DAIICT Gandhinagar

**EL103 Basic Electronics**

Core Course for Autumn 2019-20.

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List of Lectures

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| Lecture No | **Topics** | Lab/Exam |
| **1** | Teaching method, Attendance Policy, Grading Policy, Lab Policy.  Study Materials.  Why study this course? Applications of Electrical and Electronic Circuits  Challenges: Math, Science 🡪 Engineering.  -----------------------------------------------  Idea of a system, Engineering Systems in general. Circuit as a system, Input-Output-Power Supply, Passive and Active Circuits.  Linear System. Superposition theorem, Definition of Physical quantities |  |
| **2** | Signals. Signals from transducers/sensors. Line voltage. Function generators.  Step and Sinusoidal signals.  DC and AC. Analog and Digital.  Oscilloscope’s use to view and measure signals. Demo. |  |
| **3** | Ideal Voltage and Current sources.  Controlled sources VCVS, VCCS, CCVS and CCCS.  ---------------------------------------------  Resistors, resistivity, conductivity and mobility.  Conductors, Insulators, Semiconductors, p and n type semiconductors.  Ohm’s Law. |  |
| **4** | Power Dissipation in Resistors.  Colour code of discrete resistors.  Potentiometers. Resistance based Transducers, Controlled resistance devices such as Diode, BJT, MOSFETs.  ---------------------------------------------  DC- Resistive Circuit Analysis  KCL, KVL, Node and Loop Equations solving to find V and I. |  |
| **5** | DC- Resistive Circuit Analysis continued.  Use of Superposition theorem.  Load resistance.  Series and Parallel Combinations,. |  |
| **6** | DC- Resistive Circuit Analysis continued, Potentiometers |  |
| **7** | DC- Resistive Circuit Analysis continued Wheatstone Bridge and Basic Measurements with Transducers.  Star-Delta transformations |  |
| **8** | Voltage divider, Current Divider, Mesh and Node Analysis, Thevenin’s theorem |  |
| **9** | Thevenin and Norton’s theorems, Bridge circuit |  |
| **10** | Max Power transfer, Input and Output resistances.  Idea for Integrated Circuits and VLSI.  OP Amps. Ideal OP Amps. |  |
| **11** | Amplifiers with OP Amps and Resistors: Inverting and noninverting Amplifiers, Linearity of Amplifiers, Adders, Design of simple amplifiers |  |
| **12** | Circuits with OP Amps.  Difference Amplifiers, Instrumentation Amp., Transimpedance Amp., Current Source,  Applications |  |
| **13** | Instrumentation Amp,  Review for In Sem 1, Solution of Assignment 2 | In Sem Exam 1 |
| **14** | n and p type semiconductor, Idea of p-n Junction,  Bias and Depletion Layer.  Semiconductor Diodes with Forward and Reverse Bias. Ideal Diodes.  Half Wave Rectifiers. |  |
| **15** | Three terminal Semiconductor Devices.  Bipolar Junction Transistor – Basic idea. npn and pnp.  Characteristics of a npn in common-emitter configuration: Cut-off, Forward-Active and Saturation operations. |  |
| **16** | Biasing a C-E npn BJT  NOT gate with a npn BJT, Transfer Characteristics.  Voltage Divider biasing |  |
| **17** | Enhancement type MOSFET, n-channel enhancement MOSFET operation.  VGS-ID and VDS-ID Characteristics, Cut-off, Ohmic and Saturation operations.  MOSFET as a Switch  Biasing a C-S n channel e-MOSFET for Amplifier Design. |  |
| **18** | AC Signals. Step, Pulsed/Square wave signals. Periodic signals.  Sinusoidal voltages and currents. Average and RMS values. |  |
| **19** | Phase of a Sinusoid, Phase lag and lead. Phasors.  Complex numbers and variable basics. Euler’s formula. |  |
| **20** | Complex numbers and variable basics. Arithmetic operations with phasors and complex numbers  Idea of Impedance. Circuit laws and analysis with Impedances (KVL, KCL, Thevenin, for sinusoidal ac inputs) |  |
| **21** | Idea of Impedance. Circuit laws and analysis with Impedances  Basics of Laplace Transforms (one-sided). |  |
| **22** | Properties of Laplace Transform  Partial fraction expansion and inverse Laplace transform calculations |  |
| **23** | Partial fraction expansion and inverse Laplace transform calculations |  |
| **24** | Capacitance, Parallel plate capacitor. Storage of Electrostatic Energy. Current voltage relation  Inductance, Solenoidal Inductors. Ampere's law, Storage of Magnetic Energy, Current voltage relation.  Series-parallel connection of capacitors and inductors.  RC circuit analysis with unit step input. Solution of ODE with Laplace Transform, Time Constant and Rise time. Transient and steady state response  Idea of transfer function of linear time-invariant circuits |  |
| **25** | RC Circuit analysis with sinusoidal input, Transient and steady state response,  Ideas of frequency response and cut off frequency, Low pass filters |  |
| **26** | LR Circuit analysis with step and sinusoidal inputs. Compare RC and LR circuits. Obtaining transfer function with generalized impedance of sL and 1/(sC) if initial conditions = 0. | In Sem 2 |
| **27** | Analysis of series and parallel R-L-C Circuits in the s domain. 2nd order transfer functions.  Step responses of Overdamped, critically damped and underdamped cases.  Idea of natural frequency, damping, resonance and Q factor |  |
| **28** | Step and sinusoidal responses of Overdamped, critically damped and underdamped cases.  Idea of natural frequency, damping, resonance and Q factor |  |
| **29** | Frequency response calculation from transfer functions  Bode plot  Ideas of 3db Cut-off Frequency and Bandwidth  Gain and Phase Margins |  |
| **30** | Frequency response calculation from transfer functions  Bode plots  Ideas of 3db Cut-off Frequency and Bandwidth  Gain and Phase Margins |  |
| **31** | Passive R-C Low Pass Filters, High Pass filters. Integrators and differentiators, RLC bandpass filters, Active filters using Op Amps (2nd order only) |  |
| **32** | Circuits with impedances and op amps |  |
| **33** | Various circuits with positive feedback in op amps: Schmidt triggers, Astable multivibrators, Sinusoidal oscillators |  |
| **34** | Half wave rectifier based Power Supply Design  Reduction of Ripple using Capacitors |  |
| **35** | Ideal Transformers  Current, Voltage and power relations between primary and secondary.  Impedance relations between primary and secondary.  Applications of transformers |  |
| **36** | Review | End Sem Exam |