Course: Fundamentals of Semiconductor Devices

Course Code: noc19-ee04

Session: 2018-19

Duration: 12 Weeks

Assessment procedures: Weekly Assignment (25%) + proctored certification Exam (75%)

Curriculum of the Course:

Week 1 : Importance of semiconductor devices and their diverse applications.
- Introduction to semiconductors, concept of energy bands and how bands form.
- Effective mass of electrons, E-k diagram.
- Concept of holes. Concept of Fermi level, Fermi-Dirac distribution.
- Doping (extrinsic & intrinsic semiconductor), density of states.

Week 2 : Equilibrium electron-hole concentration, temperature-dependence.
- Carrier scattering and mobility,
- velocity saturation
- Drift-diffusion transport

Week 3 : Excess carrier decay & recombination,
- charge injection, continuity equation,
- quasi-Fermi level

Week 4 : p-n junction: static behaviour (depletion width, field profile),
p-n junction under forward & reverse bias
- current equations,
- generation-recombination current and reference to typical devices.

Week 5 : Zener and avalanche breakdown,
- Capacitance-voltage profiling,
- metal/semiconductor junction – Ohmic and Schottky contacts, reference to device applications.

Week 6 : MOS capacitor, charge/field/energy bands, accumulation,
- inversion, C-V (high and low frequencies), deep depletion,
- Real MOS cap: Flat-band & threshold voltage, Si/SiO2 system.

Week 7 : MOSFET: structure and operating principle, derivation of I-V,
- gradual channel approximation, substrate bias effects,
- sub-threshold current and gate oxide breakdown.
- Control of threshold voltage, short channel effects.
- Moore's Law and CMOS scaling

Week 8 : Introduction to compound semiconductors & alloys,
- commonly used compound semiconductors,
- heterostructure band diagrams and basics of MODFET & HEMT,
- introduction to quantum well,
- applications of heterostructure device technologies

Week 9 : BJT: working principle, DC parameters and current components,
- base transport factor, Early Effect,

- charge control equation & current gain, need for HBT.
- Applications of BJTs/HBTs in real-life.

Week 10 : (Basics of) - transistors for high-speed logic,

- Transistors for high frequency (RF),
- Transistors for high power switching,
- Transistors for memories,
- Transistors for low noise, transistors for the future.

Week 11 : Solar cells: principle, efficiency, Fill factor,

- Shockley-Quiesser limit, silicon solar cells, multi-junction solar cell,
- Photodetectors: operation, figures of merit (responsivity, QE, bandwidth, noise, Detectivity), examples from IR to UV detectors.

Week 12 : LEDs: working principle, radiative/non-radiative recombination,

- various types of efficiencies (EQE, WPE, IQE),
- light extraction and escape cone. Blue LED and the Nobel Prize,
- visible LEDs and chromaticity.

List of students enrolled

S.No	Student Name
1	Hina khatri
2	Aadarsh Singh
3	ADITYA CHOUDHARY
4	Tarun
5	ANJALI PARIK
6	Ansh garg
7	Brij bhushan
8	mamta mishra
9	Manvendra Shekhawat
10	Naman Mishra
11	Monalisa
12	Neha
13	Ashish Kumar pathak
14	Ravi Shankar verma
15	Sakshi Sharma
16	shikha singh
17	Vaibhav Kulshrestha
18	AVI VANAWAT
19	ved prakash meena