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# BASIC MECHANICAL ENGINEERING

## UNIT-I

\* Thermodynamics → Thermo + dynamics  
heat → power.

Thermodynamics can be defined as a science of energy. It is a science of relations between heat, work and properties of the system.

\* System → A thermodynamic system is defined as a quantity of matter or a region in space upon which attention is concentrated in the analysis of a problem.

It can be as simple as a free body or as complex as a refinery.

\* Surrounding → Rest of the universe outside the system close enough to the system to have some perceptible effect on the system is called surrounding.

\* Boundary → The real or imaginary surface that separates system from its surroundings.

\* A system and surrounding together comprise universe.

## Digital Cargo

Final Year Project Proposal

Session 20XX-20XX

A project submitted in partial fulfilment of the  
COMSATS University Degree  
of  
BS in Computer Science / Software Engineering (CUI)



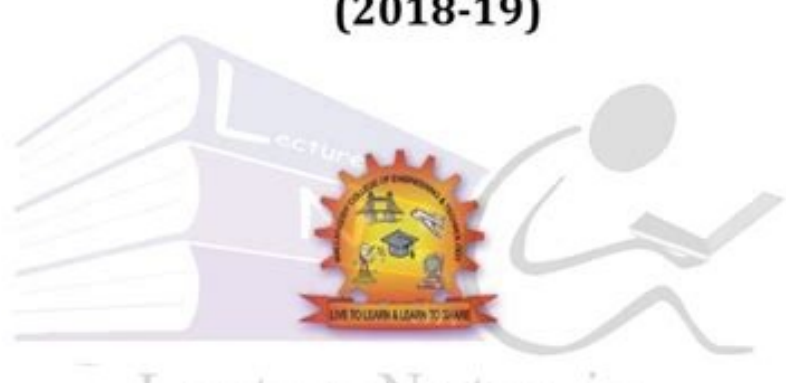
Department of Computer Science  
COMSATS University Islamabad, Lahore Campus

03 March 2020

**JAVA PROGRAMMING**  
[R17A0507]

**LECTURE NOTES**

**B.TECH II YEAR – II SEM (R17)**  
**(2018-19)**



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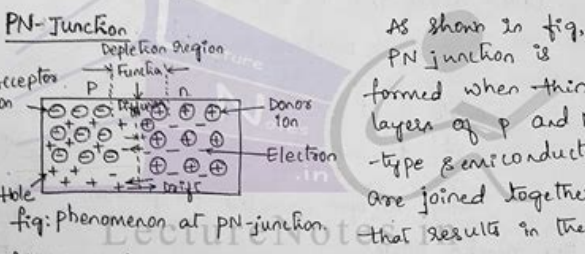
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Maitamurthy, Dhanuveluri Road, Hyderabad, Secunderabad - 500006, Telangana State, INDIA.

**SEMICONDUCTOR DIODES AND APPLICATIONS**

**APPLICATIONS**

**Introduction:** The term diode indicates a two-terminal device & a diode is a two-layer (PN-junction) device which facilitates conduction in one direction and blocks conduction in other direction. Diode offers a low resistance when forward biased and behaves as a open ckt when reverse biased. A constant voltage drop occurs across the diode when the diode is forward biased.

**PN-Junction:** As shown in fig, PN junction is formed when thin layers of P and N-type semiconductors are joined together that results in the following phenomenon.



- The majority holes from p-side diffuse into n-side and vice versa.
- Recombination of electrons and holes in a narrow region on both sides of the junction results in uncovered fixed positive ions on n-side and fixed negative ions on p-side.
- This is the depletion region where no free electrons and holes present.

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TE = thermal equilibrium MOS = metal-on-silicon MOSFET = metal-oxide-semiconductor field-effect transistor BJT = bipolar junction transistor CMOS = complementary metal-oxide-semiconductor CS = common source OCTC = open circuit time constant LEC # TOPICS SLIDES ADDITIONAL NOTES 1 Introduction to semiconductors, doping, generation/recombination, TE carrier concentrations. Carrier dynamics and transport: drift. (PDF) 2 Excess populations and minimum carrier lifetime, photoconductivity. Non-uniform concentrations and diffusion. Fick's first and second laws. (PDF) 3 The five basic equations. Device structures in TE: carriers and electrostatic potential; the 60 mV rule. Poisson's equation (PE). (PDF) Solving the five equations (PDF) Photoconductors (PDF) 4 P-n junctions in thermal equilibrium and under reverse bias, the depletion approximation (DA), comparison to PE solution. (PDF) 5 Review reverse biased junctions. Consider forward bias and the special case of minority carrier injection into quasineutral regions. (PDF) 6 Forward biased p-n junctions: carrier injection, i-v characteristics (ideal and real; forward and reverse). Engineering carrier injection. (PDF) 7 Bipolar junction transistors: two coupled diodes, terminal characteristics, regions of operation (PDF) 8 Solar cells and LEDs (light emitting diodes). (PDF) 9 MOS capacitors: the DA applied to two-terminal MOS capacitor accumulation, depletion, and inversion; VFB, VT, Q<sub>A</sub>, and Q<sub>N</sub> (PDF) 10 The three-terminal MOS capacitor. MOSFETs: begin gradual channel approximation (GCA) using DA and ignoring subthreshold carriers. (PDF) CCD Nobel Prize slides (PDF) 11 Complete GC/DA model for IDS: saturation, channel length modulation. Output characteristics; regions of operation. (PDF) Drain current model (PDF) Gradual channel approximation for MOSFETs (PDF) 12 Subthreshold operation of MOSFETs. Development of model; compare to full numerical solution. Compare to/contrast with BJTs. (PDF - 1.0MB) Sub-threshold modeling notes (PDF - 1.1MB) 13 Linear equivalent circuits for MOSFETs and BJTs at low and high frequency; transconductance of subthreshold MOSFETs. (PDF) 14 Logic inverter basics. Introduction to CMOS: transfer characteristics, noise margins, optimal device sizing. (PDF) Inverter analysis and design (PDF) Analysis of inverter switching delays (PDF) 15 CMOS analysis, continued: switching delays, power dissipation, speed/power trade-offs. (PDF) Analysis of CMOS gate delay and power (PDF) 16 CMOS analysis, continued: subthreshold leakage, scaling rules, and where it is all going. (PDF) CMOS scaling and power dissipation (PDF) CMOS scaling: comparing 1970 and 2000 (PDF) 17 Linear amplifier basics: performance metrics, current source biasing, current mirrors, mid-band range, two-port representation. (PDF) 18 Single-transistor building block stages: common-source, common-gate, and common-drain (follower) stages; characteristics and features. (PDF) 19 Differential amplifiers: large signal transfer characteristics; small signal analysis using common- and difference-mode inputs. (PDF) 20 Multi-stage amplifiers I: cascading diff stages; current source biasing; output stages. (PDF) Active loads: current mirror load, Lee load (PDF) 21 Multi-stage amplifiers II: active loads, biasing for maximum gain, input and output swings. (PDF) The marvelous cascode (PDF) 22 Multi-stage amplifiers III: examples, stage selection, speciality stages, looking at a commercial op-amp schematic. Begin frequency response. (PDF - 1.1MB) 23 Frequency response of CS amplifiers, the Miller effect. Intrinsic frequency limitations of MOSFETs. Biasing to maximize speed, power trade-off. (PDF) 24 OCTC method for estimating frequency response. Subthreshold amplifiers for ultra-lower power electronics. 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