Faculty of Science

Bachelor of Science (B.Sc.)

SUBJECT: NANOTECHNOLOGY

B.Sc. III Semester

DSE

Semiconductor Devices

Course Outcomes

	Course Outcomes	Cognitive Level
CO-I	Learner will be able to understand Basics of Semiconductor Physics	U, R
CO-II	Learner will be able to understand the Electrical Conductivity of Semiconductors	U, R
CO-III	Learner will be comfortably develop the basic knowledge of P-N Junction	U, Ap, An
CO-IV	Learner will understand the operation of Optoelectronic devices such as LDR, LED, Solar Cell.	U, Ap, C
CO-V	Learner will be able to analyse BJT circuits and develop an understanding of BJT I-V characteristics	Ap, An,E

R-Recall, U-Understand, Ap - Apply , An-Analyse, E-Evaluate, C-Create

Credit and Marking Scheme

	Credits	Marks		Total Marks
		Internal	External	
Theory	4	30	70	**100**
Practical	-	-	-	**-**
Total	**4**	**100**		

Evaluation Scheme

	Marks	
	Internal	**External**
Theory	3 Internal Exams of 15 Marks (During the Semester, Best 2 will be taken)	1 External Exams (At the End of Semester)

Content of the Course

Theory

No. of Lectures (in hours per week): 3 Hrs. per week

Total No. of Lectures: 60 Hrs. **Maximum Marks: 70**

Unit-I

Basics of Semiconductor Physics

Semiconductors review; elemental and compound semiconductors; oxide semiconductors; electrical properties: electrons in semiconductors; band structures in semiconductors; intrinsic, extrinsic and compensated semiconductors;Fermi Level, Direct and Indirect Band Gap Semiconductors, carrier concentration in Semiconductors; carriers under thermal equilibrium and non thermal equilibrium.

Unit-II

Carrier Transport

Electrical Conductivity of Semiconductors, carrier drift and diffusion; conductivity and mobility;Current density in semiconductors, , carrier transport, carrier recombination (radiative , Auger and Shockley-Read-Hall (SRH) recombination models), Hall effect.

Conducting and semiconducting nanomaterials, low dimensional Semiconductors (0D,1D,2D), emerging layered semiconductors, quantum size effects in semiconductor nanostructures .

Unit III

Semiconductor Diodes

Introduction; p-n Junction; Basic Theory of Semiconductor p-n Junction - (Depletion Region); Biasing of a p-n Junction (Forward bias, Reverse bias); p-n Junction Diode (VI-characteristics); Characteristics for Junction Diodes of Various Materials; Temperature Dependence of p-n Characteristics; Zener and Avalanche Breakdown; Zener Diode and its Characteristics;Voltage Regulation (by Zener Diode), Elementary idea of low dimensional Semiconductor lasers

Unit IV

Opto-electronic devices

Introduction ,Electromagnetic Spectrum, Photoelectric Effect; Light Dependent Resistors (LDRs); Photovoltaic Cell; Photo-Diode; Photo-Transistors; Light Emitting Diode (LED) ; QLED; Solar Cell; Liquid Crystal Display (LCD) .

Unit V

Bipolar junction transistors

Introduction; Junction Transistor; Biasing of a Transistor; Current & Voltage Symbols and Sign Conventions;Transistor Configurations; Transistor Current Components; Energy Band Diagram of a Transistor in Thermal Equilibrium; Emitter Efficiency and Base Transport Factor; Current Amplification Factors (α, β and y); Voltage Amplification; Base Width Modulation and Early Effect; Leakage Currents in a Transistor; Characteristic Curves of a Transistor (Common emitter, Common base and Common collector Configurations and their Comparison).

References

Suggested Readings:

1. Physics of Semiconductor Devices, S. M. Sze and K. K. Ng, 3rd edition 2008, John Wiley and Sons
2. Electronic Devices and Circuits, A. Mottershead, 1998, PHI Learning Pvt. Ltd.
3. Semiconductor Physics and Devices, D. A. Neamen, 4th edition, 2011, Tata McGraw Hill
4. Semiconductor Devices, D.C.Tayal & Praveen Tayal,Yash Printographics
5. Semiconductor Device Fundamentals, Robert F. Pierret , 1996, Pearson Education

Web Links:

Suggested equivalent online courses:

https://nptel.ac.in/courses/108108122

https://nptel.ac.in/courses/108106001

https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee75