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- 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](#)

- 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

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[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

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[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](#)

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

Co-ordinators : Prof. Ankur Gupta

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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

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

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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

HTML Links for 1,19,200+ NPTEL Video Lectures, Created by LinuXpert Systems, Chennai

[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](#)

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

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Lecture 25 - Existence of limit cycle for unstable system

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- Lecture 21 - BDD based verification
- Lecture 22 - Verification: ADD based verification, HDD based verification
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NPTEL : Advanced Electric Drives (Electrical Engineering)

Co-ordinators : Dr. S.P. Das

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NPTEL : High Voltage DC Transmission (Electrical Engineering)

Co-ordinators : Dr. S.N. Singh

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- 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

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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

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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

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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

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- Lecture 65 - Transients on Transmission line-I
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- 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
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- 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
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- Lecture 83 - Long wire Antenna
- Lecture 84 - Group velocity and Phase velocity
- Lecture 85 - Numerical solution of Laplace's equation

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

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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, μ -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](#)

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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

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- 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

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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

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[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](#)

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[Lecture 67 - DFT Example Problems - I](#)

[Lecture 68 - Example Problems: DFT, IDFT in Matrix form](#)

[Lecture 69 - Group/Phase Delay - Part I](#)

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[Lecture 71 - IIR Filter Structures: DF-I, DF-II](#)

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[Lecture 73 - IIR Filter Structures: Example](#)

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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

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](#)

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[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

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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

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 - Kademlia: A DHT Routing Protocol

Lecture 11 - Tapestry: An Evolution of Kademlia

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

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[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](#)

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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

HTML Links for 1,19,200+ NPTEL Video Lectures, Created by LinuXpert Systems, Chennai

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](#)

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Lecture 1 - Introduction

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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

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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

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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...1)

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 $\|u\|_2$ Time Control of a Linear Time Invariant System

Lecture 49 - Solution of Minimum $\|u\|_2$ 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_∞ Framework

Lecture 60 - Control Problem Statement in H_∞ 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

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[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

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[Lecture 33 - Multi rate Signal Processing](#)

[Lecture 34 - Multi rate Signal Processing \(Continued...\)](#)

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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

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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

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Lecture 26 - High Dimensional Linear Systems

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Lecture 28 - Linear Systems with External Input - II

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Lecture 30 - Dynamics of Nonlinear Systems - I

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[Lecture 33 - Discrete-Time Dynamical Systems - I](#)

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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

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Lecture 2 - Probability Theory

Lecture 3 - Random Variables

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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

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Lecture 2 - Instructional Objectives

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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

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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

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Lecture 31 - Energy Savings with Variable Speed Drives

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Lecture 3 - Dynamic Characteristics (Continued.)

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Lecture 9 - Resistance Temperature Detector

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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

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Lecture 29 - Tutorial

Lecture 30 - Tutorial (Continued.)

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- 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
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- Lecture 7 - Transmission Line Modeling
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- Lecture 11 - Transmission System A Review
- Lecture 12 - Transformer Model
- Lecture 13 - Synchronous Machine Model
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- Lecture 15 - Load Model
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- Lecture 23 - Review of Power System Component Models
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- Lecture 25 - Short Circuit Analysis
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- Lecture 27 - Sequence Networks
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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

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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...)

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NPTEL : NOC:Digital Control in Switched Mode Power Converters and FPGA-based Prototyping (Electrical Engineering)

Co-ordinators : Prof. Santanu Kapat

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NPTEL : Electromagnetic Fields (Electrical Engineering)

Co-ordinators : Prof. Harishankar Ramachandran

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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

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Lecture 3 - Can India Drive its EV program Innovatively and Differently and scale? - Part 2

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Lecture 5 - Charging and Swapping Infrastructure

Lecture 6 - Where will we get Lithium for batteries?

Lecture 7 - EV Subsystems

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Lecture 11 - Invertible maps, Isomorphism, Operators

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Lecture 6 - Kirchoff's voltage law (KVL)

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- 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
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- Lecture 9 - Energy levels in infinite and finite potential wells (short demo)
- Lecture 10 - Effective mass in Semiconductors
- Lecture 11 - Intrinsic carrier density
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- Lecture 13 - Fermi level in extrinsic semiconductors
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- Lecture 18 - Semiconductor bands in a electric field
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- Lecture 32 - Forward and reverse biased PN junctions
- Lecture 33 - Minority carrier injection in PN junctions
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- [Lecture 65 - Current characteristics of a short channel MOSFET](#)
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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

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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

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Lecture 23 - Why Lithium Ion Battery? - Part 1

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Lecture 25 - Batteries in Future

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Lecture 27 - SoH and SoC estimation and Self Discharge - Part 1

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Lecture 29 - Battery Pack Development - Part 1

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- Lecture 32 - Computation of Effective cost of battery - Part 2
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NPTEL : Phase-locked loops (Electrical Engineering)

Co-ordinators : Dr. Saurabh Saxena

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(Electrical Engineering)**

Co-ordinators : Prof. Yogesh Vijay Hote

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NPTEL : NOC:DC Microgrid (Electrical Engineering)

Co-ordinators : Prof. Avik Bhattacharya

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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

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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

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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

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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

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Lecture 14 - Distribution system problems and examples continued

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Lecture 25 - Electrolytic capacitor reliability and lifetime

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Lecture 27 - Common mode and differential mode model of inverters

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Lecture 30 - DG evaluation problems and examples

Lecture 31 - Switch selection in two level voltage source inverters and loss evaluation

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[Lecture 33 - Semiconductor switch design reliability considerations](#)

[Lecture 34 - AC filters for grid connected inverters](#)

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Lecture 28 - DC link current and DC capacitor current in a voltage source inverter

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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

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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

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[Lecture 37 - Current Control](#)

[Lecture 38 - Unity Power Factor Converter](#)

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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

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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](#)

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[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 \(Continued...\)](#)

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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: Integrator

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](#)

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[Lecture 40 - Subthreshold swing, Additional concepts](#)

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[Lecture 42 - Scaling of MOSFETs](#)

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[Lecture 44 - MOSFET characterization: Parameter extraction](#)

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[Lecture 46 - MOSFET as a switch](#)

[Lecture 47 - MOSFET as a switch \(Continued...\)](#)

[Lecture 48 - Amplifiers using MOSFET](#)

[Lecture 49 - Amplifiers using MOSFET \(Continued...\)](#)

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[Lecture 52 - Thin Film Transistors](#)

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- 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

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[Lecture 33 - Tissue and Cell Culture Techniques](#)

[Lecture 34 - Clean Room: Equipments Required](#)

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[Lecture 38 - Introduction to Equipments: Desiccator](#)

[Lecture 39 - Introduction to Equipments: Impedance Analyzer](#)

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[Lecture 41 - Function generator, Multimeter, Sampling, LabVIEW, NI-CDAQ](#)

[Lecture 42 - Introduction to Equipments: Stereo Microscope](#)

[Lecture 43 - Introduction to Equipments: Metallurgical Microscope](#)

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[Lecture 45 - Introduction to Equipments: Fire Alarm](#)

[Lecture 46 - Introduction to Equipments: Bio-safety Hood](#)

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[Lecture 51 - PDMS Moulding](#)

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[Lecture 54 - Simulation: Electro- Thermo- Mechanical Properties of Micro-heater using COMSOL Multiphysics](#)

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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

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Lecture 31 - Introduction to ECG Experiment

Lecture 32 - Desing and Implementation of ECG Preprocessing Stage - Part 1

Lecture 33 - Desing and Implementation of ECG Preprocessing Stage - Part 2

Lecture 34 - Desing and Implementation of ECG Preprocessing Stage - Part 3

Lecture 35 - Desing and Implementation of ECG Preprocessing Stage - Part 4

Lecture 36 - Desing and Implementation of Peak Detetor and Thresholding Circuit for ECG Signal Conditioning

Lecture 37 - Live Demonstration on ECG Signal Acquistion, Conditioning and Measurement of BPM

Lecture 38 - Understanding Analog Multipliers using Development Board

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