

Birla Institute of Technology and Science Pilani – K K Birla Goa Campus

First Semester 2020 – 2021

Course Handout (Part II)

Date: 18.08.2020

In addition to Part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No.: EEE/ECE/ INSTR F214

Course Title: Electronic Devices

Instructor-in-charge: Prof. Ramesha C K

Instructors: Prof. Abhijit Pethe and Dr. Pramila Jakhar

Scope and objective

This course aims to provide basic understanding of the structure, operation, characteristics and the limitations of the semiconductor devices. Comprehensive understanding of the devices fabricated with junctions between semiconductor to semiconductor, metal, and dielectrics, e. g., ‘p-n’ junction diodes, Field Effect Transistor (FET) and Bipolar Junction Transistor (BJT), is discussed. Starting with the explanations of the fundamentals of semiconductors like energy band formation, conduction of charge carriers, electron and hole concepts, effect of electric and magnetic fields on charge carriers, the course helps in developing the understanding about excess carriers in semiconductors. In-depth study on ‘junctions’ prepares the students for a detailed study on devices to be studied later like FET and BJT viz. commonly employed in integrated circuit technology for implementation of virtually any requirement. Concepts of semiconductor devices like microwave devices and power devices are also included.

1. Text / Reference books

- (a) B.G. Streetman & Sanjay Banerjee, “Solid State Electronic Devices”, 7th/ 6th ed., Pearson Prentice Hall.
- (b) Donald A. Neamen, “Semiconductor Physics and Devices”, 3rd ed., Tata McGraw Hill Education Private Limited.
- (c) M. S. Tyagi, “Introduction to Semiconductor Materials and Devices”, Wiley India Limited.

2. Course Plan

Lect. No.	Topic	Learning objectives	Book reference
1-3	Semiconductor materials, crystal properties and growth of the semiconductor	Understanding of Crystal lattices, Crystalline and Amorphous solids, Different techniques of crystal growing.	SB 1.1 – 1.4,
4-6	Elementary quantum mechanics	The uncertainty principle, Schroedinger wave equation, step potential, potential well, and Tunneling.	SB 2.4
7-10	Electrical conduction in solids and statistical mechanics	Periodic potential, allowed and forbidden energy bands, Density of states, Direct and indirect band gap semiconductors, effective mass. Statistical distributions, Fermi-Dirac distribution function, Fermi energy.	SB 3.1 – 3.2

10-11	Charge carriers in semiconductors, Effect of electric and magnetic fields on drift of carriers	Fermi level, equilibrium carrier concentrations, mobility, Hall effect	SB 3.3 – 3.5
12-15	Excess carriers in semiconductors	Luminescence, Einstein's relation, continuity equation, Haynes-Shockley experiment	SB 4.1 – 4.4
15-21	Junctions	pn junction, IV characteristics, breakdown diodes, Schottky barriers, Ohmic contacts	SB 5.2 – 5.5.4, 5.6-5.7
22-27	Field Effect Transistors	Junction FET, MISFET, MOS capacitor, MOSFET	SB 6.2 – 6.5
28-33	Bipolar junction transistors	BJT operations, amplification, carrier distribution, I-V characteristics etc	SB 7.1, 7.2, 7.4 – 7.7.4, 7.7.6-7.8.3
34-37	Optoelectronic Devices	Photodiodes, solar cells, LEDs and Lasers, Semiconductor Lasers	SB 8.1 – 8.4
37-38	High frequency and high power devices	Tunnels Diodes, IMPATT Diodes, GUNN Diodes, p-n-p-n Diode, SCR diode, IGBT	SB 10.1 – 10.6
38-40	Compound semiconductor devices	Compound semiconductors; HBT and HEMT	Lecture notes

3. Evaluation Scheme

EC No.	Component	Duration	Marks(%)	Date
1	Test-1 Test-2 Test-3	30 min 30 min 30 min	12 12 12	14/09/20, Monday 6:00 PM – 7:00 PM 12/10/20, Monday 6:00 PM – 7:00 PM 16/11/20, Monday 6:00 PM – 7:00 PM
2	Assignments/Surprise Tests/ Tutorials	----	29	Regular (open Book). Evaluation components will be conducted throughout the semester.
3	Comprehensive exam (Closed book)	2 hours	35	05/12/2020 (FN)

4. Tutorials

Assistance will be provided in solving the problems asked in tutorial sheets.

5. Make-up Policy

- In the case Test-1, Test-2 and Test-3 make-up will be given only for Medical cases, requiring hospitalization. A single make-up test will be conducted for all the make-up cases for which the syllabus will be the portions covered until the date of makeup test.
- No Makeup for Assignments/Surprise Tests/Tutorials (29%).
- For make for comprehensive exam – decided by the Instruction Division.

6. Chamber consultation hour

Prof. Ramesha C K
Prof. Abhijit Pethe
Dr. Pramila Jakhar

Instructor In-Charge (EEE/ECE/INSTR F214)