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

NPTEL : Advanced VLSI Design (Electronics and Communication Engineering)

Co-ordinators : Prof. A.N. Chandorkar, Prof. D.K. Sharma, Prof. Sachin Patkar, Prof. Virendra Singh

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Lecture 11 - BJT Small Signal Analysis

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Lecture 13 - BJT Amplifier - Part-2

Lecture 14 - Frequency Response of BJT Analysis - Part-1

Lecture 15 - Bipolar Junction Transistors

Lecture 16 - Transistor as a Switch

Lecture 17 - MOSFET - Part-1

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Lecture 5 - Analysis of H Bridge

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Lecture 10 - Diode characteristics

Lecture 11 - Diode Datasheets

Lecture 12 - Diode Datasheet Examples

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Lecture 14 - Switching characteristics of MOSFET

Lecture 15 - MOSFET Datasheets - I

Lecture 16 - MOSFET Datasheets - II

Lecture 17 - MOSFET Datasheet example

Lecture 18 - IGBT

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- Lecture 1 - Power systems: Overview and historical developments
- Lecture 2 - Introduction to power delivery systems
- Lecture 3 - Introduction to electrical loads
- Lecture 4 - Load diversity
- Lecture 5 - Different load indices
- Lecture 6 - Loss factor
- Lecture 7 - Load management
- Lecture 8 - Brief overview of power distribution substation
- Lecture 9 - Substation bus schemes and primary distribution network topology
- Lecture 10 - Voltage drop and power loss computations for typical radial distribution feeders
- Lecture 11 - Generalized expression for voltage drop for radial distribution feeder
- Lecture 12 - Derivation of K-constant for voltage drop computation
- Lecture 13 - Different reliability indices used in distribution networks
- Lecture 14 - Different reliability indices with numerical examples
- Lecture 15 - Mathematical concept of reliability
- Lecture 16 - Reliability evaluation of multiple units connected to series and/or parallel
- Lecture 17 - Numerical problems on reliability evaluation
- Lecture 18 - Power quality problems in distribution systems
- Lecture 19 - Forward backward load flow approach for power distribution systems
- Lecture 20 - Forward backward load flow approach for power distribution systems
- Lecture 21 - Reactive power compensation: Basic idea
- Lecture 22 - Reactive power compensation: Numerical examples
- Lecture 23 - Capacitor placement at distribution feeder: Analytical approach
- Lecture 24 - Power distribution system planning: Economic aspects
- Lecture 25 - Power distribution system planning: Different models and solution strategies
- Lecture 26 - Mono-objective power distribution system planning approach
- Lecture 27 - Multi-objective power distribution system planning approach
- Lecture 28 - Multi-objective planning incorporating sectionalizing switches and tie-lines
- Lecture 29 - Reconfiguration of power distribution networks
- Lecture 30 - Distribution networks with the integration of Distributed Generation
- Lecture 31 - Concept of microgrids

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

NPTEL : NOC:Nanophotonics, Plasmonics, and Metamaterials (Electronics and Communication Engineering)

Co-ordinators : Dr. Debabrata Sikdar, Dr. Debabrata Sikdar

- Lecture 1 - Introduction to Nanophotonics and Plasmonics
- Lecture 2 - Introduction to Metamaterials and Metasurfaces
- Lecture 3 - Overview and current status
- Lecture 4 - Electromagnetic theory of light
- Lecture 5 - Electromagnetic properties of material
- Lecture 6 - Electromagnetic waves in dielectric media
- Lecture 7 - Polarization of light
- Lecture 8 - Reflection and refraction: Fresnel equations
- Lecture 9 - Absorption, dispersion and scattering of light
- Lecture 10 - Matrix theory of dielectric layered media
- Lecture 11 - 1D Photonic crystals
- Lecture 12 - Dispersion relation and photonic band structure
- Lecture 13 - Real and reciprocal lattices
- Lecture 14 - 2D and 3D Photonic crystals
- Lecture 15 - Emerging Applications of Photonic Crystals
- Lecture 16 - Optical properties of metals
- Lecture 17 - Surface Plasmon Polaritons (SPP): Fundamentals
- Lecture 18 - Applications of SPPs
- Lecture 19 - Localized surface plasmon resonance (LSPR)
- Lecture 20 - Plasmonic nanoparticles: Antenna and Waveguides
- Lecture 21 - Applications of LSPR
- Lecture 22 - Fundamentals of metamaterials
- Lecture 23 - Effective medium theories
- Lecture 24 - Single and Double-Negative Metamaterials
- Lecture 25 - Metamaterial Perfect absorbers
- Lecture 26 - Super lens, Hyperbolic Metamaterials and Hyper lens
- Lecture 27 - Tunable photonic metamaterial based devices
- Lecture 28 - Metasurfaces and Frequency selective surfaces
- Lecture 29 - Guided mode resonances (GMR)
- Lecture 30 - Applications of metasurfaces and GMR devices
- Lecture 31 - Transformation Optics (TO) and Invisibility Cloaks

[Lecture 32 - Carpet cloaking and TO metamaterials](#)

[Lecture 33 - Introduction to alternative materials](#)

[Lecture 34 - Nanofabrication: Physical and Chemical methods](#)

[Lecture 35 - Lithography and Pattern transfer](#)

[Lecture 36 - Nanophotonic characterization methods](#)

Lecture 1 - Basic Concepts of active and reactive power

Lecture 2 - Basic Concepts of reactive power compensation

Lecture 3 - Basic mathematical modelling of power transmission systems

Lecture 4 - Derivation of the relation of sending and receiving end voltages and currents - Part A

Lecture 5 - Derivation of the relation of sending and receiving end voltages and currents - Part B

Lecture 6 - Derivations of power flow expressions

Lecture 7 - Numerical example showing determination of power flow

Lecture 8 - Generalized expression for active and reactive power at any point of a long line

Lecture 9 - Mid-point voltage and current for long, lossless transmission lines

Lecture 10 - Plot of mid-point voltage vs line loading

Lecture 11 - Numerical example of mid-point compensation - Part A

Lecture 12 - Numerical example of mid-point compensation - Part B

Lecture 13 - Effect of Mid-point compensation on power flow of transmission lines

Lecture 14 - Thyristor controlled reactor (TCR)

Lecture 15 - Harmonics in TCR and Three-phase TCR configuration

Lecture 16 - Operating Characteristics of TCR

Lecture 17 - Categorization of different types of SVC and Fixed capacitor TCR (FC-TCR)

Lecture 18 - Mechanically Switched Capacitor TCR (MSC-TCR) and Thyristor Switch Capacitor (TSC)

Lecture 19 - Thyristor Switch Capacitor (TSC)

Lecture 20 - Design of TSC-TCR: Numerical Example

Lecture 21 - SVC in enhancement of steady-state power transmission capacity

Lecture 22 - SVC in enhancement of transient stability of power systems

Lecture 23 - SVC in enhancement of synchronizing power coefficient

Lecture 24 - SVC in and power system oscillation damping

Lecture 25 - SVC in voltage control of power systems: Modelling

Lecture 26 - SVC in voltage control of power systems: Control characteristics

Lecture 27 - SVC in voltage control of power systems: Numerical example

Lecture 28 - Basic operating principle of TCSC

Lecture 29 - Basic mathematical modelling of TCSC - Part 1

Lecture 30 - Basic mathematical modelling of TCSC - Part 2

Lecture 31 - TCSC reactance and harmonics analysis

[Lecture 32 - Applications of TCSC in power systems](#)

[Lecture 33 - Basic mathematical modelling of STATCOM](#)

[Lecture 34 - Applications of STATCOM in power systems](#)

[Lecture 35 - Basic mathematical modelling of SSSC](#)

[Lecture 36 - Applications of SSSC in power systems](#)

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Lecture 1 - Introduction to 3G/4G Standards

Lecture 2 - Wireless Channel and Fading

Lecture 3 - Rayleigh Fading and BER of Wired Communication

Lecture 4 - BER for Wireless Communication

Lecture 5 - Introduction to Diversity

Lecture 6 - Multi-antenna Maximal Ratio Combiner

Lecture 7 - BER with Diversity

Lecture 8 - Spatial Diversity and Diversity Order

Lecture 9 - Wireless Channel and Delay Spread

Lecture 10 - Coherence Bandwidth of the Wireless Channel

Lecture 11 - ISI and Doppler in Wireless Communications

Lecture 12 - Doppler Spectrum and Jakes Model

Lecture 13 - Introduction to CDMA, Spread Spectrum and LFSR

Lecture 14 - Generation and Properties of PN Sequences

Lecture 15 - Correlation of PN Sequences and Jammer Margin

Lecture 16 - CDMA Advantages and RAKE Receiver

Lecture 17 - Multi-User CDMA Downlink Part I

Lecture 18 - Multi-User CDMA Downlink Part II

Lecture 19 - Multi-User CDMA Uplink and Asynchronous CDMA

Lecture 20 - CDMA Near-Far Problem and Introduction to MIMO

Lecture 21 - MIMO System Model and Zero-Forcing Receiver

Lecture 22 - MIMO MMSE Receiver and Introduction to SVD

Lecture 23 - SVD Based Optimal MIMO Transmission and Capacity

Lecture 24 - SVD Based Optimal MIMO Transmission and Capacity

Lecture 25 - OSTBCs and Introduction to V-BLAST Receiver

Lecture 26 - V-BLAST (Continued) and MIMO Beamforming

Lecture 27 - Introduction to OFDM and Multi-Carrier Modulation

Lecture 28 - IFFT Sampling for OFDM

Lecture 29 - OFDM Schematic and Cyclic Prefix

Lecture 30 - OFDM Based Parallelization and OFDM Example

Lecture 31 - OFDM Example (Continued) and Introduction to MIMO-OFDM

[Lecture 32 - MIMO-OFDM \(Continued\)](#)

[Lecture 33 - Impact of Carrier Frequency Offset \(CFO\) in OFDM](#)

[Lecture 34 - PAPR in OFDM Systems and Introduction to SC-FDMA](#)

[Lecture 35 - SC-FDMA \(Continued\) and Introduction of Wireless Propagation Models](#)

[Lecture 36 - Ground Reflection and Okumura Models](#)

[Lecture 37 - Hata Model and Log Normal Shadowing](#)

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[Lecture 39 - Introduction to Teletraffic Theory](#)

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NPTEL : NOC:Principles of Modern CDMA-MIMO-OFDM Wireless Communications (Electronics and Communication Engineering)

Co-ordinators : Prof. Aditya K. Jagannatham

- Lecture 1 - Evolution of Wireless Communication Technologies
- Lecture 2 - Modeling Wireless Channel
- Lecture 3 - Wireless Fading Channel Model
- Lecture 4 - Fading Channel Distribution
- Lecture 5 - Rayleigh Fading Channel
- Lecture 6 - Bit Error Rate (BER) Performance
- Lecture 7 - Bit Error Rate (BER) of AWGN Channels
- Lecture 8 - Bit Error Rate of Rayleigh Fading Wireless Channel
- Lecture 9 - Exact BER Expression for Rayleigh Fading Wireless Channel
- Lecture 10 - Deep Fade Analysis of Wireless Communication
- Lecture 11 - Principle of Diversity
- Lecture 12 - Multiple Antenna Diversity
- Lecture 13 - Maximal-Ratio Combining
- Lecture 14 - BER of Multiple Antenna Wireless Systems
- Lecture 15 - Approximate BER for Multiple Antenna Wireless System
- Lecture 16 - Examples for BER of Wireless Communication
- Lecture 17 - Deep Fade in Multi Antenna Systems
- Lecture 18 - Intuition for Deep Fade in Multi-Antenna System
- Lecture 19 - Definition of Diversity Order
- Lecture 20 - Max Delay Spread
- Lecture 21 - RMS Delay Spread
- Lecture 22 - Delay Spread and Inter Symbol Interference
- Lecture 23 - Coherence Bandwidth of Wireless Channel
- Lecture 24 - Mobility and Doppler Effect in Wireless Channels
- Lecture 25 - Impact of Doppler Effect on Wireless Channel
- Lecture 26 - Introduction to Code Division Multiple Access (CDMA)
- Lecture 27 - Chip Time and Bandwidth Expansion in CDMA
- Lecture 28 - Code Generation for CDMA
- Lecture 29 - CDMA Codes: Properties of PN Sequences
- Lecture 30 - BER of CDMA Systems

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[Lecture 31 - Analysis of Multi-user CDMA](#)

[Lecture 32 - Multipath Diversity in CDMA Systems](#)

[Lecture 33 - Near-Far Problem in CDMA](#)

[Lecture 34 - Multiple Input Multiple Output \(MIMO\) Systems](#)

[Lecture 35 - Examples of MIMO Systems](#)

[Lecture 36 - MIMO Receivers](#)

[Lecture 37 - BER Performance of ZF Receiver](#)

[Lecture 38 - Transmit Beamforming in MISO Systems](#)

[Lecture 39 - Alamouti Code and Space-Time Block Codes](#)

[Lecture 40 - BER of Alamouti Coded System](#)

[Lecture 41 - Singular Value Decomposition \(SVD\)](#)

[Lecture 42 - SVD in MIMO](#)

[Lecture 43 - Capacity of MIMO Wireless Systems](#)

[Lecture 44 - SVD based MIMO Transmission](#)

[Lecture 45 - Orthogonal Frequency Division Multiplexing \(OFDM\)](#)

[Lecture 46 - Transmission in Multicarrier Systems](#)

[Lecture 47 - FFT/IFFT Processing in OFDM](#)

[Lecture 48 - Cyclic Prefix in OFDM Systems](#)

[Lecture 49 - Schematic Representation of OFDM Transmitter and Receiver](#)

[Lecture 50 - BER Performance of OFDM Systems](#)

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NPTEL : NOC:Probability and Random Variables, Processes for Wireless Communications (Electronics and Communication Engineering)

Co-ordinators : Prof. Aditya K. Jagannatham

Lecture 1 - Basics - Sample Space and Events

Lecture 2 - Axioms of Probability

Lecture 3 - Conditional Probability - Mary-PAM Example

Lecture 4 - Independent Events - Mary-PAM Example

Lecture 5 - Independent Events - Block Transmission Example

Lecture 6 - Independent Events - Multiantenna Fading Example

Lecture 7 - Bayes Theorem and Aposteriori Probabilities

Lecture 8 - Maximum Aposteriori Probability (MAP) Receiver

Lecture 9 - Random Variables, Probability Density Function (PDF)

Lecture 10 - Application: Power of Fading Wireless Channel

Lecture 11 - Mean, Variance of Random Variables

Lecture 12 - Application: Average Delay and RMS Delay Spread of Wireless Channel

Lecture 13 - Transformation of Random Variables and Rayleigh Fading Wireless Channel

Lecture 14 - Gaussian Random Variable and Linear Transformation

Lecture 15 - Special Case: IID Gaussian Random Variables

Lecture 16 - Application: Array Processing and Array Gain with Uniform Linear Arrays

Lecture 17 - Random Processes and Wide Sense Stationarity (WSS)

Lecture 18 - WSS Example Narrowband Wireless Signal with Random Phase

Lecture 19 - Power Spectral Density (PSD) for WSS Random Process

Lecture 20 - PSD Application in Wireless Bandwidth Required for Signal Transmission

Lecture 21 - Transmission of WSS Random Process Through LTI System

Lecture 22 - Special Random Processes Gaussian Process and White Noise AWGN Communication Channel

Lecture 23 - Gaussian Process Through LTI System Example: WGN Through RC Low Pass Filter Not Started

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NPTEL : NOC:Estimation for Wireless Communications, MIMO, OFDM Cellular and Sensor Networks (Electronics and Communication Engineering)

Co-ordinators : Prof. Aditya K. Jagannatham

Lecture 1 - Basics - Sensor Network and Noisy Observation Model

Lecture 2 - Likelihood Function and Maximum Likelihood (ML) Estimate

Lecture 3 - Properties of Maximum Likelihood (ML) Estimate $\hat{\theta}$ – Mean and Unbiasedness

Lecture 4 - Properties of Maximum Likelihood (ML) Estimate $\hat{\theta}$ – Variance and Spread Around Mean

Lecture 5 - Reliability of the Maximum Likelihood (ML) Estimate $\hat{\theta}$ – Number of Samples Required

Lecture 6 - Estimation of Complex Parameters $\hat{\theta}$ – Symmetric Zero Mean Complex Gaussian Noise

Lecture 7 - Wireless Fading Channel Estimation $\hat{\theta}$ – Pilot Symbols and Likelihood Function

Lecture 8 - Wireless Fading Channel Estimation $\hat{\theta}$ – Pilot Training based Maximum Likelihood ML Estimate

Lecture 9 - Wireless Fading Channel Estimation $\hat{\theta}$ – Mean and Variance of Pilot Training Based Maximum Likelihood

Lecture 10 - Example $\hat{\theta}$ – Wireless Fading Channel Estimation for Downlink Mobile Communication

Lecture 11 - Cramer Rao Bound (CRB) for Parameter Estimation

Lecture 12 - Cramer Rao Bound CRB Example $\hat{\theta}$ – Wireless Sensor Network

Lecture 13 - Vector Parameter Estimation $\hat{\theta}$ – System Model for Multi Antenna Downlink Channel Estimation

Lecture 14 - Likelihood Function and Least Squares Cost Function for Vector Parameter Estimation

Lecture 15 - Least Squares Cost Function for Vector Parameter Estimation Vector Derivative Gradient

Lecture 16 - Least Squares Solution Maximum Likelihood ML Estimate Pseudo Inverse

Lecture 17 - Properties of Least Squares Estimate $\hat{\theta}$ – Mean Covariance and Distribution

Lecture 18 - Least Squares Multi Antenna Downlink Maximum Likelihood Channel Estimation

Lecture 19 - Multiple Input Multiple Output MIMO Channel Estimation $\hat{\theta}$ – Least Squares Maximum Likelihood ML

Lecture 20 - Example $\hat{\theta}$ – Least Squares Multiple Input Multiple Output MIMO Channel Estimation

Lecture 21 - Channel Equalization and Inter Symbol Interference ISI Model

Lecture 22 - Least Squares based Zero Forcing Channel Equalizer

Lecture 23 - Example of ISI Channel and Least Squares based Zero Forcing

Lecture 24 - Equalization and Approximation Error for Zero Forcing Channel Equalizer

Lecture 25 - Example Equalization and Approximation Error for Zero Forcing Channel Equalizer

Lecture 26 - Introduction to Orthogonal Frequency Division Multiplexing OFDM $\hat{\theta}$ – Cyclic Prefix CP and Circular Convolution

Lecture 27 - Introduction to Orthogonal Frequency Division Multiplexing OFDM $\hat{\theta}$ – FFT at Receiver and Flat Fading

Lecture 28 - Channel Estimation Across Each Subcarrier in Orthogonal Frequency Division Multiplexing OFDM

Lecture 29 - Example Orthogonal Frequency Division Multiplexing OFDM $\hat{\theta}$ – Transmission of Samples with Cyclic Prefix

Lecture 30 - Example Orthogonal Frequency Division Multiplexing OFDM $\hat{\theta}$ – FFT at Receiver and Channel Estimation

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[Lecture 31 - Comb Type Pilot CTP Based Orthogonal Frequency Division Multiplexing OFDM Channel Estimation](#)

[Lecture 32 - Comb Type Pilot CTP Based Orthogonal Frequency Division Multiplexing OFDM Channel Estimation](#)

[Lecture 33 - Example Comb Type Pilot CTP Based Orthogonal Frequency Division Multiplexing OFDM Channel](#)

[Lecture 34 - Frequency Domain Equalization FDE for Inter Symbol Interference ISI Removal in Wireless System](#)

[Lecture 35 - Example Frequency Domain Equalization FDE for Inter Symbol Interference ISI Removal in Wireless Channels](#)

[Lecture 36 - Example Frequency Domain Equalization FDE for Inter Symbol Interference ISI Removal in Wireless Channels](#)

[Lecture 37 - Introduction to Sequential Estimation \$\hat{A}\$ – Application in Wireless Channel Estimation](#)

[Lecture 38 - Sequential Estimation of Wireless Channel Coefficient \$\hat{A}\$ – Estimate and Variance Update Equation](#)

[Lecture 39 - Example Sequential Estimation of Wireless Channel Coefficient](#)

Lecture 1 - Introduction to Error Coding - I

Lecture 2 - Introduction to Error Coding - II

Lecture 3 - Introduction to Error Control Coding - III

Lecture 4 - Introduction to Convolutional Codes - I: Encoding

Lecture 5 - Introduction to Convolutional Codes - II: State Diagram, Trellis Diagram

Lecture 6 - Convolutional Codes: Classification, Realization

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**NPTEL : NOC:Bayesian, MMSE Estimation for Wireless Communications MIMO, OFDM Cellular and Sensor Networks
(Electronics and Communication Engineering)**

Co-ordinators : Prof. Aditya K. Jagannatham

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[Lecture 35 - MSI and LSI based Implementation of Sequential Circuits \(Continued\)](#)

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[Lecture 38 - System Design Example \(Continued\)](#)

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Lecture 3 - Diode characteristics

Lecture 4 - Rectifier

Lecture 5 - Voltage Multiplier

Lecture 6 - Full Wave Rectifier and Peak Detector

Lecture 7 - Diode as a GATE

Lecture 8 - Analog GATE

Lecture 9 - Small Signal Analysis of Diode Circuit

Lecture 10 - Zener Regulator and Voltage Regulator

Lecture 11 - Varactor Diode

Lecture 12 - Amplifiers

Lecture 13 - Cascading of Amplifiers

Lecture 14 - Cascading of Amplifiers

Lecture 15 - h and g Parameters

Lecture 16 - Two Port Analysis

Lecture 17 - Amplifier Applications

Lecture 18 - Frequency Limitations Of An Amplifier

Lecture 19 - Distortion In Amplifiers

Lecture 20 - Bipolar Junction Transistor

Lecture 21 - Transistor (BJT) Inverter

Lecture 22 - Transistor Biasing

Lecture 23 - Stable Way of Biasing

Lecture 24 - Common Emitter Amplifiers

Lecture 25 - Transistor Biasing Using Single Supply

Lecture 26 - Metal Oxide Semiconductor

Lecture 27 - Construction of a MOSFET

Lecture 28 - Varieties of MOSFETS and JFETS

Lecture 29 - Characteristics of MOSFET

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Lecture 31 - Cascading (Direct Coupling)

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[Lecture 33 - BJT Differential Amplifiers](#)

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Lecture 2 - Negative Feedback

Lecture 3 - Negative Feedback

Lecture 4 - Y-Feedback

Lecture 5 - h and g Negative Feedback

Lecture 6 - g Feedback with Mosfet

Lecture 7 - Operational Amplifier in Negative Feedback

Lecture 8 - Operational Amplifier in Negative Feedback

Lecture 9 - Positive Feedback (Regenerative)

Lecture 10 - Experimental Demonstration

Lecture 11 - Instrumentation Amplifiers

Lecture 12 - Active Filters

Lecture 13 - Simulation of Harmonic Oscillators

Lecture 14 - Oscillators

Lecture 15 - Oscillators

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Lecture 19 - Wideband Amplifiers

Lecture 20 - ICs For Video And Tuned Amplifier Applications

Lecture 21 - Power Amplifier

Lecture 22 - Power Amplifier

Lecture 23 - Class B and C Power Amplifiers

Lecture 24 - Class-B Power Amplifier Load and Drive

Lecture 25 - Control Circuits

Lecture 26 - Voltage Regulators

Lecture 27 - Voltage Regulators

Lecture 28 - Voltage Regulators

Lecture 29 - Convertors

Lecture 30 - Analog Multipliers (Modems & Mixers)

Lecture 31 - Log-Antilog Multipliers

[Lecture 32 - Multipliers](#)

[Lecture 33 - Multipliers](#)

[Lecture 34 - AGC/AVC](#)

[Lecture 35 - AGC/AVC](#)

[Lecture 36 - Experimental Demonstration](#)

[Lecture 37 - PLL \(Phase Locked Loop\)](#)

[Lecture 38 - PLL \(Phase Locked Loop\)](#)

[Lecture 39 - Lock Range Capture Range and FSK and FM](#)

Lecture 1 - Introduction to Basic concepts

Lecture 2 - Requirements for high speed circuits, devices and materials

Lecture 3 - Classification and properties of semiconductor devices

Lecture 4 - Ternary compound semiconductors and their applications

Lecture 5 - Ternary compound semiconductors and their applications (Continued.)

Lecture 6 - Crystal structures in GaAs

Lecture 7 - Dopants and impurities in GaAs and InP

Lecture 8 - Brief Overview of GaAs Technology for High Speed Devices

Lecture 9 - Epitaxial Techniques for GaAs and high speed devices

Lecture 10 - MBE and LPE for GaAs Epitaxy

Lecture 11 - GaAs and InP devices for Microelectronics

Lecture 12 - Metal Semiconductor contacts for MESFET

Lecture 13 - Metal Semiconductor contacts for MESFET (Continued.)

Lecture 14 - Metal Semiconductor contacts for MESFET (Continued.)

Lecture 15 - Ohmic contacts on semiconductors

Lecture 16 - Fermi level pinning, I V characteristics of Schottky Barrier Diodes

Lecture 17 - Schottky Barrier Diodes I V characteristics of Non idealities -1

Lecture 18 - Schottky Barrier Diodes I V characteristics of Non idealities -1

Lecture 19 - Causes of Non idealities in the Schottky Barrier Diodes (I V characteristics)

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Lecture 21 - MESFET I V characteristics Shockley's Model

Lecture 22 - MESFET Shockley's Model and velocity saturation effect

Lecture 23 - MESFET velocity saturation effect on drain current saturation

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Lecture 27 - MESFET : Effects of velocity field characteristics - Overshoot effects

Lecture 28 - MESFET : Velocity overshoot effect and self aligned MESFET SAINT

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Lecture 31 - Hetero junctions and high electron Mobility Transistor (HEMT)

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[Lecture 36 - Indium phosphide based HEMT](#)

[Lecture 37 - Pseudomorphic HEMT and Hetrojunction Bipolar Transistors](#)

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[Lecture 39 - Hetero junction Bipolar Transistors \(HBT\) \(Continued.\)](#)

[Lecture 40 - Hetero junction Bipolar Transistors \(HBT\) \(Continued.\)](#)

[Lecture 41 - Hetero junction Bipolar Transistors \(HBT\) \(Continued.\)](#)

Lecture 1 - Introduction on Solid State Devices

Lecture 2 - Evolution and Uniqueness of Semiconductor

Lecture 3 - Equilibrium Carrier Concentration

Lecture 4 - Equilibrium Carrier Concentration

Lecture 5 - Equilibrium Carrier Concentration

Lecture 6 - Equilibrium Carrier Concentration

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Lecture 10 - Equilibrium Carrier Concentration

Lecture 11 - Equilibrium Carrier Concentration

Lecture 12 - Carrier Transport

Lecture 13 - Carrier Transport (Continued.)

Lecture 14 - Carrier Transport (Continued.)

Lecture 15 - Excess Carriers

Lecture 16 - Excess Carriers (Continued.)

Lecture 17 - Procedure for Device Analysis

Lecture 18 - Procedure for Device Analysis (Continued.)

Lecture 19 - PN Junction

Lecture 20 - PN Junction (Continued.)

Lecture 21 - PN Junction (Continued.)

Lecture 22 - PN Junction (Continued.)

Lecture 23 - PN Junction (Continued.)

Lecture 24 - PN Junction (Continued.)

Lecture 25 - PN Junction (Continued.)

Lecture 26 - Bipolar Junction Transistor

Lecture 27 - Bipolar Junction Transistor (Continued.)

Lecture 28 - Bipolar Junction Transistor (Continued.)

Lecture 29 - Bipolar Junction Transistor (Continued.)

Lecture 30 - Bipolar Junction Transistor (Continued.)

Lecture 31 - Bipolar Junction Transistor (Continued.)

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[Lecture 42 - The Final Lecture - Conclusion](#)

Lecture 1 - Introduction to VLSI Design

Lecture 2 - Combinational Circuit Design

Lecture 3 - Programmable Logic Devices

Lecture 4 - Programmable Array Logic

Lecture 5 - Review of Flip-Flops

Lecture 6 - Sequential Circuits

Lecture 7 - Sequential Circuit Design

Lecture 8 - MSI Implementation of Sequential Circuits

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Lecture 10 - Verilog Modeling of Combinational Circuits

Lecture 11 - Modeling of Verilog Sequential Circuits - Core Statements

Lecture 12 - Modeling of Verilog Sequential Circuits - Core Statements(Continued.)

Lecture 13 - RTL Coding Guidelines

Lecture 14 - Coding Organization - Complete Realization

Lecture 15 - Coding Organization - Complete Realization (Continued.)

Lecture 16 - Writing a Test Bench

Lecture 17 - System Design using ASM Chart

Lecture 18 - Example of System Design using ASM Chart

Lecture 19 - Examples of System Design using Sequential Circuits

Lecture 20 - Examples of System Design using Sequential Circuits (Continued.)

Lecture 21 - Microprogrammed Design

Lecture 22 - Microprogrammed Design (Continued.)

Lecture 23 - Design Flow of VLSI Circuits

Lecture 24 - Simulation of Combinational Circuits

Lecture 25 - Simulation of Combinational and Sequential Circuits

Lecture 26 - Analysis of Waveforms using Modelsim

Lecture 27 - Analysis of Waveforms using Modelsim (Continued.)

Lecture 28 - ModelSim Simulation Tool

Lecture 29 - Synthesis Tool

Lecture 30 - Synthesis Tool (Continued.)

Lecture 31 - Synplify Tool - Schematic Circuit Diagram View

- Lecture 32 - Technology View using Synplify Tool
- Lecture 33 - Synopsys Full and Parallel Cases
- Lecture 34 - Xilinx Place & Route Tool
- Lecture 35 - Xilinx Place & Route Tool (Continued.)
- Lecture 36 - PCI Arbiter Design using ASM Chart
- Lecture 37 - Design of Memories - ROM
- Lecture 38 - Design of Memories- RAM
- Lecture 39 - Design of External RAM
- Lecture 40 - Design of Arithmetic Circuits
- Lecture 41 - Design of Arithmetic Circuits (Continued.)
- Lecture 42 - Design of Arithmetic Circuits (Continued.)
- Lecture 43 - System Design Examples
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- Lecture 46 - System Design Examples (Continued.)
- Lecture 47 - System Design Examples (Continued.)
- Lecture 48 - System Design Examples using FPGA Board
- Lecture 49 - System Design Examples using FPGA Board (Continued.)
- Lecture 50 - Advanced Features of Xilinx Project Navigator
- Lecture 51 - System Design Examples using FPGA Board (Continued.)
- Lecture 52 - System Design Examples using FPGA Board (Continued.)
- Lecture 53 - System Design Examples using FPGA Board (Continued.)
- Lecture 54 - System Design Examples using FPGA Board (Continued.)
- Lecture 55 - Project Design Suggested for FPGA/ASIC Implementations

- Lecture 1 - Introduction on VLSI Design
- Lecture 2 - Bipolar Junction Transistor Fabrication
- Lecture 3 - MOSFET Fabrication for IC
- Lecture 4 - Crystal Structure of Si
- Lecture 5 - Crystal Structure (Continued.)
- Lecture 6 - Defects in Crystal + Crystal growth
- Lecture 7 - Crystal growth Contd + Epitaxy I
- Lecture 8 - Epitaxy II - Vapour phase Epitaxy
- Lecture 9 - Epitaxy III - Doping during Epitaxy
- Lecture 10 - Molecular beam Epitaxy
- Lecture 11 - Oxidation I - Kinetics of Oxidation
- Lecture 12 - Oxidation II - Oxidation rate constants
- Lecture 13 - Oxidation III - Dopant Redistribution
- Lecture 14 - Oxidation IV - Oxide Charges
- Lecture 15 - Diffusion I - Theory of Diffusion
- Lecture 16 - Diffusion II - Infinite Source
- Lecture 17 - Diffusion III - Actual Doping Profiles
- Lecture 18 - Diffusion IV - Diffusion Systems
- Lecture 19 - Ion - Implantation Process
- Lecture 20 - Ion - Implantation Process
- Lecture 21 - Annealing of Damages
- Lecture 22 - Masking during Implantation
- Lecture 23 - Lithography - I
- Lecture 24 - Lithography - II
- Lecture 25 - Wet Chemical Etching
- Lecture 26 - Dry Etching
- Lecture 27 - Plasma Etching Systems
- Lecture 28 - Etching of Si, SiO₂, SiN and other materials
- Lecture 29 - Plasma Deposition Process
- Lecture 30 - Metallization - I
- Lecture 31 - Problems in Aluminium Metal contacts

[Lecture 32 - IC BJT - From junction isolation to LOCOS](#)

[Lecture 33 - Problems in LOCOS + Trench isolation](#)

[Lecture 34 - More about BJT Fabrication and Realization](#)

[Lecture 35 - Circuits + Transistors in ECL Circuits](#)

[Lecture 36 - MOSFET I - Metal gate vs. Self-aligned Poly-gate](#)

[Lecture 37 - MOSFET II Tailoring of Device Parameters](#)

[Lecture 38 - CMOS Technology](#)

[Lecture 39 - Latch - up in CMOS](#)

[Lecture 40 - BICMOS Technology](#)

Lecture 1 - Introduction to the course; Current and Voltage; Kirchhoff's Current and Voltage laws

Lecture 2 - Electrical circuit elements: Voltage and current sources; R, C, L; Voltage sources in series; Example of superposition

Lecture 3 - Elements in series and parallel; Superposition in linear circuits

Lecture 4 - Controlled sources; Determining the characteristics of a two terminal element; Realizing a resistor using a VCCS or a CCVS

Lecture 5 - Nodal analysis of a network with conductances and current sources; Setting up the equations; Conductance matrix; Superposition

Lecture 6 - Circuit analysis; Number of KCL and KVL equations in a circuit; Nodal analysis of a network with conductances and current sources; Setting up the equations; Conductance matrix;

Lecture 7 - Nodal analysis with voltage sources and controlled sources; Brief introduction to modified nodal analysis; Use of supernode to solve circuits with voltage sources; Superposition theorem

Lecture 8 - Mesh analysis of a circuit with resistors and voltage sources; Comparison with nodal analysis; Mesh analysis of circuits with current sources-supermesh

Lecture 9 - Choice of nodal versus mesh analysis; Circuit theorems: Pushing a voltage source through a node, splitting a current source, substitution theorem, superposition

Lecture 10 - Thevenin and Norton (theorem and) equivalent circuits; Power conservation in a circuit

Lecture 11 - Tellegen's theorem; Reciprocity theorem

Lecture 12 - Compensation Theorem; Two ports

Lecture 13 - Two port parameters-y parameters

Lecture 14 - Two port parameters(z, h, and g); Reciprocal two ports

Lecture 15 - Opamp, ideal opamp circuits, non-inverting and inverting amplifiers; Ensuring that the opamp has negative feedback

Lecture 16 - RC circuit natural response; First order differential equation

Lecture 17 - RC (first-order) circuit, complete response with step inputs; Transient(natural) and steady state(forced) responses; Zero-state and zero-input responses

Lecture 18 - Step response of RC circuit with loops of voltage sources and capacitors; RL circuits; RLC circuits

Lecture 19 - Second order(RLC circuit) natural response; Series and parallel RLC circuits; Differential equation-characteristic equation and solutions; Forced response of a second order circuit

Lecture 20 - General formulation of second order(RLC circuit) natural response; Natural frequency and damping/quality factor; Series/parallel RLC circuits; R, L, C in sinusoidal steady state

Lecture 21 - Sinusoidal steady state response of RC and RLC circuits

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 - Solutions to the assignment on units 1 and 2

Lecture 15 - Series connection-Voltage sources in series

Lecture 16 - Series connection of R, L, C, current source

Lecture 17 - Elements in parallel

Lecture 18 - Current source in series with an element; Voltage source in parallel with an element

Lecture 19 - Extreme cases: Open and short circuits

Lecture 20 - Summary

Lecture 21 - Voltage controlled voltage source (VCVS)

Lecture 22 - Voltage controlled current source (VCCS)

Lecture 23 - Current controlled voltage source (CCVS)

Lecture 24 - Current controlled current source (CCCS)

Lecture 25 - Realizing a resistance using a VCCS or CCCS

Lecture 26 - Scaling an element's value using controlled sources

Lecture 27 - Example calculation

Lecture 28 - Solution to the assignment on units 3 and 4

Lecture 29 - Power and energy absorbed by electrical elements

Lecture 30 - Power and energy in a resistor

Lecture 31 - Power and energy in a capacitor

- Lecture 32 - Power and energy in an inductor
- Lecture 33 - Power and energy in a voltage source
- Lecture 34 - Power and energy in a current source
- Lecture 35 - Goals of circuit analysis
- Lecture 36 - Number of independent KCL equations
- Lecture 37 - Number of independent KVL equations and branch relationships
- Lecture 38 - Analysis of circuits with a single independent source
- Lecture 39 - Analysis of circuits with multiple independent sources using superposition
- Lecture 40 - Superposition: Example
- Lecture 41 - Solution to the assignment on units 5 and 6
- Lecture 42 - What is nodal analysis
- Lecture 43 - Setting up nodal analysis equations
- Lecture 44 - Structure of the conductance matrix
- Lecture 45 - How elements appear in the nodal analysis formulation
- Lecture 46 - Completely solving the circuit starting from nodal analysis
- Lecture 47 - Nodal analysis example
- Lecture 48 - Matrix inversion basics
- Lecture 49 - Nodal analysis with independent voltage sources
- Lecture 50 - Supernode for nodal analysis with independent voltage sources
- Lecture 51 - Nodal analysis with VCCS
- Lecture 52 - Nodal analysis with VCVS
- Lecture 53 - Nodal analysis with CCVS
- Lecture 54 - Nodal analysis with CCCS
- Lecture 55 - Nodal analysis summary
- Lecture 56 - Solution to the assignment on units 7 and 8
- Lecture 57 - Planar circuits
- Lecture 58 - Mesh currents and their relationship to branch currents
- Lecture 59 - Mesh analysis
- Lecture 60 - Mesh analysis with independent current sources-Supermesh
- Lecture 61 - Mesh analysis with current controlled voltage sources
- Lecture 62 - Mesh analysis with current controlled current sources
- Lecture 63 - Mesh analysis using voltage controlled sources
- Lecture 64 - Nodal analysis versus Mesh analysis

Lecture 65 - Superposition theorem

Lecture 66 - Pushing a voltage source through a node

Lecture 67 - Splitting a current source

Lecture 68 - Substitution theorem: Current source

Lecture 69 - Substitution theorem: Voltage source

Lecture 70 - Substituting a voltage or current source with a resistor

Lecture 71 - Solutions

Lecture 72 - Extensions to Superposition and Substitution theorem

Lecture 73 - Thevenin's theorem

Lecture 74 - Worked out example: Thevenin's theorem

Lecture 75 - Norton's theorem

Lecture 76 - Worked out example: Norton's theorem

Lecture 77 - Maximum power transfer theorem

Lecture 78 - Preliminaries.

Lecture 79 - Two port parameters

Lecture 80 - y parameters

Lecture 81 - y parameters: Examples

Lecture 82 - Solutions.

Lecture 83 - z parameters

Lecture 84 - z parameters: Examples

Lecture 85 - h parameters

Lecture 86 - h parameters: Examples

Lecture 87 - g parameters

Lecture 88 - g parameters: Examples

Lecture 89 - Calculations with a two-port element

Lecture 90 - Calculations with a two-port element.

Lecture 91 - Degenerate cases

Lecture 92 - Relationships between different two-port parameters

Lecture 93 - Equivalent circuit representation for two ports

Lecture 94 - Reciprocity

Lecture 95 - Proof of reciprocity of resistive two-ports

Lecture 96 - Proof for 4-terminal two-ports

Lecture 97 - Reciprocity in terms of different two-port parameters

- Lecture 98 - Reciprocity in circuits containing controlled sources
- Lecture 99 - Examples
- Lecture 100 - Solutions..
- Lecture 101 - Feedback amplifier using an opamp
- Lecture 102 - Ideal opamp
- Lecture 103 - Negative feedback around the opamp
- Lecture 104 - Finding opamp signs for negative feedback
- Lecture 105 - Example: Determining opamp sign for negative feedback
- Lecture 106 - Analysis of circuits with opamps
- Lecture 107 - Inverting amplifier
- Lecture 108 - Summing amplifier
- Lecture 109 - Instrumentation amplifier
- Lecture 110 - Negative resistance and Miller effect
- Lecture 111 - Finding opamp signs for negative feedback-circuits with multiple opamps
- Lecture 112 - Opamp supply voltages and saturation
- Lecture 113 - KCL with an opamp and supply currents
- Lecture 114 - Solutions...
- Lecture 115 - Circuits with storage elements (capacitors and inductors)
- Lecture 116 - First order circuit with zero input-natural response
- Lecture 117 - First order RC circuit with zero input-Example
- Lecture 118 - First order circuit with a constant input
- Lecture 119 - General form of the first order circuit response
- Lecture 120 - First order RC circuit with a constant input-Example
- Lecture 121 - First order circuit with piecewise constant input
- Lecture 122 - First order circuit with piecewise constant input-Example
- Lecture 123 - First order circuit-Response of arbitrary circuit variables
- Lecture 124 - Summary: Computing first order circuit response
- Lecture 125 - Does a capacitor block DC?
- Lecture 126 - Finding the order of a circuit
- Lecture 127 - First order RC circuits with discontinuous capacitor voltages
- Lecture 128 - Summary: Computing first order circuit response with discontinuities
- Lecture 129 - First order RL circuits
- Lecture 130 - First order RL circuit with discontinuous inductor current-Example

- [Lecture 131 - First order RC circuit with an exponential input](#)
- [Lecture 132 - First order RC response to its own natural response](#)
- [Lecture 133 - First order RC response to a sinusoidal input](#)
- [Lecture 134 - First order RC response to a sinusoidal input-via the complex exponential](#)
- [Lecture 135 - Summary: Linear circuit response to sinusoidal input via the complex exponential](#)
- [Lecture 136 - Three methods of calculating the sinusoidal steady state response](#)
- [Lecture 137 - Calculating the total response including initial conditions](#)
- [Lecture 138 - Why are sinusoids used in measurement?](#)
- [Lecture 139 - Second order system natural response](#)
- [Lecture 140 - Second order system as a cascade of two first order systems](#)
- [Lecture 141 - Second order system natural response-critically damped and underdamped](#)
- [Lecture 142 - Generalized form of a second order system](#)
- [Lecture 143 - Numerical example](#)
- [Lecture 144 - Series and parallel RLC circuits](#)
- [Lecture 145 - Forced response of a second order system](#)
- [Lecture 146 - Steady state response calculation and Phasors](#)
- [Lecture 147 - Phasors \(Continued...\)](#)
- [Lecture 148 - Magnitude and Phase plots](#)
- [Lecture 149 - Magnitude and phase plots of a second order system](#)
- [Lecture 150 - Maximum power transfer and Conjugate matching](#)

Lecture 1 - MOS Transistor

Lecture 2 - MOS Transistor - Detailed Study

Lecture 3 - Combinational Circuits and layout

Lecture 4 - Delay

Lecture 5 - Sequential Circuits

Lecture 6 - Logical Effort

Lecture 7 - Circuit Families

Lecture 8 - Lab-01

Lecture 9 - Lab-02

Lecture 10 - Lab-03

Lecture 11 - Lab-04

Lecture 12 - Introduction to Synthesis

Lecture 13 - Libraries

Lecture 14 - RTL Coding for Synthesis

Lecture 15 - Reading Design in DC

Lecture 16 - Design Environment

Lecture 17 - Design Constraints

Lecture 18 - Compile Flow and strategies

Lecture 19 - Analysis and Reporting

Lecture 20 - Lab-05

Lecture 21 - Advanced Synthesis Techniques

Lecture 22 - Datapath Extraction Guidelines

Lecture 23 - Power - Methodology and Analysis

Lecture 24 - Lab-06

Lecture 25 - Lab-07

Lecture 26 - Lab-08

Lecture 27 - Lab-09

Lecture 28 - Static Timing Analysis - Concepts and Flow

Lecture 29 - Interconnects and Delay calculation

Lecture 30 - Clock and Exceptions

Lecture 31 - On Chip Variation

[Lecture 32 - Introduction to Crosstalk](#)

[Lecture 33 - Gaussian / Normal Distribution](#)

[Lecture 34 - Equivalence Checking / Formal Verification](#)

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NPTEL : ARM Based Development (Electronics and Communication Engineering)

Co-ordinators : Mr. S. Chandramouleeswaran

Lecture 1 - Types of computer Architectures, ISA's and ARM History

Lecture 2 - Embedded System Software and Hardware, stack implementation in ARM, Endianness, condition codes

Lecture 3 - Processor core VS CPU core, ARM7TDMI Interface signals, Memory Interface, Bus Cycle types, Register set, Operational Modes

Lecture 4 - Instruction Format, ARM Core Data Flow Model, ARM 3 stage Pipeline, ARM family attribute comparison

Lecture 5 - ARM 5 stage Pipeline, Pipeline Hazards, Data forwarding - a hardware solution

Lecture 6 - ARM ISA and Processor Variants, Different Types of Instructions, ARM Instruction set, data processing instructions

Lecture 7 - Shift Operations, shift Operations using RS lower byte, Immediate value encoding

Lecture 8 - Dataprocessing Instructions

Lecture 9 - Addressing Mode-1, Addressing Mode-2

Lecture 10 - Addressing Mode-2, LDR/STR, Addressing mode-3 with examples

Lecture 11 - Instruction Timing, Addressing Mode-4 with Examples

Lecture 12 - Swap Instructions, Swap Register related Instructions, Loading Constants

Lecture 13 - Program Control Flow, Control Flow Instructions, B & BL instructions, BX instruction

Lecture 14 - Interrupts and Exceptions, Exception Handlers, Reset Handling

Lecture 15 - Aborts, software Interrupt Instruction, undefined instruction exception

Lecture 16 - Interrupt Latency, Multiply Instructions, Instruction set examples

Lecture 17 - Thumb state, Thumb Programmers model, Thumb Implementation, Thumb Applications

Lecture 18 - Thumb Instructions, Interrupt processing

Lecture 19 - Interrupt Handelling schemes, Examples of Interrupt Handlers

Lecture 20 - Coprocessors

Lecture 21 - Coprocessor Instructions, data Processing Instruction, data transfers, register transfers

Lecture 22 - Number representations, floating point representation

Lecture 23 - Flynn's Taxonomy, SIMD and Vector Processors, Vector Floating Point Processor (VFP), VFP and ARM interactions, An example vector operation

Lecture 24 - Memory Technologies, Need for memory Hierarchy, Hierarchical Memory Organization, Virtual Memory

Lecture 25 - Cache Memory, Mapping Functions

Lecture 26 - Cache Design, Unified or split cache, multiple level of caches, ARM cache features, coprocessor 15 for system control

Lecture 27 - Processes, Memory Map, Protected Systems, ARM systems with MPU, memory Protection Unit (MPU)

Lecture 28 - Physical Vs Virtual Memory, Paging, Segmentation

Lecture 29 - MMU Advantage, virtual memory translation, Multitasking with MMU, MMU organization, Tightly coupled Memory (TCM)

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Lecture 30 - ARM Development Environment, Arm Procedure Call Standard (APCS),

Lecture 31 - Example C program

Lecture 32 - Embedded software Development, Image structure, linker inputs and outputs, memory map, application startup

Lecture 33 - AMBA Overview, Typical AMAB Based Microcontroller, AHB bus features, AHB Bus transfers, APB bus transfers, APB bridge

Lecture 34 - DMA, Peripherals, Programming Peripherals in ARM

Lecture 35 - DMA:Direct Memory Access

Lecture 36 - Protocols (I2c, SPI), UART, GPIO

Lecture 37 - ARM ISAs, ARMv5, ARMv6, ARM v7, big.little technology, ARMv8

[Lecture 1 - Embedded Systems Basics Session 1](#)

[Lecture 2 - Embedded Systems Basics Session 1 \(Continued...\)](#)

[Lecture 3 - Prerequisites for Embedded Systems Testing](#)

[Lecture 4 - Test Case Design and procedures](#)

[Lecture 5 - Test Standards](#)

[Lecture 6 - Depicting Levels of Testing](#)

[Lecture 7 - Depicting Levels of Testing \(Continued...\)](#)

[Lecture 8 - Software Life Cycle](#)

[Lecture 9 - Embedded V-Model Life Cycle](#)

[Lecture 10 - Embedded V-Model Life Cycle \(Continued...\)](#)

[Lecture 11 - Master Test Planning](#)

[Lecture 12 - Dynamic Testing](#)

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Co-ordinators : Prof. V.G.K. Murti, Mr. C. S. Ramalingam, Dr. Andrew Thangaraj

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Lecture 30 - Warning flip-flops design and operation

Lecture 31 - Single phase flip-flops design and operation

[Lecture 32 - Consideration of radiation effects in NTV](#)

[Lecture 33 - Radiation-hardened NTV sequential circuit elements](#)

[Lecture 34 - Level shifters for multi-Vdd domains](#)

[Lecture 35 - Introduction to 6T SRAM](#)

[Lecture 36 - Stability and Reliability Issues in 6T SRAM](#)

[Lecture 37 - Read and Write-Assist Circuits in 6T SRAM](#)

[Lecture 38 - Physical Insights into Channel Charge Distribution](#)

[Lecture 39 - FinFET based Standard Cell Design](#)

[Lecture 40 - Example problems](#)

Lecture 1 - Transistor Amplifier

Lecture 2 - Transistor Op-amp and Transistor Based Voltage Regulator

Lecture 3 - Some applications of transistor - I

Lecture 4 - Some applications of transistor - II

Lecture 5 - Transformer design & Heat sink design

Lecture 6 - Op-amp Based Linear Voltage Regulator

Lecture 7 - Short circuit protection for linear power supply

Lecture 8 - Temperature indicator design using Op-amp

Lecture 9 - On & off Temperature controller design

Lecture 10 - Proportional Temperature Controller Design

Lecture 11 - PID - Temperature Controller Design

Lecture 12 - Heater Drive for Various Temperature Controllers

Lecture 13 - Short Circuit Protection of Power MOSFET

Lecture 14 - Error budgeting for temperature Indicator

Lecture 15 - PID Temperature Controllers with Error Budgeting

Lecture 16 - Error Budgeting for Constant Current Sources

Lecture 17 - Error Budgeting for Thermo Couple Amplifier

Lecture 18 - Error Budgeting for Op amp Circuits

Lecture 19 - Gain Error Calculation in Op amp Circuits

Lecture 20 - Input Resistance Calculations for Op amp

Lecture 21 - Output Resistance Calculations for Op amp

Lecture 22 - Error Budgeting for Different Circuits

Lecture 23 - 4-20 mA current Transmitter design

Lecture 24 - Error budgeting for 4-20mA Current Transmitters

Lecture 25 - LVDT Based Current Transmitters

Lecture 26 - Constant Current Source Design

Lecture 27 - 4-20 MA Based Temperature Transmitter

Lecture 28 - 3-Wire Current Transmitter

Lecture 29 - Various Resistance Measurement Techniques

Lecture 30 - Ratio Transformer Technique to Measure Resistance and capacitance

Lecture 31 - Capacitive Sensor Circuit Design Examples

[Lecture 32 - Capacitive Sensor Circuit With High Impedance Amplifier](#)

[Lecture 33 - AC- applications of the Op-Amp and Lock in Amplifier Design](#)

[Lecture 34 - Design of lock in Amplifier Circuit with example](#)

[Lecture 35 - Dual Slopes ADC Design Examples](#)

[Lecture 36 - Dual Slope ADC and Successor approximation ADC](#)

[Lecture 37 - MC based ADC](#)

[Lecture 38 - Digital to analog Converter design and working, Flash ADC](#)

[Lecture 39 - Flash ADC and ADC Converter errors](#)

[Lecture 40 - Sigma delta ADC working Principle](#)

- Lecture 1 - Course Contents, Objective
- Lecture 2 - Revision of Prerequisite
- Lecture 3 - Design of Synchronous Sequential Circuits
- Lecture 4 - Analysis of Synchronous Sequential Circuits
- Lecture 5 - Top-down Design
- Lecture 6 - Controller Design
- Lecture 7 - Control algorithm and State diagram
- Lecture 8 - Case study 1
- Lecture 9 - FSM issues 1
- Lecture 10 - FSM Issues 2
- Lecture 11 - FSM Issues 3
- Lecture 12 - FSM Issues 4
- Lecture 13 - FSM Issues 5
- Lecture 14 - Synchronization 1
- Lecture 15 - Synchronization 2
- Lecture 16 - Case study 2
- Lecture 17 - Case study on FPGA Board
- Lecture 18 - Entity, Architecture and Operators
- Lecture 19 - Concurrency, Data flow and Behavioural models
- Lecture 20 - Structural Model, Simulation
- Lecture 21 - Simulating Concurrency
- Lecture 22 - Classes and Data types
- Lecture 23 - Concurrent statements and Sequential statements
- Lecture 24 - Sequential statements and Loops
- Lecture 25 - Modelling flip-flops, Registers
- Lecture 26 - Synthesis of Sequential circuits
- Lecture 27 - Libraries and Packages
- Lecture 28 - Operators, Delay modelling
- Lecture 29 - Delay modelling
- Lecture 30 - VHDL Examples
- Lecture 31 - VHDL coding of FSM

[Lecture 32 - VHDL Test bench](#)

[Lecture 33 - VHDL Examples, FSM Clock](#)

[Lecture 34 - Evolution of PLDs](#)

[Lecture 35 - Simple PLDs](#)

[Lecture 36 - Simple PLDs: Fitting](#)

[Lecture 37 - Complex PLDs](#)

[Lecture 38 - FPGA Introduction](#)

[Lecture 39 - FPGA Interconnection, Design Methodology](#)

[Lecture 40 - Xilinx Virtex FPGA's CLB](#)

[Lecture 41 - Xilinx Virtex Resource Mapping, IO Block](#)

[Lecture 42 - Xilinx Virtex Clock Tree](#)

[Lecture 43 - FPGA Configuration](#)

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Lecture 1 - Course Overview & Basics

Lecture 2 - Example Codes and their Parameters

Lecture 3 - Mathematical Preliminaries: Groups

Lecture 4 - Subgroups and Equivalence Relations

Lecture 5 - Cosets, Rings & Fields

Lecture 6 - Vector Spaces, Linear Independence and Basis

Lecture 7 - Linear Codes, & Linear independence

Lecture 8 - Spanning & Basis

Lecture 9 - The Dual Code

Lecture 10 - Systematic Generator Matrix

Lecture 11 - Minimum Distance of a Linear Code

Lecture 12 - Bounds on the size of a Code

Lecture 13 - Asymptotic Bounds

Lecture 14 - Standard Array Decoding

Lecture 15 - Performance Analysis of the SAD

Lecture 16 - State and Trellis

Lecture 17 - The Viterbi Decoder

Lecture 18 - Catastrophic Error Propagation

Lecture 19 - Path Enumeration

Lecture 20 - Viterbi Decoder over the AWGN Channel

Lecture 21 - Generalized Distributive Law

Lecture 22 - The MPF Problem

Lecture 23 - Further Examples of the MPF Problem

Lecture 24 - Junction Trees

Lecture 25 - Example of Junction Tree Construction

Lecture 26 - Message passing on the Junction tree

Lecture 27 - GDL Approach to Decoding Convolutional Codes

Lecture 28 - ML Code-Symbol Decoding of the Convolutional Code

Lecture 29 - LDPC Codes

Lecture 30 - LDPC Code Terminology

Lecture 31 - Gallager Decoding Algorithm A

[Lecture 32 - BP Decoding of LDPC Codes](#)

[Lecture 33 - BP Decoding \(Continued\)](#)

[Lecture 34 - Density Evolution under BP decoding](#)

[Lecture 35 - Convergence & Concentration Theorem - LDPC Codes](#)

[Lecture 36 - A Construction for Finite Fields](#)

[Lecture 37 - Finite Fields: A Deductive Approach](#)

[Lecture 38 - Deductive Approach to Finite Fields](#)

[Lecture 39 - Subfields of a Finite field](#)

[Lecture 40 - Transform Approach to Cyclic Codes](#)

[Lecture 41 - Estimating the Parameters of a Cyclic Code](#)

[Lecture 42 - Decoding Cyclic Codes](#)

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

NPTEL : Nanoelectronics: Devices and Materials (Electronics and Communication Engineering)

Co-ordinators : Dr. Navakanta Bhat, Prof. K.N. Bhat, Dr. S.A. Shivashankar

Lecture 1 - Introduction to Nanoelectronics

Lecture 2 - CMOS Scaling Theory

Lecture 3 - Short Channel Effects

Lecture 4 - Subthreshold Conduction

Lecture 5 - Drain Induced Barrier Lowering

Lecture 6 - Channel and Source / Drain Engineering

Lecture 7 - CMOS Process Flow

Lecture 8 - Gate oxide scaling and reliability

Lecture 9 - High-k gate dielectrics

Lecture 10 - Metal gate transistor

Lecture 11 - Industrial CMOS Technology

Lecture 12 - Ideal MOS C-V Characteristics

Lecture 13 - Effect of non idealities on C-V

Lecture 14 - MOS Parameter Extraction from C-V Characteristics

Lecture 15 - MOS Parameter Extraction from I-V Characteristics

Lecture 16 - MOSFET Analysis, sub-threshold swing $\hat{A}^{\hat{S}\hat{A}}$

Lecture 17 - Interface state density effects on $\hat{A}^{\hat{S}\hat{A}}$. Short Channel Effects (SCE) and Drain Induced Barrier Lowering (DIBL)

Lecture 18 - Velocity Saturation, Ballistic transport, and Velocity Overshoot Effects and Injection Velocity

Lecture 19 - SOI Technology and comparisons with Bulk Silicon CMOS technology

Lecture 20 - SOI MOSFET structures, Partially Depleted (PD) and Fully Depleted (FD) SOI MOSFETs

Lecture 21 - FD SOI MOSFET: Operation Modes and Threshold Voltages and Electric Fields

Lecture 22 - Sub-threshold Slope & SCE suppression in FD SOI MOSFET, Volume Inversion and Ultra thin (UTFD) SOI MOSFET and quantization Effect, FINFET

Lecture 23 - Need for MS contact Source/Drain Junction in Nano scale MOSFETs

Lecture 24 - Rectifying and Ohmic contacts and challenges in MS junction source drain MOSFET Technology

Lecture 25 - Effect of Interface states and Fermi level pinning on MS contacts on Si and passivation techniques for MS S/D MOSFETS

Lecture 26 - Germanium as an alternate to silicon for high performance MOSFETs and the challenges in Germanium Technology

Lecture 27 - Germanium MOSFET technology and recent results on surface passivated Ge MOSFETS

Lecture 28 - Compound semiconductors and hetero junction FETs for high performance

Lecture 29 - GaAs MESFETs: Enhancement and depletion types. Velocity Overshoot effects in GaAs MESFETs

Lecture 30 - Hetero-junctions and High Electron Mobility Transistors (HEMT)

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[Lecture 31 - Introduction to Nanomaterials](#)

[Lecture 32 - Basic Principles of Quantum Mechanics](#)

[Lecture 33 - Basic Principles of Quantum Mechanics \(Continued...\)](#)

[Lecture 34 - Energy bands in crystalline solids](#)

[Lecture 35 - Quantum structures and devices](#)

[Lecture 36 - Crystal growth and nanocrystals](#)

[Lecture 37 - Nanocrystals and nanostructured thin films](#)

[Lecture 38 - Nanowires and other nanostructures](#)

[Lecture 39 - Carbon Nanostructures and CVD](#)

[Lecture 40 - Atomic layer deposition \(ALD\)](#)

[Lecture 41 - Characterisation of nanomaterials](#)

Lecture 1 - Introduction to Statistical Pattern Recognition

Lecture 2 - Overview of Pattern Classifiers

Lecture 3 - The Bayes Classifier for minimizing Risk

Lecture 4 - Estimating Bayes Error; Minimax and Neymann-Pearson classifiers

Lecture 5 - Implementing Bayes Classifier; Estimation of Class Conditional Densities

Lecture 6 - Maximum Likelihood estimation of different densities

Lecture 7 - Bayesian estimation of parameters of density functions, MAP estimates

Lecture 8 - Bayesian Estimation examples; the exponential family of densities and ML estimates

Lecture 9 - Sufficient Statistics; Recursive formulation of ML and Bayesian estimates

Lecture 10 - Mixture Densities, ML estimation and EM algorithm

Lecture 11 - Convergence of EM algorithm; overview of Nonparametric density estimation

Lecture 12 - Convergence of EM algorithm, Overview of Nonparametric density estimation

Lecture 13 - Nonparametric estimation, Parzen Windows, nearest neighbour methods

Lecture 14 - Linear Discriminant Functions; Perceptron -- Learning Algorithm and convergence proof

Lecture 15 - Linear Least Squares Regression; LMS algorithm

Lecture 16 - AdaLinE and LMS algorithm; General nonlinear least-squares regression

Lecture 17 - Logistic Regression; Statistics of least squares method; Regularized Least Squares

Lecture 18 - Fisher Linear Discriminant

Lecture 19 - Linear Discriminant functions for multi-class case; multi-class logistic regression

Lecture 20 - Learning and Generalization; PAC learning framework

Lecture 21 - Overview of Statistical Learning Theory; Empirical Risk Minimization

Lecture 22 - Consistency of Empirical Risk Minimization

Lecture 23 - Consistency of Empirical Risk Minimization; VC-Dimension

Lecture 24 - Complexity of Learning problems and VC-Dimension

Lecture 25 - VC-Dimension Examples; VC-Dimension of hyperplanes

Lecture 26 - Overview of Artificial Neural Networks

Lecture 27 - Multilayer Feedforward Neural networks with Sigmoidal activation functions;

Lecture 28 - Backpropagation Algorithm; Representational abilities of feedforward networks

Lecture 29 - Feedforward networks for Classification and Regression; Backpropagation in Practice

Lecture 30 - Radial Basis Function Networks; Gaussian RBF networks

Lecture 31 - Learning Weights in RBF networks; K-means clustering algorithm

Lecture 32 - Support Vector Machines -- Introduction, obtaining the optimal hyperplane

Lecture 33 - SVM formulation with slack variables; nonlinear SVM classifiers

Lecture 34 - Kernel Functions for nonlinear SVMs; Mercer and positive definite Kernels

Lecture 35 - Support Vector Regression and ϵ -insensitive Loss function, examples of SVM learning

Lecture 36 - Overview of SMO and other algorithms for SVM; ν -SVM and ν -SVR; SVM as a risk minimizer

Lecture 37 - Positive Definite Kernels; RKHS; Representer Theorem

Lecture 38 - Feature Selection and Dimensionality Reduction; Principal Component Analysis

Lecture 39 - No Free Lunch Theorem; Model selection and model estimation; Bias-variance trade-off

Lecture 40 - Assessing Learnt classifiers; Cross Validation;

Lecture 41 - Bootstrap, Bagging and Boosting; Classifier Ensembles; AdaBoost

Lecture 42 - Risk minimization view of AdaBoost

- Lecture 1 - Introduction to Sensors, Signals and Systems
- Lecture 2 - Role of Analog Signal Processing in Electronic Products - Part I
- Lecture 3 - Role of Analog Signal Processing in Electronic Products - Part II
- Lecture 4 - Analog Signal Processing using One Port Networks
- Lecture 5 - Analog Signal Processing using One Port Networks, Passive Two Ports and Ideal amplifiers
- Lecture 6 - Synthesis of Amplifiers using Nullators and Norators
- Lecture 7 - Passive Electronic Devices for Analog Signal Processing
- Lecture 8 - Active Devices for Analog Signal Processing Systems
- Lecture 9 - Electronic Devices for Analog Circuits - Part I
- Lecture 10 - Electronic Devices for Analog Circuits - Part II
- Lecture 11 - Feedback in Systems
- Lecture 12 - Static Characteristic of Feedback Systems
- Lecture 13 - Dynamic Behaviour of Feedback Systems - Part I
- Lecture 14 - Dynamic Behavior of Feedback Systems - Part II
- Lecture 15 - Design of Feedback Amplifiers - Part I
- Lecture 16 - Design of Feedback Amplifiers - Part II
- Lecture 17 - Design of Feedback Amplifiers and Instrumentation Amplifiers
- Lecture 18 - Instrumentation Amplifiers, Integrators and Differentiators
- Lecture 19 - Non-linear Analog Signal Processing
- Lecture 20 - DC Voltage Regulators
- Lecture 21 - Filters - Approximations to ideal filter functions
- Lecture 22 - Passive Filters - Part I
- Lecture 23 - Passive Filters - Part II
- Lecture 24 - Active Filters - Part I
- Lecture 25 - Active Filters - Part II
- Lecture 26 - Active Filters: Q-enhancement
- Lecture 27 - State Space Filters
- Lecture 28 - Universal Active Filter - Effect of Active Device GB
- Lecture 29 - State-Space Filters (Tuning of Filters)
- Lecture 30 - Automatic Tuning of Filters (PLL) and Review of Filter Design
- Lecture 31 - Waveform Generation

[Lecture 32 - LC Oscillator - Effect of Non-idealities](#)

[Lecture 33 - Transconductor based Oscillator](#)

[Lecture 34 - Regenerative Comparators and Non-Sinusoidal Oscillators](#)

[Lecture 35 - Non-Sinusoidal Oscillators and VCO \(FM & FSK Generators\)](#)

[Lecture 36 - Phase and Frequency Followers](#)

[Lecture 37 - Frequency Locked Loop \(Popularly known as PLL\)](#)

[Lecture 38 - Design of PLL and FLL](#)

[Lecture 39 - Analog System Design](#)

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NPTEL : NOC:Design and Simulation of DC-DC converters using Open Source Tools (Electronics and Communication Engineering)

Co-ordinators : Prof. L. Umanand

- Lecture 1 - System Overview
- Lecture 2 - Understanding Rectifier with C-filter
- Lecture 3 - Setting up gEDA, ngSpice and Octave
- Lecture 4 - Simulation walk-through : Rectifier C-filter example
- Lecture 5 - Designing the rectifier capacitor filter circuit
- Lecture 6 - Startup surge limiting
- Lecture 7 - DC-DC converter concepts
- Lecture 8 - Buck, Boost and Buck-Boost Converters
- Lecture 9 - Simulation Example of Buck Converter
- Lecture 10 - Understanding Buck Converter
- Lecture 11 - Understanding Boost and Buck-Boost
- Lecture 12 - Forward Converter Topology
- Lecture 13 - Waveforms and Design
- Lecture 14 - Simulation of Forward Converter
- Lecture 15 - Forward Converter with Lossless Core Reset
- Lecture 16 - Transformer Design
- Lecture 17 - Inductor Design
- Lecture 18 - Flyback Converter Topology
- Lecture 19 - Pushpull Converter
- Lecture 20 - Half and Full Bridge Converters
- Lecture 21 - Close Loop Operation of Converters
- Lecture 22 - Simulation examples
- Lecture 23 - Multi-Output Converters
- Lecture 24 - Concluding Remarks

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NPTEL : NOC:Enclosure Design of Electronics Equipment (Electronics and Communication Engineering)

Co-ordinators : Prof. N. V Chalapathi Rao

Lecture 1 - Enclosure design for Electronics Equipment Introduction

Lecture 2 - Aspects and features that are non electrical and are essential to Electronic Product Realisation

Lecture 3 - Enclosure Design in electronic equipment

Lecture 4 - Design as applied to small electronics products and projects

Lecture 5 - Sketching in design for communication

Lecture 6 - Sketching as a tool with example and exercise

Lecture 7 - Sketching Part 2

Lecture 8 - Enclosures to Product design

Lecture 9 - Examples of product enclosures ID_PD

Lecture 10 - Enclosures with detailing: Examples

Lecture 11 - Alternate Designs in an everyday item

Lecture 12 - Sheet metal in small equipment (PSU)

Lecture 13 - Layouts and Materials of small equipment

Lecture 14 - Materials used for construction

Lecture 15 - Materials choice

Lecture 16 - Aluminium for common equipment

Lecture 17 - Use of Aluminium extrusions

Lecture 18 - Application of Sheet metal

Lecture 19 - Sheet Metal bending

Lecture 20 - Development of enclosures for bending

Lecture 21 - Video of Fabrication

Lecture 22 - What can be done in the lab Bending

Lecture 23 - Issues in bending and folding

Lecture 24 - Making a quick model

Lecture 25 - Detailing in plastic

Lecture 26 - Fabricating with flat plastic

Lecture 27 - Video in ID Lab

Lecture 28 - Off the shelf enclosures

Lecture 29 - Ready made enclosures

Lecture 30 - Application documentation and Selection

Lecture 31 - Index of protection, Safety

[Lecture 32 - NEMA and related](#)

[Lecture 33 - Testing for IP class](#)

[Lecture 34 - Sealed Enclosures Video](#)

[Lecture 35 - Public utility boxes](#)

[Lecture 36 - EMI Sealing](#)

[Lecture 37 - Sealed Enclosures 2](#)

[Lecture 38 - Gasketing practice](#)

[Lecture 39 - Gasketing Basics](#)

[Lecture 40 - Off the shelf Aluminum enclosures](#)

[Lecture 41 - Understanding](#)

[Lecture 42 - Heat sink enclosures](#)

[Lecture 43 - Detailing of Built in Heat sink boxes](#)

[Lecture 44 - Connector basics](#)

[Lecture 45 - Connectors - Part 2](#)

[Lecture 46 - Common connectors](#)

[Lecture 47 - Connectors \(multi way\) and CoAx](#)

[Lecture 48 - MIL C connectors](#)

[Lecture 49 - CAD in Layout Drawing](#)

[Lecture 50 - Types of CAD](#)

[Lecture 51 - CAD for enclosure Design](#)

[Lecture 52 - Egpt layout with CAD](#)

[Lecture 53 - CAD sample Example](#)

[Lecture 54 - CAD Layout](#)

[Lecture 55 - Detailing with CAD](#)

[Lecture 56 - Integrating Products with CAD](#)

[Lecture 57 - Product Detailing](#)

[Lecture 58 - Components CAD Physical Models](#)

[Lecture 59 - Sheet Metal and Plastic common details](#)

[Lecture 60 - Sample of Simple Organic Shapes](#)

[Lecture 61 - Conclusion](#)

Lecture 1 - A historical perspective

Lecture 2 - PV cell characteristics and equivalent circuit

Lecture 3 - Model of PV cell

Lecture 4 - Short Circuit, Open Circuit and peak power parameters

Lecture 5 - Datasheet study

Lecture 6 - Cell efficiency

Lecture 7 - Effect of temperature

Lecture 8 - Temperature effect calculation example

Lecture 9 - Fill factor

Lecture 10 - PV cell simulation

Lecture 11 - Identical cells in series

Lecture 12 - Load line

Lecture 13 - Non-identical cells in series

Lecture 14 - Protecting cells in series

Lecture 15 - Interconnecting modules in series

Lecture 16 - Simulation of cells in series

Lecture 17 - Identical cells in parallel

Lecture 18 - Non-identical cells in parallel

Lecture 19 - Protecting cells in parallel

Lecture 20 - Interconnecting modules

Lecture 21 - Simulation of cells in parallel

Lecture 22 - Practicals - Measuring i-v characteristics

Lecture 23 - Practicals - PV source emulation

Lecture 24 - Introduction

Lecture 25 - Insolation and irradiance

Lecture 26 - Insolation variation with time of day

Lecture 27 - Earth centric viewpoint and declination

Lecture 28 - Solar geometry

Lecture 29 - Insolation on a horizontal flat plate

Lecture 30 - Energy on a horizontal flat plate

Lecture 31 - Sunrise and sunset hour angles

Lecture 32 - Examples

Lecture 33 - Energy on a tilted flat plate

Lecture 34 - Energy plots in octave

Lecture 35 - Atmospheric effects

Lecture 36 - Airmass

Lecture 37 - Energy with atmospheric effects

Lecture 38 - Clearness index

Lecture 39 - Clearness index and energy scripts in Octave

Lecture 40 - Sizing PV for applications without batteries

Lecture 41 - Sizing PV Examples

Lecture 42 - Batteries - intro

Lecture 43 - Batteries - Capacity

Lecture 44 - Batteries - C-rate

Lecture 45 - Batteries - Efficiency

Lecture 46 - Batteries - Energy and power densities

Lecture 47 - Batteries - Comparison

Lecture 48 - Battery selection

Lecture 49 - Other energy storage methods

Lecture 50 - PV system design - Load profile

Lecture 51 - PV system design - Days of autonomy and recharge

Lecture 52 - PV system design - Battery size

Lecture 53 - PV system design - PV array size

Lecture 54 - Design toolbox in octave

Lecture 55 - MPPT concept>

Lecture 56 - Input impedance of DC-DC converters - Boost converter

Lecture 57 - Input impedance of DC-DC converters - Buck converter

Lecture 58 - Input impedance of DC-DC converters - Buck-Boost converter

Lecture 59 - Input impedance of DC-DC converters - PV module in SPICE

Lecture 60 - Input impedance of DC-DC converters -Simulation - PV and DC-DC interface

Lecture 61 - Impedance control methods

Lecture 62 - Impedance control methods- Reference cell - voltage scaling

Lecture 63 - Impedance control methods- Reference cell - current scaling

Lecture 64 - Impedance control methods- Reference cell - Sampling method

Lecture 65 - Impedance control methods- Reference cell - Power slope method 1

Lecture 66 - Impedance control methods- Reference cell - Power slope method 2

Lecture 67 - Impedance control methods- Reference cell - Hill climbing method

Lecture 68 - Practical points - Housekeeping power supply

Lecture 69 - Practical points - Gate driver

Lecture 70 - Practical points - MPPT for non-resistive loads

Lecture 71 - Simulation - MPPT

Lecture 72 - Direct PV-battery connection

Lecture 73 - Charge controller

Lecture 74 - Battery charger - Understanding current control

Lecture 75 - Battery charger - slope compensation

Lecture 76 - Battery charger - simulation of current control

Lecture 77 - Batteries in series - charge equalisation

Lecture 78 - Batteries in parallel

Lecture 79 - Peltier device - principle

Lecture 80 - Peltier element - datasheet

Lecture 81 - Peltier cooling

Lecture 82 - Thermal aspects

Lecture 83 - Thermal aspects - Conduction

Lecture 84 - Thermal aspects - Convection

Lecture 85 - Thermal aspects - A peltier refrigeration example

Lecture 86 - Thermal aspects - Radiation and mass transport

Lecture 87 - Demo of Peltier cooling

Lecture 88 - Water pumping principle

Lecture 89 - Hydraulic energy and power

Lecture 90 - Total dynamic head

Lecture 91 - Numerical solution - Colebrook formula

Lecture 92 - Octave script for head calculation

Lecture 93 - PV and Water Pumping Examples

Lecture 94 - Octave script for hydraulic power

Lecture 95 - Centrifugal pump

Lecture 96 - Reciprocating pump

Lecture 97 - PV power

- Lecture 98 - Pumped hydro application
- Lecture 99 - Grid connection principle
- Lecture 100 - PV to grid topologies Part-I
- Lecture 101 - PV to grid topologies Part-II
- Lecture 102 - PV to grid topologies Part-III
- Lecture 103 - 3ph d-q controlled grid connection intro
- Lecture 104 - 3ph d-q controlled grid connection dq-axis theory
- Lecture 105 - 3ph d-q controlled grid connection AC to DC transformations
- Lecture 106 - 3ph d-q controlled grid connection DC to AC transformations
- Lecture 107 - 3ph d-q controlled grid connection Complete 3ph grid connection
- Lecture 108 - 1ph d-q controlled grid connection
- Lecture 109 - 3ph PV-Grid interface example
- Lecture 110 - SVPWM - discrete implementation
- Lecture 111 - SVPWM - analog implementation
- Lecture 112 - Application of integrated magnetics
- Lecture 113 - Life cycle Costing Growth models
- Lecture 114 - Life cycle Costing Growth model examples
- Lecture 115 - Life cycle Costing Annual payment and present worth factor
- Lecture 116 - Life cycle Costing LCC with example - 1
- Lecture 117 - Life cycle Costing LCC example - 2
- Lecture 118 - Life cycle Costing LCC example - 3

- Lecture 1 - Introduction to Photonic Integrated Circuits
- Lecture 2 - Optical Waveguide Theory - Symmetric Waveguides
- Lecture 3 - Optical Waveguide Theory - Asymmetric Waveguides
- Lecture 4 - Vector Modes
- Lecture 5 - Channel Waveguide
- Lecture 6 - Directional Coupler and Coupled Mode Theory
- Lecture 7 - Passive Devices and Beam Propagation Method
- Lecture 8 - Dynamic Devices
- Lecture 9 - Integrated optical Systems and Applications
- Lecture 10 - Fabrication and Characterisation
- Lecture 11 - MOEMS
- Lecture 12 - Ring Resonators
- Lecture 13 - Photonic Band Gap Devices
- Lecture 14 - Lecture Summary

- Lecture 1 - Course Outline and Scope
- Lecture 2 - Biological Information Systems
- Lecture 3 - Analogy between Living Systems with Semiconductor Structures
- Lecture 4 - Action Potential - I
- Lecture 5 - Action Potential - II
- Lecture 6 - Synaptic Potential
- Lecture 7 - Threshold and Action Potential Propagation
- Lecture 8 - Anatomy of a Neuron
- Lecture 9 - Neuro Muscular Junction
- Lecture 10 - Spatial and Temporal Summation of neuronal electrical activities
- Lecture 11 - Brain Anatomy Introduction
- Lecture 12 - Architecture of the Nervous System
- Lecture 13 - Architecture of the Nervous System (Continued...)
- Lecture 14 - Analog and Digital Processing in the Neuron - I
- Lecture 15 - Analog and Digital Processing in the Neuron - II
- Lecture 16 - Energy Sources of Neuronal Systems
- Lecture 17 - Skull Demonstration
- Lecture 18 - Brain Anatomy: Skull
- Lecture 19 - Brain Anatomy 3D - I
- Lecture 20 - Brain Anatomy 3D - II
- Lecture 21 - Brain Anatomy 3D - III
- Lecture 22 - Basics of Brain Imaging Techniques
- Lecture 23 - Brain anatomy using MR images - I
- Lecture 24 - Brain anatomy using MR images - II
- Lecture 25 - Spinal Cord Anatomy
- Lecture 26 - Reflexes: Introduction
- Lecture 27 - Monosynaptic Reflexes
- Lecture 28 - Polysynaptic Reflexes
- Lecture 29 - Criteria for electrode material
- Lecture 30 - Introduction to brain stimulation
- Lecture 31 - Brain Stimulation: Device fabrication - Illustration

[Lecture 32 - Brain Stimulation: Electronic Systems \(Current Mirrors\)](#)

[Lecture 33 - Brain regions and associated functions](#)

[Lecture 34 - Human vision system - II](#)

[Lecture 35 - Network analysis during visual processing](#)

[Lecture 36 - Control of eye movements](#)

[Lecture 37 - COMSOL Multiphysics for Medical Devices](#)

[Lecture 38 - COMSOL Brain Electrical Stimulation Demo](#)

[Lecture 39 - Human vision system - III](#)

[Lecture 40 - Human auditory system - I](#)

[Lecture 41 - Human auditory system - II](#)

[Lecture 42 - Human auditory system - III](#)

[Lecture 43 - The human balance system](#)

[Lecture 44 - Movement: Introduction](#)

[Lecture 45 - Movement: Synchronization](#)

[Lecture 46 - Movement: Role of Spinall Cord](#)

[Lecture 47 - Movement: Role of Cerebellum](#)

[Lecture 48 - Memory and Learning - I](#)

[Lecture 49 - Memory and Learning - II](#)

[Lecture 50 - Microengineering devices for Neural Signal Acquisiton](#)

[Lecture 51 - Microfabrication Process for Multi Electrode Array](#)

[Lecture 52 - Introduction and Applications of Event Related Potentials](#)

[Lecture 53 - ERP Extraction Demonstration](#)

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

NPTEL : NOC:Analog Circuits and Systems (Electronics and Communication Engineering)

Co-ordinators : Prof. K Radhakrishna Rao

Lecture 1 - Introduction to Sensors, Signals and Systems

Lecture 2 - Role of Analog Signal Processing in Electronic Products - Part 1

Lecture 3 - Role of Analog Signal Processing in Electronic Products - Part 2

Lecture 4 - Analog Signal Processing using One Port Networks

Lecture 5 - Analog Signal Processing using One Port Networks, Passive Two Ports and Ideal amplifiers

Lecture 6 - Synthesis of Amplifiers using Nullators and Norators

Lecture 7 - Passive Electronic Devices for Analog Signal Processing

Lecture 8 - Active Devices for Analog Signal Processing Systems

Lecture 9 - Electronic Devices for Analog Circuits

Lecture 10 - Electronic Devices for Analog Circuits

Lecture 11 - Feedback in Systems

Lecture 12 - Static Characteristic of Feedback Systems

Lecture 13 - Dynamic Behavior of Feedback Systems - Part I

Lecture 14 - Dynamic Behavior of Feedback Systems - Part II

Lecture 15 - Design of Feedback Amplifiers

Lecture 16 - Design of Feedback Amplifiers

Lecture 17 - Design of Feedback Amplifiers and Instrumentation Amplifiers

Lecture 18 - Instrumentation Amplifiers, Integrators and Differentiators

Lecture 19 - Non-linear Analog Signal Processing

Lecture 20 - DC Voltage Regulators

Lecture 21 - Filters - Approximations to ideal filter functions

Lecture 22 - Passive Filters - Part 1

Lecture 23 - Passive Filters - Part 2

Lecture 24 - Active Filters - Part 1

Lecture 25 - Active Filters - Part 2

Lecture 26 - Active Filters: Q-enhancement

Lecture 27 - State Space Filters

Lecture 28 - Universal Active Filter - Effect of Active Device GB

Lecture 29 - State-Space Filters (Tuning of Filters)

Lecture 30 - Automatic Tuning of Filters (PLL) and Review of Filter Design

Lecture 31 - Waveform Generation

[Lecture 32 - LC Oscillator - Effect of Non-idealities](#)

[Lecture 33 - Transconductor based Oscillator](#)

[Lecture 34 - Regenerative Comparators and Non-Sinusoidal Oscillators](#)

[Lecture 35 - Non-Sinusoidal Oscillators and VCO \(FM and FSK Generators\)](#)

[Lecture 36 - Phase and Frequency Followers](#)

[Lecture 37 - Frequency Locked Loop \(Popularly known as PLL\)](#)

[Lecture 38 - Design of PLL and FLL](#)

[Lecture 39 - Analog System Design](#)