

## **Course Reform of Metal Cutting Machine Tool Design under the Background of Engineering Education Accreditation**

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### **ABSTRACT**

**The course of metal cutting machine tool design is a compulsory course in the manufacturing direction of mechanical specialty in our university. Under the background of engineering education accreditation, the course has been reformed. The new syllabus corresponding to the index points of graduation requirements was established, the teaching contents were integrated and optimized, project teaching method and diversified assessment method were designed, the evaluation method of course objectives achievement was constructed, the closed-loop course quality assurance system of Design-Implementation-Assessment-Evaluation-Improvement was formed. Students' learning initiative and the learning effect are improved.**

**Keywords:** The course of metal cutting machine tool design; Engineering education accreditation; Course objectives; Teaching reform.

### **INTRODUCTION**

Engineering education accreditation has practical guiding significance for the development of higher education in China. The basic concepts of engineering education accreditation are student-centered, outcome-based education and continuous improvement of teaching quality. It is the basic premise to take part in the certification of engineering education and an important way to improve the quality of engineering talent training [1]. It is the basic premise to take part in the engineering education accreditation to follow the concept of accreditation in course teaching, and an important way to improve the quality of talent training.

The course of metal cutting machine tool design is a compulsory course in the manufacturing direction of mechanical specialty in our university. It is the link between basic courses and practical teaching, and the basic platform for establishing relevant knowledge and skills in machine tool

design. Under the background of engineering education accreditation for mechanical specialty in our university, the teaching team reformed the course from many aspects.

## REFORM CONTENT

### Syllabus corresponding to the index points of graduation requirements

The main task of this course is to cultivate students' ability of machine tool design and application of professional knowledge through classroom teaching, experimental teaching and project research, and to support the achievement of corresponding index points in graduation requirements.

Specific course objectives are as follows: 1) Master the transmission principle and structural characteristics of all kinds of traditional machine tools, master the design principle and method of metal cutting machine tools, and have the ability of overall design, transmission design and structural design of main components of machine tools. 2) In the process of project and experiment, have team work consciousness, be able to coordinate and complete the assigned tasks, and form the final plan.

The index points of graduation requirements supported by this course are shown in Table 1.

**Table 1. The graduation requirements indicators supported by this course**

| Graduation requirements                          | Index points of graduation requirements                                                                                                                                                        | Relevance | Course objective |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------|
| Graduation requirements 1. Engineering knowledge | 1-4. Master mechanical expertise and have the ability to solve complex mechanical engineering problems by applying the knowledge                                                               | M         | objective 1      |
| Graduation requirements 9. Individuals and teams | 9-2. Mechanical as the main body, can actively work with team members in a multidisciplinary background, complete the tasks assigned by the team, assume the roles of team members and leaders | L         | objective 2      |

### Adjusting course content

The predecessor of this course is mechanical manufacturing equipment design, but in the original course, the design content of machine tool fixture is repeated with the course of mechanical manufacturing technology, therefore, the content of the course has been comprehensively adjusted.

1. The design content of machine tool fixture is only taught in the course of mechanical manufacturing technology.
2. Adjust the design of forming tool to the course of metal cutting principle, and the course was changed to metal cutting principle and tool.
3. Add to the introduction of machine tools, the course first teaches the transmission principle and main structure of typical machine tools, then first teaches the design of transmission system and main components, so that the course is more organized and more systematic. Finally, the title of the course was adjusted to the metal cutting machine tool design.

### Reforming the teaching model

Drawing on the concept and model of CDIO (Conceive-Design-Implement-Operate) engineering education [2, 3], students' ability as the guide, the project teaching model of the course of metal

cutting machine tool design is constructed, in that the student as the main body, the course project as the basis, the organic integration of theory and practice, and knowledge, ability, quality all in one. In the teaching content of the course, the design of the transmission system of the machine tool is the main line of the teaching content, so it is determined that the content of the project is to design the transmission system of the machine tool, machine tool types are selected from typical lathes, milling machines and hobbing machines.

Considering the complex structure of machine transmission system and the high requirement of machining precision, it's very difficult to process and make objects, but the virtual simulation of 3D motion can be realized conveniently. From structural design to motion simulation, students can also get a comprehensive training. Typical motion simulations designed by students are shown in Figure 1.

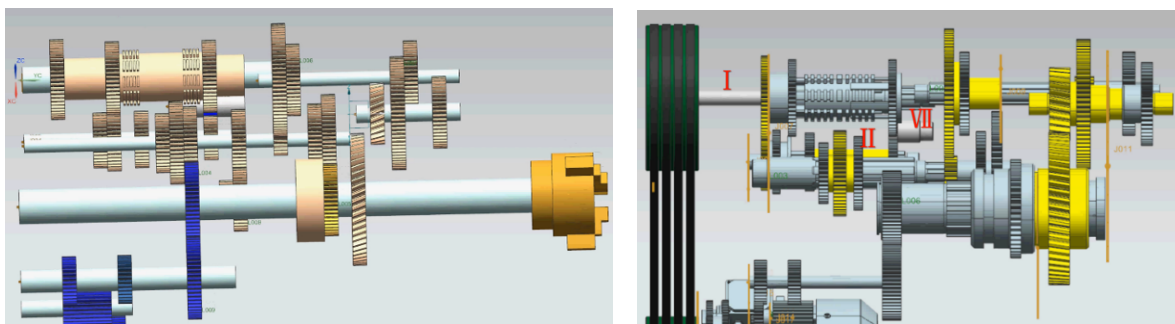


**Figure 1. Typical motion simulations designed by students**

### **Reforming the assessment model**

Scientific and reasonable assessment method has great influence on teaching and is beneficial to the improvement of teaching quality [4]. In order to pay attention to the learning process, the project, experiment, discussion, classroom test, homework and other aspects are included in the assessment index system of the course. At the same time, we attach importance to the cultivation of students' moral character. In each assessment, learning attitude, moral character, honesty consciousness, team spirit and many other aspects are considered simultaneously. This method comprehensively assesses the students' knowledge, ability and quality, and implements the whole process management to the students' course study. So that students can actively participate in the whole process of teaching activities, and the construction of style of study and examination is strongly promoted.

Before reform, the final result of the course was composed of the following parts, final examination result was 90%, and the experiment was 10%. After the reform, the final result of the course is composed of the following parts, final examination result is 55%, discussion is 5%, classroom test is 5%, experiment is 10%, and homework is 10%. Each full mark is 100 points. The corresponding relationship between each link and the course objective is: the final examination, discussion and classroom test corresponding to the course objective 1, the experiment and project corresponding to the course objective 2.

## COURSE EVALUATION AND CONTINUOUS IMPROVEMENT

At the end of the course, the achievement degree of the course objectives is calculated by synthesizing each achievement. The calculation method is:

$$\lambda_i = \frac{k_1 A_{1i} + k_2 A_{2i} + \dots + k_j A_{ji}}{k_1 A_{01} + k_2 A_{02} + \dots + k_j A_{0j}} \quad (1)$$

Where,  $\lambda_i$  is the achievement degree of course objective  $i$ ,  $k_j$  is weight coefficient of examination link  $j$ ,  $A_j$  is the actual average score of examination link  $j$ ,  $A_{0j}$  is the full score of examination link  $j$ .

At the same time, students were given questionnaires on the achievement degree of course objectives. According to their own learning situation, the students evaluate the achievement of objectives and put forward some problems. After students return to the questionnaires, the average value is used to calculate the achievement degree of each course objective.

We use two methods of calculation and investigation to analyze the achievement of course objectives, improve the teaching quality according to existing problems and suggestions. Through the reform of the course, the students' learning initiative has been improved, and the learning effect has been obviously improved. The results of the two academic years before and after the reform are shown in Table 2.

**Table 2. Comparison of results before and after the reform**

| The interval of results | The number and proportion in the interval before reform |                                 | The number and proportion in the interval after reform |                                 |
|-------------------------|---------------------------------------------------------|---------------------------------|--------------------------------------------------------|---------------------------------|
|                         | The final examination results                           | The final results of the course | The final examination results                          | The final results of the course |
| 0~59.9                  | 30 (37.0%)                                              | 25 (30.9%)                      | 5 (6.9%)                                               | 1 (1.4%)                        |
| 60~69.9                 | 22 (27.2)                                               | 25 (30.9%)                      | 24 (33.3%)                                             | 20 (27.8%)                      |
| 70~79.9                 | 15 (18.5%)                                              | 16 (19.8%)                      | 22 (30.6%)                                             | 24 (33.3%)                      |
| 80~89.9                 | 13 (16.0%)                                              | 14 (17.3%)                      | 15 (20.8%)                                             | 19 (26.4%)                      |
| 90~100                  | 1 (1.2%)                                                | 1 (1.2%)                        | 6 (8.3%)                                               | 8 (11.1%)                       |

## CONCLUSION

Under the background of engineering education accreditation, we have carried on series reform to the course of metal cutting machine tool design. The course objectives, teaching contents, teaching modes, assessment methods and evaluation methods are designed, and these designs embody the concept of outcome-based education, student-centered and continuous improvement, which can effectively improve the quality of talent training.

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