**NPTEL : Nonlinear Dynamical Systems (Electrical Engineering)**

**Co-ordinators : Prof. Harish K. Pillai, Prof. Madhu N. Belur**

Lecture 1 - Introduction

Lecture 2 - First Order systems

Lecture 3 - Classification of Equilibrium points

Lecture 4 - Lipschitz Functions

Lecture 5 - Existence/uniqueness theorems

Lecture 6 - Existence/uniqueness of solutions to differential equations

Lecture 7 - Lyapunov theorem on stability

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

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

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

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

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

Lecture 13 - Signals, operators

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

Lecture 15 - Nyquist plots and Nyquist criterion for stability

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

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

Lecture 18 - Positive real lemma proof

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

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

Lecture 21 - Loop tranformations and circle criterion

Lecture 22 - Nonlinearities based on circle criterion

Lecture 23 - Limit cycles

Lecture 24 - Popov criterion continuous, frequency-domain theorem

Lecture 25 - Popov criterion continuous, frequency-domain theorem

Lecture 26 - Describing function method

Lecture 27 - Describing Function : 2

Lecture 28 - Describing : optimal gain

Lecture 29 - Describing : optimal gain

Lecture 30 - Describing functions : Jump Hysteresis

**NPTEL : Power System Dynamics and Control (Electrical Engineering)**

**Co-ordinators : Dr. A.M. Kulkarni**

**NPTEL : Control Engineering (Prof. S.D. Agashe) (Electrical Engineering)**

**Co-ordinators : Prof. S.D. Agashe**

**NPTEL : Power Electronics (Electrical Engineering)**

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

Lecture 1 - Power Electronics

Lecture 2 - Power Electronics

Lecture 3 - Power Electronics

Lecture 4 - Power Electronics

Lecture 5 - Power Electronics

Lecture 6 - Power Electronics

Lecture 7 - Power Electronics

Lecture 8 - Power Electronics

Lecture 9 - Power Electronics

Lecture 10 - Power Electronics

Lecture 11 - Power Electronics

Lecture 12 - Power Electronics

Lecture 13 - Power Electronics

Lecture 14 - Power Electronics

Lecture 15 - Power Electronics

Lecture 16 - Power Electronics

Lecture 17 - Power Electronics

Lecture 18 - Power Electronics

Lecture 19 - Power Electronics

Lecture 20 - Power Electronics

Lecture 21 - Power Electronics

Lecture 22 - Power Electronics

Lecture 23 - Power Electronics

Lecture 24 - Power Electronics

Lecture 25 - Power Electronics

Lecture 26 - Power Electronics

Lecture 27 - Power Electronics

Lecture 28 - Power Electronics

Lecture 29 - Power Electronics

Lecture 30 - Power Electronics

Lecture 31 - Power Electronics

**NPTEL : Fabrication of Silicon VLSI Circuits using the MOS technology (Electrical Engineering)**

**Co-ordinators : Prof. A.N. Chandorkar**

**NPTEL : NOC:Computational Electromagnetics and Applications (Electrical Engineering)**

**Co-ordinators : Prof.Krish Sankaran**

Lecture 32 - Lecture 17

Lecture 33 - Lecture 18

Lecture 34 - Exercise 10

Lecture 35 - Summary week 5

Lecture 36 - Lecture 19

Lecture 37 - Lecture 20

Lecture 38 - Lecture 21

Lecture 39 - Lecture 22

Lecture 40 - Exercise 11

Lecture 41 - Summary week 6

Lecture 42 - Exercise 12

Lecture 43 - Exercise 13

Lecture 44 - Exercise 14

Lecture 45 - Exercise 15

Lecture 46 - Exercise 16

Lecture 47 - Exercise 17

Lecture 48 - Summary week 7

Lecture 49 - Lecture 23

Lecture 50 - Lecture 24

Lecture 51 - Lecture 25

Lecture 52 - Exercise 18

Lecture 53 - Exercise 19

Lecture 54 - Lab tour 3

Lecture 55 - Summary week 8

Lecture 56 - Lecture 26

Lecture 57 - Lecture 27

Lecture 58 - Lecture 28

Lecture 59 - Lecture 29

Lecture 60 - Lecture 30

Lecture 61 - Lecture 31

Lecture 62 - Lab tour 4

Lecture 63 - Summary week 9

Lecture 64 - Lecture 32

**NPTEL : NOC:Basic Electronics (Electrical Engineering)**

**Co-ordinators : Prof. Mahesh B. Patil**

Lecture 1 - A brief history of electronics

Lecture 2 - Superposition

Lecture 3 - Useful circuit techniques - 1

Lecture 4 - Useful circuit techniques - 2

Lecture 5 - Phasors - 1

Lecture 6 - Phasors - 2

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

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

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

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

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

Lecture 12 - Simulation of RC circuit

Lecture 13 - Diode circuits - 1

Lecture 14 - Diode circuits - 2

Lecture 15 - Diode circuits - 3

Lecture 16 - Diode circuits - 4

Lecture 17 - Diode circuits - 5

Lecture 18 - Diode circuits - 6

Lecture 19 - Diode rectifiers - 1

Lecture 20 - Diode rectifiers - 2

Lecture 21 - Diode rectifiers - 3

Lecture 22 - Bipolar Junction Transistor - 1

Lecture 23 - Bipolar Junction Transistor - 2

Lecture 24 - Bipolar Junction Transistor - 3

Lecture 25 - BJT amplifier - 1

Lecture 26 - BJT amplifier - 2

Lecture 27 - BJT amplifier - 3

Lecture 28 - BJT amplifier - 4

Lecture 29 - BJT amplifier - 5

Lecture 30 - BJT amplifier - 6

Lecture 31 - BJT amplifier - 7

**NPTEL : NOC:Antennas (Electrical Engineering)**

**Co-ordinators : Prof. Girish Kumar**

Lecture 1 - Antenna Introduction - I

Lecture 2 - Antenna Introduction - II

Lecture 3 - Antenna Introduction - III

Lecture 4 - Antenna Fundamentals - I

Lecture 5 - Antenna Fundamentals - II

Lecture 6 - Antenna Radiation Hazards - I

Lecture 7 - Antenna Radiation Hazards - II

Lecture 8 - Dipole Antennas - I

Lecture 9 - Dipole Antennas - II

Lecture 10 - Dipole Antennas - III

Lecture 11 - Monopole Antennas - I

Lecture 12 - Monopole Antennas - II

Lecture 13 - Loop Antennas

Lecture 14 - Slot Antennas

Lecture 15 - Linear Arrays - I

Lecture 16 - Linear Arrays - II

Lecture 17 - Linear Arrays - III

Lecture 18 - Planar Arrays

Lecture 19 - Microstrip Antennas (MSA)

Lecture 20 - Rectangular MSA

Lecture 21 - MSA Parametric Analysis - I

Lecture 22 - MSA Parametric Analysis - II

Lecture 23 - Circular MSA

Lecture 24 - Broadband MSA - I

Lecture 25 - Broadband MSA - II

Lecture 26 - Broadband MSA - III

Lecture 27 - Broadband MSA - IV

Lecture 28 - Broadband MSA - V

Lecture 29 - Compact MSA - I

Lecture 30 - Compact MSA - II

Lecture 31 - Compact MSA - III

**NPTEL : NOC:Fundamentals of Wavelets, Filter Banks and Time Frequency Analysis (Electrical Engineering)**

**Co-ordinators : Prof. V.M. Gadre**

**NPTEL : NOC:Analog Circuits (2017) (Electrical Engineering)**

**Co-ordinators : Prof. Jayanta Mukherjee**

Lecture 32 - Module 1 - Oscillators

Lecture 33 - Module 2 - Oscillator Amplitude Control , Quadrature Oscillator

Lecture 34 - Module 3 - Multivibators

Lecture 35 - Module 4 - Multivibrators (Continued...)

Lecture 36 - Module 5 - Monostable Multivibator

Lecture 37 - Module 1 - Zener Effect, Rectifiers

Lecture 38 - Module 2 - Rectifiers

Lecture 39 - Module 3 - Clamper, Peak Rectifier, Super diodes

Lecture 40 - Module 4 - BJT DC Circuits

Lecture 41 - Module 5 - Current Mirror

**NPTEL : NOC:Microwave Theory and Techniques (Electrical Engineering)**

**Co-ordinators : Prof. Girish Kumar**

**NPTEL : NOC:Principles of Digital Communications (Electrical Engineering)**

**Co-ordinators : Prof. S.N. Merchant**

Lecture 1 - Course Overview

Lecture 2 - Introduction to Information Theory

Lecture 3 - Entropy and its properties

Lecture 4 - Lossless Source Coding Theorem

Lecture 5 - Prefix Codes and Kraftâ€™s Inequality

Lecture 6 - Huffman Coding

Lecture 7 - Discrete Memory-less Channels : Mutual Information

Lecture 8 - Channel Capacity - I

Lecture 9 - Channel Capacity - II

Lecture 10 - Channel Coding Theorem

Lecture 11 - Differential Entropy - I

Lecture 12 - Differential Entropy - II

Lecture 13 - Channel Capacity - III

Lecture 14 - Channel Capacity - IV

Lecture 15 - Summary of Information Theory

Lecture 16 - Signal Space Representations - I

Lecture 17 - Signal Space Representations - II

Lecture 18 - Vector Representation of a Random Process

Lecture 19 - AWGN Vector Channel

Lecture 20 - Basics of Signal Detection: ML,MAP Detection

Lecture 21 - ML,MAP Detectors for AWGN Channel

Lecture 22 - Optimal Receiver: Matched Filter

Lecture 23 - Probability of error for Optimal Receiver

Lecture 24 - Probability of Error for M-ary Scheme

Lecture 25 - Pulse Code Modulation: Quantization

Lecture 26 - Uniform Quantizer

Lecture 27 - Step Size and Quantization Noise

Lecture 28 - Non-uniform Quantizer (Lloyd-Max Quantizer)

Lecture 29 - Companded Quantization - I

Lecture 30 - Companded Quantization - II

Lecture 31 - Differential Pulse Code Modulation DPCM - I

Lecture 65 - Channel Coding: Decoding using Standard Arrays

**NPTEL : NOC:Fundamental of Power Electronics (Electrical Engineering)**

**Co-ordinators : Prof. Vivek Agarwal**

Lecture 32 - Shunt regulator

Lecture 33 - Example on shunt regulator

Lecture 34 - Non-ideality and solution

Lecture 35 - Applications of shunt regulator

Lecture 36 - Series regulator

Lecture 37 - Efficiency of series

Lecture 38 - Negative and dual voltage regulators

Lecture 39 - Over current limiting circuits

Lecture 40 - Improvements to series regulator

Lecture 41 - Regulator performance parameters

Lecture 42 - Datasheet of few IC regulators

Lecture 43 - Common IC regulator circuits

Lecture 44 - Practicals 1

Lecture 45 - Switched mode DC-DC converter intro

Lecture 46 - Volt-sec and Amp-sec balance

Lecture 47 - Input-output relationship

Lecture 48 - Buck converter - operation and waveforms

Lecture 49 - Buck converter - component selection

Lecture 50 - Primary configurations

Lecture 51 - Boost converter

Lecture 52 - Buck-Boost converter

Lecture 53 - Simulating the primary converters

Lecture 54 - Forward converter

Lecture 55 - Core reset in forward converter

Lecture 56 - Simulating with lossy core reset

Lecture 57 - Simulating with lossless core reset

Lecture 58 - Flyback converter

Lecture 59 - Simulating the flyback converter

Lecture 60 - Octave mfile for design

Lecture 61 - Magnetics design intro

Lecture 62 - Magnetics review

Lecture 63 - Permeance

Lecture 64 - Inductor value and energy storage

Lecture 98 - Simulation of sinusoidal PWM

**NPTEL : NOC:Electrical Equipment and Machines: Finite Element Analysis (Electrical Engineering)**

**Co-ordinators : Prof. Shrikrishna V. Kulkarni**

**NPTEL : NOC:Digital Signal Processing and its Applications (Electrical Engineering)**

**Co-ordinators : Prof. V. M. Gadre**

Lecture 1 - Introduction: Digital signal processing and its objectives

Lecture 2 - Introduction to sampling and Fourier Transform

Lecture 3 - Sampling of sine wave and associate complication

Lecture 4 - Review of Sampling Theorem

Lecture 5 - Idealized Sampling, Reconstruction

Lecture 6 - Filters And Discrete System

Lecture 7 - Answering questions from previous lectures

Lecture 8 - Desired requirements for discrete system

Lecture 9 - Introduction to phasors

Lecture 10 - Advantages of phasors in discrete systems

Lecture 11 - What do we want from a discrete system?

Lecture 12 - Linearity - Homogeneity and Additivity

Lecture 13 - Shift Invariance and Characterization of LTI systems

Lecture 14 - Characterization of LSI system using itâ€™s impulse response

Lecture 15 - Introduction to convolution

Lecture 16 - Convolution: Deeper ideas and understanding

Lecture 17 - Characterisation of LSI systems, Convolution-properties

Lecture 18 - Response of LSI Systems to Complex Sinusoids

Lecture 19 - Convergence of Convolution and Bibo Stability

Lecture 20 - Commutativity and Associativity

Lecture 21 - BIBO Stability of an LSI system

Lecture 22 - Causality and memory of an LSI system

Lecture 23 - Frequency response of an LSI system

Lecture 24 - Introduction and conditions of Stability

Lecture 25 - Vectors and Inner Product

Lecture 26 - Interpretation of Frequency Response as Dot Product

Lecture 27 - Interpretation of Frequency Response as Eigenvalues

Lecture 28 - Discrete time fourier transform

Lecture 29 - DTFT in LSI System and Convolution Theorem.

Lecture 30 - Definitions of sequences and Properties of DTFT

Lecture 31 - Introduction to DTFT, IDTFT

Lecture 32 - Dual to convolution property

Lecture 33 - Multiplication Property, Introduction to Parsevalâ€™s theorem

Lecture 34 - Introduction and Property of DTFT

Lecture 35 - Review of Inverse DTFT

Lecture 36 - Parsevalâ€™s Theorem and energy and time spectral density

Lecture 37 - Discussion on Unit Step

Lecture 38 - Introduction to Z transform

Lecture 39 - Example of Z transform

Lecture 40 - Region of Convergence

Lecture 41 - Properties of Z transform

Lecture 42 - Z- Transform

Lecture 43 - Rational System

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

Lecture 45 - Double Pole Examples and their Inverse Z Transform

Lecture 46 - Partial Fraction Decomposition

Lecture 47 - LSI System Examples

Lecture 48 - Why are Rational Systems so important?

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

Lecture 50 - Introduction to Resonance in Rational Systems

Lecture 51 - Characterization of Rational LSI system

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

Lecture 53 - Recap of Rational Systems and Discrete Time Filters

Lecture 54 - Specifications for Filter Design

Lecture 55 - Four Ideal Piecewise Constant Filters

Lecture 56 - Important Characteristics Of Ideal Filters

Lecture 57 - Synthesis of Discrete Time Filters, Realizable specifications

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

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

Lecture 60 - Analog to discrete transform

Lecture 61 - Intuitive transforms, Bilinear Transformation

Lecture 62 - Steps for IIR filter design

Lecture 63 - Analog filter design using Butterworth Approximation

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

Lecture 65 - Chebychev filter Derivation

Lecture 66 - Midsem paper review discussion

Lecture 67 - The Chebyschev Approximation

Lecture 68 - Next step in design: Obtain poles

Lecture 69 - Introduction to Frequency Transformations in the Analog Domain

Lecture 70 - High pass transformation

Lecture 71 - Band pass transformation

Lecture 72 - Frequency Transformation

Lecture 73 - Different types of filters

Lecture 74 - Impulse invariant method and ideal impulse response

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

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

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

Lecture 78 - Introduction to window functions

Lecture 79 - Examples of window functions

Lecture 80 - Explanation of Gibbâ€™s Phenomenon and itâ€™s application

Lecture 81 - Comparison of FIR And IIR Filterâ€™s

Lecture 82 - Comparison of FIR And IIR Filterâ€™s

Lecture 83 - Comparison of FIR And IIR Filterâ€™s

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

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

Lecture 86 - Introduction to IIR Filter Realization and Cascade Structure

Lecture 87 - Cascade Parallel Structure

Lecture 88 - Lattice Structure

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

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

Lecture 91 - Lattice structure for an arbitrary rational system

Lecture 92 - Example realization of lattice structure for rational system

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

Lecture 94 - Principle of Duality, The Circular Convolution

**NPTEL : NOC:Stochastic Control and Communication (Electrical Engineering)**

**Co-ordinators : Prof. Ankur A. Kulkarni**

Lecture 1 - Decision Making under Uncertainty

Lecture 2 - Expected Utility Theory - I

Lecture 3 - Expected Utility Theory - II

Lecture 4 - Expected Utility Theory - III

Lecture 5 - Role of Information in Decision Making

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

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

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

Lecture 9 - Introduction to Markov Decision Processes (MDP)

Lecture 10 - Types of Policy in MDP

Lecture 11 - Interpreting randomised decision rules

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

Lecture 13 - Example of History Dependent Policies

Lecture 14 - Complexity of the problem using brute force approach

Lecture 15 - Principle of Optimality

Lecture 16 - Dynamic Programming Algorithm

Lecture 17 - DP Algo applied to Inventory Control Problem

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

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

Lecture 20 - Optimal Stopping Problem

Lecture 21 - Optimal Stopping Example: Secretary Problem

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

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

Lecture 24 - Linear System Quadratic Cost Problem

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

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

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

Lecture 28 - Stochastic Control under incomplete state information

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

Lecture 30 - Stochastic Control under incomplete state information: Example

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

Lecture 32 - Stochastic Control under incomplete state information: Example (Continued...)

Lecture 33 - Stochastic Control under incomplete state information: Example (Continued...)

Lecture 34 - LQ systems with Imperfect Information - I

Lecture 35 - LQ systems with Imperfect Information - II

Lecture 36 - LQ systems with Imperfect Information - III

Lecture 37 - LQ systems with Imperfect Information - IV

Lecture 38 - Filtering - I

Lecture 39 - Filtering - II

Lecture 40 - Kalman Filtering - I

Lecture 41 - Kalman Filtering - II

Lecture 42 - Kalman Filtering - III

Lecture 43 - Belief State Formulation - I

Lecture 44 - Belief State Formulation - II

Lecture 45 - Information Structures - I

Lecture 46 - Information Structures - II

Lecture 47 - Witsenhausen Problem - I

Lecture 48 - Witsenhausen Problem - II

Lecture 49 - Witsenhausen Problem - III

Lecture 50 - Witsenhausen Problem - IV

Lecture 51 - Witsenhausen Problem - V

Lecture 52 - Witsenhausen Problem - VI

Lecture 53 - Witsenhausen Problem - VII

Lecture 54 - Team Decision Theory - I

Lecture 55 - Team Decision Theory - II

Lecture 56 - Team Decision Theory - III

Lecture 57 - Team Decision Theory - IV

Lecture 58 - Team Decision Theory - V

Lecture 59 - Team Decision Theory - VI

Lecture 60 - Team Decision Theory - VII

Lecture 61 - Communication Theory - I

Lecture 62 - Communication Theory - II

Lecture 63 - Communication Theory - III

Lecture 64 - Communication Theory - IV

Lecture 65 - Communication Theory - V

**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

**NPTEL : Control Engineering (Prof. M. Gopal) (Electrical Engineering)**

**Co-ordinators : Prof. M. Gopal**

**NPTEL : Embedded Systems (Electrical Engineering)**

**Co-ordinators : Prof. Santanu Chaudhary**

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

**Co-ordinators : Prof. D.P. Kothari**

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

**NPTEL : Power System Dynamics (Electrical Engineering)**

**Co-ordinators : Dr. M.L. Kothari**

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

**NPTEL : Analog Electronic Circuits (Electrical Engineering)**

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

**NPTEL : Digital Communication (Electrical Engineering)**

**Co-ordinators : Prof. Surendra Prasad**

**NPTEL : Introduction To Electronic Circuits (Electrical Engineering)**

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

**NPTEL : NOC:Analog Electronic Circuit (Electrical Engineering)**

**Co-ordinators : Dr. Shouribrata Chatterjee**

**NPTEL : NOC:Nonlinear and Adaptive Control (Electrical Engineering)**

**Co-ordinators : Prof. Shubhendu Bhasin**

**NPTEL : NOC:Information Theory, Coding and Cryptography (Electrical Engineering)**

**Co-ordinators : Prof. Ranjan Bose**

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 - Ungerboek'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

**NPTEL : Engineering Electromagnetics (Electrical Engineering)**

**Co-ordinators : Prof. Sheel Aditya**

**NPTEL : NOC:Principles of Digital Communications (2018) (Electrical Engineering)**

**Co-ordinators : Prof. Abhishek Dixit**

**NPTEL : NOC:Electric Vehicles - Part 1 (Electrical Engineering)**

**Co-ordinators : Prof. Amit Jain**

**NPTEL : NOC:Power Electronics (Electrical Engineering)**

**Co-ordinators : Prof. G.Bhuvaneshwari**

**NPTEL : NOC:Electrical Machines (Electrical Engineering)**

**Co-ordinators : Prof. G.Bhuvaneshwari**

**NPTEL : Special Electromechanical Systems (Electrical Engineering)**

**Co-ordinators : Prof. S.S. Murthy**

**NPTEL : NOC:High Power Multilevel Converters - Analysis, Design and Operational Issues (Electrical Engineering)**

**Co-ordinators : Prof. Anand Rup**

Lecture 1 - Basic Understanding of Converter (Introduction to Power Converters)

Lecture 2 - Basic Understanding of Converter (Half Bridge and Full Bridge Circuit Operation)

Lecture 3 - Basic Understanding of Converter (Sinusoidal Pulse width Modulation and Three Phase Circuit)

Lecture 4 - Basic Understanding of Converter (Harmonics in Sinusoidal PWM)

Lecture 5 - Third harmonic addition in Sine PWM

Lecture 6 - Introduction to Space Vectors

Lecture 7 - Space Vector PWM - Timing Calculation

Lecture 8 - Space Vector PWM - Switching Sequence

Lecture 9 - Space Vector PWM - Using Carriers

Lecture 10 - Basic Introduction to Power Devices

Lecture 11 - Introduction to Multilevel Converters

Lecture 12 - Cascaded H-bridge Multilevel Converters

Lecture 13 - Output Voltage Waveform Synthesis in CHB Converter and Basic of Asymmetrical CHB Converters

Lecture 14 - Cascaded H-Bridge Converters: Phase-Shifted PWM

Lecture 15 - Cascaded H-Bridge Converters: Level-Shifted PWM

Lecture 16 - Fault Tolerant Operation of Cascaded H-Bridge Converter - Part I

Lecture 17 - Fault Tolerant Operation of Cascaded H-Bridge Converter - Part II

Lecture 18 - Modular Multilevel Converter - Topology and Operation

Lecture 19 - Modular Multilevel Converter - Arm and Cell Voltage Ratings

Lecture 20 - Modular Multilevel Converter - Arm Currents

Lecture 21 - Modular Multilevel Converter - Arm Energy Balancing

Lecture 22 - Modular Multilevel Converter - Different Circuit Topologies

Lecture 23 - Modular Multilevel Converter - PWM Technique and Capacitor Voltage Balancing

Lecture 24 - Modular Multilevel Converter - Fault Tolerant Operation and Commercial Production

Lecture 25 - Design of Components in MMC

Lecture 26 - Neutral Point Clamped Converter - Circuit Topology - Part I

Lecture 27 - Neutral Point Clamped Converter - Circuit Topology - Part II

Lecture 28 - Neutral Point Clamped Converter - Space Vector Diagram

Lecture 29 - Neutral Point Clamped Converter - Space Vector PWM

Lecture 30 - NPC - Sinusoidal PWM and Space Vector PWM using Single Carrier Strategy

Lecture 31 - Neutral Point Clamped Converter - Mid-point Voltage Fluctuations

**NPTEL : NOC:Introduction to Embedded System Design (Electrical Engineering)**

**Co-ordinators : Prof. Badri N Subudhi, Prof.Dhananjay V. Gadre**

Lecture 32 - ADC and DAC using R2R Ladder and Random number generation using LFSR

Lecture 33 - Serial Communication Protocols, USCI Module in MSP430

Lecture 34 - MSP430 Timer in Capture Mode

Lecture 35 - Coding Ninja

Lecture 36 - Building an Electronics Project

Lecture 37 - Circuit Prototyping Techniques

Lecture 38 - Single Purpose Computers

Lecture 39 - Single Purpose Computers (Continued...)

Lecture 40 - Recap of Course Coverage and Project Demonstration from Concept to Final

**NPTEL : NOC:Power Quality (Electrical Engineering)**

**Co-ordinators : Prof. Bhim Singh**

**NPTEL : NOC:Introduction to Electrical Engineering (Electrical Engineering)**

**Co-ordinators : Prof. Bhim Singh**

**NPTEL : NOC:Transducers for Instrumentation (Electrical Engineering)**

**Co-ordinators : Ankur Gupta**

**NPTEL : Advanced Control Systems (Electrical Engineering)**

**Co-ordinators : Prof. S. Majhi**

Lecture 1 - Introduction

Lecture 2 - Control structures and performance measures

Lecture 3 - Time and frequency domain performance measures

Lecture 4 - Design of controller

Lecture 5 - Design of controller for SISO system

Lecture 6 - Controller design for TITO processes

Lecture 7 - Limitations of PID controllers

Lecture 8 - PI-PD controller for SISO system

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

Lecture 10 - Effects of measurement noise and load

Lecture 11 - Identification of dynamic models of plants

Lecture 12 - Relay control system for identification

Lecture 13 - Off-line identification of process dynamics

Lecture 14 - On-line identification of plant dynamics

Lecture 15 - State space based identification

Lecture 16 - State space analysis of systems

Lecture 17 - State space based identification of systems - 1

Lecture 18 - State space based identification of systems - 2

Lecture 19 - Identification of simple systems

Lecture 20 - Identification of FOPDT model

Lecture 21 - Identification of second order plus dead time model

Lecture 22 - Identification of SOPDT model

Lecture 23 - Steady state gain from asymmetrical relay test

Lecture 24 - Identification of SOPDT model with pole multiplicity

Lecture 25 - Existence of limit cycle for unstable system

Lecture 26 - Identification procedures

Lecture 27 - Identification of underdamped systems

Lecture 28 - Off-line identification of TITO systems

Lecture 29 - On-line identification of TITO systems

Lecture 30 - Review of time domain based identification

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

**NPTEL : NOC:Optimization Techniques for Digital VLSI Design (Electrical Engineering)**

**Co-ordinators : Dr. Santosh Biswas, Prof. Chandan Karfa**

**NPTEL : NOC:Advanced Topics in Probability and Random Processes (Electrical Engineering)**

**Co-ordinators : Prof. Prabin K Bora**

**NPTEL : NOC:Microwave Engineering (Electrical Engineering)**

**Co-ordinators : Dr. Ratnajit Bhattacharjee**

**NPTEL : NOC:Microprocessors and Interfacing (Electrical Engineering)**

**Co-ordinators : Prof. Shaik Rafi Ahamed**

**NPTEL : NOC:Statistical Signal Processing (Electrical Engineering)**

**Co-ordinators : Prof. Prabin Kumar Bora**

**NPTEL : NOC:Computer Vision and Image Processing - Fundamentals and Applications (Electrical Engineering)**

**Co-ordinators : Prof. M. K. Bhuyan**

**NPTEL : NOC:System Design through VERILOG (Electrical Engineering)**

**Co-ordinators : Prof. Shaik Rafi Ahamed**

**NPTEL : NOC:Usability Engineering (Electrical Engineering)**

**Co-ordinators : Prof. Debayan Dhar**

Lecture 1 - Introduction to Usability

Lecture 2 - Usability - Historical Foundations

Lecture 3 - Standard Terminologies

Lecture 4 - Elements of User Experience

Lecture 5 - Usability in software development - I

Lecture 6 - Usability in software development - II

Lecture 7 - User Centered Design Process - I

Lecture 8 - User Centered Design Process - II

Lecture 9 - User Centered Design Process - III

Lecture 10 - Requirement Analysis - I (A)

Lecture 11 - Requirement Analysis - I (B)

Lecture 12 - Requirement Analysis - I (C)

Lecture 13 - Requirement Analysis - I (D)

Lecture 14 - Requirement Analysis - I (E)

Lecture 15 - Requirement Analysis - I (F)

Lecture 16 - Requirement Analysis - II (A)

Lecture 17 - Requirement Analysis - II (B)

Lecture 18 - Requirement Analysis - II (C)

Lecture 19 - Requirement Analysis - II (D)

Lecture 20 - Requirement Analysis - III (A)

Lecture 21 - Eye Tracker

Lecture 22 - Demonstration of an Eye tracking device

Lecture 23 - Requirement Analysis - III (B)

Lecture 24 - Mapping Experiences

Lecture 25 - Cognitive Issues - I

Lecture 26 - Cognitive Issues - II

Lecture 27 - Cognitive Issues - III

Lecture 28 - Cognitive Issues - IV

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

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

Lecture 31 - Conceptualization and Prototyping - I (A)

Lecture 32 - Conceptualization and Prototyping - I (B)

Lecture 33 - Conceptualization and Prototyping - I (C)

Lecture 34 - Conceptualization and Prototyping - II (A)

Lecture 35 - Conceptualization and Prototyping - II (B)

Lecture 36 - Usability heuristics and testing - I

Lecture 37 - Usability heuristics and testing - II

Lecture 38 - Usability heuristics and testing - III

Lecture 39 - Usability Testing (A)

Lecture 40 - Usability Testing (B)

Lecture 41 - Usability Testing (C)

Lecture 42 - UI/UX design based on Garret model: a case study

Lecture 43 - Effective contextual enquiry

Lecture 44 - Contextual enquiry: case study

**NPTEL : NOC:Probability and Random Processes (Electrical Engineering)**

**Co-ordinators : Prof. Ribhu, Prof. Rohit Sinha**

**NPTEL : NOC:Simulation of Communication Systems using Matlab (Electrical Engineering)**

**Co-ordinators : Dr. Ribhu**

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

**Co-ordinators : Prof. M.K. Bhuyan**

**NPTEL : Advanced Electric Drives (Electrical Engineering)**

**Co-ordinators : Dr. S.P. Das**

**NPTEL : High Voltage DC Transmission (Electrical Engineering)**

**Co-ordinators : Dr. S.N. Singh**

**NPTEL : Intelligent Systems and Control (Electrical Engineering)**

**Co-ordinators : Prof. Laxmidhar Behera**

Lecture 32 - Linear controllers using T-S fuzzy model

**NPTEL : Power Systems Operation and Control (Electrical Engineering)**

**Co-ordinators : Dr. S.N. Singh**

**NPTEL : NOC:Electromagnetic theory (Electrical Engineering)**

**Co-ordinators : Dr. Pradeep Kumar K**

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

**Co-ordinators : Prof. Aditya K. Jagannatham**

**NPTEL : NOC:An Introduction to Coding Theory (Electrical Engineering)**

**Co-ordinators : Dr. Adrish Banerjee**

**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 Decison 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 Contellation 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 / Uncertainity of source and Properties of Entropy

Lecture 28 - Entropy Example- Binary Source Maximum and Minimum Entropy of Binary Source

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

**NPTEL : NOC:Applied Engineering Electromagnetics (Electrical Engineering)**

**Co-ordinators : Dr. Pradeep Kumar K**

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

**NPTEL : NOC:Principles of Signals and Systems (Electrical Engineering)**

**Co-ordinators : Prof. Aditya K. Jagannatham**

**NPTEL : NOC:Applied Optimization for Wireless, Machine Learning, Big Data (Electrical Engineering)**

**Co-ordinators : Prof. Aditya K. Jagannatham**

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 Postive Definite (PD) Matrices and their Properties

Lecture 4 - Inner Product Space and it's Properties: Linearity, Symmetry and Positive Semi-definite

Lecture 5 - Inner Product Space and it's Properties: Cauchy Schwarz Inequality

Lecture 6 - Properties of Norm, Gaussian Elimination and Echleon 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

**NPTEL : NOC:Fiber-Optic Communication Systems and Techniques (Electrical Engineering)**

**Co-ordinators : Dr. Pradeep Kumar K**

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)

**NPTEL : NOC:Electromagnetic Waves in Guided and Wireless Media (Electrical Engineering)**

**Co-ordinators : Dr. Pradeep Kumar K**

**NPTEL : NOC:Basic Electric Circuits (Electrical Engineering)**

**Co-ordinators : Prof. Ankush Sharma**

**NPTEL : NOC:Fundamentals of Electric Drives (Electrical Engineering)**

**Co-ordinators : Prof. Shyama Prasad Das**

**NPTEL : NOC:Fuzzy Sets, Logic and Systems and Applications (Electrical Engineering)**

**Co-ordinators : Prof. Nishchal K Verma**

**NPTEL : NOC:Peer to Peer Networks (Electrical Engineering)**

**Co-ordinators : Prof. Yatindra N Singh**

**NPTEL : NOC:Applied Linear Algebra for Signal Processing, Data Analytics and Machine Learning (Electrical Engineering)**

**Co-ordinators : Prof. Aditya K. Jagannatham**

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

**NPTEL : NOC:Economic Operations and Control of Power Systems (Electrical Engineering)**

**Co-ordinators : Prof. Gururaj Mirle Vishwanath, Prof. Narayana Prasad Padhy**

**NPTEL : NOC:Digital Switching (Electrical Engineering)**

**Co-ordinators : Prof. Yatindra N Singh**

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

Lecture 17

Lecture 18

Lecture 19

Lecture 20

Lecture 21

Lecture 22

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27

Lecture 28

Lecture 29

Lecture 30

Lecture 31

**NPTEL : NOC:Analog VLSI Design (Electrical Engineering)**

**Co-ordinators : Prof. Imon Mondal**

Lecture 65

**NPTEL : Electrical Machines I (Electrical Engineering)**

**Co-ordinators : Dr. D. Kastha**

**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 Quadient Method and Networks Methods

Lecture 7 - Solution of Unconstrained Optimization Problem Using Conjugate Quadient 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)

**NPTEL : Chaos, Fractals and Dynamic Systems (Electrical Engineering)**

**Co-ordinators : Prof. S. Banerjee**

**NPTEL : Digital Signal Processing (Electrical Engineering)**

**Co-ordinators : Prof. T.K. Basu**

**NPTEL : Dynamics of Physical Systems (Electrical Engineering)**

**Co-ordinators : Prof. S. Banerjee**

**NPTEL : Energy Resources and Technology (Electrical Engineering)**

**Co-ordinators : Prof. S. Banerjee**

**NPTEL : Estimation of Signals and Systems (Electrical Engineering)**

**Co-ordinators : Prof. S. Mukhopadhyay**

Lecture 1 - Introduction

Lecture 2 - Probability Theory

Lecture 3 - Random Variables

Lecture 4 - Function of Random Variable Joint Density

Lecture 5 - Mean and Variance

Lecture 6 - Random Vectors Random Processes

Lecture 7 - Random Processes and Linear Systems

Lecture 8 - Some Numerical Problems

Lecture 9 - Miscellaneous Topics on Random Process

Lecture 10 - Linear Signal Models

Lecture 11 - Linear Mean Sq.Error Estimation

Lecture 12 - Auto Correlation and Power Spectrum Estimation

Lecture 13 - Z-Transform Revisited Eigen Vectors/Values

Lecture 14 - The Concept of Innovation

Lecture 15 - Last Squares Estimation Optimal IIR Filters

Lecture 16 - Introduction to Adaptive Filters

Lecture 17 - State Estimation

Lecture 18 - Kalman Filter-Model and Derivation

Lecture 19 - Kalman Filter-Derivation (Continued...)

Lecture 20 - Estimator Properties

Lecture 21 - The Time-Invariant Kalman Filter

Lecture 22 - Kalman Filter-Case Study

Lecture 23 - System identification Introductory Concepts

Lecture 24 - Linear Regression-Recursive Least Squares

Lecture 25 - Variants of LSE

Lecture 26 - Least Square Estimation

Lecture 27 - Model Order Selection Residual Tests

Lecture 28 - Practical Issues in Identification

Lecture 29 - Estimation Problems in Instrumentation and Control

Lecture 30 - Conclusion

**NPTEL : Illumination Engineering (Electrical Engineering)**

**Co-ordinators : Prof. N.K. Kishore**

**NPTEL : Industrial Automation and Control (Electrical Engineering)**

**Co-ordinators : Prof. S. Sen, Prof. S. Mukhopadhyay**

**NPTEL : Industrial Instrumentation (Electrical Engineering)**

**Co-ordinators : Prof. Alok Barua**

Lecture 1 - Introduction to Industrial Instrumentation

Lecture 2 - Dynamic Characteristics

Lecture 3 - Dynamic Characteristics (Continued.)

Lecture 4 - Strain gauge

Lecture 5 - Load cell

Lecture 6 - Torque Measurement

Lecture 7 - Thermistor

Lecture 8 - Thermocouples

Lecture 9 - Resistance Temperature Detector

Lecture 10 - LVDT

Lecture 11 - Capacitance Transducers

Lecture 12 - Flowmeter - I

Lecture 13 - Flowmeter - II

Lecture 14 - Flowmeter - III

Lecture 15 - Flowmeter - IV

Lecture 16 - Flowmeter - V

Lecture 17 - Problems on Temperature Sensors

Lecture 18 - Pressure Sensors

Lecture 19 - Low Pressure Measurement

Lecture 20 - pH and Viscosity Measurement

Lecture 21 - Problem and Solutions On Industrial Instrumentation

Lecture 22 - Signal Conditioning Circuits - I

Lecture 23 - Signal Conditioning Circuits - II

Lecture 24 - Piezoelectric Sensors

Lecture 25 - Ultrasonic Sensors

Lecture 26 - Nucleonic Instrumentation

Lecture 27 - Measurement Of Magnetic Field

Lecture 28 - Optoelectronic Sensor - I

Lecture 29 - Optoelectronic Sensor - II

Lecture 30 - Synchro

Lecture 31 - Dissolved Oxygen Sensors - I

**NPTEL : Networks Signals and Systems (Electrical Engineering)**

**Co-ordinators : Prof. T.K. Basu**

**NPTEL : Power System Analysis (Electrical Engineering)**

**Co-ordinators : Prof. A.K. Sinha**

**NPTEL : NOC:Industrial Automation and Control (Electrical Engineering)**

**Co-ordinators : Prof. S. Mukhopadhyay**

Lecture 32 - Flow Control Valves

Lecture 33 - Flow Control Valves (Continued...)

Lecture 34 - Hydraulic Control Systems - I

Lecture 35 - Hydraulic Control Systems - I (Continued...)

Lecture 36 - Hydraulic Control Systems - II

Lecture 37 - Hydraulic Control Systems - II (Continued...)

Lecture 38 - Industrial Hydraulic Circuit

Lecture 39 - Industrial Hydraulic Circuit (Continued...)

Lecture 40 - Pneumatic Control Systems - I

Lecture 41 - Pneumatic Control Systems - I (Continued...)

Lecture 42 - Pneumatic Systems - II

Lecture 43 - Pneumatic Systems - II (Continued...)

Lecture 44 - Energy Savings with Variable Speed Drives

Lecture 45 - Energy Savings with Variable Speed Drives (Continued...)

Lecture 46 - Introduction To CNC Machines

Lecture 47 - Introduction To CNC Machines

Lecture 48 - The Fieldbus Network - I

Lecture 49 - The Fieldbus Network - I (Continued...)

Lecture 50 - Higher Level Automation Systems

Lecture 51 - Higher Level Automation Systems (Continued...)

Lecture 52 - Course Review and Conclusion (Self Study)

**NPTEL : NOC:Medical Image Analysis (Electrical Engineering)**

**Co-ordinators : Prof. Debdoot Sheet**

**NPTEL : NOC:Biomedical Signal Processing (Electrical Engineering)**

**Co-ordinators : Prof. Sudipta Mukhopadhyay**

**NPTEL : NOC:Microprocessors and Microcontrollers (Electrical Engineering)**

**Co-ordinators : Prof. Santanu Chattopadhyay**

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Introduction (Continued...)

Lecture 4 - Basic Computer Organization

Lecture 5 - Basic computer organization

Lecture 6 - Basic Computer Organization

Lecture 7 - 8085 Microprocessors

Lecture 8 - 8085 Microprocessors (Continued...)

Lecture 9 - 8085 Microprocessors (Continued...)

Lecture 10 - 8085 Microprocessors (Continued...)

Lecture 11 - 8085 Microprocessors (Continued...)

Lecture 12 - 8085 Microprocessors (Continued...)

Lecture 13 - 8085 Microprocessors (Continued...)

Lecture 14 - 8085 Microprocessors (Continued...)

Lecture 15 - 8085 Microprocessors (Continued...)

Lecture 16 - 8085 Microprocessors (Continued...)

Lecture 17 - 8085 Microprocessors (Continued...)

Lecture 18 - 8085 Microprocessors (Continued...)

Lecture 19 - 8085 Microprocessors (Continued...)

Lecture 20 - 8085 Microprocessors (Continued...)

Lecture 21 - 8085 Microprocessors (Continued...)

Lecture 22 - 8085 Microprocessors (Continued...)

Lecture 23 - 8051 Microcontroller

Lecture 24 - 8051 Microcontroller (Continued...)

Lecture 25 - 8051Microcontroller (Continued...)

Lecture 26 - 8051 Microcontroller (Continued...)

Lecture 27 - 8051 Microcontroller (Continued...)

Lecture 28 - 8051 Microcontroller (Continued...)

Lecture 29 - 8051 Microcontroller (Continued...)

Lecture 30 - 8051 Microcontroller (Continued...)

Lecture 31 - 8051 Microcontroller (Continued...)

**NPTEL : NOC:Deep Learning For Visual Computing (Electrical Engineering)**

**Co-ordinators : Prof. Debdoot Sheet**

Lecture 1 - Introduction to Visual Computing

Lecture 2 - Feature Extraction for Visual Computing

Lecture 3 - Feature Extraction with Python

Lecture 4 - Neural Networks for Visual Computing

Lecture 5 - Classification with Perceptron Model

Lecture 6 - Introduction to Deep Learning with Neural Networks

Lecture 7 - Introduction to Deep Learning with Neural Networks

Lecture 8 - Multilayer Perceptron and Deep Neural Networks

Lecture 9 - Multilayer Perceptron and Deep Neural Networks

Lecture 10 - Classification with Multilayer Perceptron

Lecture 11 - Autoencoder for Representation Learning and MLP Initialization

Lecture 12 - MNIST handwritten digits classification using autoencoders

Lecture 13 - Fashion MNIST classification using autoencoders

Lecture 14 - ALL-IDB Classification using autoencoders

Lecture 15 - Retinal Vessel Detection using autoencoders

Lecture 16 - Stacked Autoencoders

Lecture 17 - MNIST and Fashion MNIST with Stacked Autoencoders

Lecture 18 - Denoising and Sparse Autoencoders

Lecture 19 - Sparse Autoencoders for MNIST classification

Lecture 20 - Denoising Autoencoders for MNIST classification

Lecture 21 - Cost Function

Lecture 22 - Classification cost functions

Lecture 23 - Optimization Techniques and Learning Rules

Lecture 24 - Gradient Descent Learning Rule

Lecture 25 - SGD and ADAM Learning Rules

Lecture 26 - Convolutional Neural Network Building Blocks

Lecture 27 - Simple CNN Model: LeNet

Lecture 28 - LeNet Definition

Lecture 29 - Training a LeNet for MNIST Classification

Lecture 30 - Modifying a LeNet for CIFAR

Lecture 31 - Convolutional Autoencoder and Deep CNN

**NPTEL : NOC:Power System Engineering (Electrical Engineering)**

**Co-ordinators : Prof. Debapriya Das**

**NPTEL : NOC:Fundamentals of Electrical Engineering (Electrical Engineering)**

**Co-ordinators : Prof. Debapriya Das**

Lecture 32 - First Order Circuits (Continued...)

Lecture 33 - First Order Circuits (Continued...)

Lecture 34 - First Order Circuits (Continued...)

Lecture 35 - First Order Circuits (Continued...)

Lecture 36 - First Order Circuits (Continued...)

Lecture 37 - Single phase AC circuits

Lecture 38 - Single phase AC circuits (Continued...)

Lecture 39 - Single phase AC circuits (Continued...)

Lecture 40 - Single phase AC circuits (Continued...)

Lecture 41 - Single phase AC circuits (Continued...)

Lecture 42 - Single phase AC circuits (Continued...)

Lecture 43 - Single phase AC circuits (Continued...)

Lecture 44 - Resonance and Maximum Power Transfer Theorem

Lecture 45 - Resonance and Maximum Power Transfer Theorem (Continued...)

Lecture 46 - Resonance and Maximum Power Transfer Theorem (Continued...)

Lecture 47 - Three phase circuits

Lecture 48 - Three phase circuits (Continued...)

Lecture 49 - Three phase circuits (Continued...)

Lecture 50 - Three phase circuits (Continued...)

Lecture 51 - Magnetic Circuits

Lecture 52 - Magnetic Circuits (Continued...)

Lecture 53 - Magnetic Circuits (Continued...)

Lecture 54 - Single Phase Transformer

Lecture 55 - Single Phase Transformer (Continued...)

Lecture 56 - Single Phase Transformer (Continued...)

Lecture 57 - Single Phase Transformer (Continued...)

Lecture 58 - Three phase Induction Motors

Lecture 59 - Three phase Induction Motors (Continued...)

Lecture 60 - Three phase Induction Motors (Continued...)

Lecture 61 - Three phase Induction Motors (Continued...)

Lecture 62 - DC Motors

Lecture 63 - DC Motors (Continued...)

Lecture 64 - DC Motors (Continued...)

**NPTEL : NOC:Digital Circuits (Electrical Engineering)**

**Co-ordinators : Prof. Santanu Chattopadhyay**

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Number System

Lecture 4 - Number System (Continued...)

Lecture 5 - Number System (Continued...)

Lecture 6 - Number System (Continued...)

Lecture 7 - Number System (Continued...)

Lecture 8 - Boolean Algebra

Lecture 9 - Boolean Algebra (Continued...)

Lecture 10 - Boolean Algebra (Continued...)

Lecture 11 - Boolean Algebra (Continued...)

Lecture 12 - Boolean Algebra (Continued...)

Lecture 13 - Boolean Algebra (Continued...)

Lecture 14 - Logic Gates

Lecture 15 - Logic Gates (Continued...)

Lecture 16 - Logic Gates (Continued...)

Lecture 17 - Logic Gates (Continued...)

Lecture 18 - Logic Gates (Continued...)

Lecture 19 - Logic Gates (Continued...)

Lecture 20 - Arithmetic Circuits

Lecture 21 - Arithmetic Circuits (Continued...)

Lecture 22 - Arithmetic Circuits (Continued...)

Lecture 23 - Decoders, Multiplexers, PLA

Lecture 24 - Decoders, Multiplexers, PLA (Continued...)

Lecture 25 - Decoders, Multiplexers, PLA (Continued...)

Lecture 26 - Decoders, Multiplexers, PLA (Continued...)

Lecture 27 - Decoders, Multiplexers, PLA (Continued...)

Lecture 28 - Sequential Circuits

Lecture 29 - Sequential Circuits (Continued...)

Lecture 30 - Sequential Circuits (Continued...)

Lecture 31 - Sequential Circuits (Continued...)

Lecture 65 - 8086 Microprocessor (Continued...)

**NPTEL : NOC:Analysis and Design Principles of Microwave Antennas (Electrical Engineering)**

**Co-ordinators : Dr. Amitabha Bhattacharya**

**NPTEL : NOC:Architectural Design of Digital Integrated Circuits (Electrical Engineering)**

**Co-ordinators : Prof. Indranil Hatai**

Lecture 1 - Introduction to VLSI Design Flow

Lecture 2 - Introduction to VLSI Design Flow

Lecture 3 - Introduction to VLSI Design Flow

Lecture 4 - Algorithm to Efficient Architecture Mapping

Lecture 5 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 6 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 7 - Tutorial on Algorithm to Efficient Architecture Mapping

Lecture 8 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 9 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 10 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 11 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 12 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 13 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 14 - Algorithm to Efficient Architecture Mapping (Continued...)

Lecture 15 - Efficient Adder Architecture

Lecture 16 - Efficient Adder Architecture (Continued...)

Lecture 17 - Efficient Adder Architecture (Continued...)

Lecture 18 - Efficient Adder Architecture

Lecture 19 - Efficient Adder Architecture

Lecture 20 - Efficient Adder Architecture

Lecture 21 - Efficient Adder Architecture

Lecture 22 - Efficient Adder Architecture

Lecture 23 - Efficient Adder Architecture

Lecture 24 - Efficient Adder Architecture

Lecture 25 - Pipelining and Parallel Processing

Lecture 26 - Pipelining and Parallel Processing

Lecture 27 - Multiplier Architecture

Lecture 28 - Multiplier Architecture

Lecture 29 - Multiplier Architecture

Lecture 30 - Multiplier Architecture

Lecture 31 - Multiplier Architecture

Lecture 32 - Multiplier Architecture

Lecture 33 - Multiplier Architecture

Lecture 34 - Multiplier Architecture

Lecture 35 - Squaring Circuit Design

Lecture 36 - Reconfigurable Constant Multiplier Design

Lecture 37 - Reconfigurable Constant Multiplier Design

Lecture 38 - Reconfigurable Constant Multiplier Design

Lecture 39 - Fixed Point Number Representation

Lecture 40 - Fixed Point Number Representation

Lecture 41 - CORDIC Architecture

Lecture 42 - CORDIC Architecture

Lecture 43 - CORDIC Architecture

Lecture 44 - CORDIC Architecture

Lecture 45 - Timing Analysis

Lecture 46 - Timing Analysis

Lecture 47 - Timing Analysis

Lecture 48 - Logic Hazard

Lecture 49 - FFT Architecture

Lecture 50 - FFT Architecture (Continued...)

Lecture 51 - Timing analysis Basics

Lecture 52 - Timing analysis Basics (Continued...)

Lecture 53 - Timing analysis Basics (Continued...)

Lecture 54 - Timing Issuesin Digital IC Design

Lecture 55 - Timing Issuesin Digital IC Design (Continued...)

Lecture 56 - Timing Issuesin Digital IC Design (Continued...)

Lecture 57 - Timing Issuesin Digital IC Design (Continued...)

Lecture 58 - Architectural Design of Digital Integrated Circuits

Lecture 59 - Design Tips for Basic Circuits Design (Continued...)

Lecture 60 - Design Tips for Basic Circuits Design (Continued...)

Lecture 61 - Design Tips for Basic Circuits Design (Continued...)

Lecture 62 - Low Power Digital Design

Lecture 63 - Low Power Digital Design (Continued...)

Lecture 64 - Low Power Digital Design

**NPTEL : NOC:Electrical Machines-II (Electrical Engineering)**

**Co-ordinators : Prof.Tapas Kumar Bhattacharya**

Lecture 32 - Speed and Direction of Rotating Field

Lecture 33 - Synchronous Speed and How to Calculate Induced Voltage in a Coil

Lecture 34 - Introduction to Induction Motor

Lecture 35 - Introduction to Induction Motor (Continued...)

Lecture 36 - General Expression of Torque in Terms of Stator and Rotor Fields

Lecture 37 - Torque Angle and Torque Expression

Lecture 38 - How to Fix Up Positions of Net Field, Rotor Field and Stator Field

Lecture 39 - Slip: Its Importance and Range for Motor Operation

Lecture 40 - Equivalent Circuit of 3-Phase Induction Motor

Lecture 41 - Equivalent Circuit of 3-Phase Induction Motor (Continued...)

Lecture 42 - Equivalent Circuit of 3-Phase Induction Motor (Continued...)

Lecture 43 - Expression for Electromagnetic Torque in terms of Equivalent Circuit Parameters

Lecture 44 - Maximum Electromagnetic Torque and Slip at Which it Occurs

Lecture 45 - Typical Torque Slip Characteristic and Operating Point

Lecture 46 - Change in Torque-slip Characteristic as Supply Voltage and Rotor Resistance are Varied

Lecture 47 - Types of Induction Motor - Slip Ring Type

Lecture 48 - Introduction to Cage Induction Motor

Lecture 49 - Cage Motor Can Operate for Different Stator Poles

Lecture 50 - Core Loss in Induction Motor and Simplified Equivalent Circuit

Lecture 51 - Torque Expression from Simplified Equivalent Circuit and Introduction to Circle Diagram

Lecture 52 - Circle Diagram (Continued...)

Lecture 53 - Exact Power Flow Diagram and Circle Diagram

Lecture 54 - Circle Diagram (Continued...)

Lecture 55 - Circle Diagram: Slip Line

Lecture 56 - Circle Diagram from Test Data

Lecture 57 - Starting of 3 Phase Induction Motor - Introduction

Lecture 58 - DOL and Reactor Starting

Lecture 59 - DOL and Auto Transformer Starting

Lecture 60 - Introduction to Speed Control

Lecture 61 - Idea of VVVF Speed Control of Induction Motor

Lecture 62 - Speed Contro Using Two Motors

Lecture 63 - Electrical Braking of 3 Phase Induction Motor

Lecture 64 - Braking (Continued...)

Lecture 65 - Introduction to Single Phase Induction Motor - Sequence Currents

Lecture 66 - Development of Equivalent Circuit

Lecture 67 - Development of Equivalent Circuit (Continued...)

Lecture 68 - Torque-slip Ch. of 1 ph. I-M Running on Single Winding

Lecture 69 - Introduction to Starting of 1ph. Induction Motor

Lecture 70 - Expression for Starting Torque and Need for Phase Splitting

Lecture 71 - Resistor Split 1 ph. Induction Motor

Lecture 72 - Capacitor Split 1 ph Induction Motor

Lecture 73 - Starting of 1 ph. Induction Motor (Continued...)

Lecture 74 - Synchronous Machine Construction

Lecture 75 - Synchronous Generator - Introduction

Lecture 76 - Synchronisation

Lecture 77 - Expression for Induced Voltage and O.C. Phasor Diagram

Lecture 78 - Loaded Synchronous Generator - Resultant Field

Lecture 79 - Armature Reaction and Synchronous Reactance. Basic Phasor Diagram

Lecture 80 - General Mode of Operation - Rotro Field, Stator Field and Resultant Field

Lecture 81 - Complete Phasor Diagram and Expression for Complex Power

Lecture 82 - Synchronous Motor Operation, Phasor Diagram and Power Expression

Lecture 83 - Effect of Variation of Field Current in Generator

Lecture 84 - Effect of Variation Field Current in Synchronous Motor, Introduction to Salient Pole Machine

Lecture 85 - Analysis of Salient Pole Synchronous Machine

Lecture 86 - Phasor Diagram of Salient Pole Synchronous Machine for Generator and Motor Mode

Lecture 87 - Expression for Load Angle and Expression for Power

Lecture 88 - Phasor Diagrams of Salient Pole Synchronous Generator under Various Conditions

Lecture 89 - Phasor Diagrams of Salient Pole Synchronous Motor under Various Conditions

Lecture 90 - O.C and S.C Test on Synchronous Generator

**NPTEL : NOC:Digital Electronic Circuits (Electrical Engineering)**

**Co-ordinators : Prof. Goutam Saha**

**NPTEL : NOC:Power System Dynamics, Control and Monitoring (Electrical Engineering)**

**Co-ordinators : Prof. Debapriya Das**

Lecture 32 - Transient stability, Automatic generation control conventional scenario

Lecture 33 - Automatic generation control conventional scenario

Lecture 34 - Automatic generation control conventional scenario

Lecture 35 - Automatic generation control conventional scenario

Lecture 36 - Automatic generation control conventional scenario

Lecture 37 - Automatic generation control conventional scenario

Lecture 38 - Automatic generation control conventional scenario

Lecture 39 - Automatic generation control conventional scenario

Lecture 40 - Automatic generation control conventional scenario

Lecture 41 - AGC in deregulated system

Lecture 42 - AGC in deregulated system (Continued...)

Lecture 43 - AGC in deregulated system (Continued...)

Lecture 44 - AGC in deregulated system (Continued...)

Lecture 45 - AGC in deregulated system (Continued...)

Lecture 46 - AGC in deregulated system (Continued...)

Lecture 47 - AGC in deregulated system (Continued...)

Lecture 48 - AGC in deregulated system (Continued...)

Lecture 49 - AGC in deregulated system, Reactive power and voltage control

Lecture 50 - Reactive power and voltage control

Lecture 51 - Reactive power and voltage control, State extimation in power system

Lecture 52 - State estimation in power system

Lecture 53 - State estimation in power system (Continued...)

Lecture 54 - State estimation in power system (Continued...)

Lecture 55 - State estimation in power system (Continued...)

Lecture 56 - State estimation in power system (Continued...)

Lecture 57 - Hydraulic turbine modelling

Lecture 58 - Hydraulic turbine modelling (Continued...)

Lecture 59 - Subsynchronous oscillation

Lecture 60 - Subsynchronous oscillation, Windup and non windup limits

**NPTEL : NOC:Evolution of Air Interface towards 5G (Electrical Engineering)**

**Co-ordinators : Prof. Suvra Sekhar Das**

**NPTEL : NOC:Electrical Measurement and Electronic Instruments (Electrical Engineering)**

**Co-ordinators : Prof. Avishek Chatterjee**

**NPTEL : NOC:Principles and Techniques of Modern Radar Systems (Electrical Engineering)**

**Co-ordinators : Dr. Amitabha Bhattacharya**

**NPTEL : NOC:Electrical Machines-I (Electrical Engineering)**

**Co-ordinators : Prof.Tapas Kumar Bhattacharya**

Lecture 65 - O.C.C and Load Characteristic of Separately Excited Generators

Lecture 66 - Voltage Build Up in Shunt Generator

Lecture 67 - Load Characteristic of Shunt Generator

Lecture 68 - Qualitative Discussion on Armature Reaction

Lecture 69 - Ill Effects of Armature Reaction

Lecture 70 - Compensating and Interpoles

Lecture 71 - Armature Reaction (Continued...)

Lecture 72 - Field Flux Density, Armature Flux Density and Resultant Field Distribution

Lecture 73 - Field Patterns for Both Motor and Generators

Lecture 74 - Demagnetising and Cross Magnetising mmf for Brush Shifted Machine

Lecture 75 - Calculation of Compensating, Interpole and Series Field Turns

Lecture 76 - Estimating Armature and Field Resistance from its Rating

Lecture 77 - Power Flow Diagram, Rotational Loss

Lecture 78 - Shunt Motor: Basic Equation

Lecture 79 - Starting of D.C Motor - 3-Point Starter

Lecture 80 - Speed Control of Shunt Motor - I

Lecture 81 - Speed Control of Shunt Motor - II

Lecture 82 - Speed Control of Shunt Motor - III

Lecture 83 - Field Control (Continued...)

Lecture 84 - D.C Motor Braking

Lecture 85 - Introduction to Series Motor

Lecture 86 - Series Motor Characteristics

Lecture 87 - Series Motor Speed Control

Lecture 88 - Universal Motor

Lecture 89 - Swinburne Test

Lecture 90 - Hopkinson Test

Lecture 91 - Efficiency Calculation

Lecture 92 - Field Test on D.C Series Motor

Lecture 93 - Simplex Wave winding

Lecture 94 - Wave Winding (Continued...)

**NPTEL : NOC:VLSI Signal Processing (Electrical Engineering)**

**Co-ordinators : Prof. Mrityunjay Chakraborty**

**NPTEL : NOC:Analog Electronic Circuits (Electrical Engineering)**

**Co-ordinators : Prof. Pradip Mandal**

Lecture 1 - Introduction to the course

Lecture 2 - Introduction to the constituent topics of the course and the Layout

Lecture 3 - Revisit to pre-requisite topics

Lecture 4 - Revisit to pre-requisite topics (Continued...)

Lecture 5 - Analysis of Simple Non-Linear Circuit

Lecture 6 - Analysis of Simple Non-linear Circuit (Continued...)

Lecture 7 - Revisiting BJT Characteristic

Lecture 8 - Revisiting BJT Characteristics (Continued...)

Lecture 9 - Revisiting BJT Characteristics (Continued...)

Lecture 10 - Revisiting MOSFET

Lecture 11 - Revisiting MOSFET (Continued...)

Lecture 12 - Revisiting MOSFET (Continued...)

Lecture 13 - Revisiting MOSFET (Continued...)

Lecture 14 - Analysis of simple non-linear circuit containing a BJT

Lecture 15 - Analysis of simple non-linear circuit containing a BJT (Continued...)

Lecture 16 - Analysis of simple non-linear circuit containing a MOSFET

Lecture 17 - Analysis of simple non-linear circuit containing a MOSFET (Continued...)

Lecture 18 - Linearization of non-linear circuit containing BJT

Lecture 19 - Linearization of non-linear circuit containing BJT (Continued...)

Lecture 20 - Linearization of non-linear circuit containing MOSFET

Lecture 21 - Linearization of non-linear circuit containing MOSFET (Continued...)

Lecture 22 - Linear models of Amplifiers - Part A

Lecture 23 - Linear models of Amplifiers - Part B

Lecture 24 - Common Emitter Amplifier - Part A

Lecture 25 - Common Emitter Amplifier - Part B

Lecture 26 - Common Emitter Amplifier (Continued...) - Part A

Lecture 27 - Common Emitter Amplifier (Continued...) - Part B

Lecture 28 - Common Emitter Amplifier (Continued...) - Numerical examples - Part A

Lecture 29 - Common Emitter Amplifier (Continued...) - Numerical examples - Part B

Lecture 30 - Common Emitter Amplifier (Continued...) - Design guidelines - Part A

Lecture 31 - Common Emitter Amplifier (Continued...) - Design guidelines - Part B

**NPTEL : NOC:Network Analysis (Electrical Engineering)**

**Co-ordinators : Prof. T.K. Bhattacharya**

**NPTEL : NOC:Power System Protection (Electrical Engineering)**

**Co-ordinators : Prof. Ashok Kumar Pradhan**

Lecture 1 - Faults in Power System

Lecture 2 - Elements and Features of Protection Scheme

Lecture 3 - Fault Analysis Review - Sequence Components

Lecture 4 - Fault Analysis Review - Sequence Components (Continued...)

Lecture 5 - Numerical Relaying Concept

Lecture 6 - Discrete Fourier Transform

Lecture 7 - Recursive and Half Cycle DFT and Cosine Filter

Lecture 8 - Least Square Technique

Lecture 9 - Frequency Response of Phasor Estimation techniques

Lecture 10 - In the Presence of Decaying DC

Lecture 11 - Overcurrent Relay Characteristics

Lecture 12 - Overcurrent Relay Coordination

Lecture 13 - Relay Coordination with Fuse

Lecture 14 - Introduction to Directional Relaying

Lecture 15 - Positive Sequence Directional Relay

Lecture 16 - Negative and Zero Sequence Directional Relay

Lecture 17 - Superimposed Component Based Directional Relaying

Lecture 18 - Introduction to Distance Relay

Lecture 19 - Fault Classification

Lecture 20 - Apparent Impedance Calculation

Lecture 21 - Distance Relay Implementation

Lecture 22 - Application to Double Circuit Line

Lecture 23 - Multi-terminal Lines

Lecture 24 - Protection of series compensated lines - Part I

Lecture 25 - Protection of series compensated lines - Part II

Lecture 26 - Effect of Fault Resistance

Lecture 27 - Load Encroachment

Lecture 28 - Power Swing

Lecture 29 - Power Swing Detection Techniques - Part I

Lecture 30 - Power Swing Detection Techniques - Part II

Lecture 31 - Adaptive Distance Relaying

**NPTEL : NOC:Signal Processing for mm Wave communication for 5G and beyond (Electrical Engineering)**

**Co-ordinators : Prof. Amit Kumar Dutta**

Lecture 1 - Tx- Rx Structure

Lecture 2 - Rx -Structure

Lecture 3 - Fundamental of Ray-Tracing model

Lecture 4 - General channel model - Part I

Lecture 5 - General channel model - Part I (Continued...)

Lecture 6 - General channel model - Part I (Continued...)

Lecture 7 - General channel model - Part II

Lecture 8 - Wireless channel-A ray tracing model - Part II

Lecture 9 - Wireless channel-A ray tracing model - Part II (Continued...)

Lecture 10 - Wireless channel-A ray tracing model - Part II (Continued...)

Lecture 11 - Wireless channel-A ray tracing model - Part II (Continued...)

Lecture 12 - RMS Delay spread and Doppler Effect on channel

Lecture 13 - Time Varing Model

Lecture 14 - Doppler Impact on coherence BW

Lecture 15 - Introduction to time series

Lecture 16 - AR,ARMA,MA process

Lecture 17 - Doppler with AR process model

Lecture 18 - Coherence time and parameter summery

Lecture 19 - Basic ISI channel

Lecture 20 - Channel estimation and Equalizer

Lecture 21 - precoder and MIMO

Lecture 22 - precoder and MIMO (Continued...)

Lecture 23 - Basics of mmwave spectrum

Lecture 24 - Angle of arrival and angle of departure

Lecture 25 - 3D concepts, AoA,AoD

Lecture 26 - mmWave channel model with RX beaming

Lecture 27 - mmWave channel model with RX beaming (Continued...)

Lecture 28 - mmWave channel model with RX beaming (Continued...)

Lecture 29 - mmWave channel model with RX beaming (Continued...)

Lecture 30 - mmwave channel model (Continued...)

Lecture 31 - mmWave channel model (Continued...) -Tx side multiple antenna

**NPTEL : NOC:Control and Tuning Methods in Switched Mode Power Converters (Electrical Engineering)**

**Co-ordinators : Prof. Santanu Kapat**

**NPTEL : NOC:Advanced Microwave Guided-Structures and Analysis (Electrical Engineering)**

**Co-ordinators : Prof. Bratin Ghosh**

Lecture 1 - Scattering Matrix Concepts

Lecture 2 - Scattering Matrix Concepts (Continued...)

Lecture 3 - Scattering Matrix Concepts (Continued...)

Lecture 4 - Scattering Matrix Concepts (Continued...)

Lecture 5 - Scattering Matrix Concepts Tutorials

Lecture 6 - Scattering Matrix Concepts Tutorials (Continued...)

Lecture 7 - Scattering Matrix Concepts Tutorials (Continued...)

Lecture 8 - Instantaneous form of Maxwellâ€™s equations

Lecture 9 - Instantaneous form of Maxwellâ€™s equations (Continued....)

Lecture 10 - Instantaneous form of Maxwellâ€™s equations (Continued...)

Lecture 11 - Instantaneous form of Maxwellâ€™s equations (Continued...)

Lecture 12 - Instantaneous form of Maxwellâ€™s equations (Continued...)

Lecture 13 - Instantaneous form of Maxwellâ€™s equations Tutorials

Lecture 14 - Instantaneous form of Maxwellâ€™s equations Tutorials (Continued...)

Lecture 15 - Harmonic form of Maxwellâ€™s equations

Lecture 16 - Harmonic form of Maxwellâ€™s equations (Continued...)

Lecture 17 - Harmonic form of Maxwellâ€™s equations (Continued...)

Lecture 18 - Harmonic form of Maxwellâ€™s equations Tutorials

Lecture 19 - Wave Equation and Solution

Lecture 20 - Relation between wavenumbers

Lecture 21 - Radiation from an electric current source (Continued...)

Lecture 22 - Radiation from an electric current source (Continued...)

Lecture 23 - Radiation from an electric current source (Continued...)

Lecture 24 - Wave Equation and Solution Tutorials

Lecture 25 - Radiation from an electric current source Tutorials

Lecture 26 - Radiation from a magnetic current source

Lecture 27 - Radiation from a magnetic current source (Continued...)

Lecture 28 - Radiation from a magnetic current source (Continued...)

Lecture 29 - Application of the magnetic current source (Continued...)

Lecture 30 - Radiation from a magnetic current source Tutorials

Lecture 31 - Radiation from a magnetic current source Tutorials (Continued....)

**NPTEL : NOC:Cognition and its Computation (Electrical Engineering)**

**Co-ordinators : Prof. Rajlakshmi Guha, Prof. Sharba Bandyopadhyay**

Lecture 1 - Introduction

Lecture 2 - Historical Origin of Cognition Studies

Lecture 3 - The Cognitive Revolution

Lecture 4 - Anatomical Structures of the Brain

Lecture 5 - Frontal Lobes and Cognition

Lecture 6 - Neuropsychological Testing

Lecture 7 - Eye Tracking and Cognition

Lecture 8 - EEG, fMRI, MEG

Lecture 9 - Single neuron level measurements

Lecture 10 - Single Neuron Imaging and Manipulation of Neural Activity

Lecture 11 - Introduction to Computation

Lecture 12 - Currency of Computation in Neurobiology - Action Potential

Lecture 13 - Synapse and Synaptic Transmission

Lecture 14 - Synaptic Plasticity

Lecture 15 - Short Term Plasticity and STDP

Lecture 16 - Coding by neurons

Lecture 17 - Sensory Circuits: Visual - I

Lecture 18 - Sensory Circuits: Visual - II

Lecture 19 - Sensory Circuits: Auditory - I

Lecture 20 - Sensory Circuits: Auditory - II

Lecture 21 - Sensory Circuits: Somatosensory

Lecture 22 - Sensory Circuits: Olfactory and Gustatory

Lecture 23 - Motor circuits - Sensory-motor

Lecture 24 - Reward Circuits

Lecture 25 - Executive Circuits

Lecture 26 - Types of Attention, Theories Broadbent Triessman

Lecture 27 - Alerting Orientation and Executive Network

Lecture 28 - Disorders of Attention

Lecture 29 - Basics of Perception - Object, Depth and Movement

Lecture 30 - Constancy and Illusions

Lecture 31 - Neurobiology of attention, Working Memory

Lecture 32 - Cholinergic System, Bottom up and Top down

Lecture 33 - Object Recognition

Lecture 34 - Visual Search and Pattern Recognition

Lecture 35 - Auditory Scene Analysis, McGurk Effect

Lecture 36 - Learning Processes

Lecture 37 - Learning Processes (Continued...)

Lecture 38 - Memory

Lecture 39 - Learning Disorders

Lecture 40 - Memory Failure - Forgetting

Lecture 41 - Learning in biological neural networks

Lecture 42 - Examples

Lecture 43 - Different types of Plasticity

Lecture 44 - Developmental Plasticity/Learning/Critical Period

Lecture 45 - Examples of Disorders in Plasticity

Lecture 46 - Introduction to speech and language (Development)

Lecture 47 - Components of Speech, Speech Production

Lecture 48 - Speech Perception

Lecture 49 - Lessons from Animal Communication

Lecture 50 - Language and Thought - Speech Language Disorders

Lecture 51 - Theories of Emotion

Lecture 52 - Neurophysiology of emotions - Limbic System

Lecture 53 - Problem Solving

Lecture 54 - Decision Making

Lecture 55 - Frontal cortex in decision making

Lecture 56 - Topics in current research - I

Lecture 57 - Topics in current research - II

Lecture 58 - Topics in current research - III

Lecture 59 - Topics in current research - IV

Lecture 60 - Topics in current research - V

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

**Co-ordinators : Prof. Santanu Kapat**

**NPTEL : NOC:VLSI Interconnects (Electrical Engineering)**

**Co-ordinators : Prof. Sarang Pendharker**

Lecture 1 - Introduction to VLSI interconnects

Lecture 2 - The distributed RC interconnect model

Lecture 3 - The Elmore delay

Lecture 4 - Elmore delay in interconnects

Lecture 5 - Elmore delay in branched RC interconnects

Lecture 6 - Equivalent circuit for RC interconnects

Lecture 7 - Scaling effects in interconnects

Lecture 8 - Delay mitigation in RC interconnects

Lecture 9 - RC interconnect simulation

Lecture 10 - Inductive effects in interconnects

Lecture 11 - Distributed RLC interconnect model

Lecture 12 - Transmission line equations

Lecture 13 - When to consider the inductive effects?

Lecture 14 - The transfer function of an RLC interconnect

Lecture 15 - Time domain response of a lumped RLC circuit

Lecture 16 - Equivalent Elmore model for RLC interconnects

Lecture 17 - Two-pole model of RLC interconnects from ABCD parameters

Lecture 18 - RLC interconnect simulation

Lecture 19 - Origin of the skin effect

Lecture 20 - Effective resistance at high frequencies

Lecture 21 - Equivalent circuit to simulate skin effect

Lecture 22 - Power dissipation due to interconnects

Lecture 23 - Optimum interconnect width for minimizing total power dissipation

Lecture 24 - Heating effects and thermal modeling

Lecture 25 - Compact thermal modeling with equivalent electrical circuits

Lecture 26 - Electromigration in interconnects

Lecture 27 - Mitigation of electromigration

Lecture 28 - Capacitive coupling in interconnects

Lecture 29 - Cross-talk and timing jitters in two identical interconnects

Lecture 30 - Coupling effects and mitigation techniques

Lecture 31 - Matrix formulation of coupled interconnects

**NPTEL : NOC:Semiconductor Device Modeling and Simulation (Electrical Engineering)**

**Co-ordinators : Prof. Vivek Dixit**

**NPTEL : NOC:RF and Microwave Networks (Electrical Engineering)**

**Co-ordinators : Prof. Bratin Ghosh**

Lecture 1 - The network concept

Lecture 2 - One-port network

Lecture 3 - One-port network, Two-port network

Lecture 4 - Two-port network, Signal flow graph

Lecture 5 - Tutorial - 1

Lecture 6 - General analysis of cylindrical waveguides

Lecture 7 - TE to z mode analysis of cylindrical waveguides

Lecture 8 - TE to z mode analysis of cylindrical waveguides (Continued...), TM to z mode analysis

Lecture 9 - Normalization of mode vectors, Characteristics of eigen values and eigen functions

Lecture 10 - Wave impedance for TE and TM to z modes, Transmission line analogy for mode voltage

Lecture 11 - Transmission line equivalence for TE and TM modes, Power calculation using

Lecture 12 - Tutorial - 2

Lecture 13 - Modal expansion in cylindrical waveguides, Concept of mode orthogonality

Lecture 14 - Concept of mode orthogonality (continued), Determination of arbitrary mode

Lecture 15 - Power orthogonality in cylindrical waveguides

Lecture 16 - Tutorial - 3

Lecture 17 - Modal expansion of fields in rectangular waveguides

Lecture 18 - Modal expansion of fields in rectangular waveguides (Continued), Capacitive rectangular

Lecture 19 - Capacitive rectangular waveguide junction (Continued...)

Lecture 20 - Inductive rectangular waveguide junction (Continued...)

Lecture 21 - Inductive rectangular waveguide junction (Continued...), Construction of solutions

Lecture 22 - Cylindrical waveguide junctions (Continued...)

Lecture 23 - Cylindrical waveguide junctions (Continued...)

Lecture 24 - Cylindrical waveguide junctions (Continued...), Example of capacitive rectangular

Lecture 25 - Cylindrical waveguide junctions (Continued...), Example of capacitive rectangular

Lecture 26 - Example of inductive waveguide junction (Continued...), Alternative equivalent circuit

Lecture 27 - Tutorial - 4

Lecture 28 - Obstacles in waveguides

Lecture 29 - Obstacles in waveguides (Continued...)

Lecture 30 - Obstacles in waveguides (Continued...)

Lecture 31 - Small obstacles in waveguides

Lecture 32 - Small obstacles in waveguides (Continued...)

Lecture 33 - Small obstacles in waveguides, Reciprocity

Lecture 34 - Reciprocity

Lecture 35 - Reciprocity (Continued...)

Lecture 36 - Tutorial - 5

Lecture 37 - Posts in rectangular waveguide

Lecture 38 - Posts in rectangular waveguide (Continued...)

Lecture 39 - Posts in rectangular waveguide (Continued...)

Lecture 40 - Posts in rectangular waveguide (Continued...)

Lecture 41 - Diaphragms in waveguide

Lecture 42 - Diaphragms in waveguide (Continued...)

Lecture 43 - Diaphragms in waveguide (Continued...)

Lecture 44 - Diaphragms in waveguide (Continued...)

Lecture 45 - Tutorial - 6

Lecture 46 - Currents in Waveguides

Lecture 47 - Currents in Waveguides (Continued...)

Lecture 48 - Coaxial to waveguide junction with matched termination

Lecture 49 - Coaxial to waveguide feeds with arbitrary termination

Lecture 50 - Coaxial to waveguide feeds with arbitrary termination (Continued...)

Lecture 51 - Coaxial to waveguide feeds with arbitrary termination (Continued...)

Lecture 52 - Coaxial to waveguide feeds with arbitrary termination (Continued...)

Lecture 53 - Tutorial - 7

Lecture 54 - Apertures in the ground plane

Lecture 55 - Apertures in the ground plane (Continued...)

Lecture 56 - Apertures in the ground plane (Continued...)

Lecture 57 - Apertures in the ground plane (Continued...), Plane current sheets

Lecture 58 - Plane current sheets (Continued...)

Lecture 59 - Tutorial - 8

Lecture 60 - Excitation of Apertures

Lecture 61 - Tutorial - 9

Lecture 62 - Modal expansion in cavities

Lecture 63 - Probes in cavities

Lecture 64 - Tutorial - 10

**NPTEL : NOC:Introduction to Adaptive Signal Processing (Electrical Engineering)**

**Co-ordinators : Prof. Mrityunjoy Chakraborty**

Lecture 1 - Introduction to Adaptive Filters

Lecture 2 - Probability and Random Variables

Lecture 3 - General Set of Random Variables

Lecture 4 - Statistical Impedance, Covariance Matrices

Lecture 5 - Multivariate Gaussian Density

Lecture 6 - Complex Random Variables

Lecture 7 - Introduction to Hermitian Matrices

Lecture 8 - Eigenvalues and eigenvectors of Hermitian Matrices

Lecture 9 - Spectral Decomposition of Hermitian Matrices

Lecture 10 - Positive Definite and Semidefinite Matrices

Lecture 11 - Introduction to Discrete Time Random Processes

Lecture 12 - Power Spectral Density (PSD)

Lecture 13 - PSD and Linear Time Invariant Systems

Lecture 14 - Optimal FIR Filter

Lecture 15 - Optimal FIR Filter (Continued...)

Lecture 16 - LMS Algorithm

Lecture 17 - Convergence Proof of LMS Algorithm

Lecture 18 - Convergence Proof of LMS Algorithm (Continued...)

Lecture 19 - Application of Adaptive Filter

Lecture 20 - Application of Adaptive Filter (Continued...)

Lecture 21 - Application of Adaptive Filter (Continued...)

Lecture 22 - Applications of Adaptive Filter

Lecture 23 - Applications of Adaptive Filter

Lecture 24 - Second Order Analysis of LMS Algorithm

Lecture 25 - Second Order Analysis of LMS Algorithm (Continued...)

Lecture 26 - Second Order Analysis of LMS Algorithm (Continued...)

Lecture 27 - Second Order Analysis of LMS Algorithm (Continued...)

Lecture 28 - NLMS Algorithm

Lecture 29 - NLMS Algorithm

Lecture 30 - Affine Projection Algorithm (APA)

Lecture 31 - Affine Projection Algorithm (APA)

**NPTEL : NOC:Nanobiophotonics: Touching Our Daily Life (Electrical Engineering)**

**Co-ordinators : Dr. Basudev Lahiri**

**NPTEL : Modelling and Analysis of Electric Machines (Electrical Engineering)**

**Co-ordinators : Dr. Krishna Vasudevan**

**NPTEL : Analog ICs (Electrical Engineering)**

**Co-ordinators : Prof. K. Radhakrishna Rao**

**NPTEL : Digital Integrated Circuits (Electrical Engineering)**

**Co-ordinators : Prof. Amitava Dasgupta**

**NPTEL : Electromagnetic Fields (Electrical Engineering)**

**Co-ordinators : Prof. Harishankar Ramachandran**

Lecture 1 - Introduction To Vector

Lecture 2 - Introduction To Vector (Continued...)

Lecture 3 - Coulomb's Law

Lecture 4 - Electric Field

Lecture 5 - Electro Static Potential

Lecture 6 - The Gradient

Lecture 7 - Gauss's Law

Lecture 8 - Poisson's Equation

Lecture 9 - Energy In The Field

Lecture 10 - Sample Problems In Electrostatics

Lecture 11 - Fields In Materials

Lecture 12 - Fields In Material Bodies

Lecture 13 - Displacement Vectors

Lecture 14 - Capacitors

Lecture 15 - Method Of Images

Lecture 16 - Poisson's Equation 2 Dimensions

Lecture 17 - Field Near Sharp Edges And Points

Lecture 18 - Magnetic Field 1

Lecture 19 - Magnetic Field 2

Lecture 20 - Stokes Theorems

Lecture 21 - The curl

Lecture 22 - Field due to current loop

Lecture 23 - Ampere's law

Lecture 24 - Examples of Ampere's law

Lecture 25 - Inductance

Lecture 26 - Mutual Inductance

Lecture 27 - Faraday's law

Lecture 28 - Magnetic Energy

Lecture 29 - Magnetic Energy (Continued...)

Lecture 30 - Magnetic Energy (Continued...)

Lecture 31 - Generalised Ampere's Law

**NPTEL : Networks and Systems (Electrical Engineering)**

**Co-ordinators : Prof. V.G.K. Murti**

Lecture 1 - Introductory Concepts - 1

Lecture 2 - Introductory Concepts - 2

Lecture 3 - Introductory Concepts - 3

Lecture 4 - Introductory Concepts - 4

Lecture 5 - Introductory Concepts - 5

Lecture 6 - Introductory Concepts - 6

Lecture 7 - Fourier Series - 1

Lecture 8 - Fourier Series - 2

Lecture 9 - Fourier Series - 3

Lecture 10 - Fourier Series - 4

Lecture 11 - Fourier Series - 5

Lecture 12 - Fourier Series - 6

Lecture 13 - Fourier Transforms - 1

Lecture 14 - Fourier Transforms - 2

Lecture 15 - Fourier Transforms - 3

Lecture 16 - Fourier Transforms - 4

Lecture 17 - Fourier Transforms - 5

Lecture 18 - Fourier Transforms - 6

Lecture 19 - Fourier Transforms - 7

Lecture 20 - Laplace Transforms - 1

Lecture 21 - Laplace Transforms - 2

Lecture 22 - Laplace Transforms - 3

Lecture 23 - Laplace Transforms - 4

Lecture 24 - Laplace Transforms - 5

Lecture 25 - Laplace Transforms - 6

Lecture 26 - Application of Laplace Transforms - 1

Lecture 27 - Application of Laplace Transforms - 2

Lecture 28 - Application of Laplace Transforms - 3

Lecture 29 - Application of Laplace Transforms - 4

Lecture 30 - Network Functions - 1

Lecture 31 - Network Functions - 2

**NPTEL : Probability Foundation for Electrical Engineers (Electrical Engineering)**

**Co-ordinators : Dr. Krishna Jagannathan**

**NPTEL : NOC:Analog Circuits (Electrical Engineering)**

**Co-ordinators : Dr. Nagendra Krishnapura**

Lecture 1 - Introduction to the course

Lecture 2 - Obtaining power gain

Lecture 3 - Obtaining power gain using a linear two port?

Lecture 4 - One port (two terminal) nonlinear element

Lecture 5 - Nonlinear circuit analysis

Lecture 6 - Small signal incremental analysis - graphical view

Lecture 7 - Small signal incremental analysis

Lecture 8 - Incremental equivalent circuit

Lecture 9 - Large signal characteristics of a diode

Lecture 10 - Analysis of diode circuits

Lecture 11 - Small signal model of a diode

Lecture 12 - Two port nonlinearity

Lecture 13 - Small signal equivalent of a two port network

Lecture 14 - Small signal equivalent circuit of a two port network

Lecture 15 - Gain of a two port network

Lecture 16 - Constraints on small signal parameters to maximize the gain

Lecture 17 - Constraints on large signal characteristics to maximize the gain

Lecture 18 - Implications of constraints in terms of the circuit equivalent

Lecture 19 - MOS transistor-description

Lecture 20 - MOS transistor large signal characteristics

Lecture 21 - MOS transistor large signal characteristics - graphical view

Lecture 22 - MOS transistor small signal characteristics

Lecture 23 - Linear (Triode) region of the MOS transistor

Lecture 24 - Small signal amplifier using the MOS transistor

Lecture 25 - Basic amplifier structure

Lecture 26 - Problems with the basic structure

Lecture 27 - Adding bias and signal-ac coupling

Lecture 28 - Common source amplifier with biasing

Lecture 29 - Common source amplifier: Small signal equivalent circuit

Lecture 30 - Common source amplifier analysis: Effect of biasing components

Lecture 31 - Constraint on the input coupling capacitor

Lecture 131 - PNP transistor

**NPTEL : NOC:Introduction to Non Linear Dynamics (Electrical Engineering)**

**Co-ordinators : Prof. Gaurav Raina**

Lecture 1 - A brief introduction to modelling

Lecture 2 - Dynamics and Nonlinear systems: getting started

Lecture 3 - 1-Dimensional Flows, Flows on the Line, Lecture 1

Lecture 4 - 1-Dimensional Flows, Flows on the Line, Lecture 2

Lecture 5 - 1-Dimensional Flows, Flows on the Line, Lecture 3

Lecture 6 - 1-Dimensional Flows, Flows on the Line, Lecture 4

Lecture 7 - 1-Dimensional Flows, Flows on the Line, Lecture 5

Lecture 8 - 1-Dimensional Flows, Flows on the Line, Lecture 6

Lecture 9 - 1-Dimensional Flows, Bifurcations, Lecture 1

Lecture 10 - 1-Dimensional Flows, Bifurcations, Lecture 2

Lecture 11 - 1-Dimensional Flows, Bifurcations, Lecture 3

Lecture 12 - 1-Dimensional Flows, Bifurcations, Lecture 4

Lecture 13 - 1-Dimensional Flows, Bifurcations, Lecture 5

Lecture 14 - 1-Dimensional Flows, Bifurcations, Lecture 6

Lecture 15 - 1-Dimensional Flows, Flows on the Circle, Lecture 1

Lecture 16 - 1-Dimensional Flows, Flows on the Circle, Lecture 2

Lecture 17 - 2-Dimensional Flows, Linear Systems, Lecture 1

Lecture 18 - 2-Dimensional Flows, Linear Systems, Lecture 2

Lecture 19 - 2-Dimensional Flows, Linear Systems, Lecture 3

Lecture 20 - 2-Dimensional Flows, Linear Systems, Lecture 4

Lecture 21 - 2-Dimensional Flows, Phase Plane, Lecture 1

Lecture 22 - 2-Dimensional Flows, Phase Plane, Lecture 2

Lecture 23 - 2-Dimensional Flows, Phase Plane, Lecture 3

Lecture 24 - 2-Dimensional Flows, Limit Cycles, Lecture 1

Lecture 25 - 2-Dimensional Flows, Limit Cycles, Lecture 2

Lecture 26 - 2-Dimensional Flows, Limit Cycles, Lecture 3

Lecture 27 - 2-Dimensional Flows, Bifurcations, Lecture 1

Lecture 28 - 2-Dimensional Flows, Bifurcations, Lecture 2

Lecture 29 - 2-Dimensional Flows, Bifurcations, Lecture 3

**NPTEL : NOC:Control Engineering (Electrical Engineering)**

**Co-ordinators : Prof. Ramkrishna.P**

Lecture 1 - Introduction to Systems and Control

Lecture 2 - Modelling of Systems

Lecture 3 - Elements of Modelling

Lecture 4 - Examples of Modelling

Lecture 5 - Solving Problems in Modelling of Systems

Lecture 6 - Laplace Transforms

Lecture 7 - Inverse Laplace Transforms

Lecture 8 - Transfer Function of Modelling Block Diagram Representation

Lecture 9 - Solving Problems on Laplace Transforms and Transfer Functions

Lecture 10 - Block Diagram Reduction, Signal Flow Graphs

Lecture 11 - Solving Problems on Block Diagram Reduction, Signal Flow Graphs

Lecture 12 - Time Response Analyzsis of systems

Lecture 13 - Time Response specifications

Lecture 14 - Solving Problems on Time Response Analyzsis ans specifications

Lecture 15 - Stability

Lecture 16 - Routh Hurwitz Criterion

Lecture 17 - Routh Hurwitz Criterion T 1

Lecture 18 - Closed loop System and Stability

Lecture 19 - Root Locus Technique

Lecture 20 - Root Locus Plots

Lecture 21 - Root Locus Plots (Continued...)

Lecture 22 - Root Locus Plots (Continued...)

Lecture 23 - Root Locus Plots (Continued...)

Lecture 24 - Introduction to Frequency Response

Lecture 25 - Frequency Response Plots

Lecture 26 - Relative Stability

Lecture 27 - Bode plots

Lecture 28 - Basics of Control design Proportional, Integral and Derivative Actions

Lecture 29 - Basics of Control design Proportional, Integral and Derivative Actions

Lecture 30 - Problems on PID Controllers

Lecture 31 - Basics of Control design Proportional, Integral and Derivative Actions

**NPTEL : NOC:Analog IC Design (Electrical Engineering)**

**Co-ordinators : Prof. S. Aniruddhan**

**NPTEL : NOC:Probability Foundations for Electrical Engineers (Electrical Engineering)**

**Co-ordinators : Prof. R.Aravind, Dr. Andrew Thangaraj**

**NPTEL : NOC:Introduction to Photonics (Electrical Engineering)**

**Co-ordinators : Prof. Balaji Srinivasan**

Lecture 32 - Semiconductor light Source and detector LED Characteristics

Lecture 33 - Lab Demonstration: Semiconductor Sources

Lecture 34 - Semiconductor light Source and detector Laser Characteristics

Lecture 35 - Semiconductor Detectors - 1

Lecture 36 - Semiconductor Detectors - 2

Lecture 37 - Semiconductor Detectors - 3

Lecture 38 - Lab Demonstration: Semiconductor Detectors

Lecture 39 - Semiconductor Detectors - 4

Lecture 40 - Light manipulation-Mallus' Law

Lecture 41 - Light manipulation-Birefringence

Lecture 42 - Light manipulation-Faraday Rotation

Lecture 43 - Lab Demonstration: Manipulation of Light Intensity and Polarization

Lecture 44 - Non-linear optics-Pockels effect

Lecture 45 - Non-linear optics-Kerr Effect

Lecture 46 - Lab Demonstration: Manipulation of Light Electro Optic Modulator (EOM)

Lecture 47 - Non-linear optics-stimulated Brillouin scattering

Lecture 48 - Non-linear optics-stimulated Raman scattering

**NPTEL : NOC:Multirate DSP (Electrical Engineering)**

**Co-ordinators : Prof. David Kovil Pillai**

Lecture 1 - Introduction to Multirate DSP - Part 1

Lecture 2 - Introduction to Multirate DSP - Part 2

Lecture 3 - Sampling and Nyquist criterion - Part 1

Lecture 4 - Sampling and Nyquist criterion - Part 2

Lecture 5 - Signal Reconstruction - Part 1

Lecture 6 - Signal Reconstruction - Part 2

Lecture 7 - Reconstruction filter - Part 1

Lecture 8 - Reconstruction filter - Part 2

Lecture 9 - Discrete time processing of continuous time signal - Part 1

Lecture 10 - Discrete time processing of continuous time signal - Part 2

Lecture 11 - DT processing of CT signal example

Lecture 12 - Time scaling- upsampler and downsampler - Part 1

Lecture 13 - Time scaling- upsampler and downsampler - Part 2

Lecture 14 - Upsampler and downsampler- continued - Part 1

Lecture 15 - Upsampler and downsampler- continued - Part 2

Lecture 16 - Decimator properties

Lecture 17 - Properties of Upsampler and Downsampler

Lecture 18 - Fractional sampling rate change - Part 1

Lecture 19 - Fractional sampling rate change - Part 2

Lecture 20 - Multiplexer/ demultiplexer interpretation

Lecture 21 - Noble identities and polyphase decomposition - Part 1

Lecture 22 - Noble identities and polyphase decomposition - Part 2

Lecture 23 - Polyphase decomposition continued - Part 1

Lecture 24 - Polyphase decomposition continued - Part 2

Lecture 25 - Introduction to Multirate Filter Banks

Lecture 26 - Applications of Multirate - Part 1

Lecture 27 - Applications of Multirate - Part 2

Lecture 28 - Spectral Analysis of Filter Bank - Part 1

Lecture 29 - Spectral Analysis of Filter Bank - Part 2

Lecture 30 - DFT and High Resolution Spectral Analysis - Part 1

Lecture 31 - DFT and High Resolution Spectral Analysis - Part 2

Lecture 32 - Transmultiplexer and Maximally Decimated Filterbanks - Part 1

Lecture 33 - Transmultiplexer and Maximally Decimated Filterbanks - Part 2

Lecture 34 - Maximally Decimated Filterbanks 2 - Part 1

Lecture 35 - Maximally Decimated Filterbanks 2 - Part 2

Lecture 36 - Study of Two-channel filter bank

Lecture 37 - Introduction to Quadrature Mirror Filters (QMF)

Lecture 38 - 2-channel QMF Filter Bank Design

Lecture 39 - Study of All-pass filters

Lecture 40 - Study of All-pass lattice

Lecture 41 - All-pass decomposition, the study of Mth band and Nyquist filters

Lecture 42 - Study of two-channel filter bank with perfect reconstruction

Lecture 43 - First part name : Perfect Reconstruction Final Overview. Second part name : Introduction to OFDM- Motivation - Part 1

Lecture 44 - First part name : Perfect Reconstruction Final Overview. Second part name : Introduction to OFDM- Motivation - Part 2

Lecture 45 - Capacity of wireless channels - CSIR - Part 1

Lecture 46 - Capacity of wireless channels - CSIT - Part 2

Lecture 47 - Capacity of wireless channels - Formulation of capacity calculation - Part 3

Lecture 48 - Capacity of wireless channels - Formulation of capacity calculation (Continued...) - Part 1

Lecture 49 - Capacity of wireless channels - Formulation of capacity calculation (Continued...) - Part 2

Lecture 50 - Capacity of wireless channels - Time-invariant Frequency selective channel - Part 3

Lecture 51 - Capacity of wireless channels - Time varying Frequency selective channels - Part 1

Lecture 52 - Multi-rate DSP framework for Multi-carrier Modulation - Part 2

Lecture 53 - MCM with overlapping spectra - Part 1

Lecture 54 - Recap of multirate DSP concepts for building OFDM - Part 2

Lecture 55 - Introduction to Redundancy and it's implementation in multi-rate framework - Part 3

Lecture 56 - M-channel multicarrier Transceiver - Part 1

Lecture 57 - M-channel multicarrier Transceiver - Part 2

Lecture 58 - M-channel multicarrier Transceiver - Part 3

Lecture 59 - Pseudo -circulant structure - Part 1

Lecture 60 - Pseudo -circulant structure - Part 2

Lecture 61 - MCM impairments and CP - Part 1

Lecture 62 - MCM impairments and CP - Part 2

Lecture 63 - Orthogonal Frequency Division Multiplexing - Part 1

Lecture 64 - Orthogonal Frequency Division Multiplexing - Part 2

**NPTEL : NOC:LDPC and Polar Codes in 5G Standard (Electrical Engineering)**

**Co-ordinators : Dr. Andrew Thangaraj**

**NPTEL : NOC:Electromagnetic Compatibility, EMC (Electrical Engineering)**

**Co-ordinators : Prof. Daniel Mansson, Prof. Rajeev Thottappillil**

**NPTEL : NOC:Mapping Signal Processing Algorithms to Architectures (Electrical Engineering)**

**Co-ordinators : Prof. Nitin Chandrachoodan**

Lecture 65 - Hardware model

Lecture 66 - Force Directed Scheduling

Lecture 67 - DEMO: HLS on FFT

Lecture 68 - DEMO: FFT Simulation and Optimization

Lecture 69 - DEMO: CPU interfacing

Lecture 70 - Software Compilation

Lecture 71 - Optimization Examples

Lecture 72 - Loop optimizations - 1

Lecture 73 - Loop optimizations - 2

Lecture 74 - Loop optimizations - 3

Lecture 75 - Software pipelining - 1

Lecture 76 - Software pipelining - 2

Lecture 77 - FFT Optimization

Lecture 78 - Demo: Vivado setup

Lecture 79 - Background: CPUs and FPGAs

Lecture 80 - Demo: Vivado HLS FFT IP Export

Lecture 81 - Demo: Vivado ILA and VIO on hardware

Lecture 82 - Demo: FFT on FPGA board

Lecture 83 - Demo: Simulating SoC and SDK

Lecture 84 - Background: Understanding ELF files

Lecture 85 - On-chip communication basics

Lecture 86 - Many-to-Many communication

Lecture 87 - AXI bus handshaking

Lecture 88 - AXI bus (Continued...)

Lecture 89 - Demo: Microblaze processor on FPGA

Lecture 90 - Demo: Performance counter AXI peripheral

Lecture 91 - Demo: HW accelerator for FPGA

Lecture 92 - DMA and arbitration

Lecture 93 - Network-on-chip basics

Lecture 94 - NoC - Topologies and metrics

Lecture 95 - NoC - Routing

Lecture 96 - NoC - Switching and flow control

Lecture 97 - Systolic Arrays - Background

**NPTEL : NOC:Linear System Theory (Electrical Engineering)**

**Co-ordinators : Prof. Ramakrishna Pasumarthi**

Lecture 1 - Introduction to Linear Systems

Lecture 2 - System Models

Lecture 3 - System Models - Part 1

Lecture 4 - System Models - Part 2

Lecture 5 - General Representation

Lecture 6 - Sets, Functions and Fields

Lecture 7 - Linear Algebra - Vector Spaces and Metric Spaces

Lecture 8 - Linear Algebra - Span, Basis and Subspaces

Lecture 9 - Linear Algebra - Linear Maps and Matrices

Lecture 10 - Linear Algebra - Fundamental Subspaces and Rank-Nullity

Lecture 11 - Tutorial 1 on Linear Algebra

Lecture 12 - Linear Algebra - Change of Basis and Similarity Transformation

Lecture 13 - Linear Algebra - Invariant Subspaces, Eigen Values and Eigen Vectors

Lecture 14 - Linear Algebra - Diagonalization and Jordan Forms

Lecture 15 - Linear Algebra - Eigen Decomposition and Singular Value Decomposition

Lecture 16 - Tutorial 2 on Linear Algebra

Lecture 17 - Solutions to LTI Systems

Lecture 18 - State Transition Matrix for LTI systems

Lecture 19 - Forced Reponse of Continuous and Discrete LTI system

Lecture 20 - State Transition Matrix and Solutions to LTV systems

Lecture 21 - Equilibrium Points

Lecture 22 - Limit Cycles and Linearisation

Lecture 23 - Stability Analysis and Types of Stability

Lecture 24 - Lyapunov Stability

Lecture 25 - Stability of Discrete Time Systems

Lecture 27 - Controllability and Reachability

Lecture 28 - Controllability Matrix and Controllable Systems

Lecture 29 - Controllability Tests

Lecture 30 - Controllability of Discrete Time Systems

Lecture 31 - Controllable Decomposition

Lecture 32 - Stabilizability

**NPTEL : NOC:Digital Signal Processing (Electrical Engineering)**

**Co-ordinators : C. S. Ramalingam**

**NPTEL : NOC:Computational Electromagnetics (Electrical Engineering)**

**Co-ordinators : Prof. Uday Khankhoje**

**NPTEL : NOC:Transmission Lines and Electromagnetic Waves (Electrical Engineering)**

**Co-ordinators : Dr. Ananth Krishnan**

**NPTEL : NOC:Digital IC Design (Electrical Engineering)**

**Co-ordinators : Prof. Janakiraman**

Lecture 65 - Array Multiplier - Timing Analysis

Lecture 66 - Carry Save Multiplier

Lecture 67 - Carry Save Multiplier - Signed Multiplication

Lecture 68 - Introduction to Pipelining

Lecture 69 - Time Borrowing

Lecture 70 - Master Slave Flip Flop

Lecture 71 - Flop Timing Parameters

Lecture 72 - Alternate Circuit Implementations

Lecture 73 - Clock Overlap

Lecture 74 - C2MOS Flop

Lecture 75 - Flop Characterization

Lecture 76 - Max and Min Delay of Flop Based Systems

Lecture 77 - Flop Min Delay Constraint

Lecture 78 - Latch - Max and Min Delay Constraints

Lecture 79 - Latch - Timing Analysis with Skew

Lecture 80 - Time Borrowing

**NPTEL : NOC:Power Management Integrated Circuits (Electrical Engineering)**

**Co-ordinators : Prof. Qadeer Ahmad Khan**

**NPTEL : NOC:DC Power Transmission Systems (Electrical Engineering)**

**Co-ordinators : Prof. Krishna S**

Lecture 1 - Course contents

Lecture 2 - Introduction

Lecture 3 - Historical developments

Lecture 4 - Power semiconductor devices

Lecture 5 - General converter configuration

Lecture 6 - Choice of converter configuration: Valve utilization factor

Lecture 7 - Choice of converter configuration: Transformer utilization factor

Lecture 8 - Converter configuration for pulse number equal to 6

Lecture 9 - Analysis of 6 pulse LCC neglecting inductance

Lecture 10 - Analysis of 6 pulse LCC neglecting inductance: Jumps in voltage across a valve

Lecture 11 - Analysis of 6 pulse LCC neglecting inductance: Average DC side voltage

Lecture 12 - Fourier series - Part 1

Lecture 13 - Fourier series - Part 2

Lecture 14 - Analysis of 6 pulse LCC neglecting inductance: DC side voltage harmonics

Lecture 15 - Analysis of 6 pulse LCC neglecting inductance: Fundamental and harmonic components of AC side current

Lecture 16 - Definitions: Delay angle, angle of advance, commutation margin angle

Lecture 17 - Commutation margin angle in a 6 pulse LCC neglecting inductance - Part 1

Lecture 18 - Commutation margin angle in a 6 pulse LCC neglecting inductance - Part 2

Lecture 19 - Instantaneous power on AC and DC sides in a 6 pulse LCC neglecting inductance

Lecture 20 - Average power on AC and DC sides in a 6 pulse LCC neglecting inductance

Lecture 21 - 6 pulse LCC with inductance

Lecture 22 - 2 and 3 valve conduction mode of 6 pulse LCC

Lecture 23 - 2 and 3 valve conduction mode of 6 pulse LCC: DC side voltage harmonics

Lecture 24 - 2 and 3 valve conduction mode of 6 pulse LCC: DC side voltage and voltage across a valve

Lecture 25 - 2 and 3 valve conduction mode of 6 pulse LCC: Fundamental and harmonic components of AC side current

Lecture 26 - Extinction angle

Lecture 27 - Extinction angle: Commutation margin angle for normal inverter operation of 6 pulse LCC

Lecture 28 - 3 and 4 valve conduction mode of 6 pulse LCC

Lecture 29 - Analysis of 3 and 4 valve conduction mode of 6 pulse LCC - Part 1

Lecture 30 - Analysis of 3 and 4 valve conduction mode of 6 pulse LCC - Part 2

Lecture 31 - Analysis of 3 and 4 valve conduction mode of 6 pulse LCC - Part 3

Lecture 32 - 3 valve conduction mode of 6 pulse LCC

Lecture 33 - Commutation margin angle

Lecture 34 - Normalization

Lecture 35 - Characteristics of 6 pulse LCC - Part 1

Lecture 36 - Characteristics of 6 pulse LCC - Part 2

Lecture 37 - Steady state analysis of a general LCC - Part 1

Lecture 38 - Steady state analysis of a general LCC - Part 2

Lecture 39 - Steady state analysis of a general LCC - Application to 6 pulse LCC

Lecture 40 - 6 pulse LCC with resistance included on the AC side

Lecture 41 - 6 pulse LCC with resistance, inductance and voltage source on the DC side - Part 1

Lecture 42 - 6 pulse LCC with resistance, inductance and voltage source on the DC side - Part 2

Lecture 43 - Power factor

Lecture 44 - Capacitor commutated converter - Part 1

Lecture 45 - Capacitor commutated converter - Part 2

Lecture 46 - 12 pulse LCC - Part 1

Lecture 47 - 12 pulse LCC - Part 2

Lecture 48 - Modes of operation of 12 pulse LCC

Lecture 49 - Purposes of transformer

Lecture 50 - Applications of DC transmission

Lecture 51 - Types of DC link: Monopolar

Lecture 52 - Types of DC link: Bipolar and homopolar

Lecture 53 - DC link control

Lecture 54 - DC link control: Control variables

Lecture 55 - Considerations that influence selection of control

Lecture 56 - Converter control characteristics

Lecture 57 - MTDC systens: Applications

Lecture 58 - Types of MTDC systems

Lecture 59 - Non-characteristic harmonics

Lecture 60 - Effect of firing angle errors

Lecture 61 - Problems with harmonics

Lecture 62 - Single tuned filter

Lecture 63 - Design of single tuned filter - Part 1

Lecture 64 - Design of single tuned filter - Part 2

**NPTEL : NOC:Optical Engineering (Electrical Engineering)**

**Co-ordinators : Prof. Shanti Bhattacharya**

Lecture 1 - Introduction to Optical Engineering

Lecture 2 - Geometric Optics Basics

Lecture 3 - Refraction at a single surface

Lecture 4 - Lab 1 Introduction to OSLO

Lecture 5 - Stops and Rays

Lecture 6 - Aperture stop - Part 1

Lecture 7 - Aperture stop - Part 2

Lecture 8 - Lab 2 OSLO

Lecture 9 - Imaging equation for thick lens using ABCD matrix

Lecture 10 - Ray Tracing Matrix - Part 1

Lecture 11 - Ray Tracing Matrix - Part 2

Lecture 12 - Principal Planes

Lecture 13 - Lab 3 OSLO

Lecture 14 - Tracing rays through optical pupils - Part 1

Lecture 15 - Tracing rays through optical pupils - Part 2

Lecture 16 - Aberrations

Lecture 17 - Monochromatic Aberrations - Part 1

Lecture 18 - Monochromatic Aberrations - Part 2

Lecture 19 - Lab 4 - OSLO

Lecture 20 - Chromatic Aberrations and Aberration correction

Lecture 21 - Aberration correction

Lecture 22 - Revisiting Ray intercept curves

Lecture 23 - Lab 5 - OSLO

Lecture 24 - Interesting Geometric phenomena and applications

Lecture 25 - Gaussian beams introduction

Lecture 26 - Gaussian beams

Lecture 27 - Lab 6 - OSLO

Lecture 28 - ransformation of a Gaussian beam

Lecture 29 - Transformation of a Gaussian beam due to a lens and a mirror

Lecture 30 - Application of Gaussian beam equations

Lecture 31 - Interferometry basics

**NPTEL : NOC:Nonlinear System Analysis (Electrical Engineering)**

**Co-ordinators : Dr. Arun D. Mahindrakar, Prof. Ramkrishna Pasumarthy**

**NPTEL : NOC:Signals and Systems (Electrical Engineering)**

**Co-ordinators : Prof. Kushal K. Shah**

Lecture 65 - LTI System Response for Periodic Input Signal

Lecture 66 - Fourier Series in Continuous-Time : Examples I

Lecture 67 - Fourier Series in Continuous-Time : Examples II

Lecture 68 - Discrete-Time Convolution Sum

Lecture 69 - Discrete-Time Convolution Sum Examples and Properties

Lecture 70 - LCCDE Representation of Discrete-Time LTI Systems

Lecture 71 - Impulse Train Sampling

Lecture 72 - Reconstruction of Continuous-Time Signal

Lecture 73 - Nyquist Sampling Theorem and Aliasing

Lecture 74 - Fourier Transform of Sampled Signals

Lecture 75 - DTFT : Examples I

Lecture 76 - DTFT Properties I: Periodicity, Linearity, Time/Frequency shifting, and Conjugation

Lecture 77 - DTFT Properties II: Differencing and Accumulation in Time Domain, Differentiation in Frequency Domain

Lecture 78 - DTFT Properties III: Time Reversal, Time Expansion, Convolution and Parsevaalâ€™s Relation

Lecture 79 - DTFT : Examples II

Lecture 80 - DTFT in Complex Frequency Domain

Lecture 81 - Z-Transform : Properties of ROC

Lecture 82 - Z-Transform Properties I: Linearity, Time-Shifting, Time-Expansion, Time-Reversal, and Z-Scaling

Lecture 83 - Z-Transform Properties II: Conjugation and Convolution

Lecture 84 - Z-Transform Properties III: Causality and Stability

Lecture 85 - Z-Transform : Examples I

Lecture 86 - Z-Transform : Examples II

Lecture 87 - Block Diagram Representation

**NPTEL : NOC:Linear Dynamical Systems (Electrical Engineering)**

**Co-ordinators : Prof. Tushar Jain**

**NPTEL : NOC:A brief Introduction of Micro-Sensors (Electrical Engineering)**

**Co-ordinators : Prof. Santanu Talukder**

**NPTEL : NOC:Fiber Optic Communication Technology (Electrical Engineering)**

**Co-ordinators : Prof. Deepa Venkitesh**

Lecture 1 - Introduction to FOCT: Prerequisites, Course Content and Learning Outcomes

Lecture 2 - Communication through the ages

Lecture 3 - Communication: Basics - 1

Lecture 4 - Communication: Basics - 2

Lecture 5 - Digital Communication for Optical Communication

Lecture 6 - Digital modulation: Basics - 2

Lecture 7 - Digital modulation: Basics - 3

Lecture 8 - Optical communication system

Lecture 9 - Assignment Discussion - Week 1

Lecture 10 - Optical Sources

Lecture 11 - Semiconductor gain media- structure, spectrum

Lecture 12 - Optical sources: LED

Lecture 13 - External Quantum Efficiency

Lecture 14 - Modulation Bandwidth of LED

Lecture 15 - Optical and Electrical Bandwidth of LED

Lecture 16 - Emission Pattern of LED

Lecture 17 - Optical Sources: Laser Diodes over LEDs

Lecture 18 - Laser Diodes: Resonator Concepts 1a

Lecture 19 - Laser Diodes: Resonator Concepts 1b

Lecture 20 - Laser Diodes: Resonator Concepts 1c

Lecture 21 - Assignment Discussion - Week 2

Lecture 22 - Laser Diodes: Gain Coefficient

Lecture 23 - Laser Diodes: Photon life time

Lecture 24 - Laser rate equation: Steady State solution1

Lecture 25 - Laser rate equation: LI Chara

Lecture 26 - Laser power derivation

Lecture 27 - Modulation Response of Laser - 1

Lecture 28 - Modulation Response of Laser - 2

Lecture 29 - Modulation Response of Laser - 3

Lecture 30 - Setbacks of direct modulation of laser: Modulation Chirp

Lecture 31 - Setbacks of direct modulation of laser: Transcient Chirp

Lecture 98 - Stimulated Raman Scattering

Lecture 99 - Components - Directional Couplers

Lecture 100 - Components - VOA, Polariser, Polarisation Controllers

Lecture 101 - Components - Isolator

Lecture 102 - Components - Circulator, Definitions

Lecture 103 - Components - Wavelength filters

Lecture 104 - Components - Arrayed Waveguide Gratings, WSS

Lecture 105 - Balanced Detection

Lecture 106 - Polarisation Diverse Coherent Receiver

Lecture 107 - Phase and Polarisation Diverse Coherent Reciever

Lecture 108 - Overview of impairments in coherent optical communication

Lecture 109 - Transceiver impairments - Generation and Compensation

Lecture 110 - Channel Impairments - Generation and Compensation

Lecture 111 - Demo video

Lecture 112 - Introduction to Optical Networks

Lecture 113 - Layers of Optical Network

Lecture 114 - SDH/SONET Layering, Frame Structure

Lecture 115 - Physical Networks Topologies

Lecture 116 - Topology specific Link Design

Lecture 117 - Network Protection

Lecture 118 - Access Networks- PON

Lecture 119 - Optical Interconnects, Data Centers

Lecture 120 - Optical communication for Wireless Fronthauling

**NPTEL : NOC:Image Signal Processing (Electrical Engineering)**

**Co-ordinators : Prof. A. N. Rajagopalan**

Lecture 32 - Shape from Focus - Examples

Lecture 33 - Shape from Focus - Tensor Voting

Lecture 34 - DFD Principle

Lecture 35 - Motion Blur

Lecture 36 - Image Transforms - Introduction

Lecture 37 - Image Transforms - Motivation

Lecture 38 - 1D Unitary Transforms - Introduction

Lecture 39 - Extending 1D Unitary Transform to 2D - Motivation

Lecture 40 - Extending 1D Unitary Transform to 2D - Example

Lecture 41 - Alternative Forms of 2D

Lecture 42 - Kronecker Product

Lecture 43 - Kronecker Product - (Example Revisited)

Lecture 44 - Extending 1D Unitary Transform to 2D - Summary

Lecture 45 - 1D DFT to 2D DFT

Lecture 46 - 2D DFT Visualization

Lecture 47 - 2D DFT - Computation

Lecture 48 - 1D DCT - Definition, Motivation

Lecture 49 - Relation to DFT

Lecture 50 - 2D DCT and Walsh-Haddamard Transform

Lecture 51 - Data Dependent Transforms, Karhunen Loeve Transform

Lecture 52 - Karhunen-Loeve Transform (KLT) - Concept

Lecture 53 - Karhunen-Loeve Transform (KLT) - Applications

Lecture 54 - Karhunen-Loeve Transform (KLT) - Applications

Lecture 55 - Singular Value Decomposition (SVD)

Lecture 56 - Applications of SVD

Lecture 57 - Change detection

Lecture 58 - Image Thresholding

Lecture 59 - Adaptive Local thresholding - Motivation

Lecture 60 - Chow-Kaneko Local thresholding

Lecture 61 - K-Means Method

Lecture 62 - ISODATA Method

Lecture 63 - Theory of Histogram Equalization and Modification

Lecture 64 - Histogram Equalization example

**NPTEL : NOC:Fundamentals of Electric Vehicles: Technology and Economics (Electrical Engineering)**

**Co-ordinators : Prof. Ashok Jhunjhunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha, Prof. L Kannan**

Lecture 32 - Fundamentals of Battery Pack Design

Lecture 33 - Mechanical Design - Part 1

Lecture 34 - Mechanical Design - Part 2

Lecture 35 - Mechanical Design - Part 3

Lecture 36 - Mechanical Design - Part 4

Lecture 37 - Thermal Design - Part 1

Lecture 38 - Thermal Design - Part 2

Lecture 39 - Thermal Design - Part 3

Lecture 40 - Thermal Design - Part 4

Lecture 41 - Electrical Design - Part 1

Lecture 42 - Electrical Design - Part 2

Lecture 43 - Electrical Design - Part 3

Lecture 44 - BMS Design of Electic Vehicle - Part 1

Lecture 45 - BMS Design of Electic Vehicle - Part 2

Lecture 46 - BMS Design of Electic Vehicle - Part 3

Lecture 47 - EV Motors and Controllers - Understanding Flow - Part 1

Lecture 48 - EV Motors and Controllers - Understanding Flow - Part 2

Lecture 49 - Power and Efficiency

Lecture 50 - Torque Production - Part 1

Lecture 51 - Torque Production - Part 2

Lecture 52 - Torque Production - Part 3

Lecture 53 - Speed and Back EMF

Lecture 54 - The d-q Equivalent circuit - Part 1

Lecture 55 - The d-q Equivalent circuit - Part 2

Lecture 56 - Field-oriented Control

Lecture 57 - Three phase AC - Part 1

Lecture 58 - Three phase AC - Part 2

Lecture 59 - Thermal Design - Part 1

Lecture 60 - Thermal Design - Part 2

Lecture 61 - Engineering Considerations - Part 1

Lecture 62 - Engineering Considerations - Part 2

Lecture 63 - Future Frontiers

Lecture 64 - EV Chargers: Introduction

**NPTEL : NOC:Applied Linear Algebra (Electrical Engineering)**

**Co-ordinators : Prof. Andrew Thangaraj**

**NPTEL : NOC:Basic Electrical Circuits (Electrical Engineering)**

**Co-ordinators : Dr. Nagendra Krishnapura**

Lecture 1 - Preliminaries

Lecture 2 - Current

Lecture 3 - Voltage

Lecture 4 - Electrical elements and circuits

Lecture 5 - Kirchhoff's current law (KCL)

Lecture 6 - Kirchhoff's voltage law (KVL)

Lecture 7 - Voltage source

Lecture 8 - Current source

Lecture 9 - Resistor

Lecture 10 - Capacitor

Lecture 11 - Inductor

Lecture 12 - Mutual inductor

Lecture 13 - Linearity of elements

Lecture 14 - Series connection-Voltage sources in series

Lecture 15 - Series connection of R, L, C, current source

Lecture 16 - Elements in parallel

Lecture 17 - Current source in series with an element; Voltage source in parallel with an element

Lecture 18 - Extreme cases: Open and short circuits

Lecture 19 - Summary

Lecture 20 - Voltage controlled voltage source (VCVS)

Lecture 21 - Voltage controlled current source (VCCS)

Lecture 22 - Current controlled voltage source (CCVS)

Lecture 23 - Current controlled current source (CCCS)

Lecture 24 - Realizing a resistance using a VCCS or CCCS

Lecture 25 - Scaling an element's value using controlled sources

Lecture 26 - Example calculation

Lecture 27 - Power and energy absorbed by electrical elements

Lecture 28 - Power and energy in a resistor

Lecture 29 - Power and energy in a capacitor

Lecture 30 - Power and energy in an inductor

Lecture 31 - Power and energy in a voltage source

**NPTEL : NOC:Optical Fiber Sensors (Electrical Engineering)**

**Co-ordinators : Prof. Balaji Srinivasan**

Lecture 1 - Introduction to optical sensors

Lecture 2 - Different types of optical sensors

Lecture 3 - Overview of distributed sensors

Lecture 4 - Optical sensors system

Lecture 5 - Optical sources

Lecture 6 - Optical receivers - 1

Lecture 7 - Optical receivers - 2

Lecture 8 - Optical receivers - 3

Lecture 9 - Optical receiver design

Lecture 10 - Noise Analysis

Lecture 11 - Sensor Performance characteristics

Lecture 12 - Noise Mitigation Techniques

Lecture 13 - Lock in detection

Lecture 14 - Amplitude modulated sensors - 1

Lecture 15 - Gas absoprtion spectroscopy

Lecture 16 - Amplitude modulated sensors - 2

Lecture 17 - Amplitude modulated sensors - 3

Lecture 18 - Amplitude modulated sensors - 4

Lecture 19 - Problem Discussion

Lecture 20 - Pulse-oximeter

Lecture 21 - Phase modulated sensors - 1

Lecture 22 - Phase modulated sensors - 2

Lecture 23 - Phase modulated Sensors - 3

Lecture 24 - Phase modulated sensors - 4

Lecture 25 - Phase modulated sensors - 5

Lecture 26 - Phase modulated sensors - 6

Lecture 27 - Phase modulated sensors - 7

Lecture 28 - Phase modulated sensors - 8

Lecture 29 - Phase modulated sensors - 9

Lecture 30 - Phase modulated sensors - 10

Lecture 31 - Phase modulated Sensors - 11

Lecture 32 - Wavelength modulated sensors - 1

Lecture 33 - Wavelength modulated sensors - 2

Lecture 34 - Wavelength modulated sensors - 3

Lecture 35 - Wavelength modulated sensors - 4

Lecture 36 - Wavelength modulated sensors - 5

Lecture 37 - Wavelength modulated sensors - 6

Lecture 38 - Wavelength modulated sensors - 7

Lecture 39 - Wavelength modulated sensors - 8

Lecture 40 - Polarization modulated sensors - 1

Lecture 41 - Polarization modulated sensors - 2

Lecture 42 - Polarization modulated sensors - 3

**NPTEL : NOC:Introduction to Time - Varying Electrical Networks (Electrical Engineering)**

**Co-ordinators : Prof. Shanthi Pavan**

Lecture 32 - Linear Periodically Time-Varying Systems (LPTV)

Lecture 33 - Response of an LPTV system to a complex exponential input

Lecture 34 - Harmonic Transfer Functions

Lecture 35 - Zadeh expansion of an LPTV system

Lecture 36 - MNA analysis of LPTV networks

Lecture 37 - MNA stamp of a periodically time varying conductance

Lecture 38 - MNA stamp of a capacitor and a voltage source in an LPTV network

Lecture 39 - Analysis of an example LPTV network - Part 1

Lecture 40 - Analysis of an example LPTV network - Part 2

Lecture 41 - LPTV network analysis, RC filter, time-varying

Lecture 42 - Impedance and admittance in LTI and LPTV networks

Lecture 43 - Thevenin and Norton's Theorems for LPTV networks

Lecture 44 - The N-path principle

Lecture 45 - N-path example

Lecture 46 - Time-domain intuition of the N-path principle

Lecture 47 - N-path example: Time-Interleaved ADCs

Lecture 48 - Dc-dc converter as an LPTV system

Lecture 49 - N-path principle: Multiphase dc-dc converter

Lecture 50 - The N-path filter

Lecture 51 - Computing H_0(j2\pi f_s) for a 4-path filter

Lecture 52 - Input impedance of the 4-path filter at f_s

Lecture 53 - Computing H_0(j2\pi 2 f_s) for a 4-path filter

Lecture 54 - Determining H_0 for input frequency deviations from f_s

Lecture 55 - Reciprocity and Inter-reciprocity in LPTV networks : Part 1

Lecture 56 - Reciprocity and Inter-reciprocity in LPTV networks : Part 2, the transfer-function theorem

Lecture 57 - Why is the transfer-function theorem important?

Lecture 58 - The frequency-reversal theorem for inter-reciprocal (adjoint) LPTV networks : introduction

Lecture 59 - The frequency-reversal theorem for inter-reciprocal (adjoint) LPTV networks : derivation

Lecture 60 - Why is the frequency-reversal theorem important?

Lecture 61 - Inter-reciprocity in signal-flow graphs

Lecture 62 - Applications of inter-reciprocity: analysis of chopped amplifiers

Lecture 63 - Applications of inter-reciprocity: analysis of chopped amplifiers (Continued...)

Lecture 64 - Applications of inter-reciprocity: chopping with square-wave modulation

**NPTEL : NOC:Digital System Design (Electrical Engineering)**

**Co-ordinators : Prof. Neeraj Goel**

Lecture 32 - Ripple carry adder

Lecture 33 - Carry look ahead adder

Lecture 34 - Modeling BUS in Verilog

Lecture 35 - Fast adder:Carry select adder

Lecture 36 - Multiple operand adder

Lecture 37 - Multiplication

Lecture 38 - Iterative circuits - 1

Lecture 39 - Iterative circuits - 2

Lecture 40 - Introduction to sequential circuits

Lecture 41 - Latches

Lecture 42 - D-Flip-flops

Lecture 43 - More Flip-flops

Lecture 44 - Counters

Lecture 45 - Verilog-Behavior model - 1

Lecture 46 - Verilog-Behavior model - 2

Lecture 47 - Registers - 1

Lecture 48 - Registers - 2

Lecture 49 - Memory

Lecture 50 - Sequential circuit analysis

Lecture 51 - Derivation state graph

Lecture 52 - Sequence detector: Example 1

Lecture 53 - Sequence detector: Example 2

Lecture 54 - State machine reduction

Lecture 55 - State encoding

Lecture 56 - Multi-cycle adder design

Lecture 57 - Pipelined adder design

Lecture 58 - Multiplication design

Lecture 59 - Division hardware design

Lecture 60 - Interacting state machines

Lecture 61 - Register Transfer Level design

Lecture 62 - GCD computer at RTL Level

Lecture 63 - RTL Design - Bubble sort

Lecture 64 - RTL Design - Traffic light controller

**NPTEL : NOC:Stochastic Modeling and the Theory of Queues (Electrical Engineering)**

**Co-ordinators : Prof. Krishna Jagannathan**

Lecture 32 - Elementary Renewal Theorem

Lecture 33 - The Renewal Equation

Lecture 34 - The Renewal Equation (Continued...)

Lecture 35 - G/G/1 Queue and Little's theorem

Lecture 36 - Little's theorem

Lecture 37 - M/G/1 Queue

Lecture 38 - M/G/1 Queue and PK Formula

Lecture 39 - M/G/1 Queue and PK Formula (Continued...)

Lecture 40 - Ensemble rewards - Age and Duration

Lecture 41 - Ensemble rewards - Age and Duration (Continued...)

Lecture 42 - Key Renewal Theorem and Ensemble rewards

Lecture 43 - Introduction to finite state Discrete Time Markov Chains

Lecture 44 - Class and Types of Classes in a DTMC

Lecture 45 - Periodicity in a DTMC

Lecture 46 - Matrix Representation of a DTMC

Lecture 47 - The long term behaviour of a DTMC

Lecture 48 - Stationary Distribution and Long term behaviour of a DTMC - Part 1

Lecture 49 - Stationary Distribution and Long term behaviour of a DTMC - Part 2

Lecture 50 - Stationary Distribution and Long term behaviour of a DTMC - Part 3

Lecture 51 - Spectral Properties of Stochastic Matrices - Part 1

Lecture 52 - Spectral Properties of Stochastic Matrices - Part 2

Lecture 53 - The Short-term Behaviour of a DTMC

Lecture 54 - Introduction to Countable-state DTMC

Lecture 55 - Introduction to Countable-state DTMC (Continued...)

Lecture 56 - The Strong Markov Property

Lecture 57 - Renewal Theory applied to DTMC's

Lecture 58 - Stationary Distribution of a Countable State Space DTMC and Renewal Theory

Lecture 59 - Stationary Distribution of a Countable State Space DTMC and Renewal Theory (Continued...)

Lecture 60 - Stationary Distribution and The Steady State Behaviour of a Countable-state DTMC - Part 1

Lecture 61 - Stationary Distribution and The Steady State Behaviour of a Countable-state DTMC - Part 2

Lecture 62 - Convergence to Steady State of a Coutable-state DTMC (Stochastic Coupling)

Lecture 63 - The Birth-Death Markov Chains

Lecture 64 - The Reversibility Markov Chains

**NPTEL : NOC:Integrated Photonics Devices and Circuits (Electrical Engineering)**

**Co-ordinators : Prof. Bijoy Krishna Das**

**NPTEL : NOC:Introduction to Semiconductor Devices (Electrical Engineering)**

**Co-ordinators : Prof. Naresh Kumar Emani**

Lecture 1 - Types of Semiconductors

Lecture 2 - Classical Vs Quantum Mechanics

Lecture 3 - Electrons in infinite and finite 1D potential well

Lecture 4 - 3D potential well model of atom and Bohr's model

Lecture 5 - Covalent bonds and inter-atomic interactions in Silicon

Lecture 6 - Energy band formation

Lecture 7 - Electron hole pair generation

Lecture 8 - Direct and Indirect bandgap semiconductors

Lecture 9 - Energy levels in infinite and finite potential wells (short demo)

Lecture 10 - Effective mass in Semiconductors

Lecture 11 - Intrinsic carrier density

Lecture 12 - Doping and extrinsic semiconductors

Lecture 13 - Fermi level in extrinsic semiconductors

Lecture 14 - Temperature dependence of Fermi level

Lecture 15 - Temperature dependence of Fermi level

Lecture 16 - Charge neutrality relationship

Lecture 17 - Drift current and energy band representation of kinetic energy of carriers

Lecture 18 - Semiconductor bands in a electric field

Lecture 19 - Diffusion current

Lecture 20 - Non-uniform doping

Lecture 21 - Equilibrium Vs Nonequilibrium carrier response

Lecture 22 - Minority carrier diffusion equation (MCDE) - Example problems

Lecture 23 - Quasi Fermi level in nonequilibrium conditions

Lecture 24 - Quasi Fermi level and minority carrier diffusion length

Lecture 25 - Semiconductor device fabrication

Lecture 26 - PN Junctions - An introduction

Lecture 27 - PN Junction electrostatics

Lecture 28 - Energy band diagram of PN junction

Lecture 29 - Depletion width and peak electric field

Lecture 30 - PN junction electrostatics - examples

Lecture 31 - Demo of PN Junction Lab on Nanohub

Lecture 65 - Current characteristics of a short channel MOSFET

Lecture 66 - Threshold voltage characteristics of short channel MOSFET

Lecture 67 - MOSFETs in the 21st century

Lecture 68 - Optical absorption and bandgap

Lecture 69 - Introduction to solar cells

Lecture 70 - Efficiency of a solar cell

Lecture 71 - Types of photodetectors

Lecture 72 - PIN and avalanche Photodectectors

Lecture 73 - Photodetector metrics

Lecture 74 - Radiative absoption and emission processes

Lecture 75 - Materials for optoelectronic devices

Lecture 76 - Operation of a light emitting diode (LED)

Lecture 77 - LED emission spectrum

Lecture 78 - Stimulated emission and lasing

**NPTEL : NOC:Electric Vehicles and Renewable Energy (Electrical Engineering)**

**Co-ordinators : Prof. Ashok Jhunjhunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha, Prof. L Kannan**

Lecture 32 - Computation of Effective cost of battery - Part 2

Lecture 33 - Charging Batteries

Lecture 34 - Fundamentals of Battery Pack Design

Lecture 35 - Electrical Design of Battery Pack - Part 1

Lecture 36 - Electrical Design of Battery Pack - Part 2

Lecture 37 - Electrical Design of Battery Pack - Part 3

Lecture 38 - Mechanical Design of Battery Pack - Part 1

Lecture 39 - Mechanical Design of Battery Pack - Part 2

Lecture 40 - Mechanical Design of Battery Pack - Part 3

Lecture 41 - Mechanical Design of Battery Pack - Part 4

Lecture 42 - Thermal Design of Battery Pack - Part 1

Lecture 43 - Thermal Design of Battery Pack - Part 2

Lecture 44 - Thermal Design of Battery Pack - Part 3

Lecture 45 - Thermal Design of Battery Pack - Part 4

Lecture 46 - BMS Design and Embedded System - Part 1

Lecture 47 - BMS Design and Embedded System - Part 2

Lecture 48 - BMS Design and Embedded System - Part 3

Lecture 49 - BMS Design and Embedded System - Part 4

Lecture 50 - BMS Design and Embedded System - Part 5

Lecture 51 - Cell Testing and Characterization - Part 1

Lecture 52 - Cell Testing and Characterization - Part 2

Lecture 53 - EV Motors and Controllers - Vehicle Dynamics - Part 1

Lecture 54 - EV Motors and Controllers - Vehicle Dynamics - Part 2

Lecture 55 - EV Motors and Controllers - Understanding Flow - Part 1

Lecture 56 - EV Motors and Controllers - Understanding Flow - Part 2

Lecture 57 - Power and Efficiency

Lecture 58 - Torque Production - Part 1

Lecture 59 - Torque Production - Part 2

Lecture 60 - Torque Production - Part 3

Lecture 61 - Speed and Back EMF

Lecture 62 - The d-q Equivalent circuit - Part 1

Lecture 63 - The d-q Equivalent circuit - Part 2

Lecture 64 - Field-oriented Control

**NPTEL : Phase-locked loops (Electrical Engineering)**

**Co-ordinators : Dr. Saurabh Saxena**

Lecture 32 - Noise Analysis in CP-PLL - Part I

Lecture 33 - Noise Analysis in CP PLL - Part II

Lecture 34 - Noise Analysis in CP-PLL - Part III

Lecture 35 - Noise Simulations for CP-PLL Blocks

Lecture 36 - Introduction to Oscillators

Lecture 37 - Low Swing Ring Oscillator - Part I

Lecture 38 - Low-Swing Ring Oscillator - Part II

Lecture 39 - Large-Swing Ring Oscillator - Part I

Lecture 40 - Large-Swing Ring Oscillator - Part II

Lecture 41 - Large-Swing Ring Oscillator - Part III

Lecture 42 - Large-Swing Ring Oscillator - Part IV

Lecture 43 - Large-Swing Ring Oscillator - Part V

Lecture 44 - Supply Regulated VCO - Part I

Lecture 45 - Supply Regulated VCO - Part II

Lecture 46 - Supply Regulated VCO - Part III

Lecture 47 - Phase Noise in Ring Oscillators

Lecture 48 - Circuit level Design of PFD - Part I

Lecture 49 - Circuit level Design of PFD - Part II

Lecture 50 - Circuit level Design of PFD - Part III

Lecture 51 - Circuit level Design of Charge Pump - Part I

Lecture 52 - Circuit-level Design of Charge Pump - Part II

Lecture 53 - Circuit-level Design of Charge Pump - Part III

Lecture 54 - Circuit-level Design of Charge Pump - Part IV

Lecture 55 - Circuit-level Design of Charge Pump - Part V

Lecture 56 - Circuit-level Design of Charge Pump - Part VI

Lecture 57 - Circuit-level Design of Clock Frequency Divider

Lecture 58 - Techniques for Wide Frequency Range Clock Multiplier

Lecture 59 - Introduction to Digital PLL

Lecture 60 - Design of Time-to-Digital Converter

Lecture 61 - Small Signal Analysis of Digital PLL

Lecture 62 - Noise Analysis in Digital PLL

Lecture 63 - Analog/Digital Hybrid PLL - Part I

Lecture 64 - Analog/Digital Hybrid PLL - Part II

Lecture 65 - Course Summary

**NPTEL : NOC:Fundamentals of Nano and Quantum Photonics (Electrical Engineering)**

**Co-ordinators : Prof. Naresh Kumar Emani**

**NPTEL : NOC:Analog Electronic Circuits (IITM) (Electrical Engineering)**

**Co-ordinators : Prof. Shanthi Pavan**

**NPTEL : NOC:Modern Computer Vision (Electrical Engineering)**

**Co-ordinators : Prof. A. N. Rajagopalan**

**NPTEL : NOC:Optical Wireless Communications for Beyond 5G Networks and IoT (Electrical Engineering)**

**Co-ordinators : Prof. Anand Srivastava**

Lecture 32 - Higher order CSK

Lecture 33 - NOMA

Lecture 34 - NOMA VLC

Lecture 35 - MIMO

Lecture 36 - VLC based MIMO NOMA

Lecture 37 - Power allocation in VLC based MIMO NOMA

Lecture 38 - Hybrid Network LiFi and WiFi Coexistance

Lecture 39 - Vehicle to Vehicle communication using Visible light

Lecture 40 - Anand Singh Part - 1

Lecture 41 - Anand Singh Part - 2

Lecture 42 - Dilnasin lecture - 1

Lecture 43 - Saswati Paramita

Lecture 44 - Dilnashin Tutorial - 2

Lecture 45 - Guriendar Prof Anand 001

Lecture 46 - Rehana Prof Anand

**NPTEL : NOC:VLSI Design Flow: RTL to GDS (Electrical Engineering)**

**Co-ordinators : Prof. Sneh Saurabh**

**NPTEL : NOC:Fundamentals of Wireless Communication (Hindi) (Electrical Engineering)**

**Co-ordinators : Dr.Vivek Bohara**

**NPTEL : NOC:Sensor Technologies: Physics, Fabrication, and Circuits (Electrical Engineering)**

**Co-ordinators : Prof.Mitradip Bhattacharjee**

**NPTEL : NOC:Optimal Control (Electrical Engineering)**

**Co-ordinators : Prof. Barjeev Tyagi**

Lecture 1 - Introduction and Performance Index

Lecture 2 - Basic Concepts of Calculus of Variation

Lecture 3 - The Basic Variational Problem

Lecture 4 - Fixed End Point Problem

Lecture 5 - Free End Point Problem

Lecture 6 - Free End Point Problem (Continued...)

Lecture 7 - Free End Point Problem (Continued...)

Lecture 8 - Free End Point Problem (Continued...)

Lecture 9 - Optimum of Functions with Conditions

Lecture 10 - Optimum of Functions with Conditions (Lagrange Multiplier Method)

Lecture 11 - Optimum of Functional with Conditions

Lecture 12 - Variational Approach to Optimal Control Systems

Lecture 13 - Variational Approach to Optimal Control Systems (Continued...)

Lecture 14 - Linear Quadratic Optimal Control Systems

Lecture 15 - Linear Quadratic Optimal Control Systems (Continued...)

Lecture 16 - Linear Quadratic Optimal Control Systems (Continued...)

Lecture 17 - Linear Quadratic Optimal Control Systems (Continued...)

Lecture 18 - Linear Quadratic Optimal Control Systems (Continued...)

Lecture 19 - Linear Quadratic Optimal Control Systems (Optimal Value of Performance Index)

Lecture 20 - Infinite Horizon Regulator Problem

Lecture 21 - Infinite Horizon Regulator Problem (Continued...)

Lecture 22 - Analytical Solution of MDRE - State Transition Matrix Approach

Lecture 23 - Analytical Solution of MDRE - Similarity Transformation Approach

Lecture 24 - Analytical Solution of MDRE - Similarity Transformation Approach (Continued...)

Lecture 25 - Frequency Domain Interpretation of LQR - Linear Time Invariant System

Lecture 26 - Frequency Domain Interpretation of LQR - Linear Time Invariant System (Continued...)

Lecture 27 - LQR with a Specified Degree of Stability

Lecture 28 - Inverse Matrix Riccati Equation

Lecture 29 - Linear Quadratic Tracking System

Lecture 30 - Discrete-Time Optimal Control Systems

Lecture 31 - Discrete-Time Optimal Control Systems (Continued...)

**NPTEL : NOC:Basics of Software Defined Radios and Practical Applications (Electrical Engineering)**

**Co-ordinators : Dr. Meenakshi Rawat**

**NPTEL : NOC:Electrical Distribution System Analysis (Electrical Engineering)**

**Co-ordinators : Prof. G. B. Kumbhar**

**NPTEL : NOC:Introduction to Smart Grid (Electrical Engineering)**

**Co-ordinators : Prof. Premalata Jena, Prof. N.P. Padhy**

**NPTEL : NOC:Facts Devices (Electrical Engineering)**

**Co-ordinators : Prof. Avik Bhattacharya**

**NPTEL : NOC:Advanced Linear Continuous Control Systems: Applications with MATLAB Programming and Simulink (Electrical Engineering)**

**Co-ordinators : Prof. Yogesh Vijay Hote**

**NPTEL : NOC:Computer Aided Power System Analysis (Electrical Engineering)**

**Co-ordinators : Prof. Biswarup Das**

**NPTEL : NOC:Advance Power Electronics and Control (Electrical Engineering)**

**Co-ordinators : Prof. Avik Bhattacharya**

**NPTEL : NOC:CMOS Digital VLSI Design (Electrical Engineering)**

**Co-ordinators : Prof. Sudeb Dasgupta**

**NPTEL : NOC:Microelectronics: Devices to Circuits (Electrical Engineering)**

**Co-ordinators : Prof. Sudeb Dasgupta**

Lecture 1 - Bipolar Junction Transistor : Physical structure and Modes of Operation

Lecture 2 - Bipolar Junction Transistor : Modes of operation - I

Lecture 3 - Bipolar Junction Transistor : Modes of operation - II

Lecture 4 - BJT Operation in active mode Circuit symbol and conventions - I

Lecture 5 - BJT Operation in active mode Circuit symbol and conventions - II

Lecture 6 - BJT as an amplifier small circuit model - I

Lecture 7 - BJT as an amplifier small circuit model - II

Lecture 8 - BJT Small Signal Circuit Model - I

Lecture 9 - BJT Small Signal Circuit Model - II

Lecture 10 - BJT as a switch and Ebers Moll Model

Lecture 11 - Simple BJT Inverter and second order effects

Lecture 12 - BJT Second order effects - I

Lecture 13 - BJT Second order effects - II

Lecture 14 - MOS Transistor basics - I

Lecture 15 - MOS Transistor basics - II

Lecture 16 - MOS Transistor basics - III

Lecture 17 - MOS Parasitic and SPICE Model

Lecture 18 - CMOS Inverter Basics - I

Lecture 19 - CMOS Inverter Basics - II

Lecture 20 - CMOS Inverter Basics - III

Lecture 21 - Power Analysis - I

Lecture 22 - Logical Efforts - I

Lecture 23 - Fabrication-Process - I

Lecture 24 - Fabrication-Process - II

Lecture 25 - Biasing of Amplifier and its behaviour as an Analog switch - I

Lecture 26 - Biasing of Amplifier and its behaviour as an Analog switch - II

Lecture 27 - Biasing of Amplifier and its behaviour as an Analog switch - III

Lecture 28 - CMOS CS/CG/CD Amplifier Configuration

Lecture 29 - CMOS CG/CD Amplifier Configuration

Lecture 30 - Internal CAP Models and high frequency Modelling - I

Lecture 31 - Internal CAP Models and high frequency Modelling - II

**NPTEL : NOC:DC Microgrid (Electrical Engineering)**

**Co-ordinators : Prof. Avik Bhattacharya**

**NPTEL : NOC:Power Quality Improvement Technique (Electrical Engineering)**

**Co-ordinators : Prof. Avik Bhattacharya**

**NPTEL : NOC:Power System Protection and Switchgear (Electrical Engineering)**

**Co-ordinators : Prof. Bhaveshkumar R. Bhalja**

Lecture 32 - Protection against Transients and Surges along with System Response to Severe Upsets - I

Lecture 33 - Protection against Transients and Surges along with System Response to Severe Upsets - II

Lecture 34 - Arc Interruption Theory in Circuit Breaker - I

Lecture 35 - Arc Interruption Theory in Circuit Breaker - II

Lecture 36 - Arc Interruption Theory in Circuit Breaker - III

Lecture 37 - Arc Interruption Theory in Circuit Breaker - IV

Lecture 38 - Types of Circuit Breakers

Lecture 39 - Testing, Commissioning and Maintenance of Relays - I

Lecture 40 - Testing, Commissioning and Maintenance of Relays - II

**NPTEL : An Introduction to Electronics Systems Packaging (Electrical Engineering)**

**Co-ordinators : Prof. G.V. Mahesh**

Lecture 1 - Introduction and Objectives of the course

Lecture 2 - Definition of a system and history of semiconductors

Lecture 3 - Products and levels of packaging

Lecture 4 - Packaging aspects of handheld products; Case studies in applications

Lecture 5 - Case Study (continued); Definition of PWB, summary and Questions for review

Lecture 6 - Basics of Semiconductor and Process flowchart; Video on â€œSand-to-Siliconâ€

Lecture 7 - Wafer fabrication, inspection and testing

Lecture 8 - Wafer packaging; Packaging evolution; Chip connection choices

Lecture 9 - Wire bonding, TAB and flipchip-1

Lecture 10 - Wire bonding, TAB and flipchip-2; Tutorials

Lecture 11 - Why packaging? & Single chip packages or modules (SCM)

Lecture 12 - Commonly used packages and advanced packages; Materials in packages

Lecture 13 - Advances packages (continued); Thermal mismatch in packages; Current trends in packaging

Lecture 14 - Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits; Quiz on packages

Lecture 15 - Electrical Issues â€“ I; Resistive Parasitic

Lecture 16 - Electrical Issues â€“ II; Capacitive and Inductive Parasitic

Lecture 17 - Electrical Issues â€“ III; Layout guidelines and the Reflection problem

Lecture 18 - Electrical Issues â€“ IV; Interconnection

Lecture 19 - Quick Tutorial on packages; Benefits from CAD; Introduction to DFM, DFR & DFT

Lecture 20 - Components of a CAD package and its highlights

Lecture 21 - Design Flow considerations; Beginning a circuit design with schematic work and component layout

Lecture 22 - Demo and examples of layout and routing; Technology file generation from CAD; DFM check list and design rules; Design for Reliability

Lecture 23 - Review of CAD output files for PCB fabrication; Photo plotting and mask generation

Lecture 24 - Process flow-chart; Vias; PWB substrates

Lecture 25 - Substrates continued; Video highlights; Surface preparation

Lecture 26 - Photoresist and application methods; UV exposure and developing; Printing technologies for PWBs

Lecture 27 - PWB etching; Resist stripping; Screen-printing technology

Lecture 28 - Through-hole manufacture process steps; Panel and pattern plating methods

Lecture 29 - Video highlights on manufacturing; Solder mask for PWBs; Multilayer PWBs; Introduction to microvias

Lecture 30 - Microvia technology and Sequential build-up technology process flow for high-density interconnects

**NPTEL : Power Electronics and Distributed Generation (Electrical Engineering)**

**Co-ordinators : Dr. Vinod John**

Lecture 1 - Course introduction and overview

Lecture 2 - Distributed generation technologies

Lecture 3 - Distributed storage technologies

Lecture 4 - Distribution system protection

Lecture 5 - Circuit breaker coordination

Lecture 6 - Symmetrical component analysis and sequence excitation

Lecture 7 - Modeling of distribution system components

Lecture 8 - Protection components

Lecture 9 - Impact of distributed generation of distribution protection

Lecture 10 - Consumption and distribution grounding

Lecture 11 - Islanding of distribution systems

Lecture 12 - Modeling of islanded distribution systems

Lecture 13 - Distribution system problems and examples

Lecture 14 - Distribution system problems and examples continued

Lecture 15 - Anti-islanding methods

Lecture 16 - Solid state circuit switching

Lecture 17 - Relaying for distributed generation

Lecture 18 - Feeder voltage regulation

Lecture 19 - Grounding, distribution protection coordination problems and examples

Lecture 20 - Ring and network distribution

Lecture 21 - Economic evaluation of DG systems

Lecture 22 - Design for effective initial cost

Lecture 23 - Single phase inverters

Lecture 24 - DC bus design in voltage source inverter

Lecture 25 - Electrolytic capacitor reliability and lifetime

Lecture 26 - Inverter switching and average model

Lecture 27 - Common mode and differential mode model of inverters

Lecture 28 - Two leg single phase inverter

Lecture 29 - Distribution system problems, and examples

Lecture 30 - DG evaluation problems and examples

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

**NPTEL : Pulse width Modulation for Power Electronic Converters (Electrical Engineering)**

**Co-ordinators : Dr. G. Narayanan**

**NPTEL : Switched Mode Power Conversion (Electrical Engineering)**

**Co-ordinators : Prof. L. Umanand, Prof. V. Ramanarayanan**

**NPTEL : Basic Electrical Technology (Electrical Engineering)**

**Co-ordinators : Prof. L. Umanand**

**NPTEL : Industrial Drives - Power Electronics (Electrical Engineering)**

**Co-ordinators : Prof. K. Gopakumar**

**NPTEL : NOC:Design for Internet of Things (Electrical Engineering)**

**Co-ordinators : Prof. T.V. Prabhakar**

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

**NPTEL : NOC:Advances in UHV Transmission and Distribution (Electrical Engineering)**

**Co-ordinators : Prof Subba Reddy B**

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 nad 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

**NPTEL : NOC:Mathematical Methods and Techniques in Signal Processing (Electrical Engineering)**

**Co-ordinators : Prof. Shayan Srinivasa Garani**

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

**NPTEL : NOC:Electronics Enclosures Thermal Issues (Electrical Engineering)**

**Co-ordinators : Prof. N. V Chalapathi Rao**

**NPTEL : NOC:Integrated Circuits, MOSFETs, Op-Amps and their Applications (Electrical Engineering)**

**Co-ordinators : Prof. Hardik Jeetendra Pandya**

**NPTEL : NOC:Semiconductor Devices and Circuits (Electrical Engineering)**

**Co-ordinators : Prof. Sanjiv Sambandan**

**NPTEL : NOC:Fabrication Techniques for MEMs-based Sensors: Clinical Perspective (Electrical Engineering)**

**Co-ordinators : Prof. Hardik Jeetendra Pandya**

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 Interdigited Electrodes

Lecture 20 - Process flow for Fabrication of Interdigited Electrodes (Continued...)

Lecture 21 - Process flow for Fabrication of ETM phenotyping

Lecture 22 - Process flow for Fabrication of Piezo canteliver

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27 - Microchip for Rapid Drug Screening

Lecture 28 - Microchip for Rapid Drug Screening (Continued...)

Lecture 29 - A Microfluidic chip for rapid bacterial antibiotic Susceptibility testing

Lecture 30 - Smart Catheter

Lecture 31 - Smart Catheter: Flexible Force Sensor

Lecture 32 - Smart Catheter: Flexible Force Sensor (Continued...)

Lecture 33 - Tissue and Cell Culture Techniques

Lecture 34 - Clean Room: Equipments Required

Lecture 35 - GLP: Gowning Procedure for using Lab

Lecture 36 - Introduction to Equipments: Refridgerator

Lecture 37 - Gowning Procedure for using Biological Lab Setup

Lecture 38 - Introduction to Equipments: Desiccator

Lecture 39 - Introduction to Equipments: Impedance Analyzer

Lecture 40 - Introduction to Equipments: DAQ

Lecture 41 - Function generator, Multimeter, Sampling, LabVIEW, NI-CDAQ

Lecture 42 - Introduction to Equipments: Stereo Microscope

Lecture 43 - Introduction to Equipments: Metallurgical Microscope

Lecture 44 - Introduction to Equipments: Inverted Microscope

Lecture 45 - Introduction to Equipments: Fire Alarm

Lecture 46 - Introduction to Equipments: Bio-safety Hood

Lecture 47 - Introduction to Equipments: Peristaltic Pump

Lecture 48 - Introduction to Equipments: Incubator

Lecture 49 - Introduction to Equipments: Oven

Lecture 50 - Introduction to Equipments: Micromanipulator

Lecture 51 - PDMS Moulding

Lecture 52 - 3D Printing

Lecture 53 - Introduction to Fabricated Sensors

Lecture 54 - Simulation: Electro- Thermo- Mechanical Properties of Micro-heater using COMSOL Multiphysics

Lecture 55 - Simulation: Electro- Thermo- Mechanical Properties of Micro-heater using COMSOL Multiphysics (Continued...)

**NPTEL : NOC:Op-Amp Practical Applications: Design, Simulation and Implementation (Electrical Engineering)**

**Co-ordinators : Prof. Hardik Jeetendra Pandya**

**NPTEL : NOC:Physical Modelling for Electronics Enclosures using Rapid prototyping (Electrical Engineering)**

**Co-ordinators : Prof. N. V Chalapathi Rao**

**NPTEL : NOC:Recent Advances in Transmission Insulators (Electrical Engineering)**

**Co-ordinators : Prof Subba Reddy B**

**NPTEL : NOC:Fundamentals of Semiconductor Devices (Electrical Engineering)**

**Co-ordinators : Prof. Digbijoy N. Nath**

**NPTEL : NOC:Advanced IOT Applications (Electrical Engineering)**

**Co-ordinators : Prof. T V Prabhakar**

Lecture 1 - Overview of localization using IoT sensors

Lecture 2 - Outdoor localization without GPS - I

Lecture 3 - Outdoor localization without GPS - II

Lecture 4 - Outdoor localization using elevation - pressure mapping

Lecture 5 - Localization using IMU sensors - I

Lecture 6 - Localization using IMU sensors - II

Lecture 7 - Localization using IMU sensors - III

Lecture 8 - RFID based localization - I

Lecture 9 - RFID based localization - II

Lecture 10 - Simulation of simple algorithms for object detection

Lecture 11 - Building smart vehicle for collision avoidance

Lecture 12 - Basic computer vision algorithms - Part 1

Lecture 13 - Basic computer vision algorithms - Part 2

Lecture 14 - Code walkthrough of computer vision algorithm

Lecture 15 - Introduction to LiDAR

Lecture 16 - Range estimation and Obstacle avoidance

Lecture 17 - Introduction to vehicle platooning

Lecture 18 - Building blocks for autonomous vehicles - 1

Lecture 19 - Building blocks for autonomous vehicles - 2

Lecture 20 - On Board Diagnostics and protocols

Lecture 21 - Diagnostic services and fuel-injection ratio control unit

Lecture 22 - Real time event processing and Anomaly detection

Lecture 23 - OBD-II and stream processing demonstration

Lecture 24 - Speech recognition - Part 1

Lecture 25 - Speech recognition - Part 2

Lecture 26 - Speech recognition - Part 3

Lecture 27 - Speech recognition - Part 4

Lecture 28 - Device Security - Part 1

Lecture 29 - Device Security - Part 2

Lecture 30 - Device Security - Part 3

Lecture 31 - Need for air quality monitoring

Lecture 32 - Air quality : pollutants and standards

Lecture 33 - Introduction to air quality sensors

Lecture 34 - Calibration techniques for IoT air quality sensors

Lecture 35 - Sensor types : semiconductor and electrochemical

Lecture 36 - Air quality : Overview of system design

Lecture 37 - Air quality : System design - Part 1

Lecture 38 - Air quality : System design - Part 2

Lecture 39 - Air quality : Real time measurement for a drive cycle

Lecture 40 - Introduction to First Responder networks

Lecture 41 - First Responders - Applications - Part 1

Lecture 42 - First Responders - Applications - Part 2

Lecture 43 - Cargo monitoring for tamper detection - Part 1

Lecture 44 - Cargo monitoring for tamper detection - Part 2

**NPTEL : NOC:Electronic Systems for Cancer Diagnosis (Electrical Engineering)**

**Co-ordinators : Prof. Hardik Jeetendra Pandya**

Lecture 32 - Basic building blocks of Electronics System: Filters (Continued...)

Lecture 33 - Basic building blocks of Electronics System: Filters (Continued...)

Lecture 34 - Basic building blocks of Electronics System: Data Converteres

Lecture 35 - Basic building blocks of Electronics System: Data Converteres (Continued...)

Lecture 36 - Basic building blocks of Electronics System: Signal Conditioning Circuits

Lecture 37 - Etching Process and Figure of Merits

Lecture 38 - ECG Signal Processing to calculate BPM

Lecture 39 - ECG Signal Processing to calculate BPM (Continued...)

Lecture 40 - ECG Signal Processing to calculate BPM (Continued...)

Lecture 41 - ECG Signal Processing to calculate BPM (Continued...)

Lecture 42 - ECG Signal Processing to calculate BPM (Continued...)

Lecture 43 - ECG Signal Processing to calculate BPM [Continued...)

Lecture 44 - MEMS based Force Sensor for Catheter Contact Force Measurement

Lecture 45 - 3D Printing: Introduction and Work Flow

Lecture 46 - 3D Fabrication Techniques

Lecture 47 - Gowning Procedure in Clean Room

Lecture 48 - Introduction to Equipments: Desiccators

Lecture 49 - PDMS Moulding procedure

Lecture 50 - Introduction to Equipments: Pristaltic Pump

Lecture 51 - Introduction to Equipments: Stereo Microscopy, Metallurgical Microscopy, Inverted Microscopy

Lecture 52 - Micromanipulator

Lecture 53 - Biosafety Cabinet and Ultrasonicbath

Lecture 54 - Incubator Shaker

Lecture 55 - Hotplate and Microcentrifuge

Lecture 56 - Autoclave

Lecture 57 - Impedance Analyser

Lecture 58 - Rapid Prototyping using 3D Printer

Lecture 59 - Etching Process

Lecture 60 - Electronic System for Drug Screening

Lecture 61 - Introduction to Equipments: DAQ

Lecture 62 - Introduction to Equipments: DAQ (Continued...)

Lecture 63 - Electronic Module for Gas sensor

Lecture 64 - Fabrication process flow for a metal oxide gas sensor

**NPTEL : NOC:Electronic Modules for Industrial Applications using Op-Amps (Electrical Engineering)**

**Co-ordinators : Prof. Hardik Jeetendra Pandya**

**NPTEL : NOC:Sensors and Actuators (Electrical Engineering)**

**Co-ordinators : Prof. Hardik Jeetendra Pandya**

Lecture 31 - Demonstration of Microheaters in COMSOL Multiphysics

Lecture 32 - Introduction to Cleanroom facilities for biomedical applications

Lecture 33 - Physical Deposition Techniques

Lecture 34 - Demonstration on peristaltic pump in cleanroom

Lecture 35 - Installation of Oxygen Plasma System

Lecture 36 - Demonstration of IR Based Sensor using Arduino

Lecture 37 - Illustration of fabricated Microfluidic Device for biochips with PDMS moulding

Lecture 38 - Photolithography - Part 2

Lecture 39 - Photolithography - Part 3

Lecture 40 - Introduction and Demonstration of Shape Memory Alloy

Lecture 41 - Applications of Shape Memory Alloy as a light weight actuators

Lecture 42 - Discussion on Fabricated Sensor with Silicon as Substrate

Lecture 43 - Discussion and Microscopic Inspection of Fabricated Sensor with Silicon as a Substrate

Lecture 44 - Tissue Deparaffinization for Biosensors

Lecture 45 - Clean room guidelines and Cancer Dianostic tool

Lecture 46 - Basics of Pressure Sensor and Demonstration using Arduino Microcontroller

Lecture 47 - Basics of Stepper Motor and Demonstration using Arduino Microcontroller

Lecture 48 - Microscopic Inspection of Diced wafers and CNT Sensing Layer for fabricated sensor

Lecture 49 - Process flow for Microcantilever for Mechanical Phenotyping of breast cancer tissues

Lecture 50 - Applications of microcantilever for Mechanical Phenotyping of breast cancer tissues

Lecture 51 - Installation and Introduction to Physical Vapour Deposition System

Lecture 52 - Human Machine Interface for Controlling Deposition System

Lecture 53 - Flexible MEMS for phenotyping tissue properties - I

Lecture 54 - Flexible MEMS for phenotyping tissue properties - II

Lecture 55 - System Demonstration for Physical Vapor Deposition

Lecture 56 - Introduction to CAD Modelling - I

Lecture 57 - Introduction to CAD Modelling - II

Lecture 58 - Biosensors for ETM Phenotyping of breast cancer tissues for better prognosis

Lecture 59 - Biosensors for Electrothermal sensor

Lecture 60 - MEMS based sensor for catheter contact force measurement

Lecture 61 - Microfluidics based Drug Screening

Lecture 62 - Basic aspects of 3D Printing

Lecture 63 - 3D Printing Materials and Demonstration of Remote 3D Printing

**NPTEL : NOC:Neural Networks for Signal Processing-I (Electrical Engineering)**

**Co-ordinators : Prof. Shayan Srinivasa Garani**

**NPTEL : NOC:Electronics Equipment Integration and Prototype Building (Electrical Engineering)**

**Co-ordinators : Prof. N.V.Chalapathi Rao**

**NPTEL : NOC:Design and Simulation of Power Conversion using Open Source Tools (Electrical Engineering)**

**Co-ordinators : Prof. L. Umanand**

**NPTEL : NOC:Introductory Neuroscience and Neuro-Instrumentation (Electrical Engineering)**

**Co-ordinators : Prof. Mahesh Jayachandra**

Lecture 32 - Different Brain Computer Interfaces

Lecture 33 - Introduction to EEGLAB, ERPLAB and AEP Demonstration (1)

Lecture 34 - Introduction to EEGLAB, ERPLAB and AEP Demonstration (2)

Lecture 35 - Introduction to Photolithography

Lecture 36 - Basics of BCI Experimentation: Stimuli Generation and Insertion

Lecture 37 - MMN Demonstration with EEGLAB and ERPLAB (1)

Lecture 38 - MMN Demonstration with EEGLAB and ERPLAB (2)

Lecture 39 - Introduction to Photolithography (2)

Lecture 40 - Basics of Instrumentation Amplifier and Online Simulation

Lecture 41 - Basics of BCI Experimentation: Experimental Setup and Biopotential Acquisition

Lecture 42 - P300 Demonstration with EEGLAB/ERPLAB (1)

Lecture 43 - P300 Demonstration with EEGLAB/ERPLAB (2)

Lecture 44 - Wavelet Analysis with VEP (1)

Lecture 45 - Details of Lithography, E-beam Lithography and Mask Aligner

Lecture 46 - Basics of BCI Experimentation: Signal Acquisition using MATLAB (EEGLAB)

Lecture 47 - Wavelet Analysis with VEP (2)

Lecture 48 - Demonstration: Resting Membrane Potential

Lecture 49 - Demonstration: Membrane Time Constant (Ï„)

Lecture 50 - Photoresist (SU-8) and soft lithography

Lecture 51 - Physical Vapour Deposition: Thermal Evaporation

Lecture 52 - Introduction to Epilepsy and Classification

Lecture 53 - Epileptogenisis

Lecture 54 - Demonstration: Membrane Length Constant (Î»)

Lecture 55 - Demonstration: Action Potential

Lecture 56 - Demonstration: Voltage Clamp

Lecture 57 - Demonstration: Synaptic Potentials & Current

Lecture 58 - Physical Vapour Deposition: E-beam Evaporation

Lecture 59 - Physical Vapour Deposition: Sputtering

Lecture 60 - Recent Trends: Epilepsy Classification using EEG data

Lecture 61 - Demonstration: Wireless EEG with dry electrodes

Lecture 62 - Basics of EEG, ERP and acquisition

Lecture 63 - Photolithography with example

Lecture 64 - Stress Tissue Analysis using COMSOL Multiphysics

Lecture 65 - Recent Trends: Microelectrode Arrays and Deep Brain Stimulation

**NPTEL : NOC:Information Theory (Electrical Engineering)**

**Co-ordinators : Prof. Himanshu Tyagi**

Lecture 32 - Shape of measures of information

Lecture 33 - Data processing inequality

Lecture 34 - Midyear Review

Lecture 35 - Proof of Fano's inequality

Lecture 36 - Variational formulae

Lecture 37 - Capacity as information radius

Lecture 38 - Proof of Pinsker's inequality

Lecture 39 - Continuity of entropy

Lecture 40 - Lower bound for compression

Lecture 41 - Lower bound for hypothesis testing

Lecture 42 - Review 7

Lecture 43 - Lower bound for random number generation

Lecture 44 - Strong converse

Lecture 45 - Lower bound for minmax statistical estimation

Lecture 46 - Variable length source codes

Lecture 47 - Review 8

Lecture 48 - Kraft's inequality

Lecture 49 - Shannon code

Lecture 50 - Huffman code

Lecture 51 - Minmax Redundancy

Lecture 52 - Type based universal compression

Lecture 53 - Review 9

Lecture 54 - Arithmetic code

Lecture 55 - Online probability assignment

Lecture 56 - Compression of databases: A scheme

Lecture 57 - Compression of databases: A lower bound

Lecture 58 - Repetition code

Lecture 59 - Channel capacity

Lecture 60 - Sphere packing bound for BSC

Lecture 61 - Random coding bound for BSC

Lecture 62 - Random coding bound for general channel

Lecture 63 - Review 11

Lecture 64 - Converse proof for channel coding theorem

**NPTEL : NOC:Photonic Integrated Circuit (Electrical Engineering)**

**Co-ordinators : Prof. Shankar Kumar Selvaraja**

Lecture 1 - Photonic integrated circuits course introduction

Lecture 2 - Wave optics review

Lecture 3 - Electromagnetic theory review - 1

Lecture 4 - Electromagnetic theory review - 2

Lecture 5 - Photonic integrated circuits: an introduction

Lecture 6 - Photonic integrated circuits evolution

Lecture 7 - Photonic integrated circuit components - 1

Lecture 8 - Photonic integrated circuit components - 2

Lecture 9 - Dispersion

Lecture 10 - Phase velocity and Group velocity

Lecture 11 - Anisotropic medium and reciprocity

Lecture 12 - Polarisation in anisotropic medium

Lecture 13 - Optical axes

Lecture 14 - Waveguide structure

Lecture 15 - Waveguide modes - 1

Lecture 16 - Waveguide modes - 2

Lecture 17 - Field Equation

Lecture 18 - Guided modes in symmetric slab waveguides

Lecture 19 - Waveguide design - Boundary value formulation

Lecture 20 - Waveguide design - BVP solution

Lecture 21 - Waveguide design - Perturbation approach

Lecture 22 - Waveguide design - Effective Index method

Lecture 23 - Coupled mode theory - 1

Lecture 24 - Coupled mode theory - 2

Lecture 25 - Two-mode coupling

Lecture 26 - Co and counter propagating mode coupling

Lecture 27 - Phase matching

Lecture 28 - Directional coupler

Lecture 29 - Y-splitter

Lecture 30 - Multi-Mode Interference coupler

Lecture 31 - MZI

**NPTEL : NOC:Design for Internet of Things (2021) (Electrical Engineering)**

**Co-ordinators : Prof. T V Prabhakar**

Lecture 1 - Introduction and Definition of IoT

Lecture 2 - Location, Applications, and Power

Lecture 3 - Challenges - Part 1

Lecture 4 - Challenges - Part 2

Lecture 5 - Challenges - Part 3

Lecture 6 - Challenges - Part 4

Lecture 7 - Unique ID

Lecture 8 - Introduction to RFID

Lecture 9 - RFID DEMO

Lecture 10 - RFID Theory - 1

Lecture 11 - RFID Theory - 2

Lecture 12 - RFID Theory - 3

Lecture 13 - Energy harvesting - 1

Lecture 14 - Energy harvesting - 2

Lecture 15 - Energy harvesting - 3

Lecture 16 - Power management systems - 1

Lecture 17 - Power management systems - 2

Lecture 18 - Battery life calculation

Lecture 19 - Introduction to System Design for low power

Lecture 20 - LDO - 1

Lecture 21 - LDO - 2

Lecture 22 - LDO - 3

Lecture 23 - Buck converter - 1

Lecture 24 - Buck converter - 2

Lecture 25 - Lab experiment

Lecture 26 - Introduction to Sensors and Actuators

Lecture 27 - Sensors

Lecture 28 - Actuators

Lecture 29 - Case study on Sensing and Actuation

Lecture 30 - Introduction to low power software

Lecture 31 - ADC driver design and development

**NPTEL : NOC:Mathematical Aspects of Biomedical Electronic System Design (Electrical Engineering)**

**Co-ordinators : Prof. Chandramani Singh**

**NPTEL : NOC:Concentration Inequalities (Electrical Engineering)**

**Co-ordinators : Prof. Himanshu Tyagi**

Lecture 1 - Why study concentration inequalities?

Lecture 2 - Chernoff bound

Lecture 3 - Examples of Chernoff bound for common distributions

Lecture 4 - Hoeffding and Bernstein inequalities

Lecture 5 - Azuma and McDiarmid inequalities

Lecture 6 - Bounding variance using the Efron-Stein inequality

Lecture 7 - The Gaussian-Poincare inequality

Lecture 8 - Tail bounds using the Efron-Stein inequality

Lecture 9 - Herbst's argument and the entropy method

Lecture 10 - Log-Sobolev inequalities

Lecture 11 - Binary and Gaussian Log-Sobolev inequalities and concentration

Lecture 12 - Variational formulae forKullback-Leibler and Bregman Divergence

Lecture 13 - A modified log-Sobolev inequality and concentration

Lecture 14 - Introduction to the transportation method for showing concentration bounds

Lecture 15 - Transportation lemma and a proof of McDiarmid's inequality using the transportation method

Lecture 16 - Concentration bounds for functions beyond bounded difference using transportation method

Lecture 17 - Marton's conditional transportation cost inequality

Lecture 18 - Isoperimetry and concentration of measure

Lecture 19 - Isoperimetry and bounded difference

Lecture 20 - Equivalence of Stam's inequality and log Sobolev inequality

Lecture 21 - An information theoretic proof of log Sobolev inequality

Lecture 22 - Hypercontractivity and strong data processing inequality for RÃ©nyi divergence

Lecture 23 - An information theoretic characterization of hypercontractivity

Lecture 24 - Equivalence of Gaussian hypercontractivity and Gaussian log Sobolev inequality

Lecture 25 - Uniform deviation bounds for random walks and the law of the iterated logarithm

Lecture 26 - Self normalized concentration inequalities and application to online regression

**NPTEL : NOC:Real-Time Digital Signal Processing (Electrical Engineering)**

**Co-ordinators : Prof. Rathna G N**

Lecture 1 - Introduction

Lecture 2 - Basics of Signal Processing

Lecture 3 - Lab - CCS

Lecture 4 - Number System

Lecture 5 - Architecture - 1

Lecture 6 - Architecture - 2

Lecture 7 - Real-time Constraints

Lecture 8 - FIR - Filters

Lecture 9 - Pipelining and Parallel Processing for Low Power Applications - I

Lecture 10 - Pipelining and Parallel Processing for Low Power Applications - II

Lecture 11 - Lab: Sine Generation

Lecture 12 - IIR Filters - 1

Lecture 13 - IIR Filters - 2

Lecture 14 - Lab: Sine Generatioon, FIR and IIR

Lecture 15 - Lab 3 IIR Filter as Resonator

Lecture 16 - Lab 4 Use of FDA tool box to generate co-efficients

Lecture 17 - Lab: Real-Time Audio Output through Sine Generation

Lecture 18 - IIR Filters 4

Lecture 19 - Lab: FIR Filter in generation of music

Lecture 20 - Lab: Real-Time Audio Output through FIR Filter

Lecture 21 - DFT, DTFT, twiddle factors, properties, circular convolution and examples

Lecture 22 - Complexity of Filtering and the FFT

Lecture 23 - Lab: Filtering Using FFT

Lecture 24 - Lab: FFT in CCS

Lecture 25 - FFT - 1

Lecture 26 - FFT - 2

Lecture 27 - FFT - 3

Lecture 28 - Overlap - Add

Lecture 29 - Overlap Save Method

Lecture 30 - Lab: Overlap Add and Save Method using MATLAB

Lecture 31 - Correlation

**NPTEL : NOC:Advanced Neural Science for Engineers (Electrical Engineering)**

**Co-ordinators : Prof. Vikas V**

Lecture 32 - Lab 9 - 3D Printing for neural devices

Lecture 33 - Introduction to Biopotentials

Lecture 34 - EEG: Introduction, Demonstration and Applications

Lecture 35 - Neural Implants: Fabrication and Characterization

Lecture 36 - Design of Wireless Biphasic Pulse Generator

Lecture 37 - Basics of EEG/ERP Experimental Desing

Lecture 38 - Micromachining and Etching

Lecture 39 - Epileptic Seizure Detection and Classification

Lecture 40 - Newborn Hearing Screening - I

Lecture 41 - Newborn Hearing Screening - II

Lecture 42 - Applications of EEG/ERP Experimental Design

Lecture 43 - Flexible MEA for Electrocorticography Signal Acquisition

Lecture 44 - Flexible biodegradable MEAs

Lecture 45 - Microneedle Electrode Array

Lecture 46 - Neurosurgery-based MEA Implantation - I

Lecture 47 - Neurosurgery-based MEA Implantation - II

Lecture 48 - Neurosurgery-based MEA Implantation - III

Lecture 49 - Neurosurgery-based MEA Implantation - IV

Lecture 50 - Deep Brain Stimulation/Recording for Parkinson's - I

Lecture 51 - Deep Brain Stimulation/Recording for Parkinson's - II

Lecture 52 - Computational Neuroscience Fundamentals

Lecture 53 - Mathematical Analysis in Neural Science

Lecture 54 - Neuroanatomy for Neural Engineering

**NPTEL : NOC:Design of Electric Motors (Electrical Engineering)**

**Co-ordinators : Dr. Prathap Reddy**