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# DIGIMAT - The No.1 Autonomous Learning 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 8 - Admittance Smith Chart
- Lecture 9 - Experimental setup for transmission line measurements
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Lecture 22 - Problem Solving Session: FT, DFT, & Z Transforms

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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

Lecture 9 - Design of Sequential Circuits using One Hot Controller

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

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Lecture 17 - System Design using ASM Chart

Lecture 18 - Example of System Design using ASM Chart

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

Lecture 21 - Microprogrammed Design

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Lecture 23 - Design Flow of VLSI Circuits

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- Lecture 35 - Xilinx Place & Route Tool (Continued.)
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- Lecture 48 - System Design Examples using FPGA Board
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- Lecture 50 - Advanced Features of Xilinx Project Navigator
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- Lecture 3 - MOSFET Fabrication for IC
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- 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
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- Lecture 16 - Diffusion II - Infinite Source
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- Lecture 19 - Ion - Implantation Process
- Lecture 20 - Ion - Implantation Process
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- Lecture 23 - Lithography - I
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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

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Lecture 2 - Current

Lecture 3 - Voltage

Lecture 4 - Electrical elements and circuits

Lecture 5 - Kirchoff's current law (KCL)

Lecture 6 - Kirchoff'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

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- 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
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- Lecture 39 - Analysis of circuits with multiple independent sources using superposition
- Lecture 40 - Superposition: Example
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- 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
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- Lecture 49 - Nodal analysis with independent voltage sources
- Lecture 50 - Supernode for nodal analysis with independent voltage sources
- Lecture 51 - Nodal analysis with VCCS
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- Lecture 54 - Nodal analysis with CCCS
- Lecture 55 - Nodal analysis summary
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- Lecture 79 - Two port parameters
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- Lecture 88 - g parameters: Examples
- Lecture 89 - Calculations with a two-port element
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- 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
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- 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
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- 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

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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

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Lecture 10 - Lab-03

Lecture 11 - Lab-04

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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

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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

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Lecture 31 - On Chip Variation

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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 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

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Lecture 7 - Depicting Levels of Testing (Continued...)

Lecture 8 - Software Life Cycle

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Lecture 24 - Programming Using Tcl/Tk - II

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# DIGIMAT - The No.1 Autonomous Learning 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**

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