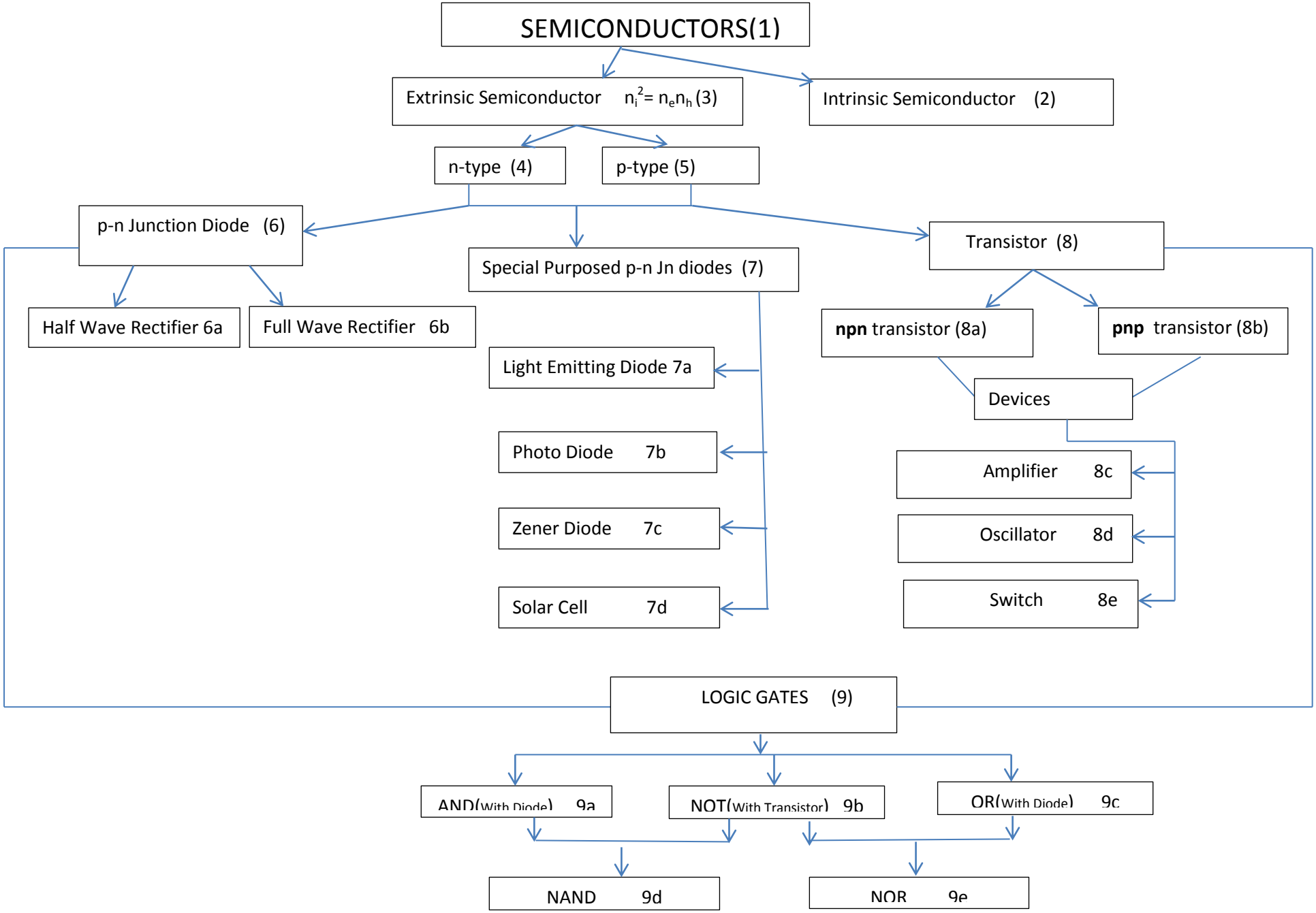

SEMICONDUCTORS(1)
Extrinsic Semiconductor $n_i^2 = n_e n_h$ (3)
Intrinsic Semiconductor (2)
n-type (4)
p-type (5)
p-n Junction Diode (6)
Half Wave Rectifier 6a
Full Wave Rectifier 6b
Special Purposed p-n Jn diodes (7)
Light Emitting Diode 7a
Photo Diode 7b
Zener Diode 7c
Solar Cell 7d
Transistor (8)
npn transistor (8a)
pnp transistor (8b)
Devices
Amplifier 8c
Oscillator 8d
Switch 8e
LOGIC GATES (9)
AND(With Diode) 9a
NOT(With Transistor) 9b
OR(With Diode) 9c
NAND 9d
NOR 9e

LEARNING OBJECTIVES

1. A **semiconductor** is a material which has electrical conductivity to a degree between that of a metal (such as copper) and that of an insulator (such as glass). Semiconductors are the foundation of modern solid state electronics, including transistors, solar cells, light-emitting diodes (LEDs), quantum dots and digital and analog integrated circuits.
2. **An intrinsic semiconductor,** also called an un doped semiconductor is a pure semiconductor without any significant dopant species present. The number of charge carriers is therefore determined by the properties of the material itself. In intrinsic semiconductors the number of excited electrons and the number of holes are equal: $n_e = n_h$
3. An **extrinsic semiconductor** is a semiconductor that has been doped, that is, into which a doping agent has been introduced, giving it different electrical properties than the intrinsic (pure) semiconductor.
4. N-type semiconductors are created by doping an intrinsic semiconductor with donor impurities(Penta valent elements). Extrinsic semiconductors with a larger electron concentration than hole concentration are known as n-type semiconductors. In n-type semiconductors, electrons are the majority carriers and holes are the minority carriers. In an n-type semiconductor, the Fermi energy level is greater than that of the intrinsic semiconductor and lies closer to the conduction band than the valence band.
5. P-type semiconductors are created by doping an intrinsic semiconductor with acceptor impurities (trivalent element) p-type semiconductors have a larger hole concentration than electron concentration. In p-type semiconductors, holes are the majority carriers and electrons are the minority carriers. P-type semiconductors have Fermi energy levels below the intrinsic Fermi energy level. The Fermi energy level lies closer to the valence band than the conduction band in a p-type semiconductor.
6. A **p–n junction** is a boundary or interface between two types of semiconductor material, p-type and n-type, inside a single crystal of semiconductor.

6a&b The Half wave rectifier and Full wave rectifiers are circuits, which convert an ac voltage to dc voltage.

7a Light Emitting Diode It is a heavily doped p-n junction which under forward bias emits spontaneous radiation. LEDs are used as indicator lamps in many devices and are increasingly used for general lighting.

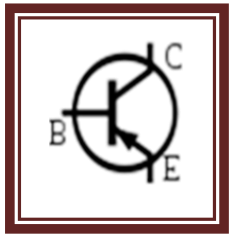
7b A **photodiode** is a type a special type of p-n junction capable of converting light into either current or voltage, depending upon the mode of operation.

7c A **Zener diode** is a diode which allows current to flow in the forward direction in the same manner as an ideal diode, but also permits it to flow in the reverse direction when the voltage is above a certain value known as the breakdown voltageor "zener voltage" .

7d A **solar cell** (also called a **photovoltaic cell**) is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect. It is a form of photoelectric cell

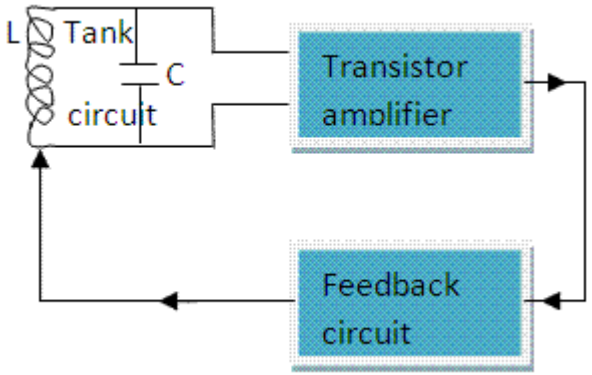
8. A **transistor** is a semiconductor device used to amplify and switch electronic signals and electrical power. It is composed of semiconductor material with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current through another pair of terminals.

8a &b The circuit symbols are shown in the figs for **npn** and **pnp** transistors respectively. The charge carriers in **npn** transistor are electrons where as holes are the carriers in **pnp** transiostor. The mobility of electrons being greater than that of holes the most commonly used transistor type is the **npn**

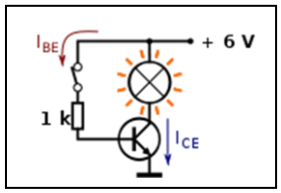


8c Transistor as an amplifier**:** The common-emitter amplifier is designed so that a small change in voltage (Vin) changes the small current through the base of the transistor; the transistor's current amplification combined with the properties of the circuit mean that small swings in Vin produce large changes in Vout.**Various configurations of single transistor amplifier are possible, with some providing current gain, some voltage gain, and some both.**

8d. Oscillator: **A device which is used for providing the alternating output from a d.c source is called as an oscillator. For maintaining and starting of oscillator need not any external signal.It can produces an output continuous. A simple oscillator circuit is similar to the amplifier circuit. But the difference is an oscillator can provides its own input signal**



8e Transistors are commonly used as electronic switches, both for high-power applications such as switched-mode power supplies and for low-power applications such as logic gates.



9 (a - e) A **logic gate** is an idealized or physical device implementing a Boolean function, that is, it performs a logical operation on one or more logical inputs, and produces a single lo gical output. Digital systems are said to be constructed by using logic gates. These gates are the AND, OR, NOT, NAND, NOR