Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 1833-1846
Article History: Received: 02 April 2022, Revised: 15 April 2022, Accepted: 24 April 2022, Publication: 04 May 2022

Research on Curriculum Reform and Practice of Power System in Application-Oriented Colleges

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Abstract:

Aiming at the problems existing in the learning of power system analysis course of electrical engineering and automation specialty of application-oriented undergraduate, this paper deeply analyzes the ideas and methods of studying content reform and reflects the characteristics of the combination of theory and practice of application-oriented undergraduate. TO cultivate senior technical talents in electrical engineering, engineering application is integrated into the theoretical and practical learning of power system courses. Combined with the three power system professional courses of power system relay protection principle, power system automation, and power plant electrical part, according to the industry certification standards, optimize the classroom learning and practical learning mode, integrate and optimize the curriculum resources, realize the repetition and redundancy of learning contents of different courses, build an application-oriented learning mode of taking engineering application as the goal and paying equal attention to theory and practice, and strengthen computer-aided learning, Make full use of learning resources such as superstar wisdom classroom and rain classroom to enrich learning means. This study has important practical value and guiding significance for improving learning quality, improving pupils' professional ability, and cultivating technical talents to meet the needs of the power industry and enterprises.

Keywords*: Applied Undergraduate colleges, Power system courses, Reform, Practice.*

I. INTRODUCTION

The electrical engineering and automation specialty is one of the largest specialties in science specialty. The research fields of this major in provincial local universities are different, and the curriculum and experimental conditions are also very poor. In addition, it mainly trains electrical engineering and technical talents for local economic construction. The major of electrical engineering and automation at Hubei Normal University (hereinafter referred to as "our university") evolved from the major in the motor [1]. At present, the courses in the power systems are only "power engineering", "power system analysis" and "power system relay protection". This series of courses are highly practical, but due to a large number of students, less experimental equipment, and experimental teaching hours, the experimental content is simplified, and the expected experimental effect can’t be achieved. With the rapid development of the power industry, new technologies and products are constantly applied to this field. Society has higher and

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higher requirements for the cultivation of high-quality applied talents. In addition to mastering solid theoretical knowledge, students pay more attention to the combination of theory and practice and have the ability to practice and innovate. Therefore, it is particularly important to reform the practical teaching of power system courses [2].

Application-oriented undergraduate is a new educational model in Colleges and universities, which takes the orientation of undergraduate education as the standard and the cultivation of application-oriented talents as the core. It emphasizes both "practical ability" and "innovative ability" [3]. As a basic course for the electrical engineering and automation specialty, how to embody the characteristics of application-oriented undergraduates and cultivate skilled and post-oriented talents mainly reflects two aspects: one is "knowledge quality"; the second is "ability and quality". Knowledge quality is mainly manifested in the scope of professional knowledge should be broad, the depth of professional knowledge should not be too high, the derivation and proof of formulas and theorems should be omitted appropriately, and the applicability of conclusions should be paid attention to; Ability and quality are mainly reflected in strengthening operation skills and norms, improving practical ability and comprehensive quality ability. Therefore, the teaching reform goal of the applied undergraduate power system course is to "highlight the application characteristics, pay attention to practical ability and improve the teaching quality", and around the local economic development, highlight the application characteristics as the premise of the teaching reform and improve the education and teaching quality as the goal of the reform.

II. NECESSITY OF IMPLEMENTING CURRICULUM REFORM OF POWER SYSTEM

For electrical engineering and automation, a typical engineering major, more and more attention has been paid to practical engineering application in the teaching process, especially for the currently advocated outcomes-based education (OBE), it is necessary to reflect the engineering background in the teaching process, Let the students know how to apply it to practical engineering problems based on of learning theoretical knowledge. Under such an environmental background, the way of cultivating talents focuses more on the cultivation of innovative and practical abilities [4]. The original scripted course is bound to be outdated and impracticable. It is imperative and the general trend to think about and implement the reform of power system-related courses. "Power system relay protection principle", "power system automation" and "electrical part of the power plant" are traditional electrical courses of electrical engineering and automation specialty. The nature of the courses is closely related to the actual engineering background, and the contents interact with each other and have strong relevance [5].

However, most of the current teaching methods focus on separate teaching in semesters, ignoring the connection between courses, and the learning cycle interval is too long, which is easy to cause the disconnection of students' knowledge points, the resistance to learning new knowledge, and the deviation between the learned knowledge and practical engineering. How to integrate the relevance of the curriculum, turn the raw and abstract knowledge points into engineering common sense that students can easily accept, and improve students' ability to solve practical engineering problems through the interrelated knowledge network has become a problem that needs to be considered in the teaching process. At present,

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colleges and universities have successively implemented reform measures for power system courses, such as project-driven learning method, sky disk learning method, flipped classroom, etc., but these methods are aimed at a single course, and solving practical problems in engineering requires students to have the ability of cross-subject knowledge, Therefore, the integration of power system courses and the reform and practice of teaching methods have certain practical significance for the cultivation of applied talents.

III. EXISTING PROBLEMS OF POWER SYSTEM COURSES AT THIS STAGE

3.1 Lack of Interest in Learning

Power system courses involve interdisciplinary teaching in many fields. Whether it is power science, electronics, or control science, it will involve more subject contents and knowledge systems [6]. The involved knowledge fields are generally wide, and the theoretical depth and breadth are relatively strong. Students need to have a certain degree of curriculum foundation, and the requirements for students' basic professional quality are relatively high. Looking at the current state of college students, many students' professional foundation is not very solid, and their acceptance of courses with a deeper theoretical level is generally low. A phenomenon caused by the above situation is that students' learning enthusiasm for power electronic technology courses is insufficient, and their learning initiative and enthusiasm are not high enough, which makes it difficult to fundamentally improve the learning quality.

3.2 Single Teaching Means

At present, in classroom teaching, major colleges and universities usually still adopt the main teaching mode with teaching materials as the core, rely on PPT, blackboard writing, and other traditional teaching media, and use the way of active indoctrination to help students understand more complex electronic knowledge, which plays an extremely limited role in improving students' interest, Even many times there are students absent in the classroom [7]. At the same time, based on the high difficulty of the course itself, the theories involved are some more abstract and profound theories. It is difficult for students to dialectically understand its content without sufficient practical work experience. In this process, the teaching means and methods of colleges and universities are also relatively single, and few teaching activities are carried out through simulation, which leads to students' lack of practical understanding of the hardware equipment of electronic power.

3.3 Obsolete Content System

With the continuous development of the economy and society, the development of power system courses is more rapid, which greatly exceeds the speed of updating the teaching material system [8]. At present, the more general power electronic technology courses often take thyristor as the main research object and teaching goal, but there is no mainline concept for some freshmen's fully controlled devices and power system courses. With the further development of power electronic technology, many new

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components have gradually stepped into the center of the stage. Because they have incomparable advantages in power, efficiency, and cost, they have gradually formed a market-oriented alternative process, and their production scale is further expanded and widely used in practical production and life. However, in the current teaching material system, the reference to these contents is very limited, resulting in the further disconnection between the teaching content and the actual needs, which is of limited help to the students' practical ability. In terms of curriculum arrangement of the power system, the existing teaching material system still adds more space to the internal working principle of various components, but the proportion involved in practical application links is still insufficient. However, the talent plan of colleges and universities, its purpose is to cultivate comprehensive and compound talents with high quality, high level, and high skills, which requires further reform of power system courses and strengthening their teaching value.

IV. REFORM IDEAS AND METHODS OF TEACHING CONTENT OF POWER SYSTEM ANALYSIS

4.1 Renewal of Teaching Ideas

In teaching thought, we must firmly establish the goal of "highlighting application characteristics, paying attention to practical ability and improving teaching quality". Take the application-oriented undergraduate teaching as the training mode [9]. In terms of teaching form, get rid of the unitary form, let students use basic theoretical knowledge to participate in the actual system development, and extract the operation data and topology of the system. Cultivate students' application ability in engineering practice. Promote the combination of teaching and research, so that students can better understand the cutting-edge knowledge of the subject.

Cognitive teaching is mainly video teaching, which aims to enhance students' perceptual understanding of relevant teaching contents. To this end, we have collected many video materials and purchased a set of CD-ROMs published by China Electric Power Press, and lectured by well-known experts or professors in the power system. These video materials cover the latest production process, latest science and technology, latest t-process, and latest equipment of the power system. A small number of videos are interspersed in the teaching process and shown in class, the most of them let students watch by themselves after class. For example, when explaining the production process of electric energy, the textbook usually has a schematic diagram of the production process of a thermal power plant or hydropower plant, and a paragraph describing the production process of electric energy, but the students can't see or touch the boiler, steam turbine (turbine), dam and related auxiliary equipment. Usually, we only give a brief introduction to this part in class and play some video teaching videos introducing the overview of the power system and production process. And ask them to watch some relevant lecture CDs after class. These video teaching films enable students to have a certain understanding of the structure and operation of the whole power system, which not only broadens students' vision but also improves students' interest in learning and achieves twice the result with half the effort [10].

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Excellent courses are exemplary courses with the characteristics of first-class teachers, first-class teaching contents, first-class teaching methods, first-class teaching materials, and first-class teaching management. It aims to cultivate high-quality talents to meet the needs of national and local development and focuses on improving students' international competitiveness. Integrate various teaching reform achievements, strengthen the use of information technology in the teaching process, strengthen the close combination of scientific research and teaching, and vigorously promote the rational understanding of high school students on power system analysis. With the rapid development of the power systems and modern engineering education, the original knowledge structure, teaching content, and teaching methods of this course can't adapt to the development trend. Because of the above problems, curriculum construction must be carried out in three aspects: teachers, theoretical teaching, and practical teaching. The goal of this course construction is to build a high-level teacher team, teach students how to learn engineering courses, cultivate students' engineering thinking methods, emphasize the combination of theory and practice, and focus on solving practical problems through the theoretical, and practical teaching of "power system analysis". Improve students' ability to analyze and solve practical problems. At the same time, it lays a good foundation for the study of follow-up professional courses.

4.2 Optimization of Teaching Content

To adapt to the application-oriented undergraduate teaching, aiming at the knowledge and ability quality that should be reflected in the teaching reform of power system analysis, we have adjusted and optimized the teaching content of the course and put forward new teaching requirements, which are carried out from the following three aspects [11].

First, revise the talent training setting, reduce the theoretical class hours, increase the practical content, and form a new teaching model. The ultimate goal of cultivating talents in applied undergraduate colleges is to serve the local economy. Therefore, while teaching basic theory, let students participate in the concept, design, operation, and optimization of the whole power system, to improve students' engineering practice training ability. The name and class hours of the experiment are shown in TABLE I, which mainly includes power flow analysis and calculation experiment of power system, power balance experiment of power system, and static stability analysis of power system.

TABLE I. Practical teaching contents

Serial number	Experiment name	Time(hours)
1	Power system power flow analysis and calculation experiment	2
2	Power system power balance experiment	2
3	Static stability analysis of power system	2
4	Dynamic stability analysis of power system	2

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Secondly, add auxiliary teaching materials to fully understand the frontier of the discipline. When selecting teaching materials for the course, the planning teaching materials shall be mainly used, and the compilation of auxiliary teaching materials shall be added. Through the auxiliary teaching materials, we can fully understand the scientific research achievements of the industry at home and abroad. The focus is to intersperse the theoretical content in the practical course so that students can deeply understand the cutting-edge and hot issues of the current development of the industry from practice. This can effectively consolidate professional knowledge and improve students' interest in professional learning; At the same time, considering that most of the students majoring in electrical engineering and automation will serve the power industry in the region after graduation when introducing the power network and explaining the calculation of power flow (including simple power flow and complex power flow), they often take the operation state of the actual power grid system as an example to realize the training goal of applied undergraduate talents.

Finally, add curriculum design. The course design is a comprehensive practical teaching of power system analysis, which reviews the knowledge points as a whole. The course of power system analysis includes two-course designs: one is power flow calculation, which is a very important calculation of power systems. According to the given operating conditions of the power system, it is a calculation to determine the parameters during steady-state operation, which can analyze and study various problems during power system planning and operation for inspection and prediction. Through this course design, students will have a comprehensive understanding of the steady-state analysis process and improve their ability to analyze problems; in terms of short-circuit calculation, to avoid short-circuit, correctly select and design the electrical equipment and relay protection device on the system. Through short-circuit calculation, the consequences of short-circuiting can be reduced, so that students can analyze and summarize various problems encountered in short-circuit in advance, and improve their ability to solve problems.

4.3 Adopt Modern Teaching Methods and Means

With the rapid development of educational information technology, the traditional blackboard teaching in the course of power system analysis is difficult to meet the needs of modern education and teaching. The teaching method can’t describe the specific operation of the actual power system, and students have difficulties understanding it. To improve the teaching effect of theory courses and attract students' interest, we must adopt diversified teaching methods and means [12].

4.3.1 Multimedia and blackboard teaching shall be adopted in classroom teaching

Firstly, the advantages of blackboard teaching are used in formula derivation to attract students to think actively and participate in the whole derivation process, which is conducive to the understanding of knowledge points; Secondly, when teaching more abstract content, combine multimedia demonstration to make the teaching content more specific, visualized and vivid, deepen students' understanding of the content, and use multimedia combined with blackboard teaching to achieve twice the result with half the effort in the course of power system analysis.

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4.3.2 Simulation teaching

To further visualize the power flow change of the power system, it presents a dynamic change process. Dynamic simulation teaching with computer simulation can express more vividly and intuitively, and the simulation software can be directly run through students' curriculum design. While it is easy to understand and master knowledge, it can increase students' proficiency and participate in engineering practice in the whole process, which is an effect unmatched by other teaching methods.

Establish a comprehensive laboratory of the power system to strengthen the experimental teaching of the course. To enable students to strengthen their understanding and understanding of the actual devices of the power system, the college has purchased some power system relay protection and automatic device test-bed and established a comprehensive laboratory of the power system. The laboratory has a strong experimental ability. In addition to many conventional experiments such as relay characteristic parameter test, three-stage current protection, circuit breaker control circuit, and automatic reclosing, it can also complete other relevant design and comprehensive experiments. A conventional experiment is a necessary experiment in the experimental class. The teaching method of combining demonstration experiment and verification experiment is adopted. Design and comprehensive experiment is the choice. It does not occupy the experimental class hours and is designed and debugged by students independently, which can be completed in combination with practical links such as curriculum design or graduation design. Through these practical links, we can cultivate students' observation ability and thinking ability, deepen students' understanding and mastery of classroom knowledge, improve students' practical ability and practical ability, and lay a solid foundation for students to go to corresponding posts in the future.

Set up power system simulation experiments to strengthen students' understanding and consolidation of theoretical knowledge. The power system simulation experiment we set up includes PSASP and MATLAB. PSASP is a powerful comprehensive program for power system analysis. It is a common software for power system calculation and Simulation in China. PSASP can perform various calculations on the power systems. It includes more than ten calculation modules, such as power system power flow calculation, optimal power flow, reactive power optimization, short-circuits calculation, network loss analysis, relay protection setting calculation, transient stability calculation, and small-signal stability calculation. However, due to the limitation of experimental hours, we mainly let students do power flow calculation and short-circuit calculation experiments. To ensure the experimental effect, psasp7.0 software is installed on 80 computers in the college computer room. During the experiment, each person has one computer. It is required that students operate and design independently from data input to result in output. To realize the organic combination of theory and practice. The experimental content is the power flow calculation and short circuit calculation of a 9-node power system. Before the experiment, the wiring diagram of the system is arranged for the students. The students are required to name and number the bus, line, transformer, and other components in the diagram, input the system parameters in the text mode and complete the power flow calculation of short-circuit point current and voltage when various types of short-circuit occur in different places. After the experiment, it is required to complete the corresponding experimental report and make a qualitative analysis of the experimental results. The Simulink toolbox

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provided by MATLAB is a software package for modeling, simulation, and analysis of dynamic systems. It provides users with a model interface for modeling with a block diagram, which is intuitive, convenient, and flexible. The power system module PSB (Power System Blocksets) includes various motor simulation models, power electronic device models, and various measurement device models. Simulink has two parts: system modeling and system simulation, which can be operated by clicking and dragging. It can quickly build the simulation model of the system, and then use its functions to simulate and analyze the system. The simulation experiment is arranged in a group of 5-6 after all the professional courses in the seventh semester. The students mainly study independently. The teachers only answer questions in their spare time. They are required to complete the system modeling and parameter set within the specified time. Finally, the simulation results are demonstrated to the teachers, the corresponding experimental reports are completed, and the simulation experimental results are qualitatively analyzed.

4.3.3 Network teaching

To make full use of students' spare time and use the teaching method of a flipped classroom, the course of power system analysis, including syllabus, lesson plan courseware, electronic teaching materials, references, practical guidance, problem sets and answers, teaching videos, etc., is uploaded to the network through a public account so that students can preview, familiarize and understand in advance and enter the classroom with questions, After class, you can also review effectively. In addition, to facilitate students' learning, online communication platforms such as online counseling, Q & A, and online self-test are also set up. Teaching resources online can better solve the relevant problems encountered by students in pre-class preview and post-class review, help to improve students' autonomous learning ability, and also provide strong support for the diversification of classroom teaching methods. The University uses the central and local co-construction funds to purchase the comprehensive program for power system analysis of the Chinese Academy of Electric Power Sciences PSASP 7.0, KONE power grid planning computer-aided decision-making system powernnetv3.0, electrical computer-aided design EPLAN elect-c P8, silumin transformation and distribution automation system configuration platform monitoring and other software SEPR Power system software such as Se Cho will be able to carry out power system power flow calculation, relay protection, network loss analysis, short-circuit calculation, stability calculation, powerful grid planning graphic platform based on GIS, electrical design, perfect SCADA system function and many other experimental contents. Increase students' computer hours and cultivate students' computer application ability and development ability. The software simulation teaching module (ASP) is established on the excellent course website, and the simulation program is written in MATLAB language. A total of 13 power system digital simulation software packages are compiled, including power system admittance matrix calculation, power system power flow calculation, power system symmetrical short-circuit current calculation, power system asymmetric short-circuit current calculation, and power system stability analysis. Students can modify the model parameters of various components of the power system by themselves, carry out simulation analyses such as steady-state power flow calculation, deeply understand the impact of the change of system parameters on the system operation mode, and greatly improve students' rational understanding of power system analysis.

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4.4 Cultivate Students' Engineering Innovation Ability

To organically combine students' theory and practice, according to different contents, let students voluntarily organize and establish learning groups. Each group participates in Teachers' scientific research content in the whole process and makes use of links such as data access, proposal, experimental data analysis and processing, thesis writing so that students can not only exercise their practical operation ability but also cultivate the spirit of team cooperation, It broadens the vision of engineering practice and improves the ability of engineering innovation. From now on, cultivate their ability to work independently and improve students' enthusiasm for the course of power system analysis. When teachers carry out teaching work, they can organically decompose the curriculum, take the actual project application as the specific teaching goal, and the design process of each project can also be decomposed into different tasks. In the actual teaching process, we should do a good job in teaching around subtasks, help students realize independent thinking, and strengthen the practical application of the knowledge system. In the process of teaching, we should pay special attention to guiding students to learn to think, be able to excavate the essence of the problem from the common phenomenon, arouse interest in the theoretical knowledge through substantive thinking, and fundamentally consolidate their own power electronics technology foundation. It should be noted that during the course, we must closely focus on the basic knowledge of power electronic devices, take converter technology as the core content of the knowledge system, and form a systematic understanding of circuits and electronic knowledge.

The key how to transitioning from "teacher-centered" to "student-centered" lies in the reform of teaching mode, pre-class preparation, and autonomous learning. Flipping the classroom teaching mode and information-based teaching means can reflect its advantages, that is, the course teaching is divided into three inseparable parts, namely, before class, during class, and after class.

Before class, the teacher designs the teaching plan according to the requirements of project-based teaching content. The idea is to guide students' learning enthusiasm first, which mainly reflects the application of this course. The specific method is to collect relevant pictures, and videos, make various forms of multimedia courseware and micro-courses and fully show students the application of power electronics technology in our daily life. These materials are released to students through the WeChat group, QQ group, teacher teaching space, and other network tools; Some simple and clear learning tasks are put forward in the pre-class video materials to let students realize the learning priorities in the class. Teachers guide students to establish learning groups, supervise and urge each other, unite and cooperate, and jointly participate in the pre-class learning of the project. According to their characteristics and time arrangement, students can find learning materials on the designated network for pre-class learning, or download and save learning resources for learning at any time.

In class, the purpose of teaching is to help students solve problems in the process of self-study, help students digest the theoretical knowledge, and guide students to apply and consolidate the theoretical knowledge. The specific teaching process is as follows. Comment on project tasks and sort out problems, uniformly sort out and feedback on the problems encountered in students' autonomous learning and project

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implementation and evaluate the effect of project tasks. In the course, the teaching means are mainly information-based means. The key to the theoretical analysis of power electronics is to make the graphics and waveform move. Therefore, MATLAB/ Simulink is used to build the circuit for simulation teaching, and flash is used to make the courseware for the on-off change of switch and the change of energy flow so that students can directly feel the principle of circuit analysis. This greatly improves the effect of classroom teaching. In classroom teaching, arrange communication and discussion links, throw out the problems prepared by teachers, discuss and summarize in the form of groups, encourage students to spread and think actively, and cultivate students' sense of teamwork and independent innovation spirit.

After class, after each project task is completed, there is a comprehensive modular test, which is convenient for students to actively summarize the learning content and fill in gaps. Due to the online teaching of audio-visual materials in the classroom, if students encounter problems in the test, they can also use the network to learn the course knowledge anytime and anywhere and find problems. This teaching method using a network platform can make up for the shortcomings of traditional classroom teaching and provide a flexible learning mode and a large number of rich learning resources. In the process of implementation, certain results have been achieved. Students' learning enthusiasm and after-school communication feel that the teaching effect of using flipped classroom teaching mode and information-based teaching means has improved students' ability.

4.5 Strengthen Practical Teaching Links

With the rapid development of information technology, students can easily obtain many high-quality learning resources through smartphones. In addition, post-90s college students have active thinking and a strong ability to accept new things, so the traditional injection teaching method can’t adapt to the modern teaching system. According to the requirements of the training objectives of applied talents, the new teaching methods and teaching means should meet the needs of employers for talents, mobilize students' learning initiative and enthusiasm, and attract students' attention from the Internet back to the classroom.

4.5.1 Teaching method combining heuristic teaching with research and practicality

In the process of teaching, we should change the situation of teachers singing monologues, strengthen the interaction between teachers and students, and students should change from passive acceptance to active participation. A class is like a movie. The teaching content is a script. Teachers should position their identity as the director, control the teaching progress and focus, and lead the students who were originally just the audience into the teaching process to make them excellent actors. Whether a class is wonderful or not is closely related to teachers, students, and teaching contents. Therefore, teachers should enrich teaching content, introduce example problems in the power system, guide students to actively think about problem-solving methods by using their knowledge, and also provide several different solutions to problems. Students can determine the best scheme through discussion. For example, when explaining the "characteristics of various power plants", introduce the examples of the Three Gorges hydropower station, Tian Huang ping Pumped Storage Power Plant, and Daya Bay nuclear power plant, guide students to

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analyze and summarize the characteristics of various power plants from the geographical location and working principle of various power plants and determine the reasonable combination power generation scheme of various power plants in different seasons. In teaching practice, combined with the characteristics of strong performance desire and active thinking of students after 1990, we also tried to exchange the roles of teachers and students and achieved good teaching results, that is, 1-2 students were invited to explain a certain knowledge point, and teachers and students listened to the class together. The knowledge points are arranged for the students two weeks in advance so that the students have enough time to prepare, during which they can communicate with the teachers about the problems in lesson preparation. In the process of preparing materials and explaining them on stage, students' understanding of knowledge points is greatly enhanced and their interest in learning is significantly improved. At the same time, teachers can also find students' deviations and existing problems in their understanding of knowledge points and adjust the teaching plan and teaching progress. In recent years, the campus recruitment of the State Grid Corporation of China has broadened the employment channels for electrical students. Whether it is the written examination and interview uniformly arranged by the State Grid Corporation of China, or the job requirements, students need to have higher professional practice and innovation ability.

Therefore, in the teaching process of power system analysis, we should pay more attention to the cultivation of ability, increase practice links, build training laboratories and actively establish off-campus practice bases. The training laboratory introduces the teaching experiment system of power system microcomputer protection and its comprehensive automation. The system combines the actual operation situation of the power system industry, meets the requirements of undergraduate teaching and training, and takes into account scientific research and test. The primary electrical part adopts physical simulation, which can truly reflect the steady-state and transient operating conditions of the power system. Through this system, students can complete many typical experiments of power system analysis, such as single loop steady-state symmetrical operation experiment, power system fault calculation and analysis experiment, the influence of short circuit type on power system transient stability experiment, the influence of fault removal time on transient stability experiment, etc. To cultivate students' autonomous learning and innovation ability, teachers can guide students to carry out extended reading in their spare time and complete research and design topics through autonomous learning. For example, "voltage regulation by reactive power compensation" can guide students to read relevant materials about advanced reactive power optimization methods, the impact of reactive power on network loss, and the economic distribution of reactive load, and complete the comprehensive design of reactive power compensation capacity determination, network loss calculation, and reactive load distribution of simple power system. A topic runs through many important knowledge points. Students can realize that knowledge is interrelated rather than separated in calculation and design.

4.5.2 Innovative teaching methods

The combination of multimedia and blackboard writing cannot meet the characteristics and training requirements of students at this stage. It is far from enough to stick to the course teaching of "power system analysis". The course teaching team uses the network teaching platform software of Hebei

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Agricultural University to establish the "power system analysis" network course. The course platform includes course teaching resources, teaching micro-videos, teaching materials, teaching references, and other relevant teaching materials. Students can access the network course content at any time through computers or smartphones for online learning, homework Participate in course topic discussions and tests. Teachers can also manage the course through the teaching platform, broadcast the teaching live, count the number of visits of students and the learning progress of the course, comprehensively evaluate students according to the completion of tasks such as tests, homework, video viewing, and course interaction, and supervise students with low evaluation scores. In the classroom, students and teachers can rely on the mobile client of the teaching platform to realize multiple tasks such as signing in, issuing questions, and answering questions. The problem of students playing on mobile phones in class has also been greatly improved. Mobile phones not only will not affect learning but also become a learning assistant.

4.6 Establish a Comprehensive Assessment and Evaluation Mechanism

4.6.1 Evaluate the usual performance in combination with the classroom performance and learning after class

Conduct comprehensive evaluation. In the past, only relying on students' attendance, classroom tests, and after-school homework to determine their usual grades can’t fully reflect students' learning ability. After the curriculum reform, the learning situation of students on the network teaching platform will be included in the evaluation scope of usual performance, including the situation of answering questions in class, the activity of participating in the topic discussion, whether to watch teaching videos continuously, the length of video viewing, reading relevant professional materials, etc. Improve the frequency of the usual test. To synchronize with the questions of the campus recruitment test of the national home appliance network, the test focuses on multiple-choice questions and judgment questions, which can not only save time but also reflect the students' mastery of the content of this class. After-class homework is an important means to test the learning effect. In addition to the topics that students can complete independently, a comprehensive analysis topic that can reflect the actual project is added. The topic design covers the key contents of multiple chapters, such as the power system network loss calculation problem, which is divided into completing the equivalent circuit, determining the power flow calculation method, and programming the algorithm, According to the system operation data, select the network loss calculation method, calculate the network loss, and put forward the loss reduction and energy-saving scheme. Students form groups voluntarily, clarify the division of labor and complete it together. Score the team members according to the completion. It not only improves the ability to comprehensively analyze practical problems but also cultivates a sense of innovation and team spirit. The forms of homework also tend to be more diversified, such as writing and submitting reading reports according to reading materials; Setting the topic, guiding students to collect relevant literature around the topic requirements, completing 1 ~ 2 scientific and technological papers every semester, and train students' ability to self-study, summarize and analyze problems.

Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 1833-1846
Article History: Received: 02 April 2022, Revised: 15 April 2022, Accepted: 24 April 2022, Publication: 04 May 2022

4.6.2 More reasonable final examination

Combined with the characteristics of power system analysis" and based on the curriculum syllabus, the course team designed and completed the test question bank system of power system analysis. The system platform has a friendly interface, simple operation, a random selection of test papers, wider proposition coverage, moderate difficulty, and significantly improved accuracy and standardization. The questions in the question bank are closer to the actual problems of the power system and more comprehensive.

4.7 Construction of Teachers

The key to the construction of excellent courses is the construction of teachers. The key to the construction of teachers lies in the improvement of teaching levels. We should have high-level curriculum leaders, keynote teachers, and excellent teaching quality. Over the years, we have constantly changed our teaching concepts and engaged in teaching with a research attitude. It needs careful design to teach a course well. Teaching a course well requires long-term research and long-term accumulation. Each teacher should have the professionalism of teaching work, and further promote teachers to do a good job in teaching in combination with school teaching supervision and college teaching supervision. In addition, young teachers are also required to participate in lecture competitions, get exercise and improvement, spot check teaching plans, listen to each other, carry out teaching and research activities, and form a climate of advocating teaching. In terms of knowledge structure, our teaching team is composed of professors, doctoral guides, associate professors, and lecturers, and young and middle-aged teachers whole have doctoral degrees or in-service doctors, covering all aspects of talents needed for theoretical teaching and experiment. In terms of age structure, we combine the old, middle-aged, and young teachers, mainly middle-aged and young teachers, and have formed a strong allocation of teachers in classroom teaching, curriculum experiment, curriculum design, teaching guidance, and other links.

V. CONCLUSION

The practical teaching reform measures of power system courses have been fully implemented in the major of electrical engineering and automation in our university. The practice in recent years has proved that the practical teaching of this series of courses runs through the theoretical teaching, which not only improves the teaching quality and teaching level, realizes the zero connection between teaching and t process, but also solves the monotonous and time-consuming traditional theoretical teaching methods A profound and difficult problem with poor effect. In recent years, the students majoring in electrical engineering and automation in our university have won many awards in the National College Students' electronic design competition and the provincial Challenge Cup competition. The rate of postgraduate entrance examinations has increased year by year, and the employment rate of graduates has increased year by year. They have obtained obvious talent training benefits and have been widely recognized and praised by society. It can be seen that the innovative practical teaching platform of power system courses is conducive to the development of electrical engineering and Automation Specialty in our university and the cultivation of applied high-quality talents in local colleges and universities.

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ISSN: 1520-0191
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ACKNOWLEDGEMENTS

This research was supported by National Natural Science Foundation of China (Grant No. 162072164), and the Natural Science Foundation of Hubei Province (Grant No. 2021CFB578) and Teaching and Research Project of Hubei Normal University in 2021 (No. 2021042)

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