Over a past several years, Silicon CMOS Technology has become the dominant fabrication process for relatively high performance and cost effective VLSI circuits. The development is indicated by the way in which the number of transistors integrated in circuits, on single chip has grown RISC chips in which it is possible to process some 35 millions instructions per second. In order to improve on this through put rate it will be necessary to improve the technology, both in term of scaling and processing.

1.2 IC TECHNOLOGIES

The fig. 1.1 shows the major IC technologies and logic circuits families that are currently in use. The member of each family are made with the same technology, have a similar circuits structure, and exhibit the same basic feature. Each logic circuits family offer a unique set of advantages and disadvantages.

The selection of a logic family is based on such consideration, power logic flexibility, speed of operation dissipation and cost. We will make some brief remark on each of the four technologies as shown in fig. 1.1.

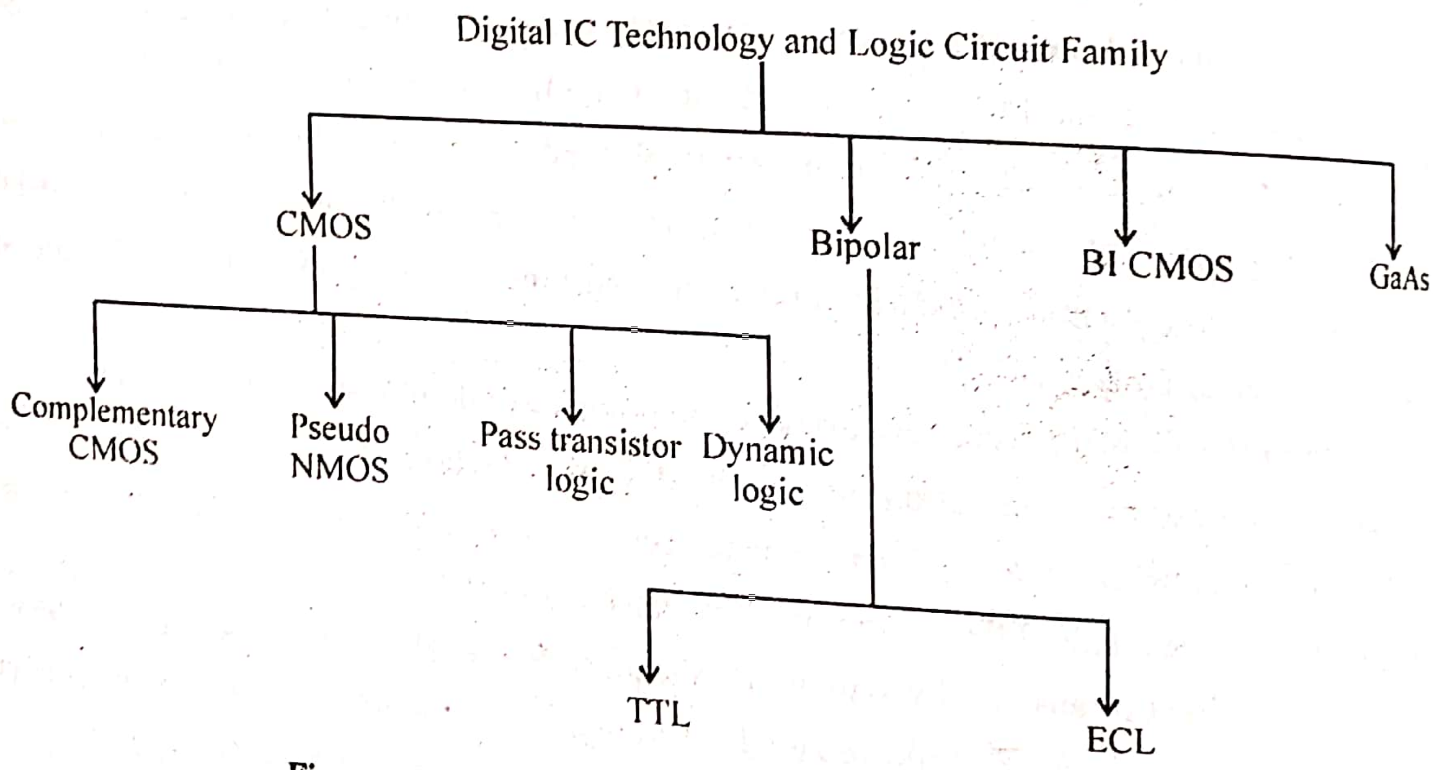

Figure 1.1 : Digital IC Technology and Logic Circuit Family

1.2.1 CMOS

CMOS technology is by a large margin, the most dominant of all the IC technologies available for digital circuit design. CMOS has replaced NMOS, which was employed in the early days of VLSI. The important reason for this development, is low power dissipation of CMOS circuits. The CMOS has also replaced bipolar as the technology of choice in digital system design and has made possible level of integration, (packing density) and a range of application, neither of which would have been possible with bipolar technology.

Some of regions for CMOS displacing bipolar technology in digital applications are as follows :

(i) CMOS logic circuits dissipate much less power than bipolar logic circuits and thus can pack more CMOS circuits on a chip than is possible with bipolar circuits.

(ii) The high input impedance of the MOS transistor allows the designer to use charge storage as a means for the temporary storage information in both logic and memory circuits. This technique cannot be used in bipolar circuits.

(iii) The feature size of the MOS transistor has decreased dramatically over the years, with some recently reported design. Utilizing channel length as short as 0.06 μm. This permits very tight circuit packing and, corresponding, very high level of integration.

The various forms of CMOS, complementary CMOS circuits based on the inverter, are the most widely used. These are available both as SSI and MSI for assembling digital system on PCBs. Complementary CMOS used in VLSI logic and memory circuit design. In some applications, complementary CMOS is supplemented by one of two other MOS logic circuit forms. These are :

(i) Pseudo NMOS

(ii) Pass transistor logic

The fourth type of CMOS logic circuit utilize dynamic technique to obtain faster circuit operation, while keeping the power dissipation low. The dynamic CMOS logic represents an area of growing importance (Design of memory chip).

1.2.2 Bipolar

The two bipolar logic families which are most widely used at present are :

(i) TTL (Transistor Transistor Logic)

(ii) ECL (Emitter Coupled Logic)

For the higher speed of operation of TTL, are made possible by preventing the BJT from saturating and thus avoiding the slow turn off process of a saturated transistor. These non saturated version of TTL utilize the schottky diode, are called schottky TTL.

The bipolar logic family in present use is emitter coupled logic (ECL). It is based on the current switch implementation of the inverter. In which saturation is avoided, very high speeds of operation are possible in all logic family. ECL is also used in VLSI circuit design when very high operating speeds are required and the designer is willing to accept higher power dissipation and increased silicon area.

1.2.3 Bi CMOS

The Bi CMOS combines the high operating speeds possible with BJTs with the low power dissipation and other excellent characteristics of CMOS. Like CMOS, Bi CMOS allows for the implementation of both analog and digital circuits on the same chip. The Bi CMOS is used in special applications, including memory chips where its high performance as a high speed capacitive current driver justifies the more complex process technology.

1.2.4 GaAs (Gallium Arsenide)

The high carrier mobility in GaAs results in very high speeds of operation. This have been demonstrated in a number of digital IC Chip, utilizing GaAs technology. The GaAs is "Emerging Technology".

1.3 MOS AND VLSI TECHNOLOGY

Within the bounds of MOS technology, the possible circuit realizations may be based on PMOS, NMOS, CMOS and BiCMOS devices. This text deal with NMOS, then with CMOS and BiCMOS. CMOS is the dominant technology, the some of illustration of designing process will be presented in NMOS as follows :

(i) For NMOS technology, the design method and design rules are easily learned, this providing excellent introduction to structured design for VLSI.

(ii) NMOS technology, provides excellent background to other technology.

(iii) For GaAs technology some arrangements in relation to logic design are similar to thos employed in NMOS technology.