

# Teaching Exploration of Digital Integrated Circuit Design with In-depth Integration of Curriculum Ideology and Politics

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## Abstract

**In order to adhere to the educational concept of "student development-oriented" and implement the fundamental task of "cultivating morality and fostering people", this paper takes the course Digital Integrated Circuit Design as the research object, deeply analyzes the "teaching pain points" and the characteristics of the course itself, and expounds the reform direction of teaching objectives and contents after integrating curriculum ideology and politics. By closely combining practical cases and cutting-edge achievements, this paper excavates curriculum ideology and politics elements from multiple perspectives, providing references for the curriculum ideology and politics teaching reform of integrated circuit-related majors.**

## Keywords

**Curriculum Ideology and Politics; Integrated Circuit-related Majors; Ideology and Politics Elements.**

## 1. Introduction

The integrated circuit industry is the core of the information technology industry, and it is a strategic, fundamental, and leading industry that supports economic and social development and ensures national security [1]. It is widely used in the fields of computers, industrial control, communications, consumer electronics, etc. With the rapid rise of emerging technologies such as artificial intelligence, big data, and the Internet of Things, the integrated circuit industry has an increasingly urgent demand for talents, and many universities have added integrated circuit-related majors.

Digital Integrated Circuit Design is a core backbone course for majors related to integrated circuit design and integrated systems, and it is also an entry written examination course for many enterprises engaged in integrated circuit design, semiconductor manufacturing, and electronic system integration. Traditional curriculum teaching focuses on knowledge imparting, but lacks guidance on students' values, resulting in low learning enthusiasm, inactive classroom atmosphere, and difficulty in fully meeting the objectives of cultivating high-quality talents in the new era. Integrating curriculum ideology and politics into teaching conforms to the requirements of the contemporary background and educational connotation, and plays an important role in cultivating students' firm feelings for the country and sense of mission. The course Digital Integrated Circuit Design features abundant contents, wide-ranging knowledge, and close relevance to social life, containing rich curriculum ideology and politics resources [2]. Through the teaching exploration of Digital Integrated Circuit Design, curriculum ideology and politics can be organically integrated into professional knowledge, and teaching contents can keep pace with the times, so as to cultivate students' overall quality and innovative thinking while mastering professional knowledge.

## 2. Curriculum Overview

The course "Digital Integrated Circuit Design" mainly teaches the analysis and design methods of digital integrated circuits from the transistor level and the circuit level. Mainly based on CMOS integrated circuits and MOS transistors, this paper describes the static and switching characteristics of MOS inverters, combined MOS logic circuits, sequential MOS logic circuits, dynamic logic circuits, arithmetic combination modules, etc.[3], and introduces the methods and processes of large-scale integrated circuit design. The focus is on various circuit types of the basic units of digital integrated circuits, and the analysis and design optimization are carried out from the aspects of circuit structure principles, as well as their speed, power consumption and area. The course "Digital Integrated Circuit Design" is usually taught to senior students. This stage is a crucial turning point for students to enter society and also a key period for cultivating their career outlook and comprehensive abilities.

This course has high requirements for students' professional knowledge level and covers a wide range of contents. Considering the severe situation of "neck - sticking" faced by the current chip field, in order to effectively implement the important mission of "educating people for the Party and cultivating talents for the country", teaching staff urgently need to fully recognize the urgency and necessity of comprehensively improving teaching effects. By actively exploring innovative teaching models and methods, and integrating ideological and political contents into the teaching process, they can lay a solid educational foundation for cultivating professional talents meeting the development needs of the national chip industry. To this end, this course plans to deeply integrate ideological and political education through three dimensions: focusing on the guidance of career selection concepts and professional development goals, strengthening the cultivation of scientific literacy and craftsmanship spirit, and analyzing the challenges and difficulties faced by the industry to stimulate the fighting spirit, so as to achieve the close integration of value shaping, knowledge imparting and ability cultivation in one.

## 3. Teaching Pain Points

(1) Rapid knowledge update causing timeliness issues in teaching contents.

The industry is developing rapidly, with new processes, technologies, and design methods emerging continuously, such as advanced semiconductor manufacturing processes and low-power design technologies. However, teaching contents may not be updated in a timely manner, leading to a disconnection between what students learn and actual industrial needs.

(2) Shallow excavation of curriculum ideology and politics resources, resulting in insufficient educational functions.

Digital Integrated Circuit Design is rich in course contents, closely linked to real-life and hot news, and contains abundant ideology and politics resources. Under the traditional teaching model, there is a common tendency to emphasize knowledge objectives while neglecting ability and quality objectives. The teaching process fails to fully explore ideology and politics elements, resulting in insufficient guidance and shaping of students' values.

## 4. Teaching Exploration

Aiming at the above-mentioned teaching pain points, this paper carefully analyzes the deep-seated causes of the current situation. In accordance with the spirit of the Ministry of Education's teaching reform to promote the implementation of "cultivating morality and fostering people" and "student-centered", Digital Integrated Circuit Design has carried out explorations in teaching objectives and contents, so as to improve the quality of talent cultivation.

## 4.1. Teaching Objectives

Based on the innovative design concepts of "moral education and talent cultivation" and "student development-centered", more emphasis is placed on the cultivation of students' ability goals and emotional attitude and value goals on the basis of the original curriculum objectives. According to Bloom's classification method of the emotional domain of educational goals, we divide teaching goals into five levels, namely acceptance, response, value-oriented, organization, and characterization of the value system in sequence. At the acceptance level, students develop an initial interest in this course. They can listen attentively to the teacher's explanations of the course content in class, show attention to the course introduction cases proposed by the teacher, and actively look up the latest developments, industry information and course-related resources in the field of digital integrated circuit design. At the reaction level, students actively participate in classroom interactions, proactively answer questions raised by teachers, carefully complete practical tasks in the course, such as CMOS inverter circuit simulation experiments, and explore methods to solve problems in the process of practice. At the value level, students can, through the knowledge they have learned, deeply recognize the important position and value of digital integrated circuit design in the modern electronic information industry, and understand its key role in promoting scientific and technological progress and social development. Identify with and practice the values such as scientific rigor, innovation and progress conveyed in the course of study. At the organizational level, students can construct a systematic professional knowledge system and a complete value concept framework, and possess the ability to solve complex problems. In the characterization level of the value system, students internalize the values such as innovation, rigor and collaboration advocated in the field of digital integrated circuit design as their core values, forming a stable professional attitude and personal qualities. In future studies and work, students will be able to actively disseminate professional knowledge and excellent values in the field of digital integrated circuit design, influence people around me, and promote the development and progress of the entire industry.

## 4.2. Teaching Contents

### 4.2.1. Teaching contents keep pace with the times, closely combining practical cases and cutting-edge achievements

In classroom teaching, life scenarios are deeply integrated with cutting-edge industry technologies, and vivid cases are used to ignite students' learning enthusiasm. For example, when explaining the current development of integrated circuits, the teacher takes the Kirin 9000s and Kirin 9020 chips carried by Huawei Mate Pro series mobile phones as the starting point. Through high-definition disassembly videos, the teacher shows the precise circuit layout inside the chips, and combines dynamic data charts to compare chip performance, intuitively demonstrating the top level and vigorous development trend of China's integrated circuit field. Then, by asking students questions such as "How does the 5nm process actually improve chip performance?" and "What does doubling the number of transistors mean for integrated circuits?", the teacher guides students to observe key indicators such as "transistor density" and "process technology" in chip parameters. By disassembling the technical meaning behind "5nm", the teacher analyzes how field-effect transistors have become the core driving force for the rapid growth of integrated circuit performance by continuously reducing size and optimizing structure. In the progressive Q&A and discussion, professional knowledge such as the working principle and manufacturing process of field-effect transistors is naturally introduced, transforming national pride into a curiosity to explore professional mysteries, and achieving the deep integration of emotional resonance and knowledge imparting.

#### 4.2.2. Deep Integration of Curriculum Ideology and Politics: Realizing Soft Value Guidance through Hard Professional Knowledge

Taking professional knowledge as the carrier, this course deeply excavates the curriculum ideology and politics resources of Digital Integrated Circuit Design, and organically integrates national spirit, professional ideals, and scientific pursuit into the teaching system. By developing a series of teaching cases for curriculum ideology and politics, teachers not only impart hard-core knowledge such as integrated circuit design principles and technical processes, but also cultivate students' national pride, professional identity, scientific literacy, craftsmanship spirit, and social responsibility in a subtle way, so as to stimulate innovative thinking and a sense of mission.

(1) Focusing on the Guidance of Career Selection Concepts and Professional Development Goals  
Maintain an ordinary mind, objectively view personal conditions and social needs, and choose careers and jobs based on reality. The integrated circuit industry chain covers diversified links such as upstream material research and development, midstream chip manufacturing, and downstream product applications, with fine division of labor and close collaboration in each field. Facing the industry status quo of diverse job types and different salary levels, the course adopts modular teaching to disassemble the panoramic map of the integrated circuit industry chain, and analyze the core responsibilities and capability requirements of positions such as chip design engineers, process technology experts, and test verification specialists. Combined with industry development trends, it analyzes the talent demand gaps in emerging fields such as artificial intelligence chips and quantum computing chips. Students are guided to rationally view salary differences, and encouraged to choose positions that can stimulate internal driving forces based on personal interests and strengths, industry development prospects, and national strategic needs. By connecting personal career ideals with the grand cause of national scientific and technological self-reliance, students can find their positioning and make contributions in the broad landscape of the integrated circuit industry.

(2) Strengthening the Cultivation of Scientific Literacy and Craftsmanship Spirit

Looking back on the development history of China's integrated circuits, the patriotic feelings and fighting spirit of the older generation of scientists are the most vivid ideological and political teaching materials. In the early 1950s, the older generation of scientists resolutely returned to China, devoted themselves to the semiconductor cause, and took the lead in establishing a joint semiconductor teaching and research section of five universities, cultivating the first batch of semiconductor professionals for our country.

Today, the integrated circuit field has developed into a cutting-edge industry integrating multiple disciplines such as electronic information, physics, chemistry, and materials, and there is an urgent need for compound talents with comprehensive knowledge reserves and integrated innovation capabilities. In the course, teachers take the touching deeds of industry pioneers as the breakthrough point, and integrate the scientific research spirit of "rigorous and realistic, overcoming difficulties" into the teaching of the digital integrated circuit design process. From the repeated deduction of chip architecture design, to the pursuit of excellence in manufacturing processes, and then to the meticulous testing and verification, students are guided to understand the profound connotation of the craftsman spirit. Students are inspired to build a solid foundation with solid professional learning, cultivate the spirit of independent thinking, respond to technological iteration with lifelong learning, and inherit and carry forward the patriotic spirit and craftsman spirit of scientists.

(3) Analyzing Industry Challenges to Inspire Struggle Spirit

In the course teaching, news about ZTE, Huawei and other companies being sanctioned by foreign countries in the chip field and the development of these enterprises after the sanctions are introduced. The current situation of "neck - sticking" and a series of measures to promote

the localization substitution of chips are analyzed. The competition logic behind the foreign technological blockade against China is recognized, so as to stimulate students' sense of responsibility and mission to strive for the country's prosperity. At the same time, it is pointed out that to solve the problem of neck - sticking in the chip field, we must adhere to scientific and technological self - reliance and self - improvement, and adhere to the core position of innovation in the overall situation of China's modernization drive. Students are made to clearly understand that only by relying on independent innovation can we truly break the technological blockade. Combined with the innovation trend in the field of integrated circuit design, students are encouraged to drive technological progress with innovation in their future career development.

## 5. Conclusions

The teaching exploration of "Digital Integrated Circuit Design", which deeply integrates ideological and political education into the curriculum, has established a three-in-one education model of "knowledge imparting, ability cultivation, and value shaping" by deeply integrating ideological and political elements such as career choice and career development goals, scientific literacy and craftsmanship spirit, patriotic feelings, and serving the country through science and technology with professional knowledge. With the increasingly fierce competition in science and technology and the in-depth advancement of educational reform, the integration of ideological and political education in courses in professional teaching needs to be continuously deepened. Subsequent research will be guided by the standards of new engineering construction, dynamically establishing a precise mechanism for mining ideological and political elements, achieving a deep integration of ideological and political resources with professional content, and providing a more solid educational support and theoretical basis for cultivating morally and professionally competent talents in the field of integrated circuits who are willing to shoulder the responsibility of national rejuvenation, as well as promoting the development of the integrated circuit field in China.

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