

# Design of Principles of Communications Course Based on BOPPPS Model

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**Abstract**—As the core professional course of communication and electronics, the course of Principles of Communication plays an important role in the cultivation of students' professional basic theoretical knowledge and practical ability. To strengthen the deep integration of modern information technology and education and teaching, solve the problem of teaching and learning mode innovation, cultivate students' thinking ability and innovation ability, give full play to the leading role of students, enable students to be input to active output, introduce BOPPPS and takes the modulation and demodulation of 2PSK as an example for teaching design. Our goal is to improve the teaching effect of innovative teaching methods, and puts forward requirements for the teachers and evaluation system of teaching, thus providing a reference for the comprehensive training of communication and electronic talents.

**Keywords**—principles of communications course, BOPPPS, 2PSK

## I. INTRODUCTION

For the discipline of information and communication engineering, the principle of communication is a compulsory course for communication engineering and electronic engineering and is the basis for subsequent professional courses. At present, the communication majors of various institutions regard “communication principles” as a subject in the entrance examination and re-examination of master's students, and its importance can be seen. This course is both highly theoretical and systematic, as well as highly engineering and practical [1]. Through the study of this course, students will master the basic principles of various information transmission in communication systems, the characteristics and analysis of stochastic processes and the performance analysis methods of communication systems, have a certain ability to analyze and solve engineering experiments and practical problems in communication system design, and have the ability to comprehensively use theoretical and technical means to design communication systems, laying a solid foundation for the subsequent study of related professional courses [2–4]. Improving the teaching of Principles of Communication courses will help improve

the quality of undergraduate teaching in communication and electronics.

This course theoretically establishes a complete communication system architecture and analysis methods and system models for communication system performance, analyzes the basic principles and transmission process of communication systems from baseband transmission and bandpass transmission, and gives analysis and design schemes for functional modules such as coding, modulation, channel, and reception in communication systems. This course pays attention to the close combination of the theory of “information transmission” and engineering application, so that students can deeply understand the connotation and essence of communication systems and lay a solid theoretical foundation for in-depth study and research of various modern communication technologies.

## II. PRINCIPLES OF COMMUNICATION COURSE OBJECTIVES

Principles of Communication focuses on the principles of information transmission. Through learning, students should be familiar with the channel model of communication systems, master the basic principles and anti-noise performance of various digital communication systems, master the basic principles and implementation methods of source coding, and be familiar with the basic principles of error coding and synchronization. The specific teaching objectives of this course are as follows:

- Master the basic principles and anti-noise performance of various digital communication systems.
- Master the basic principles and implementation methods of source coding.
- Familiar with the basic principles of error coding and synchronization, able to analyze the process and link of the communication system, and able to analyze the effectiveness and reliability of the communication system according to given conditions.
- Be able to conduct demand analysis according to the design indicators of the communication system, and design the block diagram structure, process, links, and signals of the communication system.

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- Be able to conduct experimental research and verification of the basic coding and modulation Principles of Communication systems.
- Familiar with the current situation of information and communication engineering and the development of communication technology.

### III. TEACHING CONTENT

Currently, the Principles of Communication course is 48 hours of classroom instruction and 24 hours of experimentation, using multimedia teaching. The textbook used in the course is “Principles of Communication (Seventh Edition)” compiled by teacher Fan Changxin of the National Defense Education Publishing House [5]. The book consists of 13 chapters. According to the consideration of previous courses and communication development, the course team mainly introduces the part of this book on digital communication, which consists of 8 chapters, because digital communication mainly studies the digital signal transmission mechanism and its reliability and effectiveness from the physical layer of the network, to provide a solid physical foundation for the establishment of a reliable and efficient Internet.

The following takes the modulation and demodulation of 2PSK as an example for teaching design.

### IV. FRONT-END ANALYTICS

#### A. *Teaching Content Analysis*

From ancient times to the present, communication technology has played an important role in people's life and work production. In today's highly information age, information and communication have become the “lifeblood” of modern society. Especially after the outbreak of the new crown pneumonia epidemic, the epidemic is raging, people's work, life, learning and entertainment have mostly moved online, and the demand for information and communication technology services in the whole society has exploded. Hundreds of millions of people work online, many students take online classes, and the transaction of daily necessities is also realized online... As the mainstream of contemporary communication technology, wireless communication serves the people all the time. The basis of wireless communication is modulation technology, introducing why modulation is needed, several basic types of modulation, is one of the important contents of the Principles of Communication course. This course is the content of Principles of Communication course Chapter 7, introducing the types and characteristics of modulation, 2PSK signal expressions, time domain waveforms and modulators, demodulation block diagram, transmission bandwidth and band utilization, etc.

#### B. *Learner Profiling Analysis*

This course is intended for junior undergraduate students majoring in communication and electronic information, who have completed the introductory courses advanced mathematics, probability theory and

mathematical statistics, linear algebra, and signals and systems. This course is the basic knowledge of communication systems that can be seen everywhere, which is closely related to the lives of students and easy to stimulate students' interest, so students can master the basic principles of 2PSK modulation and demodulation through the development of this course.

### V. DESIGN OF TEACHING OBJECTIVES

Teaching goal is the most important step of teaching design, and the first step of entry. When we design teaching, we must first ask ourselves, what problem does this knowledge solve? If we don't know, then we need to learn how this knowledge came about. Where is it used? How to use it? If teaching students book knowledge is just like telling stories to others, only telling the ending without telling the process, isn't this a kind of spiritual destruction? No wonder students don't listen.

Focusing on the problem seems simple, in fact, the quality of the problem is the key, knowledge is generated in a specific background, and to be applied to the specific scene, so first to return to the generation and application of knowledge in the scene and the problem, focusing the problem to solve two problems, one is the application of the situation, the second is to raise questions. In addition, three things should be done: first, the focused problem needs to cause cognitive disharmony; second, the student should have similar experiences, that is, close to life, have the motivation to solve the problem; third, the student should have the emotion to stimulate the solution of the problem, and think that solving the problem is urgent, necessary, and valuable. In fact, this step is also the introduction stage, or the opening stage, we need to use warm stories, shocking pictures, cognitive imbalances, real scenes, etc., to trigger the emotional resonance of students, to seize the attention of students.

#### A. *Knowledge & Skills*

- Through the study of this course, students can master the basic principles, processes, and signal changes of 2PSK in bandpass transmission, which can be used to analyze the transmission scheme of the digital communication system and conduct experimental research and verification.
- Be able to conduct demand analysis according to the design indicators of the communication system, and design the block diagram structure, process, links and signals of the communication system.
- Cultivate students' ability to learn independently, explore independently, learn collaboratively, and apply creatively.

#### B. *Process and Methods*

It is human instinct to use old knowledge to solve problems. We need to first activate students' old knowledge related to new knowledge, and link the new knowledge with the old knowledge, to be more solid. If students have no old knowledge, they need to supplement the old knowledge first. Or readjust the cognitive structure to form a new network, which is also called

adaptation, such as finding that a lot of middle school knowledge is wrong after going to college (established under certain conditions). Activating old knowledge requires three aspects: First, encourage students to try to solve problems with old knowledge and organize groups for collective association; second, give the initiative to students and do not rush to give new knowledge, but let students fully think or discuss; third, give applause to each student's participation, so that students can feel respected, noticed, appreciated, and have a sense of participation and accomplishment.

1) Through the BOPPPS [6] teaching model, the teaching based on students' learning is carried out, including six stages: bridge-in, objective, pre-test, participatory learning, post-test and summary.

The purpose of communication is to convey information quickly and accurately. During the **bridge** and **objective** phases, students should also be given a quick and accurate understanding of the course content. Provide the main knowledge points of this section to students through mind maps.

The pedagogical question begs: Why do you need modulation? Can wired communication systems be unmodulated? Can the wireless communication system be unmodulated? How is the 2PSK signal modulated and demodulated? How does the signal change in each part?

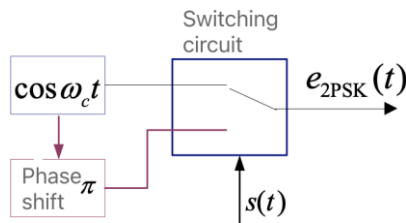


Fig. 1. 2PSK signal generation.

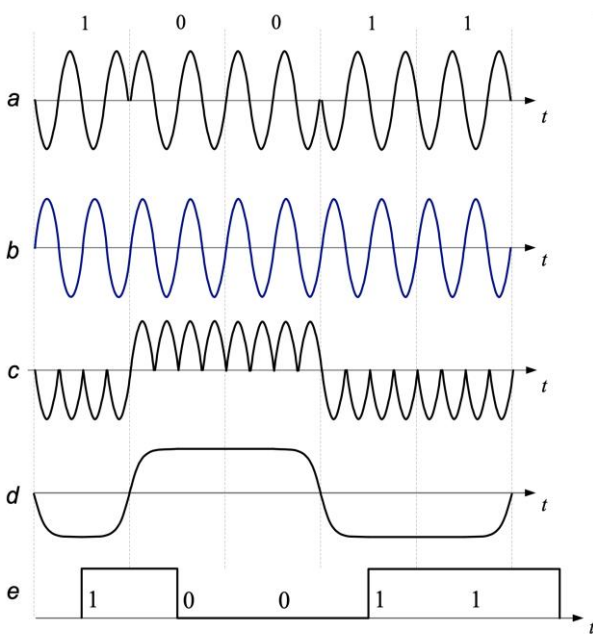


Fig. 2. 2PSK demodulates waveforms.

Explanation of the problem is as follows:

- The size of the antenna must be comparable to the wavelength of the transmitted signal.
- Move multiple baseband signals to different carrier frequencies to realize channel multiplexing and improve frequency band utilization.
- Expand signal bandwidth, improve system anti-interference ability, anti-fading ability, and exchange bandwidth for signal-to-noise ratio.
- The wired communication system can be unmodulated, and the wireless communication system must be modulated.

In the **pre-test** stage, the rain classroom was used to investigate students' mastery of 2ASK and 2FSK, and the teaching focus of the 2PSK part was adjusted.

After that, through the course teaching, the basic principles of 2PSK modulation are introduced (as shown in Figs. 1 and 2), and combined with the application scenarios of modulation, students are promoted to think, and students are guided to communicate introduction to deepen their understanding of this modulation type. In the process, the concepts should be clearly explained, and the principle of linking theory with practice should be implemented, and attention should be paid to the cultivation of students' logical thinking ability, engineering viewpoint and analysis and problem-solving ability.

In **participatory learning**, based on curriculum team building, relatively complete blended reform teaching resources, including videos, animations, software, documents, test questions, using a variety of ways to fully stimulate students' enthusiasm for learning, guide students to actively participate in learning activities, and further deepen students' understanding of what they have learned.

According to the different interests and abilities of students, teachers can assign tasks according to the groups of students, so that students can learn from each other in the process of communication and cooperation. Teachers need to provide enough opportunities for students to actively participate in the class and guide students to think and think about the course content. That's the best optimization point. At the same time, teachers need to guide students to criticize each other and exchange their views through discussion, communication and asking questions.

In the **post-test** stage, the rain class is used to examine the students' mastery of 2PSK to judge the absorption of the class.

In the **summary** stage, teachers need to summarize the discussion and test of the students, and once again emphasized the application value of PSK2 in real life. Teachers guide students to think and establish their own mind map, which is convenient for clarifying students' knowledge concepts and giving play to students' subjective initiative, cultivating students' ability to summarize, and deepening students' understanding and memory of course content.

Students are required to understand, analyze, reason, evaluate, create, etc. At the same time, they need to step by step, and demonstrate new knowledge by analogy, example, and other methods, means and dimensions. Fill the previous gap cognitively by solving problems and try to give answers by students themselves through layers of guidance; To have full interaction, increase the participation of students; Inspire students to solve problems on their own.

In the summary, the teacher emphasizes the key points and difficulties of this lesson, and the areas that students need to further strengthen, and encourages students to continue to explore the knowledge in this field and prepare for the next lesson. At the same time, teachers can also assign tasks and homework for the next class to promote students' in-depth understanding and mastery of what they have learned.

2) *Through the laboratory teaching of theoretical courses, students understand and master the principles of 2PSK and communication processes (as shown in Fig. 3), and cultivate students' ability to think independently, analyze problems and design problem solving.*

Teachers need to strengthen experimental teaching, help students to combine basic theory with practice, and let students learn and master knowledge in practice.

Teachers can encourage students to be creative and open up their minds. This can be done by asking students to solve real problems, design solutions, and engage in hands-on activities. Teachers should provide the necessary guidance and support to help students achieve their goals.

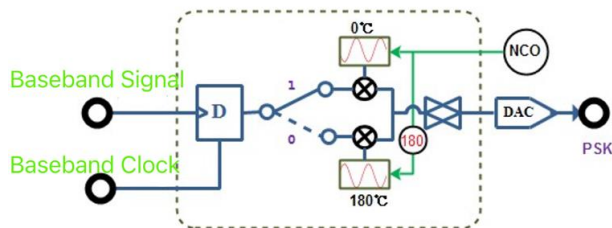


Fig. 3. 2PSK laboratory teaching activities.

3) *While completing the homework in class, students will also take the initiative to complete the test questions in each chapter, actively participate in discussions in the online discussion area, answer students' questions, and actively use MOOC [7] to prepare and review before and after class.*

The mark of this session is that new knowledge becomes old knowledge, completely integrated, like changing gears in a car, completely forgetting what the coach told you, and completely letting the subconscious take over. To achieve integration is not easy, from the perspective of cognitive psychology, to achieve a deep understanding of a knowledge, in addition to understanding, but also need to organize and simplify it, that is, to form their own version of notes, speeches, schemas, frameworks, etc., in addition, you also need to discuss with others to further deepen their understanding. In addition to the efforts in class, it also requires continuous improvement after class.

### C. The Value Expansion of Ideological and Political Elements

Teachers should guide students to understand and think about social development and human progress in the digital age and improve their ideological and political literacy and social responsibility.

Unity and cooperation are the team spirit we advocate, in our study and life, there are many things that need to be united and need cooperation to be completed. This case starts from the basic concept of 2PSK modulation, 2PSK modulation requires the baseband signal to change the phase information of the carrier, so that the carrier carries the baseband signal information and then transmits it in the system, both of which are indispensable. Let students experience the importance of solidarity and cooperation. Students report that individuals, families, groups, teams, and society strongly agree on the importance of persevering in solidarity and cooperation. In the process of unity and cooperation, not only the value of the individual, but also the strength of the team can be reflected.

In the future, we will explore the integration path of Principles of Communication courses and ideological and political education, teach the meaning of the course, learning methods and innovative entrepreneurship, cultivate students' sense of innovation, and stimulate students' enthusiasm for learning. Teach students the love of science and the enthusiasm to serve the country and stimulate students' sense of responsibility for the country and the nation. Deeply explore professional characteristics, establish a link between revitalizing Chinese and our generation of young people in the classroom, and accumulate strength for the cultivation of communication talents in China.

### D. Pedagogical Means

Teachers need to design the course teaching as an interactive teaching method and introduce more interactive activities and inquiry topics in the course to promote students' participation and learning interest.

Teachers can use modern multimedia tools, combined with charts and experimental cases to present knowledge and stimulate students' interest and participation.

Multimedia course teaching, laboratory platform teaching and intelligent teaching mode based on rain classroom and MOOC self-learning complement each other to realize the functions of diversified teachers and students, real-time interaction, and full-cycle data analysis of teaching, to promote students' in-depth understanding of course knowledge and cultivate their interest in independent learning.

## VI. CONCLUSION

This paper explains how to design the teaching scheme of "Principles of Communication" according to the BOPPPS model, implement the student-centered teaching concept, pay attention to natural curriculum ideology and politics, emphasize problem-oriented teaching methods, pay attention to the training of innovative thinking

methods, and pay attention to the evaluation of teaching effects. With the theme of “2PSK modulation and demodulation”, the above concepts and methods are detailed how to implement them into each lesson of classroom teaching and achieve good teaching.

#### CONFLICT OF INTEREST

The authors declare no conflict of interest.

#### AUTHOR CONTRIBUTIONS

Rong Geng and Ce Ji conducted the research; Chunhong Cao analyzed the information; Rong Geng wrote the paper; all authors had approved the final version.

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