lecture 35 - Induction Motor - Part 1](#)

[Lecture 36 - Induction Motor - Part 2](#)

[Lecture 37 - Induction Motor - Part 3](#)

[Lecture 38 - Induction Motor - Part 4](#)

[Lecture 39 - Synchronous Machine](#)

Lecture 1 - Electric Drive

Lecture 2 - Controlled Rectifier - Part-1

Lecture 3 - Controlled Rectifier - Part-2 (Three phase)

Lecture 4 - Controlled Rectifier - Part-3 (Three phase)

Lecture 5 - Controlled Rectifier - Part-4 (Three Phase)

Lecture 6 - Controlled Rectifier - Part-5 (Three Phase)

Lecture 7 - Power Electronics Improvements

Lecture 8 - Four Quadrant Dc to Dc Converter

Lecture 9 - Sine Triangle PWM Control of Converter

Lecture 10 - Front-end Ac-Dc Converter with harmonic control

Lecture 11 - Ac to Dc Converter Close Loop Control Schematic

Lecture 12 - Ac-Dc Converter Close loop Control Block Diagram

Lecture 13 - Design of the Converter Controller & AC to DC

Lecture 14 - Front-End Ac to Dc Converter-Design

Lecture 15 - Front-End Ac to Dc Converter - Simulation study

Lecture 16 - Dc Motor Speed Control - Introduction

Lecture 17 - Dc Motor Speed Control - Block Diagram

Lecture 18 - Dc Motor Speed Control Current Control & S C L

Lecture 19 - Dc-Motor Speed Control Controller Design - Part-1

Lecture 20 - Dc Motor Speed Control Controller Design - Part-2

Lecture 21 - Dc Motor Speed Control Controller Design - Part-3

Lecture 22 - Basics of DC to AC Converter - Part-1

Lecture 23 - Basics of DC to AC Converter - Part-2

Lecture 24 - Inverter Sine Triangle PWM

Lecture 25 - Inverter - Current Hysteresis Controlled PWM

Lecture 26 - C H controlled & Basics of space vector PWM

Lecture 27 - Space Vector PWM - Part-2

Lecture 28 - Space Vector PWM - Part-3

Lecture 29 - Space Vector PWM Signal Generation

Lecture 30 - Speed Control of Induction Motor - Part-1

Lecture 31 - Speed Control of Induction Motor - Part-2

[Lecture 32 - High dynamic performance of I M Drive](#)

[Lecture 33 - Dynamic Model of Induction Motor - Part-1](#)

[Lecture 34 - Dynamic Model of Induction Motor - Part-2](#)

[Lecture 35 - Vector Control of Induction Motor](#)

[Lecture 36 - Effect of Switching Time lag in Inverter](#)

[Lecture 37 - Power Switch Protection - Snubbers](#)

Lecture 1 - Introduction to IOTs - Part I

Lecture 2 - Introduction to IOTs - Part II

Lecture 3 - Introduction to IOTs - Examples

Lecture 4 - IOT applications - I

Lecture 5 - IOT applications - II

Lecture 6 - Power management in IOT device

Lecture 7 - Introduction to LDO

Lecture 8 - Design with an LDO

Lecture 9 - Introduction to switching regulators

Lecture 10 - Designing with LDO's, switching regulators and case studies - Part I

Lecture 11 - Designing with LDO's, switching regulators and case studies - Part II

Lecture 12 - Designing with LDO's, switching regulators and case studies - Part II

Lecture 13 - Designing with LDO's, switching regulators and case studies - Part IV

Lecture 14 - Power Conditioning with Energy Harvesters - I

Lecture 15 - Power Conditioning with Energy Harvesters - II

Lecture 16 - Power Conditioning with Energy Harvesters - III

Lecture 17 - Battery less power supply and battery life calculation for embedded devices - I

Lecture 18 - Battery less power supply and battery life calculation for embedded devices - II

Lecture 19 - Battery less power supply and battery life calculation for embedded devices - III

Lecture 20 - Introduction to MQTT

Lecture 21 - Quality of Service in MQTT

Lecture 22 - Standards and Security in MQTT

Lecture 23 - Introduction and Implementation of AMQP

Lecture 24 - Implementation of CoAP and MDNS

Lecture 25 - Basics of RFID

Lecture 26 - RFID protocol and applications

Lecture 27 - BLE Security

Lecture 28 - LPWAN technologies

Lecture 29 - Choice of Microcontrollers

Lecture 30 - Case Study 1 - Joule Jotter

Lecture 31 - Case Study 2 - Cloud Based Systems

Lecture 1 - Advantages of HVAC/DC Transmission, Introduction to Grid Management

Lecture 2 - Transmission system development, Important components of transmission system

Lecture 3 - Insulation coordination, over voltage in power systems

Lecture 4 - Design/selection of insulators, Importance of grading/cc rings

Lecture 5 - Non ceramic insulators performance-service experience

Lecture 6 - Failure of apparatus in the field, importance of reliability and testing

Lecture 7 - Pollution flashover phenomena, modeling etc

Lecture 8 - Planning of High Voltage laboratories

Lecture 9 - Importance of High Voltage testing and techniques employed

Lecture 10 - Basic philosophy of HV testing, tests for various HV apparatus

Lecture 11 - HV testing techniques for various apparatus

Lecture 12 - HV testing on Composite Insulators

Lecture 13 - Surface degradation studies on composite insulators

Lecture 14 - Surface morphological techniques for composite insulators

Lecture 15 - Conductors used for EHV/UHV transmission

Lecture 16 - Corona and interference on transmission lines

Lecture 17 - Introduction of HTLS conductors and their advantages

Lecture 18 - Mechanical considerations for HV conductors

Lecture 19 - Introduction to Towers and importance of foundations

Lecture 20 - Selection/Design of clearances for HV towers

Lecture 21 - Design Optimization for UHV towers

Lecture 22 - Introduction to 1100kV HVDC

Lecture 23 - Introduction to HV Substations

Lecture 24 - Types of Substations, comparison

Lecture 25 - Insulation coordination, Components in a typical substation

Lecture 26 - Preventive maintenance of Substation

Lecture 27 - Electric and magnetic fields, mitigations techniques

Lecture 28 - Importance of Grounding, reducing Earthing resistance

Lecture 29 - Introduction to the use of Fiber optic cables, OPGW

Lecture 30 - Introduction to communication and SCADA

Lecture 31 - Precautions and safety measures in substation

[Lecture 32 - Electrical hazards, minimum clearances in substation](#)

[Lecture 33 - Importance of Generation of HVDC in the laboratory](#)

[Lecture 34 - Importance of Generation of HVAC, Impulse Voltage and Currents in the laboratory](#)

[Lecture 35 - Measurements of High Voltages](#)

[Lecture 36 - Measurements of High Voltages \(Continued...\)](#)

[Lecture 37 - Introduction to digital recorders, measurement](#)

[Lecture 38 - Upgradation/uprating of transmission lines- advantages](#)

[Lecture 39 - Upgradation/uprating of transmission lines- advantages \(Continued...\)](#)

[Lecture 40 - Summary of the course](#)

- Lecture 1 - Introduction to signal processing
- Lecture 2 - Basics of signals and systems
- Lecture 3 - Linear time-invariant systems
- Lecture 4 - Modes in a linear system
- Lecture 5 - Introduction to state space representation
- Lecture 6 - State space representation
- Lecture 7 - Non-uniqueness of state space representation
- Lecture 8 - Introduction to vector space
- Lecture 9 - Linear independence and spanning set
- Lecture 10 - Unique representation theorem
- Lecture 11 - Basis and cardinality of basis
- Lecture 12 - Norms and inner product spaces
- Lecture 13 - Inner products and induced norm
- Lecture 14 - Cauchy Schwartz inequality
- Lecture 15 - Orthonormality
- Lecture 16 - Problem on sum of subspaces
- Lecture 17 - Linear independence of orthogonal vectors
- Lecture 18 - Hilbert space and linear transformation
- Lecture 19 - Gram Schmidt orthonormalization
- Lecture 20 - Linear approximation of signal space
- Lecture 21 - Gram Schmidt orthogonalization of signals
- Lecture 22 - Problem on orthogonal complement
- Lecture 23 - Problem on signal geometry (4-QAM)
- Lecture 24 - Basics of probability and random variables
- Lecture 25 - Mean and variance of a random variable
- Lecture 26 - Introduction to random process
- Lecture 27 - Statistical specification of random processes
- Lecture 28 - Stationarity of random processes
- Lecture 29 - Problem on mean and variance
- Lecture 30 - Problem on MAP Detection
- Lecture 31 - Fourier transform of dirac comb sequence

[Lecture 32 - Sampling theorem](#)

[Lecture 33 - Basics of multirate systems](#)

[Lecture 34 - Frequency representation of expanders and decimators](#)

[Lecture 35 - Decimation and interpolation filters](#)

[Lecture 36 - Fractional sampling rate alterations](#)

[Lecture 37 - Digital filter banks](#)

[Lecture 38 - DFT as filter bank](#)

[Lecture 39 - Noble Identities](#)

[Lecture 40 - Polyphase representation](#)

[Lecture 41 - Efficient architectures for interpolation and decimation filters](#)

[Lecture 42 - Problems on simplifying multirate systems using noble identities](#)

[Lecture 43 - Problem on designing synthesis bank filters](#)

[Lecture 44 - Efficient architecture for fractional decimator](#)

[Lecture 45 - Multistage filter design](#)

[Lecture 46 - Two-channel filter banks](#)

[Lecture 47 - Amplitude and phase distortion in signals](#)

[Lecture 48 - Polyphase representation of 2-channel filter banks, signal flow graphs and perfect reconstruction](#)

[Lecture 49 - M-channel filter banks](#)

[Lecture 50 - Polyphase representation of M-channel filter bank](#)

[Lecture 51 - Perfect reconstruction of signals](#)

[Lecture 52 - Nyquist and half band filters](#)

[Lecture 53 - Special filter banks for perfect reconstruction](#)

[Lecture 54 - Introduction to wavelets](#)

[Lecture 55 - Multiresolution analysis and properties](#)

[Lecture 56 - The Haar wavelet](#)

[Lecture 57 - Structure of subspaces in MRA](#)

[Lecture 58 - Haar decomposition - 1](#)

[Lecture 59 - Haar decomposition - 2](#)

[Lecture 60 - Wavelet Reconstruction](#)

[Lecture 61 - Haar wavelet and link to filter banks](#)

[Lecture 62 - Demo on wavelet decomposition](#)

[Lecture 63 - Problem on circular convolution](#)

[Lecture 64 - Time frequency localization](#)

[Lecture 65 - Basic analysis: Pointwise and uniform continuity of functions](#)

[Lecture 66 - Basic Analysis : Convergence of sequence of functions](#)

[Lecture 67 - Fourier series and notions of convergence](#)

[Lecture 68 - Convergence of Fourier series at a point of continuity](#)

[Lecture 69 - Convergence of Fourier series for piecewise differentiable periodic functions](#)

[Lecture 70 - Uniform convergence of Fourier series of piecewise smooth periodic function](#)

[Lecture 71 - Convergence in norm of Fourier series](#)

[Lecture 72 - Convergence of Fourier series for all square integrable periodic functions](#)

[Lecture 73 - Problem on limits of integration of periodic functions](#)

[Lecture 74 - Matrix Calculus](#)

[Lecture 75 - KL transform](#)

[Lecture 76 - Applications of KL transform](#)

[Lecture 77 - Demo on KL Transform](#)

[Lecture 78 - Live Session](#)

[Lecture 79 - Live Session 2](#)

Lecture 1 - Electronic Equipment Thermal issues

Lecture 2 - Practical Examples - 1

Lecture 3 - Practical Examples - 2

Lecture 4 - CEDT worked examples - 1

Lecture 5 - CEDT worked examples - 2

Lecture 6 - Text book theory

Lecture 7 - Sample heat sinks

Lecture 8 - Published correlations - 1

Lecture 9 - Published correlations - 2

Lecture 10 - Parallel combined effects

Lecture 11 - Mounting of packages

Lecture 12 - Combined Rth of devices

Lecture 13 - Schonholzer moduls

Lecture 14 - 1972 model paper

Lecture 15 - Jensen model

Lecture 16 - Thermal management - 1

Lecture 17 - Thermal management - 2

Lecture 18 - Round up of full model

Lecture 19 - Fan cooling

Lecture 20 - Thermo-electric cooling

Lecture 21 - On-the-net DIY work

Lecture 22 - Practical video

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27 - Real packages

Lecture 28 - Prior art

Lecture 29 - OTS standard profiles

Lecture 30 - CAD detailed design of profiles

Lecture 31 - Round up

[Lecture 32 - 4X Peltier Cooler](#)

[Lecture 33 - Manufacturing Video](#)

[Lecture 34 - Peltier heat sink](#)

- Lecture 1 - Introduction to Integrated Circuits (IC) Technology
- Lecture 2 - Introduction to fabrication of IC: Substrates
- Lecture 3 - Introduction to IC fabrication
- Lecture 4 - Introduction to IC fabrication (Continued...)
- Lecture 5 - Introduction to the fabrication of sensors
- Lecture 6 - Introduction to fabrication technology
- Lecture 7 - Introduction to fabrication technology (Continued...)
- Lecture 8 - Introduction to fabrication technology (Continued...)
- Lecture 9 - Introduction to fabrication technology (Continued...)
- Lecture 10 - Introduction to fabrication technology (Continued...)
- Lecture 11 - Process flow for Fabrication of MOSFETs
- Lecture 12 - Operation of Enhancement type MOSFET
- Lecture 13 - Operation of Depletion type MOSFET
- Lecture 14 - MOSFETs Characteristics and Applications (Current Mirrors)
- Lecture 15 - Introduction to Operational Amplifiers
- Lecture 16 - Operational Amplifier Characteristics
- Lecture 17 - Operational Amplifier Characteristics (Continued...)
- Lecture 18 - Characteristics of an op-amp (Continued...)
- Lecture 19 - Operational Amplifier Configurations
- Lecture 20 - Operational Amplifier Configurations (Continued...)
- Lecture 21 - Applications of Operational Amplifier: Differential Amplifier
- Lecture 22 - Applications of Operational Amplifier: Integerator
- Lecture 23 - Applications of Operational Amplifier: Differentiator
- Lecture 24 - Introduction to Passive and Active Filters and op-amp as Low Pass Filter
- Lecture 25 - Operational Amplifier as a High Pass Filter
- Lecture 26 - Operational Amplifier as a Band Pass and Band Reject Filter
- Lecture 27 - Introduction to Oscillator
- Lecture 28 - RC Phase Shift Oscillator using Op-amp
- Lecture 29 - Wein Bridge Oscillator using Op-amp
- Lecture 30 - Hartley and Colpitts Oscillator using Op-amp
- Lecture 31 - Working of Crystal Oscillators

- Lecture 32 - Construction and Operation of UJT Relaxation Oscillators
- Lecture 33 - Introduction to Noise and its Types
- Lecture 34 - Analysis of Data Sheets of an Op-Amp
- Lecture 35 - Analysis of Data Sheets of an Op-Amp (Continued...)
- Lecture 36 - Analysis of Data Sheets of an Op-Amp (Continued...)
- Lecture 37 - Experiment - Introduction to Laboratory Equipment
- Lecture 38 - Experiment - Measurement of Active and Passive elements using Multimeter
- Lecture 39 - Experiment - Working with Laboratory Equipment: Power Supply
- Lecture 40 - Experiment - Working with Laboratory Equipment: Function Generator, Oscilloscope
- Lecture 41 - Experiment - Op-Amp Characteristics: Input Bias Current
- Lecture 42 - Experiment - Op-Amp Characteristics: Input Offset Current
- Lecture 43 - Experiment - Op-Amp Characteristics: Input Offset Voltage
- Lecture 44 - Experiment - Op-Amp as Inverting Amplifier
- Lecture 45 - Experiment - Op-Amp as Non-Inverting Amplifier
- Lecture 46 - Experiment - To study input and output voltage range of an Op-Amp
- Lecture 47 - Experiment - Differential amplifier using op-amp
- Lecture 48 - Experiment - To study the gain of instrumentation amplifier
- Lecture 49 - Experiment - Summing amplifier using op-amp
- Lecture 50 - Experiment - To study op-amp based comparator
- Lecture 51 - Experiment - To study op-amp based integrator and differentiator
- Lecture 52 - Experiment - Study of passive low pass filter
- Lecture 53 - Experiment - Op-amp based active low pass filter
- Lecture 54 - Experiment - Passive and active high pass filter
- Lecture 55 - Experiment - Introduction to experimental set-up of band pass filter
- Lecture 56 - Experiment - Passive and active band pass filter
- Lecture 57 - Experiment - Introduction to experimental set-up for band reject filter
- Lecture 58 - Experiment - Active band reject filter
- Lecture 59 - Experiment - Peak detector circuit using Op-Amp

Lecture 1 - Quantum Mechanics: Concept of Wave Particle, Schrodingers Equation

Lecture 2 - Quantum Mechanics: Particle in a Box

Lecture 3 - Quantum Mechanics: Particle in a Box (Continued...), Harmonic Oscillator

Lecture 4 - Solids: Formation of Bands, Kronig-Penny Model

Lecture 5 - Solids: Kronig-Penny Model (Continued...)

Lecture 6 - Solids: Electrons and Holes

Lecture 7 - Solids: Electrons and Holes (Continued...)

Lecture 8 - Solids: Crystals

Lecture 9 - Density of States

Lecture 10 - Density of States (Continued...), Fermi Function

Lecture 11 - Fermi Function - Carrier Concentration

Lecture 12 - Doping

Lecture 13 - Doping (Continued...)

Lecture 14 - Recombination and Generation

Lecture 15 - Recombination and Generation (Continued...)

Lecture 16 - Recombination and Generation (Continued...), Charge Transport

Lecture 17 - Charge Transport (Continued...)

Lecture 18 - Continuity Equation

Lecture 19 - Junctions

Lecture 20 - Metal Semiconductor Junctions

Lecture 21 - Schottky Contact: Electrostatics

Lecture 22 - Schottky Contact: Current-Voltage (IV) Characteristics

Lecture 23 - Schottky Contact: IV Characteristics (Continued...)

Lecture 24 - Schottky Contact: Small Signal Impedance

Lecture 25 - PN Junctions: Electrostatics

Lecture 26 - PN Junctions: IV Characteristics

Lecture 27 - PN Junctions: Small Signal Impedance

Lecture 28 - PN Junctions: Non-Idealities

Lecture 29 - Bipolar Junction Transistors (BJT)

Lecture 30 - BJT: IV Characteristics

Lecture 31 - BJT: Non-Idealities and Equivalent Circuit Modeling

- [Lecture 32 - Metal Oxide Semiconductor Capacitor \(MOSCAP\)](#)
- [Lecture 33 - MOSCAP \(Continued...\)](#)
- [Lecture 34 - MOSCAP: CV Characteristics](#)
- [Lecture 35 - MOSCAP: CV Characteristics \(Continued...\)](#)
- [Lecture 36 - MOSFET: Introduction](#)
- [Lecture 37 - MOSFET: I-V characteristics](#)
- [Lecture 38 - MOSFET: I-V characteristics \(Continued...\)](#)
- [Lecture 39 - MOSFET: I-V characteristics \(Continued...\)](#)
- [Lecture 40 - Subthreshold swing, Additional concepts](#)
- [Lecture 41 - Trapped charge, Body-bias](#)
- [Lecture 42 - Scaling of MOSFETs](#)
- [Lecture 43 - Scaling of MOSFETs \(Continued...\), Leakage currents in MOSFETs](#)
- [Lecture 44 - MOSFET characterization: Parameter extraction](#)
- [Lecture 45 - MOSFET characterization: Trapped charges, contact resistance](#)
- [Lecture 46 - MOSFET as a switch](#)
- [Lecture 47 - MOSFET as a switch \(Continued...\)](#)
- [Lecture 48 - Amplifiers using MOSFET](#)
- [Lecture 49 - Amplifiers using MOSFET \(Continued...\)](#)
- [Lecture 50 - Circuits: Frequency Response, Noise](#)
- [Lecture 51 - Introduction: Amorphous Semiconductors](#)
- [Lecture 52 - Thin Film Transistors](#)
- [Lecture 53 - Tutorials Session - 1](#)
- [Lecture 54 - Tutorials Session - 2](#)
- [Lecture 55 - Tutorials Session - 3](#)

Lecture 1 - Introduction to Microengineering Devices

Lecture 2 - Introduction to Microengineering Devices (Continued...)

Lecture 3 - Introduction to Microengineering Devices (Continued...)

Lecture 4 - Silicon, silicon di-oxide and photolithography

Lecture 5 - Silicon, silicon di-oxide and photolithography (Continued...)

Lecture 6 - Physical Vapour Deposition

Lecture 7 - Physical Vapour Deposition (Continued...)

Lecture 8 - Photolithography

Lecture 9 - Mask Aligner

Lecture 10 - Mask Aligner (Continued...)

Lecture 11 - Micromachining

Lecture 12 - Micromachining: Fabrication of VOC Sensor

Lecture 13 - Micromachining: Fabrication of VOC Sensor (Continued...)

Lecture 14 - Micromachining: Fabrication of VOC Sensor and Cantilever

Lecture 15 - Chemical Vapour Deposition

Lecture 16 - Typical Microfabricated Devices for Biomedical Applications

Lecture 17 - Cancer Diagnostic Tool

Lecture 18 - Process flow for Fabrication of Micro Heater

Lecture 19 - Process flow for Fabrication of Interdigitated Electrodes

Lecture 20 - Process flow for Fabrication of Interdigitated Electrodes (Continued...)

Lecture 21 - Process flow for Fabrication of ETM phenotyping

Lecture 22 - Process flow for Fabrication of Piezo canteliver

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27 - Microchip for Rapid Drug Screening

Lecture 28 - Microchip for Rapid Drug Screening (Continued...)

Lecture 29 - A Microfluidic chip for rapid bacterial antibiotic Susceptibility testing

Lecture 30 - Smart Catheter

Lecture 31 - Smart Catheter: Flexible Force Sensor

[Lecture 32 - Smart Catheter: Flexible Force Sensor \(Continued...\)](#)

[Lecture 33 - Tissue and Cell Culture Techniques](#)

[Lecture 34 - Clean Room: Equipments Required](#)

[Lecture 35 - GLP: Gowning Procedure for using Lab](#)

[Lecture 36 - Introduction to Equipments: Refridgerator](#)

[Lecture 37 - Gowning Procedure for using Biological Lab Setup](#)

[Lecture 38 - Introduction to Equipments: Desiccator](#)

[Lecture 39 - Introduction to Equipments: Impedance Analyzer](#)

[Lecture 40 - Introduction to Equipments: DAQ](#)

[Lecture 41 - Function generator, Multimeter, Sampling, LabVIEW, NI-CDAQ](#)

[Lecture 42 - Introduction to Equipments: Stereo Microscope](#)

[Lecture 43 - Introduction to Equipments: Metallurgical Microscope](#)

[Lecture 44 - Introduction to Equipments: Inverted Microscope](#)

[Lecture 45 - Introduction to Equipments: Fire Alarm](#)

[Lecture 46 - Introduction to Equipments: Bio-safety Hood](#)

[Lecture 47 - Introduction to Equipments: Peristaltic Pump](#)

[Lecture 48 - Introduction to Equipments: Incubator](#)

[Lecture 49 - Introduction to Equipments: Oven](#)

[Lecture 50 - Introduction to Equipments: Micromanipulator](#)

[Lecture 51 - PDMS Moulding](#)

[Lecture 52 - 3D Printing](#)

[Lecture 53 - Introduction to Fabricated Sensors](#)

[Lecture 54 - Simulation: Electro- Thermo- Mechanical Properties of Micro-heater using COMSOL Multiphysics](#)

[Lecture 55 - Simulation: Electro- Thermo- Mechanical Properties of Micro-heater using COMSOL Multiphysics \(Continued...\)](#)

Lecture 1 - Introduction/Summary on Op-amps

Lecture 2 - Introduction/Summary on Op-amps (Continued...)

Lecture 3 - Introduction/Summary on Op-amps (Continued...)

Lecture 4 - Effect of Loading and Input Impedance - Part 1

Lecture 5 - Effect of Loading and Input Impedance - Part 2

Lecture 6 - Effect of Loading and Input Impedance - Part 3

Lecture 7 - Effect of Loading and Input Impedance - Part 4

Lecture 8 - Introduction to an Analog Circuit Development Board (TI ASLK Pro)

Lecture 9 - Op-amp Applications: Half Wave Rectifier

Lecture 10 - Op-amp Applications: Full Wave Rectifier

Lecture 11 - Op-amp Applications: Clipper

Lecture 12 - Op-amp Circuits using Diodes: Clamper

Lecture 13 - Understanding the Range of Feedback Amplifiers

Lecture 14 - Op-amps as Phase Shift Oscillator

Lecture 15 - Op-amp as Wein Bridge Oscillator

Lecture 16 - Op-amp as Hartley Oscillator

Lecture 17 - Op-amp as Colpitts Oscillator

Lecture 18 - Op-amps as Comparator: Window Comparator

Lecture 19 - Op-amp with Positive Feedback: Inverting Schmitt Trigger

Lecture 20 - Op-amp with Positive Feedback: Non-Inverting Schmitt Trigger

Lecture 21 - Op-amp with Positive Feedback: Astable Multivibrator

Lecture 22 - Op-amp with Positive Feedback: Monostable Multivibrator

Lecture 23 - Op-amp based Voltage Controlled Current Source

Lecture 24 - Measure of Unknown Resistance by Constant Current Drive Circuit Implemented using Op-amp

Lecture 25 - Design and Development of Temperature Controlled Circuit using Op-amp as ON-OFF, Proportional and Proportional Integral Controllers: Introduction

Lecture 26 - Implementation of Error Detector Circuit and Signal Conditioning Circuit for Temperature Control

Lecture 27 - Implementation of Plant/Heating Circuit and ON-OFF Controller

Lecture 28 - Implementation of P and PI Controllers

Lecture 29 - Experiment on Controlling the Temperature on the Plant using different Controllers

Lecture 30 - Experiment: Design and Implementation of Signal Conditioning unit for Thermocouple Cold Junction Compensation

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

Lecture 31 - Introduction to ECG Experiment

Lecture 32 - Design and Implementation of ECG Preprocessing Stage - Part 1

Lecture 33 - Design and Implementation of ECG Preprocessing Stage - Part 2

Lecture 34 - Design and Implementation of ECG Preprocessing Stage - Part 3

Lecture 35 - Design and Implementation of ECG Preprocessing Stage - Part 4

Lecture 36 - Design and Implementation of Peak Detector and Thresholding Circuit for ECG Signal Conditioning

Lecture 37 - Live Demonstration on ECG Signal Acquisition, Conditioning and Measurement of BPM

Lecture 38 - Understanding Analog Multipliers using Development Board

Lecture 39 - Application: Automatic Gain Controller using Development Board

Lecture 40 - Introduction to Data-Acquisition

Lecture 41 - Analog to Digital Conversion Circuits and Experiment on 2-bit Flash Type ADC

Lecture 42 - Digital to Analog Conversion Circuits and Experiment on 4-bit R-2R DAC

Lecture 43 - DAC Basics using Development Board - Introduction

Lecture 44 - Understanding DAC 7821 Datasheet

Lecture 45 - Basic DAC Experiment on Variable Gain Amplifier

Lecture 46 - Understanding DAC: Experiment on Variable Square and Triangular Wave Generator

Lecture 47 - Introduction to CDAQ (Compact DAQ)

Lecture 48 - Software-in-Loop based Temperature Controller using CDAQ and LabVIEW

Lecture 1 - Products prototyping

Lecture 2 - Prototype concepts

Lecture 3 - Physical simulation

Lecture 4 - Rapid Prototyping

Lecture 5 - Products detailing

Lecture 6 - Advantages of Design Modelling

Lecture 7 - Sample product concept

Lecture 8 - Product sample exercise 1

Lecture 9 - Exercise in product sample 2

Lecture 10 - Integration of components 1

Lecture 11 - Components integration in models

Lecture 12 - 3D printing detail 1

Lecture 13 - 3D printing detail 2

Lecture 14 - 3D print assembly design

Lecture 15 - Heat spreader to 3D print

Lecture 16 - Metallic, 3D, build up 1

Lecture 17 - 3D build up 2

Lecture 18 - 3D design 1 from Photo snap

Lecture 19 - 3D design 2 from Photo snap

Lecture 20 - 3D Laser cuts 1, prints

Lecture 21 - 3D Laser cuts 2, open source public prints

Lecture 22 - Demo of 3D Part print

Lecture 23 - Building a model 1

Lecture 24 - Building a model 2

Lecture 25 - Common place objects

Lecture 26 - Materials

Lecture 27 - Future 3D In biology

Lecture 28 - Product clamp variants

Lecture 29 - Product clamp build up

Lecture 30 - Multi direction features

Lecture 31 - Multi direction features (Continued...)

[Lecture 32 - Fastening detail](#)

[Lecture 33 - Flat objects](#)

[Lecture 34 - Modularity](#)

[Lecture 35 - Creative design work](#)

[Lecture 36 - Creative designs](#)

[Lecture 37 - Using flat features](#)

[Lecture 38 - Organic shapes](#)

[Lecture 39 - Simulation for alternate use](#)

- Lecture 1 - Introduction to Transmission and distribution Insulators
- Lecture 2 - Manufacturing process for Ceramic/glass Insulators
- Lecture 3 - Manufacturing process for Polymeric Insulators
- Lecture 4 - Design Considerations of Transmission Insulators
- Lecture 5 - Field experience of Ceramic/Glass and Polymeric Insulators
- Lecture 6 - Comparison of Transmission Insulators
- Lecture 7 - Environmental issues with transmission Insulators
- Lecture 8 - Reliability and Philosophy of Testing
- Lecture 9 - Testing of Ceramic, Glass and Composite Insulators
- Lecture 10 - Cleaning methods adopted for Insulators
- Lecture 11 - Cleaning methods adopted for Insulators (Continued...)
- Lecture 12 - Coating techniques for Insulators
- Lecture 13 - Introduction to Hybrid Insulators

Lecture 1 - Introduction to semiconductors

Lecture 2 - Introduction to energy bands

Lecture 3 - Fundamentals of band structure

Lecture 4 - Band structure (Continued...) and Fermi-Dirac distribution

Lecture 5 - Density of states

Lecture 6 - Doping and intrinsic carrier concentration

Lecture 7 - Equilibrium carrier concentration

Lecture 8 - Temperature-dependence of carrier concentration

Lecture 9 - High doping effects and incomplete ionization

Lecture 10 - Carrier scattering and mobility

Lecture 11 - Low-field and high-field transport, introduction to diffusion

Lecture 12 - Drift-diffusion and trap statistics

Lecture 13 - Current continuity equation

Lecture 14 - Continuity equation (Continued...) and introduction to p-n junction

Lecture 15 - p-n junction under equilibrium

Lecture 16 - p-n junction under equilibrium (Continued...)

Lecture 17 - p-n junction under bias

Lecture 18 - p-n junction under bias (Continued...)

Lecture 19 - p-n junction: generation-recombination currents

Lecture 20 - Application of p-n junctions

Lecture 21 - Breakdown of junction and C-V profiling

Lecture 22 - Introduction to Schottky junction

Lecture 23 - Schottky junction under equilibrium

Lecture 24 - Schottky junction under bias

Lecture 25 - Introduction to transistors: BJT

Lecture 26 - Basics of BJT

Lecture 27 - Working of BJT

Lecture 28 - Working of BJT (Continued...)

Lecture 29 - Delays in BJT

Lecture 30 - MOS: Introduction

Lecture 31 - MOS: Capacitance-voltage

Lecture 32 - Ideal MOS system: derivation of threshold voltage

Lecture 33 - MOS C-V in more details

Lecture 34 - MOSFET - An introduction

Lecture 35 - Gradual Channel Approximation: Derivation of I-V characteristics

Lecture 36 - Substrate bias effect and subthreshold conduction in MOSFET

Lecture 37 - Short Channel Effects in MOSFET

Lecture 38 - Introduction to compound semiconductors

Lecture 39 - Basics of heterojunctions

Lecture 40 - Band diagram of heterojunctions

Lecture 41 - Heterojunctions (Continued....)

Lecture 42 - Heterojunction transistors

Lecture 43 - III-nitrides

Lecture 44 - Solar cell basics

Lecture 45 - Solar cell (Continued...)

Lecture 46 - Solar cell: Shockley Quiesser Limit

Lecture 47 - Basics of photodetectors

Lecture 48 - Photodetectors: figures of merit and types of devices

Lecture 49 - Junction photodetectors

Lecture 50 - Basics of recombination

Lecture 51 - Basics of LED

Lecture 52 - LED: light extraction and design issues

Lecture 53 - Visible LED: photometry and colorimetry

Lecture 54 - Transistors for power electronics

Lecture 55 - Transistors for power electronics (Continued...) and for RF electronics

Lecture 56 - Transistors for RF (Continued...) and transistors for Memory

Lecture 57 - Basics of microelectronic fabrication

Lecture 58 - Microelectronic fabrication (Continued...)

Lecture 59 - Summary

Lecture 1 - Overview of localization using IoT sensors

Lecture 2 - Outdoor localization without GPS - I

Lecture 3 - Outdoor localization without GPS - II

Lecture 4 - Outdoor localization using elevation - pressure mapping

Lecture 5 - Localization using IMU sensors - I

Lecture 6 - Localization using IMU sensors - II

Lecture 7 - Localization using IMU sensors - III

Lecture 8 - RFID based localization - I

Lecture 9 - RFID based localization - II

Lecture 10 - Simulation of simple algorithms for object detection

Lecture 11 - Building smart vehicle for collision avoidance

Lecture 12 - Basic computer vision algorithms - Part 1

Lecture 13 - Basic computer vision algorithms - Part 2

Lecture 14 - Code walkthrough of computer vision algorithm

Lecture 15 - Introduction to LiDAR

Lecture 16 - Range estimation and Obstacle avoidance

Lecture 17 - Introduction to vehicle platooning

Lecture 18 - Building blocks for autonomous vehicles - 1

Lecture 19 - Building blocks for autonomous vehicles - 2

Lecture 20 - On Board Diagnostics and protocols

Lecture 21 - Diagnostic services and fuel-injection ratio control unit

Lecture 22 - Real time event processing and Anomaly detection

Lecture 23 - OBD-II and stream processing demonstration

Lecture 24 - Speech recognition - Part 1

Lecture 25 - Speech recognition - Part 2

Lecture 26 - Speech recognition - Part 3

Lecture 27 - Speech recognition - Part 4

Lecture 28 - Device Security - Part 1

Lecture 29 - Device Security - Part 2

Lecture 30 - Device Security - Part 3

Lecture 31 - Need for air quality monitoring

[Lecture 32 - Air quality : pollutants and standards](#)

[Lecture 33 - Introduction to air quality sensors](#)

[Lecture 34 - Calibration techniques for IoT air quality sensors](#)

[Lecture 35 - Sensor types : semiconductor and electrochemical](#)

[Lecture 36 - Air quality : Overview of system design](#)

[Lecture 37 - Air quality : System design - Part 1](#)

[Lecture 38 - Air quality : System design - Part 2](#)

[Lecture 39 - Air quality : Real time measurement for a drive cycle](#)

[Lecture 40 - Introduction to First Responder networks](#)

[Lecture 41 - First Responders - Applications - Part 1](#)

[Lecture 42 - First Responders - Applications - Part 2](#)

[Lecture 43 - Cargo monitoring for tamper detection - Part 1](#)

[Lecture 44 - Cargo monitoring for tamper detection - Part 2](#)

Lecture 1 - Tissue and Cell Culture Techniques: Introduction

Lecture 2 - Tissue and Cell Culture Techniques: Methods

Lecture 3 - Tissue and Cell Culture Techniques: Devices

Lecture 4 - Cleanroom Equipments

Lecture 5 - Cleanroom Equipments (Continued...)

Lecture 6 - Introduction to photolithography

Lecture 7 - Photolithography: Mask Aligner

Lecture 8 - Photolithography: Designing Mask Aligner

Lecture 9 - Micromachining Techniques

Lecture 10 - Breast Cancer and Oral Cancer Statistics

Lecture 11 - Fabrication of MEMs-based Biochip for cancer diagnosis

Lecture 12 - Fabrication of MEMs-based Biochip for cancer diagnosis (Continued...)

Lecture 13 - Fabrication of Piezoresistive Sensor

Lecture 14 - Fabrication of Piezoresistive Sensor (Continued...)

Lecture 15 - Fabrication of SU-8 pillar on piezoresistive Sensor

Lecture 16 - Portable Cancer Diagnostic Tool Using a Disposable MEMS-Based Biochip

Lecture 17 - Mechanical Phenotyping of Breast Cancer using MEMS

Lecture 18 - Electrical characterization of Breast Tissue Cores

Lecture 19 - Fabrication of MEMS-based sensor for electro-mechanical phenotyping of breast cancer

Lecture 20 - Fabrication of electro-mechanical sensor (Continued...)

Lecture 21 - Assembly of the electro-mechanical sensor

Lecture 22 - Silicon substrate devices for breast cancer diagnosis

Lecture 23 - Understanding the methods and mechanism to study cell morphology

Lecture 24 - Cytology - A detail study on Spin Coater and Cytospin

Lecture 25 - Techniques in oral cytology studies

Lecture 26 - Techniques in cell morphology analysis

Lecture 27 - Comparative study on diagnostic tools for oral cancer screening

Lecture 28 - Basic building blocks of Electronics System: Amplifiers

Lecture 29 - Basic building blocks of Electronics System: Amplifiers (Continued...)

Lecture 30 - Basic building blocks of Electronics System: Amplifiers (Continued...)

Lecture 31 - Basic building blocks of Electronics System: Filters

- [Lecture 32 - Basic building blocks of Electronics System: Filters \(Continued...\)](#)
- [Lecture 33 - Basic building blocks of Electronics System: Filters \(Continued...\)](#)
- [Lecture 34 - Basic building blocks of Electronics System: Data Converteres](#)
- [Lecture 35 - Basic building blocks of Electronics System: Data Converteres \(Continued...\)](#)
- [Lecture 36 - Basic building blocks of Electronics System: Signal Conditioning Circuits](#)
- [Lecture 37 - Etching Process and Figure of Merits](#)
- [Lecture 38 - ECG Signal Processing to calculate BPM](#)
- [Lecture 39 - ECG Signal Processing to calculate BPM \(Continued...\)](#)
- [Lecture 40 - ECG Signal Processing to calculate BPM \(Continued...\)](#)
- [Lecture 41 - ECG Signal Processing to calculate BPM \(Continued...\)](#)
- [Lecture 42 - ECG Signal Processing to calculate BPM \(Continued...\)](#)
- [Lecture 43 - ECG Signal Processing to calculate BPM \[Continued...\]](#)
- [Lecture 44 - MEMS based Force Sensor for Catheter Contact Force Measurement](#)
- [Lecture 45 - 3D Printing: Introduction and Work Flow](#)
- [Lecture 46 - 3D Fabrication Techniques](#)
- [Lecture 47 - Gowning Procedure in Clean Room](#)
- [Lecture 48 - Introduction to Equipments: Desiccators](#)
- [Lecture 49 - PDMS Moulding procedure](#)
- [Lecture 50 - Introduction to Equipments: Pristaltic Pump](#)
- [Lecture 51 - Introduction to Equipments: Stereo Microscopy, Metallurgical Microscopy, Inverted Microscopy](#)
- [Lecture 52 - Micromanipulator](#)
- [Lecture 53 - Biosafety Cabinet and Ultrasonicbath](#)
- [Lecture 54 - Incubator Shaker](#)
- [Lecture 55 - Hotplate and Microcentrifuge](#)
- [Lecture 56 - Autoclave](#)
- [Lecture 57 - Impedance Analyser](#)
- [Lecture 58 - Rapid Prototyping using 3D Printer](#)
- [Lecture 59 - Etching Process](#)
- [Lecture 60 - Electronic System for Drug Screening](#)
- [Lecture 61 - Introduction to Equipments: DAQ](#)
- [Lecture 62 - Introduction to Equipments: DAQ \(Continued...\)](#)
- [Lecture 63 - Electronic Module for Gas sensor](#)
- [Lecture 64 - Fabrication process flow for a metal oxide gas sensor](#)

[Lecture 65 - MEMS Simulation using Comsol Multiphysics](#)

[Lecture 66 - Introduction to COMSOL Multiphysics](#)

[Lecture 67 - COMSOL Examples for MEMS Applications](#)

[Lecture 68 - COMSOL Examples for MEMS Applications \(Continued...\)](#)

[Lecture 69 - Demonstration of Thermal Actuator and Understanding of Application Builder](#)

[Lecture 70 - Closed loop control of temperature sensor](#)

[Lecture 71 - Experimental Set-up of closed loop control of temperature sensor](#)

Lecture 1 - Introduction to Op-amp

Lecture 2 - Introduction Wafer Manufacturing Process and Clean room Protocols

Lecture 3 - Introduction to Fabrication Process Technology and Op-amp

Lecture 4 - Op-amp Characteristics and Datasheet Parameters

Lecture 5 - Overview of Active Filters and Oscillators

Lecture 6 - Overview of Op-amp Oscillators

Lecture 7 - Introduction to ECG Experiment

Lecture 8 - Design and Implementation of ECG Preprocessing Stage - Part 1

Lecture 9 - Design and Implementation of ECG Preprocessing Stage - Part 2

Lecture 10 - Design and Implementation of ECG Preprocessing Stage - Part 3

Lecture 11 - Design and Implementation of ECG Preprocessing Stage - Part 4

Lecture 12 - Design and Implementation of Peak Detector and Thresholding Circuit for ECG Signal Conditioning

Lecture 13 - Experiment: Live Demonstration of ECG Signal Acquisition, Conditioning and Measurement of BPM

Lecture 14 - Application: ECG Signals for detecting AF and the role of sensors

Lecture 15 - Photolithography: Masks

Lecture 16 - Understanding the process of photolithography

Lecture 17 - Photolithography: Mask Aligner

Lecture 18 - Photolithography: Designing of Mask Aligner System

Lecture 19 - Fabrication of Piezoresistive Sensor

Lecture 20 - Fabrication of MEMS based Catheter Contact Force Sensor

Lecture 21 - Design of Speed Control of DC Motor: Introduction

Lecture 22 - Design of Speed Control of DC Motor: Circuit Explanation

Lecture 23 - Design of Speed Control of DC Motor: Encoder Calibration

Lecture 24 - Design of Speed Control of DC Motor: Encoder Signal Conditioning Circuit - 1

Lecture 25 - Design of Speed Control of DC Motor: Encoder Signal Conditioning Circuit - 2

Lecture 26 - Design of Speed Control of DC Motor: Encoder Signal Conditioning Circuit - 3

Lecture 27 - Design of Speed Control of DC Motor: Encoder Signal Conditioning Circuit - 4

Lecture 28 - Design of Speed Control of DC Motor: Error Amplifier

Lecture 29 - Design of Speed Control of a DC Motor using Op-amp: Controllers

Lecture 30 - Design of Speed Control of a DC Motor using Op-amp: Circuit Implementation

Lecture 31 - Design of Speed Control of a DC Motor using DAQ - Part 1

- [Lecture 32 - Design of Speed Control of a DC Motor using DAQ - Part 2](#)
- [Lecture 33 - Design of Speed Control of a DC Motor using DAQ - Part 3](#)
- [Lecture 34 - Introduction to Hot-Wire Anemometer](#)
- [Lecture 35 - Signal-conditioning Circuit for Hot-Wire Anemometer](#)
- [Lecture 36 - Signal-conditioning Circuit for Hot-Wire Anemometer Part 2](#)
- [Lecture 37 - Signal-conditioning Circuit for Hot-Wire Anemometer: Simulation](#)
- [Lecture 38 - Signal-conditioning Circuit for Hot-Wire Anemometer: Experiment](#)
- [Lecture 39 - Introduction to Gas Sensors](#)
- [Lecture 40 - Fabrication Process for Gas Sensor](#)
- [Lecture 41 - Signalconditioning Circuit for Operating Heater Voltage of MQ-7 Gas Sensor - Part 1](#)
- [Lecture 42 - Signalconditioning Circuit for Operating Heater Voltage of MQ-7 Gas Sensor - Part 2](#)
- [Lecture 43 - Signalconditioning Circuit for Operating Heater Voltage of MQ-7 Gas Sensor - Part 3](#)
- [Lecture 44 - Fundamentals of Electrophysiological signals](#)
- [Lecture 45 - Fundamentals of EEG Signal](#)
- [Lecture 46 - Application of EEG Signal for Detection of Hearing Loss](#)
- [Lecture 47 - Closed loop control of temperature using DAQ and LabVIEW](#)
- [Lecture 48 - Experimental Set-up of closed loop control of temperature sensor](#)
- [Lecture 49 - Introduction to MEMS Simulation using Comsol Multiphysics](#)
- [Lecture 50 - Introduction to COMSOL Multiphysics](#)
- [Lecture 51 - COMSOL Examples for MEMS Applications](#)
- [Lecture 52 - COMSOL Examples for MEMS Applications \(Continued...\)](#)
- [Lecture 53 - Demonstration of Thermal Acuator and Understanding of Application Builder](#)

Lecture 1 - Sensors - Part 1

Lecture 2 - Sensors - Part 2

Lecture 3 - Sensors - Part 3

Lecture 4 - Sensors - Part 4

Lecture 5 - Sensors - Part 5

Lecture 6 - Recent Microsensors based system: E-Nose

Lecture 7 - Recent Microsensors based system: Force Sensor, Basics of Actuators

Lecture 8 - Microfabrication Basics

Lecture 9 - Introduction to cleanroom

Lecture 10 - Cleanroom Protocols

Lecture 11 - Introduction to Cleanroom Equipments: Micromanipulator, Stereo Microscope, metallurgical microscope, Incubator, Static Incubator, Inverted Microscope, Oven, Autoclave, Sonicator

Lecture 12 - Fabrication Process Flow of Microheater and Micromachining

Lecture 13 - Wafer Bonding and PDMS moulding

Lecture 14 - Overview of MEMS based sensors

Lecture 15 - Introduction to Cleanroom Equipments: Impedance Analyzer, LCR Meter, Micromanipulator

Lecture 16 - Introduction to Cleanroom Equipments: Biosafety Hood and safety

Lecture 17 - Process Sensor Process Flow, Cell based Diagnosis Device

Lecture 18 - Basics of Patterning and Drug Screening Device

Lecture 19 - MEMS applications in automobile system

Lecture 20 - Arduino Interfacing for Sensors and Actuators

Lecture 21 - Demonstration of DC Motor as an actuator

Lecture 22 - Demonstration of peristaltic pump using Arduino

Lecture 23 - Demonstration of PDMS Patterning

Lecture 24 - Crystal Orientation and Si-SiO₂ interface

Lecture 25 - Surface Profilometry and Physical Vapour Deposition Techniques

Lecture 26 - Introduction to COMSOL Multiphysics and Modelling Examples

Lecture 27 - Demonstration of Thermal Actuators using COMSOL

Lecture 28 - Demonstration of MQ3 Gas sensor using Arduino

Lecture 29 - Photolithography - Part 1

Lecture 30 - Signal Conditioning Circuit for Temperature Sensors

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

- Lecture 31 - Demonstration of Microheaters in COMSOL Multiphysics
- Lecture 32 - Introduction to Cleanroom facilities for biomedical applications
- Lecture 33 - Physical Deposition Techniques
- Lecture 34 - Demonstration on peristaltic pump in cleanroom
- Lecture 35 - Installation of Oxygen Plasma System
- Lecture 36 - Demonstration of IR Based Sensor using Arduino
- Lecture 37 - Illustration of fabricated Microfluidic Device for biochips with PDMS moulding
- Lecture 38 - Photolithography - Part 2
- Lecture 39 - Photolithography - Part 3
- Lecture 40 - Introduction and Demonstration of Shape Memory Alloy
- Lecture 41 - Applications of Shape Memory Alloy as a light weight actuators
- Lecture 42 - Discussion on Fabricated Sensor with Silicon as Substrate
- Lecture 43 - Discussion and Microscopic Inspection of Fabricated Sensor with Silicon as a Substrate
- Lecture 44 - Tissue Deparaffinization for Biosensors
- Lecture 45 - Clean room guidelines and Cancer Diagnostic tool
- Lecture 46 - Basics of Pressure Sensor and Demonstration using Arduino Microcontroller
- Lecture 47 - Basics of Stepper Motor and Demonstration using Arduino Microcontroller
- Lecture 48 - Microscopic Inspection of Diced wafers and CNT Sensing Layer for fabricated sensor
- Lecture 49 - Process flow for Microcantilever for Mechanical Phenotyping of breast cancer tissues
- Lecture 50 - Applications of microcantilever for Mechanical Phenotyping of breast cancer tissues
- Lecture 51 - Installation and Introduction to Physical Vapour Deposition System
- Lecture 52 - Human Machine Interface for Controlling Deposition System
- Lecture 53 - Flexible MEMS for phenotyping tissue properties - I
- Lecture 54 - Flexible MEMS for phenotyping tissue properties - II
- Lecture 55 - System Demonstration for Physical Vapor Deposition
- Lecture 56 - Introduction to CAD Modelling - I
- Lecture 57 - Introduction to CAD Modelling - II
- Lecture 58 - Biosensors for ETM Phenotyping of breast cancer tissues for better prognosis
- Lecture 59 - Biosensors for Electrothermal sensor
- Lecture 60 - MEMS based sensor for catheter contact force measurement
- Lecture 61 - Microfluidics based Drug Screening
- Lecture 62 - Basic aspects of 3D Printing
- Lecture 63 - 3D Printing Materials and Demonstration of Remote 3D Printing

Lecture 1 - The human brain

Lecture 2 - Introduction to Neural Networks

Lecture 3 - Models of a neuron

Lecture 4 - Feedback and network architectures

Lecture 5 - Knowledge representation

Lecture 6 - Prior information and invariances

Lecture 7 - Learning processes

Lecture 8 - Perceptron - 1

Lecture 9 - Perceptron - 2

Lecture 10 - Batch perceptron algorithm

Lecture 11 - Perceptron and Bayes classifier

Lecture 12 - Linear regression - 1

Lecture 13 - Linear regression - 2

Lecture 14 - Linear regression - 3

Lecture 15 - Logistic regression

Lecture 16 - Multi-layer perceptron - 1

Lecture 17 - Multi-layer perceptron - 2

Lecture 18 - Back propagation - 1

Lecture 19 - Back propagation - 2

Lecture 20 - XOR problem

Lecture 21 - Universal approximation function

Lecture 22 - Complexity Regularization and Cross validation

Lecture 23 - Convolutional Neural Networks (CNN)

Lecture 24 - Cover's Theorem

Lecture 25 - Multivariate interpolation problem

Lecture 26 - Radial basis functions (RBF)

Lecture 27 - Recursive least squares algorithm

Lecture 28 - Comparison of RBF with MLP

Lecture 29 - Kernel regression using RBFs

Lecture 30 - Kernel Functions

Lecture 31 - Basics of constrained optimization

- Lecture 32 - Optimization with equality constraint
- Lecture 33 - Optimization with inequality constraint
- Lecture 34 - Support Vector Machines (SVM)
- Lecture 35 - Optimal hyperplane for linearly separable patterns
- Lecture 36 - Quadratic optimization for finding optimal hyperplane
- Lecture 37 - Optimal hyperplane for non-linearly separable patterns
- Lecture 38 - Inner product kernel and Mercer's theorem
- Lecture 39 - Optimal design of an SVM
- Lecture 40 - μ -insensitive loss function
- Lecture 41 - XOR problem revisited using SVMs
- Lecture 42 - Hilbert Space
- Lecture 43 - Reproducing Kernel Hilbert Space
- Lecture 44 - Representer Theorem
- Lecture 45 - Generalized applicability of the representer theorem
- Lecture 46 - Regularization Theory
- Lecture 47 - Euler-Lagrange Equation
- Lecture 48 - Regularization Networks
- Lecture 49 - Generalized RBF networks
- Lecture 50 - XOR problem revisited using RBF
- Lecture 51 - Structural Risk Minimization
- Lecture 52 - Bias-Variance Dilemma
- Lecture 53 - Estimation of regularization parameters
- Lecture 54 - Basics of L1 regularization
- Lecture 55 - Grafting
- Lecture 56 - Kernel PCA
- Lecture 57 - Hebbian based maximum eigen filter - 1
- Lecture 58 - Hebbian based maximum eigen filter - 2
- Lecture 59 - Hebbian based maximum eigen filter - 3
- Lecture 60 - VC dimension
- Lecture 61 - Autoencoders
- Lecture 62 - Denoising Autoencoders
- Lecture 63 - Demo - Perceptron
- Lecture 64 - Demo - Motivation for CNN

[Lecture 65 - Back propagation in Convolutional Neural Network](#)

[Lecture 66 - Ethics in AI research and coverage summary](#)

DIGIMAT - The No.1 Learning Management Platform for Creative Learning

NPTEL : NOC:Electronics Equipment Integration and Prototype Building (Electrical Engineering)

Co-ordinators : Prof. N.V.Chalapathi Rao

- Lecture 1 - Introduction to electronics products
- Lecture 2 - Examples from real life: Parts to system
- Lecture 3 - Common Simulation of flat prismatic parts
- Lecture 4 - Common flat parts enclosures
- Lecture 5 - Real life parts to scale on a graph
- Lecture 6 - Early First steps
- Lecture 7 - Top down, outside to internals
- Lecture 8 - Using a print and fabrication video
- Lecture 9 - Details of displays and keys
- Lecture 10 - Improvement on marking and skill
- Lecture 11 - Mass production in sheet metal
- Lecture 12 - Prototyping of user interfaces for concepts
- Lecture 13 - Stacking of equipment to make a system
- Lecture 14 - Recapitulating a sub system
- Lecture 15 - Off the shelf enclosures and making a user interface
- Lecture 16 - Looking around for concepts and integration
- Lecture 17 - Representation on paper
- Lecture 18 - Example features of surfaces and solids
- Lecture 19 - Simple and curved surfaces
- Lecture 20 - Describing inclined surfaces
- Lecture 21 - Basics of engineering Drawing
- Lecture 22 - Introduction to sizing and fits
- Lecture 23 - Practical mechanical assemblies
- Lecture 24 - Analogous Mechanical - Electronics detailing
- Lecture 25 - Solid modelling
- Lecture 26 - Importance of dimensioning
- Lecture 27 - Ease of editing redesign
- Lecture 28 - Dimensioning of electronics components
- Lecture 29 - 2D flat representation
- Lecture 30 - Electronics to Mechanical interfacing
- Lecture 31 - Complexity of 3D assemblies with wiring

[Lecture 32 - Illustrative simple design](#)

[Lecture 33 - Practical detailing](#)

[Lecture 34 - Rendered on screen](#)

[Lecture 35 - Fastenings and hardware](#)

[Lecture 36 - Fastener representation, detailing](#)

[Lecture 37 - Practical detailing.](#)

[Lecture 38 - Recapitulation, context of course](#)

[Lecture 39 - Low cost is the key](#)

Lecture 1 - Getting started with NgSpice

Lecture 2 - Refractoring the .cir

Lecture 3 - Sub-circuits

Lecture 4 - gschem and netlist generation

Lecture 5 - Setting up for simulation with Octave

Lecture 6 - Getting started with equation based simulation

Lecture 7 - Resuming a simulation in Octave

Lecture 8 - PV cell model - review

Lecture 9 - PV cell characteristic - review

Lecture 10 - PV cell - symbol and subcircuit

Lecture 11 - Rectifier-capacitor filter - operation review

Lecture 12 - Rectifier-capacitor filter - NgSpice simulation

Lecture 13 - Rectifier-capacitor filter with non-idealities

Lecture 14 - 3 phase Rectifier-capacitor filter

Lecture 15 - Equation based simulation in Octave

Lecture 16 - Passive power factor improvement - review

Lecture 17 - Passive power factor circuit in NgSpice

Lecture 18 - Buck converter - review

Lecture 19 - Buck converter - NgSpice

Lecture 20 - Boost converter - review

Lecture 21 - Boost converter - NgSpice

Lecture 22 - Buck-boost converter - review

Lecture 23 - Buck-boost converter - NgSpice

Lecture 24 - Equation based simulation of converters

Lecture 25 - Forward Converter - review

Lecture 26 - Forward Converter simulation

Lecture 27 - Understanding Core flux reset

Lecture 28 - Core flux reset - simulation

Lecture 29 - Flyback converter - review

Lecture 30 - Flyback converter - simulation

Lecture 31 - Pushpull converter - review

- [Lecture 32 - Pushpull converter - simulation](#)
- [Lecture 33 - Half bridge converter - review](#)
- [Lecture 34 - Half bridge converter - simulation](#)
- [Lecture 35 - Full bridge converter - review](#)
- [Lecture 36 - Full bridge converter - simulation](#)
- [Lecture 37 - Close loop operation](#)
- [Lecture 38 - Close loop with feed forward control](#)
- [Lecture 39 - NgSpice simulation of close loop control](#)
- [Lecture 40 - Battery charging with current control](#)
- [Lecture 41 - Slope compensation for current control](#)
- [Lecture 42 - NgSpice simulation of battery charging](#)
- [Lecture 43 - Single phase PWM for single phase inverter](#)
- [Lecture 44 - NgSpice simulation of single phase PWM](#)
- [Lecture 45 - 2-axes theory for 3-phase systems](#)
- [Lecture 46 - Transformations for 2 and 3 axes systems](#)
- [Lecture 47 - Maximum power point tracking - NgSpice](#)
- [Lecture 48 - Space vector PWM - digital](#)
- [Lecture 49 - Space vector PWM - analog](#)
- [Lecture 50 - SVPWM analog - NgSpice simulation](#)
- [Lecture 51 - Induction motor model](#)
- [Lecture 52 - Induction motor simulation in Octave](#)
- [Lecture 53 - V/F control of induction motor - NgSpice](#)

- Lecture 1 - Cellular (Microscopic) Structure of the Central Nervous System (CNS)
- Lecture 2 - Anatomical (Macroscopic) structure of the CNS
- Lecture 3 - Introduction to Cleanroom and IC Fabrication Techniques
- Lecture 4 - Introduction to EEG applications for Hearing Loss
- Lecture 5 - Electrophysiological Recordings
- Lecture 6 - Neocortical Circuits
- Lecture 7 - The resting Membrane Potential
- Lecture 8 - Applications of MEMS Fabrication Technologies
- Lecture 9 - Fundamentals of biopotentials and applications
- Lecture 10 - Fundamentals of EEG and applications
- Lecture 11 - The Action Potential (1)
- Lecture 12 - The Action Potential (2)
- Lecture 13 - Axonology, Neuronal Biophysics (1)
- Lecture 14 - Axonology, Neuronal Biophysics (2)
- Lecture 15 - Experimental Setup for EEG Recording
- Lecture 16 - Introduction to Cleanroom Protocols and Demonstration of Gowning Procedure
- Lecture 17 - Electromagnetic Stimulation of the Brain (1)
- Lecture 18 - Electromagnetic Stimulation of the Brain (2)
- Lecture 19 - Introduction to Event Related Potentials
- Lecture 20 - Introduction to 3D Printing
- Lecture 21 - 3D Printing: Applications and Demonstrations
- Lecture 22 - Introduction to Event Related Potentials (2)
- Lecture 23 - Different Event Related Potentials (1)
- Lecture 24 - Different Event Related Potentials (2)
- Lecture 25 - Introduction to Silicone Wafer Processing Techniques
- Lecture 26 - Basics of Silicone Dioxide: Oxidation, Characterization and Applications
- Lecture 27 - Inverse Problem, EEG source localization (1)
- Lecture 28 - Inverse Problem, EEG source localization (2)
- Lecture 29 - Introduction to Brain Computer Interfaces
- Lecture 30 - Signal Conditioning Circuit for EEG Bioamplifiers
- Lecture 31 - Basics of BCI Experimentation: Introduction BCI Applications

- Lecture 32 - Different Brain Computer Interfaces
- Lecture 33 - Introduction to EEGLAB, ERPLAB and AEP Demonstration (1)
- Lecture 34 - Introduction to EEGLAB, ERPLAB and AEP Demonstration (2)
- Lecture 35 - Introduction to Photolithography
- Lecture 36 - Basics of BCI Experimentation: Stimuli Generation and Insertion
- Lecture 37 - MMN Demonstration with EEGLAB and ERPLAB (1)
- Lecture 38 - MMN Demonstration with EEGLAB and ERPLAB (2)
- Lecture 39 - Introduction to Photolithography (2)
- Lecture 40 - Basics of Instrumentation Amplifier and Online Simulation
- Lecture 41 - Basics of BCI Experimentation: Experimental Setup and Biopotential Acquisition
- Lecture 42 - P300 Demonstration with EEGLAB/ERPLAB (1)
- Lecture 43 - P300 Demonstration with EEGLAB/ERPLAB (2)
- Lecture 44 - Wavelet Analysis with VEP (1)
- Lecture 45 - Details of Lithography, E-beam Lithography and Mask Aligner
- Lecture 46 - Basics of BCI Experimentation: Signal Acquisition using MATLAB (EEGLAB)
- Lecture 47 - Wavelet Analysis with VEP (2)
- Lecture 48 - Demonstration: Resting Membrane Potential
- Lecture 49 - Demonstration: Membrane Time Constant (τ_m)
- Lecture 50 - Photoresist (SU-8) and soft lithography
- Lecture 51 - Physical Vapour Deposition: Thermal Evaporation
- Lecture 52 - Introduction to Epilepsy and Classification
- Lecture 53 - Epileptogenesis
- Lecture 54 - Demonstration: Membrane Length Constant (λ_m)
- Lecture 55 - Demonstration: Action Potential
- Lecture 56 - Demonstration: Voltage Clamp
- Lecture 57 - Demonstration: Synaptic Potentials & Current
- Lecture 58 - Physical Vapour Deposition: E-beam Evaporation
- Lecture 59 - Physical Vapour Deposition: Sputtering
- Lecture 60 - Recent Trends: Epilepsy Classification using EEG data
- Lecture 61 - Demonstration: Wireless EEG with dry electrodes
- Lecture 62 - Basics of EEG, ERP and acquisition
- Lecture 63 - Photolithography with example
- Lecture 64 - Stress Tissue Analysis using COMSOL Multiphysics

Lecture 1 - What is information?

Lecture 2 - How to model uncertainty?

Lecture 3 - Basic concepts of probability

Lecture 4 - Estimates of random variables

Lecture 5 - Limit theorems

Lecture 6 - Review

Lecture 7 - Source model

Lecture 8 - Motivating examples

Lecture 9 - A compression problem

Lecture 10 - Shannon entropy

Lecture 11 - Random hash

Lecture 12 - Review 2

Lecture 13 - Uncertainty and randomness

Lecture 14 - Total variation distance

Lecture 15 - Generating almost random bits

Lecture 16 - Generating samples from a distribution using uniform randomness

Lecture 17 - Typical sets and entropy

Lecture 18 - Review 3

Lecture 19 - Hypothesis testing and estimation

Lecture 20 - Examples

Lecture 21 - The log-likelihood ratio test

Lecture 22 - Kullback-Leibler divergence and Stein's lemma

Lecture 23 - Properties of KL divergence

Lecture 24 - Review 4

Lecture 25 - Information per coin-toss

Lecture 26 - Multiple hypothesis testing

Lecture 27 - Error analysis of multiple hypothesis testing

Lecture 28 - Mutual information

Lecture 29 - Fano's inequality

Lecture 30 - Measures of information

Lecture 31 - Chain rules

Lecture 32 - Shape of measures of information

Lecture 33 - Data processing inequality

Lecture 34 - Midyear Review

Lecture 35 - Proof of Fano's inequality

Lecture 36 - Variational formulae

Lecture 37 - Capacity as information radius

Lecture 38 - Proof of Pinsker's inequality

Lecture 39 - Continuity of entropy

Lecture 40 - Lower bound for compression

Lecture 41 - Lower bound for hypothesis testing

Lecture 42 - Review 7

Lecture 43 - Lower bound for random number generation

Lecture 44 - Strong converse

Lecture 45 - Lower bound for minmax statistical estimation

Lecture 46 - Variable length source codes

Lecture 47 - Review 8

Lecture 48 - Kraft's inequality

Lecture 49 - Shannon code

Lecture 50 - Huffman code

Lecture 51 - Minmax Redundancy

Lecture 52 - Type based universal compression

Lecture 53 - Review 9

Lecture 54 - Arithmetic code

Lecture 55 - Online probability assignment

Lecture 56 - Compression of databases: A scheme

Lecture 57 - Compression of databases: A lower bound

Lecture 58 - Repetition code

Lecture 59 - Channel capacity

Lecture 60 - Sphere packing bound for BSC

Lecture 61 - Random coding bound for BSC

Lecture 62 - Random coding bound for general channel

Lecture 63 - Review 11

Lecture 64 - Converse proof for channel coding theorem

[Lecture 65 - Additive Gaussian Noise channel](#)

[Lecture 66 - Mutual information and differential entropy](#)

[Lecture 67 - Channel coding theorem for Gaussian channel](#)

[Lecture 68 - Parallel channels and water-filling](#)

Lecture 1 - Photonic integrated circuits course introduction

Lecture 2 - Wave optics review

Lecture 3 - Electromagnetic theory review - 1

Lecture 4 - Electromagnetic theory review - 2

Lecture 5 - Photonic integrated circuits: an introduction

Lecture 6 - Photonic integrated circuits evolution

Lecture 7 - Photonic integrated circuit components - 1

Lecture 8 - Photonic integrated circuit components - 2

Lecture 9 - Dispersion

Lecture 10 - Phase velocity and Group velocity

Lecture 11 - Anisotropic medium and reciprocity

Lecture 12 - Polarisation in anisotropic medium

Lecture 13 - Optical axes

Lecture 14 - Waveguide structure

Lecture 15 - Waveguide modes - 1

Lecture 16 - Waveguide modes - 2

Lecture 17 - Field Equation

Lecture 18 - Guided modes in symmetric slab waveguides

Lecture 19 - Waveguide design - Boundary value formulation

Lecture 20 - Waveguide design - BVP solution

Lecture 21 - Waveguide design - Perturbation approach

Lecture 22 - Waveguide design - Effective Index method

Lecture 23 - Coupled mode theory - 1

Lecture 24 - Coupled mode theory - 2

Lecture 25 - Two-mode coupling

Lecture 26 - Co and counter propagating mode coupling

Lecture 27 - Phase matching

Lecture 28 - Directional coupler

Lecture 29 - Y-splitter

Lecture 30 - Multi-Mode Interference coupler

Lecture 31 - MZI

[Lecture 32 - Micro-Ring Resonators](#)

[Lecture 33 - Light-chip coupling](#)

[Lecture 34 - End-fire coupling](#)

[Lecture 35 - Light Modulator introduction](#)

[Lecture 36 - Electro-Optic effect](#)

[Lecture 37 - Waveguide modulator](#)

[Lecture 38 - Optical transition in semiconductors](#)

[Lecture 39 - Transition rates](#)

[Lecture 40 - Absorption and gain in semiconductors](#)

[Lecture 41 - Semiconductor Light Emitting Diodes](#)

[Lecture 42 - Semiconductor Light Emitting Diodes \(Continued...\)](#)

[Lecture 43 - Semiconductor Lasers](#)

[Lecture 44 - Semiconductor photodetector](#)

[Lecture 45 - Semiconductor photodetector noise](#)

[Lecture 46 - Fabrication process - 1](#)

[Lecture 47 - Fabrication process - 2](#)

[Lecture 48 - PIC technology - Building a simple circuit](#)

[Lecture 49 - PIC for communication](#)

[Lecture 50 - PIC for sensing - 1](#)

[Lecture 51 - PIC for sensing - 2](#)

Lecture 1 - Introduction and Definition of IoT

Lecture 2 - Location, Applications, and Power

Lecture 3 - Challenges - Part 1

Lecture 4 - Challenges - Part 2

Lecture 5 - Challenges - Part 3

Lecture 6 - Challenges - Part 4

Lecture 7 - Unique ID

Lecture 8 - Introduction to RFID

Lecture 9 - RFID DEMO

Lecture 10 - RFID Theory - 1

Lecture 11 - RFID Theory - 2

Lecture 12 - RFID Theory - 3

Lecture 13 - Energy harvesting - 1

Lecture 14 - Energy harvesting - 2

Lecture 15 - Energy harvesting - 3

Lecture 16 - Power management systems - 1

Lecture 17 - Power management systems - 2

Lecture 18 - Battery life calculation

Lecture 19 - Introduction to System Design for low power

Lecture 20 - LDO - 1

Lecture 21 - LDO - 2

Lecture 22 - LDO - 3

Lecture 23 - Buck converter - 1

Lecture 24 - Buck converter - 2

Lecture 25 - Lab experiment

Lecture 26 - Introduction to Sensors and Actuators

Lecture 27 - Sensors

Lecture 28 - Actuators

Lecture 29 - Case study on Sensing and Actuation

Lecture 30 - Introduction to low power software

Lecture 31 - ADC driver design and development

[Lecture 32 - Power optimization](#)

[Lecture 33 - Introduction to protocols](#)

[Lecture 34 - MQTT - 1](#)

[Lecture 35 - MQTT - 2](#)

[Lecture 36 - COAP - 1](#)

[Lecture 37 - COAP - 2](#)

[Lecture 38 - Websockets](#)

[Lecture 39 - Introduction to low power wireless - 1](#)

[Lecture 40 - Introduction to low power wireless - 2](#)

[Lecture 41 - Bluetooth low energy \(BLE\) - 1](#)

[Lecture 42 - Bluetooth low energy \(BLE\) - 2](#)

[Lecture 43 - IEEE 802.15.4e - 1](#)

[Lecture 44 - IEEE 802.15.4e - 2](#)

[Lecture 45 - IEEE 802.15.4e - 3](#)

[Lecture 46 - Wi-Fi](#)

[Lecture 47 - Introduction to Wide area technologies](#)

[Lecture 48 - LoRa - 1](#)

[Lecture 49 - LoRa - 2](#)

[Lecture 50 - NBIoT, LTEM1](#)

[Lecture 51 - BLE mesh technology](#)

[Lecture 52 - Course conclusion](#)

Lecture 1 - Introduction to Signals and Systems

Lecture 2 - MATLAB Demo on Signal Types and Moving Average System

Lecture 3 - Microfabrication Basics for Biomedical Systems

Lecture 4 - Fluid Flow in Body Lumen

Lecture 5 - Fourier Series

Lecture 6 - Continuous Time Fourier Transform

Lecture 7 - Biological Tissues as disordered systems

Lecture 8 - Introduction to electrical equivalent circuit models for biological systems

Lecture 9 - Discrete Time Fourier Transform and Sampling

Lecture 10 - Percolation Theory and applications in biological tissues

Lecture 11 - Electrical properties of cells and tissues revisited: Examples and Applications

Lecture 12 - Linear Algebra - I

Lecture 13 - MATLAB Live Demo on Moving average and signal acquisition

Lecture 14 - Oxidation and Thickness Characterization

Lecture 15 - Basics of Photolithography with Process flow examples

Lecture 16 - Linear Algebra - II

Lecture 17 - Introduction to Biomedical Optics

Lecture 18 - Optical Properties of Tissues and Mathematical modelling

Lecture 19 - System of Linear Equations

Lecture 20 - Scaling Laws

Lecture 21 - Thermal Properties of a tissue

Lecture 22 - Introduction to Probability

Lecture 23 - Tissue Electrode Interface

Lecture 24 - Thermal Properties of a tissue and cells

Lecture 25 - Probability: Random Variables and CDF

Lecture 26 - Basics of Silicon, Silicon Dioxide for Microfabrication Process

Lecture 27 - Mechanical Properties of human brain tissues and modelling

Lecture 28 - Probability: Important measures and generating functions

Lecture 29 - Near Infrared Spectroscopy and Ultrasound Techniques

Lecture 30 - Thermal Properties of Tissues and Modelling

Lecture 31 - Multisim Simulations for Biomedical Signal Conditioning Circuit

[Lecture 32 - Cleanroom Entry Demonstration](#)

[Lecture 33 - Spin Coating Demonstration](#)

[Lecture 34 - Common Random Variables](#)

[Lecture 35 - Introduction to signal Conditioning circuits for biomedical devices](#)

[Lecture 36 - Signal Conditioning circuits units and design](#)

[Lecture 37 - E Beam Evaporation System Demonstration](#)

[Lecture 38 - Joint and Marginal Probability Distribution](#)

[Lecture 39 - Temperature Sensor Interfacing Analysis](#)

[Lecture 40 - Demo of Temperature data acquisition system using LabVIEW](#)

[Lecture 41 - Recent Trends in Biomedical Electronic System Design](#)

[Lecture 42 - Aspects of Biomedical Electronics System Design](#)

Lecture 1 - Why study concentration inequalities?

Lecture 2 - Chernoff bound

Lecture 3 - Examples of Chernoff bound for common distributions

Lecture 4 - Hoeffding and Bernstein inequalities

Lecture 5 - Azuma and McDiarmid inequalities

Lecture 6 - Bounding variance using the Efron-Stein inequality

Lecture 7 - The Gaussian-Poincare inequality

Lecture 8 - Tail bounds using the Efron-Stein inequality

Lecture 9 - Herbst's argument and the entropy method

Lecture 10 - Log-Sobolev inequalities

Lecture 11 - Binary and Gaussian Log-Sobolev inequalities and concentration

Lecture 12 - Variational formulae for Kullback-Leibler and Bregman Divergence

Lecture 13 - A modified log-Sobolev inequality and concentration

Lecture 14 - Introduction to the transportation method for showing concentration bounds

Lecture 15 - Transportation lemma and a proof of McDiarmid's inequality using the transportation method

Lecture 16 - Concentration bounds for functions beyond bounded difference using transportation method

Lecture 17 - Marton's conditional transportation cost inequality

Lecture 18 - Isoperimetry and concentration of measure

Lecture 19 - Isoperimetry and bounded difference

Lecture 20 - Equivalence of Stam's inequality and log Sobolev inequality

Lecture 21 - An information theoretic proof of log Sobolev inequality

Lecture 22 - Hypercontractivity and strong data processing inequality for Rényi divergence

Lecture 23 - An information theoretic characterization of hypercontractivity

Lecture 24 - Equivalence of Gaussian hypercontractivity and Gaussian log Sobolev inequality

Lecture 25 - Uniform deviation bounds for random walks and the law of the iterated logarithm

Lecture 26 - Self normalized concentration inequalities and application to online regression

Lecture 1 - Introduction

Lecture 2 - Basics of Signal Processing

Lecture 3 - Lab - CCS

Lecture 4 - Number System

Lecture 5 - Architecture - 1

Lecture 6 - Architecture - 2

Lecture 7 - Real-time Constraints

Lecture 8 - FIR - Filters

Lecture 9 - Pipelining and Parallel Processing for Low Power Applications - I

Lecture 10 - Pipelining and Parallel Processing for Low Power Applications - II

Lecture 11 - Lab: Sine Generation

Lecture 12 - IIR Filters - 1

Lecture 13 - IIR Filters - 2

Lecture 14 - Lab: Sine Generation, FIR and IIR

Lecture 15 - Lab 3 IIR Filter as Resonator

Lecture 16 - Lab 4 Use of FDA tool box to generate co-efficients

Lecture 17 - Lab: Real-Time Audio Output through Sine Generation

Lecture 18 - IIR Filters 4

Lecture 19 - Lab: FIR Filter in generation of music

Lecture 20 - Lab: Real-Time Audio Output through FIR Filter

Lecture 21 - DFT, DTFT, twiddle factors, properties, circular convolution and examples

Lecture 22 - Complexity of Filtering and the FFT

Lecture 23 - Lab: Filtering Using FFT

Lecture 24 - Lab: FFT in CCS

Lecture 25 - FFT - 1

Lecture 26 - FFT - 2

Lecture 27 - FFT - 3

Lecture 28 - Overlap - Add

Lecture 29 - Overlap Save Method

Lecture 30 - Lab: Overlap Add and Save Method using MATLAB

Lecture 31 - Correlation

Lecture 32 - Lab: Different ways of implementing FFT in CCS

Lecture 33 - Adaptive Filter

Lecture 34 - Lab: LMS Algorithm in MATLAB

Lecture 35 - LMS Algorithm

Lecture 36 - Lab: Error surface and error contour

Lecture 37 - Adaptive Filter Applications

Lecture 38 - Lab: Application of adaptive filter in MATLAB

Lecture 39 - Adaptive Echo Cancellation

Lecture 40 - Lab: Application of adaptive filter in CCS, Echo, scrambling and graphic equalizer in MATLAB

Lecture 41 - Graphic Equalizer

Lecture 42 - Lab: Adaptive filters (MATLAB)

Lecture 43 - Speech Coding - I

Lecture 44 - Speech Coding - II

Lecture 45 - Speech Coding - III

Lecture 46 - Lab: LPC for speech synthesis

Lecture 47 - Discrete Cosine Transform - 1

Lecture 48 - Discrete Cosine Transform - 2

Lecture 49 - Discrete Cosine Transform - 3

Lecture 50 - Discrete Cosine Transform - 4

Lecture 51 - Lab: Adaptive filters (CCS) - 1

Lecture 52 - Lab: Adaptive filters (CCS) - 2

Lecture 53 - Lab: Discrete Cosine Transformation

Lecture 54 - Lab: Echogeneration

Lecture 55 - Lab: Using JiDSP

Lecture 56 - Summary

- Lecture 1 - Introduction to Biomedical Research
- Lecture 2 - Fabricated Biosensors and Systems
- Lecture 3 - Lab 1 - Introduction to the Fabrication lab
- Lecture 4 - Lab 2 - Cleanroom and Gowning Protocol
- Lecture 5 - Developed Systems at a glance
- Lecture 6 - Silicon and Silicon Dioxide
- Lecture 7 - Piranha Cleaning of Silicon Wafer
- Lecture 8 - Polyimide Coating on Silicon Wafer
- Lecture 9 - Thermal Oxidation of Silicon and Thickness measurement
- Lecture 10 - Fundamental of Physical Vapour Deposition
- Lecture 11 - Lab 3 - Lithography: Demonstration
- Lecture 12 - Sputtering
- Lecture 13 - Basics of Photolithography
- Lecture 14 - Lab 4 - E-Beam Evaporation: Demo
- Lecture 15 - Photolithography - II
- Lecture 16 - Photolithography - III
- Lecture 17 - Lab 5 - E-Beam Evaporation: Demo - II
- Lecture 18 - Lab 6 - Liftoff Demonstration
- Lecture 19 - Lithography Optics - I
- Lecture 20 - Soft Lithography - I
- Lecture 21 - Soft Lithography - II
- Lecture 22 - Lab 7 - Sputtering Demonstration - I
- Lecture 23 - Lab 8 - Sputtering Demonstration - II
- Lecture 24 - Thin Film Deposition: CVD - I
- Lecture 25 - Thin Film Deposition: CVD - II
- Lecture 26 - Lithography Optics - II
- Lecture 27 - Role of Fabrication in Neural Engineering
- Lecture 28 - Micromachining
- Lecture 29 - Overview of Experimental Neurophysiology
- Lecture 30 - Fabrication of Neural Implants
- Lecture 31 - Introduction to Packaging for Neural Systems

- Lecture 32 - Lab 9 - 3D Printing for neural devices
- Lecture 33 - Introduction to Biopotentials
- Lecture 34 - EEG: Introduction, Demonstration and Applications
- Lecture 35 - Neural Implants: Fabrication and Characterization
- Lecture 36 - Design of Wireless Biphasic Pulse Generator
- Lecture 37 - Basics of EEG/ERP Experimental Design
- Lecture 38 - Micromachining and Etching
- Lecture 39 - Epileptic Seizure Detection and Classification
- Lecture 40 - Newborn Hearing Screening - I
- Lecture 41 - Newborn Hearing Screening - II
- Lecture 42 - Applications of EEG/ERP Experimental Design
- Lecture 43 - Flexible MEA for Electroencephalography Signal Acquisition
- Lecture 44 - Flexible biodegradable MEAs
- Lecture 45 - Microneedle Electrode Array
- Lecture 46 - Neurosurgery-based MEA Implantation - I
- Lecture 47 - Neurosurgery-based MEA Implantation - II
- Lecture 48 - Neurosurgery-based MEA Implantation - III
- Lecture 49 - Neurosurgery-based MEA Implantation - IV
- Lecture 50 - Deep Brain Stimulation/Recording for Parkinson's - I
- Lecture 51 - Deep Brain Stimulation/Recording for Parkinson's - II
- Lecture 52 - Computational Neuroscience Fundamentals
- Lecture 53 - Mathematical Analysis in Neural Science
- Lecture 54 - Neuroanatomy for Neural Engineering

Lecture 1 - History Prospect of Electrical Machines

Lecture 2 - Electric Fields

Lecture 3 - Magnetic Fields - 1

Lecture 4 - Magnetic Fields - 2

Lecture 5 - Electric and Magnetic Circuits Interface

Lecture 6 - Magnetic Materials and Concepts of BH Curves

Lecture 7 - Analysis of Magnetic Circuits With and Without Air Gaps

Lecture 8 - Example Problems of Magnetic Circuits

Lecture 9 - Magnetic Circuits with Multiple Windings and Permanent Magnets

Lecture 10 - Force Equations in Electromechanical Systems - 1

Lecture 11 - Force Equations in Electromechanical Systems - 2

Lecture 12 - Design of Electromagnetic Systems

Lecture 13 - Realization of Electrical Machines - 1

Lecture 14 - Realization of Electrical Machines - 2

Lecture 15 - Magnetic Fields in DC Machines - 1

Lecture 16 - Magnetic Fields in AC Machines - 1

Lecture 17 - Magnetic Fields in AC Machines - 2

Lecture 18 - Magnetic Fields in AC Machines - 3

Lecture 19 - MMFDistribution ofAC Machines

Lecture 20 - Basics of Electrical Machine Windings

Lecture 21 - Stator winding design-single layer winding

Lecture 22 - Stator winding design-double layer winding

Lecture 23 - Stator Winding Design-Fractional Slot Double Layer Winding

Lecture 24 - Variable Pole Machine Stator Winding Design (Pole-Phase Modulation) - 1

Lecture 25 - Variable Pole Machine Stator Winding Design (Pole-Phase Modulation) - 2

Lecture 26 - Importance of Motor Design and Standards of Electric Motors

Lecture 27 - Electric Machine Sizing Equations-Output Power and Volume (D2L) Product Equation

Lecture 28 - Lab Session on Re-winding of Induction Motor (Example: Double Layer Winding)

Lecture 29 - The Figure of Merits for Electric Motors and Aspect Ratio to Decouple the D2L Product

Lecture 30 - Electric Machine Sizing Equations-Output Power Equation in terms of D3L Product - 1

Lecture 31 - Electric Machine Sizing Equations-Output Power Equation in terms of D3L Product - 2

- Lecture 32 - Analysis of Copper Function and Output Function w r t the Electric Machine D3L Product Eqn
- Lecture 33 - Example Problems on Output Power Equation in terms of D3L Product
- Lecture 34 - Electric Machine Sizing Equations-Output Power Equation in terms of D the power 2.5 L Product
- Lecture 35 - Design Procedure of an Electric Machine
- Lecture 36 - Name Plate Details and Datasheets of Induction Motor
- Lecture 37 - Design of Induction Machine- Stator Design - 1 (Stator Core design)
- Lecture 38 - Design of Induction Machine- Stator Design - 2 (Stator Winding Design)
- Lecture 39 - Design of Induction Machine- Stator Design - 3 (Stator Slot Geometry)
- Lecture 40 - Design of Induction Machine- Rotor Design - 1 (Rotor Slots Selection)
- Lecture 41 - Design of Induction Machine- Rotor Design - 2 (Rotor MMF and Bar Currents)
- Lecture 42 - Design of Induction Machine- Rotor Design - 3 (Rotor Slot Geometry)
- Lecture 43 - Design of Induction Machine- Rotor Design - 4 (Skewing of Rotor)
- Lecture 44 - Design of Induction Machine- Rotor Design - 4 (Resistance of Rotor Winding)
- Lecture 45 - Carter's Coefficient of Electrical Machines
- Lecture 46 - Effective Length Equations of the Machine Core with Different Stator and Rotor Lengths
- Lecture 47 - Stator MMF and Magnetizing Current Equations of Induction Machine
- Lecture 48 - Magnetizing Inductance of Induction Machine
- Lecture 49 - Stator and Rotor Leakage Inductances of Induction Machine
- Lecture 50 - Equivalent Circuit Parameters of Induction Machine
- Lecture 51 - Loss Calculation of Induction Machine - 1
- Lecture 52 - Loss Calculation of Induction Machine - 2 and Performance Parameters of Induction Motor
- Lecture 53 - Switched Reluctance Machine Sizing Equations-Output Power and Volume (D2L) Product Equation
- Lecture 54 - The Figure of Merits for SRM and Example Problem on Output Power Equation i t f D2L Product
- Lecture 55 - Design of Switched Reluctance Machine: Stator Design - 1
- Lecture 56 - Design of Switched Reluctance Machine: Stator Design - 2 and Rotor Design
- Lecture 57 - Procedure for Calculation of SRM Inductance: Aligned Inductance - 1
- Lecture 58 - Calculation of SRM Inductance: Aligned Inductance - 2
- Lecture 59 - Efficiency and Loss Calculation of SRM
- Lecture 60 - Importance of Thermal Design and Thermal Limits for Electrical Machines
- Lecture 61 - Electric and Thermal Circuits Interface
- Lecture 62 - Heat Transfer Methods and Basic Equations for Thermal Resistance
- Lecture 63 - Heat Flow in Electrical Machines
- Lecture 64 - Cooling Methods and Standards for Electrical Machines

[Lecture 65 - Basics of Thermal Equivalent Circuits](#)

[Lecture 66 - Thermal Equivalent Circuit - 1](#)

[Lecture 67 - Thermal Equivalent Circuit - 2](#)

- Lecture 1 - An Introduction to the course and outline of the course
- Lecture 2 - Historical overview of the development of microwave devices
- Lecture 3 - Applications of semiconductor microwave devices
- Lecture 4 - Applications of semiconductor microwave devices (Continued...)
- Lecture 5 - Heterojunction device physics
- Lecture 6 - Heterojunction device physics (Continued...) and III-nitrides
- Lecture 7 - III-nitrides and polarization
- Lecture 8 - III-nitride high electron mobility transistors
- Lecture 9 - Varactors and Schottky multipliers
- Lecture 10 - Varactors and Schottky multipliers (Continued...)
- Lecture 11 - Diodes for microwave applications
- Lecture 12 - IMPATT diode
- Lecture 13 - Tunnel diodes and Introduction to Gunn diodes
- Lecture 14 - Gunn diode and its modes
- Lecture 15 - Introduction to MESFETs
- Lecture 16 - Advanced concepts of GaAs MESFETs
- Lecture 17 - GaAs MESFET fabrication and practical aspects
- Lecture 18 - Practical aspects of FET design and small-signal model
- Lecture 19 - GaAs MESFETs: cut-off frequency and aspects of power devices
- Lecture 20 - GaAs MESFETs for power amplifiers
- Lecture 21 - Modulation doping in compound semiconductors
- Lecture 22 - Band diagram of MODFETs/HEMTs
- Lecture 23 - Design issues and methodology for microwave HEMTs
- Lecture 24 - Small-signal model and noise in HEMTs
- Lecture 25 - The concept of pseudomorphic or pHEMTs
- Lecture 26 - Multi-finger HEMTs
- Lecture 27 - pHEMTs for low noise and introduction to InP HEMT
- Lecture 28 - InP HEMTs for power and the concept of metamorphic HEMTs
- Lecture 29 - AlGaIn/GaN HEMT: applications, structure, substrates and FOM
- Lecture 30 - AlGaIn/GaN HEMT: device basics, current collapse and passivation
- Lecture 31 - AlGaIn/GaN HEMT: gate process, field-plate and trade-offs in design

- Lecture 32 - AlGaIn/GaN HEMT: Practical aspects and commercial HEMTs
- Lecture 33 - GaN RF HEMT on eval board, and emerging topics of research
- Lecture 34 - Linearity in GaN HEMTs - A device perspective
- Lecture 35 - Nanoscale MOSFETs and short channel effects
- Lecture 36 - Parasitic resistances and capacitances in nanoscale MOSFETs
- Lecture 37 - RF MOSFET Layout and RF Silicon-on-insulator
- Lecture 38 - Noise in MOSFETs and Introduction to LDMOS
- Lecture 39 - Working of LDMOS and VDMOS
- Lecture 40 - LDMOS: Parasitics, and the concept of RESURF
- Lecture 41 - LDMOS: HCI, snapback, finger layout and some aspects of commercial devices
- Lecture 42 - BJT: common base and common emitter from the device point of view
- Lecture 43 - BJT: Kirk effect, Ebers-Moll model and base transit time
- Lecture 44 - BJT: small-signal model, gain and cut-off frequency
- Lecture 45 - BJT: Emitter and base designs and drift transistor
- Lecture 46 - Collector design in modern BJT and Introduction to HBTs
- Lecture 47 - HBT: base current and collapse of the current gain
- Lecture 48 - High-frequency HBT and Introduction to SiGe HBT
- Lecture 49 - SiGe HBT: various resistances and capacitances, scaling and aspects of BiCMOS
- Lecture 50 - Basics of microwave: transmission line theory
- Lecture 51 - Waveguides, T-lines and introduction to 2-port networks
- Lecture 52 - S-parameters and the basics of Smith Chart
- Lecture 53 - Smith chart and matching
- Lecture 54 - Impedance matching using Smith Chart and stub line
- Lecture 55 - Passives in microwave circuits
- Lecture 56 - Inductors in microwave circuits
- Lecture 57 - More on passive elements in microwave circuits
- Lecture 58 - On-wafer measurement and S-parameters
- Lecture 59 - On-wafer de-embedding
- Lecture 60 - On-wafer and fixture-based measurements and calibration
- Lecture 61 - More on fixtures and basic transistor concepts for power amplifiers