B. Sc. Physical Science (Electronics)
Semester 5

DISCIPLINE SPECIFIC CORE COURSE – DSC-14
PHYSICS OF DEVICES

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Physics of Devices DSC – 14	4	2	0	2	Class XII pass with Physics and Mathematics as main subjects	Network Analysis and Analog Electronics

LEARNING OBJECTIVES

This paper is based on advanced electronics which starts with in depth understanding of junctions through energy bands and covers the devices such as UJT, JFET, MOSFET, etc.

LEARNING OUTCOMES

At the end of this course, students will be able to,

- Develop the basic knowledge of semiconductor device physics and electronic circuits along with the practical technological considerations and applications.
- Understand the operation of devices such as UJT, JFET, MOS, various bias circuits of MOSFET, basics of CMOS and charge coupled devices.
- Learn to analyse MOSFET circuits and develop an understanding of MOSFET I-V characteristics and the allowed frequency limits.
- Apply concepts for the regulation of power supply by developing an understanding of various kinds of RC filters classified on the basis of allowed range of frequencies.
- Learn to use semiconductor diode as a clipper and clamper circuit

SYLLABUS OF DSC – 14

THEORY COMPONENT

Unit – I (5 Hours)

Intrinsic, n and p type semiconductors, effective mass, carrier concentrations-fermi level in intrinsic;

electron and hole concentrations in equilibrium, temperature dependence, introduction to direct and indirect band gap semiconductors using energy level diagram

Unit – II (8 Hours)

Barrier formation in pn junction diode, depletion width, contact potential, diode equation, tunnel diode, storage and depletion capacitances, varactor diode, metal-semiconductor contacts: Schottky junction and Ohmic junction using energy band diagram, heterojunction(qualitative, using energy level diagrams)

Unit – III (8 Hours)

Transistor as a two port network, h parameter equivalent circuit, small signal analysis of a single stage amplifier, input and output impedance, current and voltage gains; cascading transistor amplifiers, two stage RC coupled amplifier and frequency response, low, mid and high frequency range response

Unit – IV (9 Hours)

Characteristic and working of UJT, relaxation oscillator. Field Effect Transistors: JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage,Current-Voltage Output Characteristics. Introduction to metal oxide semiconductor (MOS) device/MOSFET, threshold voltage, enhancement and depletion mode MOSFETS, output and transfer characteristics. basic idea of CMOS

References:

Essential 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) Integrated Electronics, J. Millman and C. C. Halkias, 1991, Tata Mc-Graw Hill.

5) Electronics: Fundamentals and Applications, J. D. Ryder, 2004, Prentice Hall.

6) Solid State Electronic Devices, B. G. Streetman and S. K. Banerjee, 7th edition

7) Introduction to Measurements and Instrumentation, A. K. Ghosh, 4th edition, 2017, PHI Learning.

PRACTICAL COMPONENT

At least five experiments to be performed from the following list.

1. To study the output and transfer characteristics of a JFET..
2. To design a dc power supply with a C filter and voltage regulator.
3. To design a single stage CE amplifier of given mid gain
4. To study the characteristics of a UJT
5. To design a simple relaxation oscillator using UJT.
6. Two stage RC coupled amplifier frequency response.
7. Study of IV characteristics of MOSFET
8. a. Study IV characteristics of CE BJT

   b. obtain h parameters from the characteristic curves

References for laboratory work:

1) Advanced PC based instrumentation; Concepts and Practice, N. Mathivanan, 2007, Prentice-Hall of India

2) Basic Electronics: A text lab manual, P. B. Zbar, A. P. Malvino, M. A. Miller,1994, Mc- Graw Hill