

Discussion on the Problems and Teaching Methods of Mechanical Design Basis

Yong Yang ^{1, a*}, Yuanjing Zhang ^{1,b}, Quansheng Jiang ^{1,c}, Wei Liu ^{1,d},
Jianfeng Yang ^{1,e} and Zhengqi Wu ^{1,f}

¹College of Mech. Eng., Suzhou Univ. of Science and Tech., Suzhou 215009, China

^ayangyong5114360@163.com; ^b346694174@qq.com; ^c28497374@qq.com,

^d641458242@qq.com; ^eosgimpbkhnid@qq.com; ^f773811812@qq.com

*the corresponding author

Keywords: Mechanical; Design; Basis; Teaching; Problems; Teaching; Methods

Abstract. This paper analyses the characteristics of the course education of mechanical design basis, and also points out the existing problems. On this basis, aiming at these problems, the teaching methods and teaching improvement measures of mechanical design basis are discussed. Practical results show that the proposed teaching improvement measures have a good effect on improving the education of mechanical design basis.

Introduction

The course of mechanical design basis is the synthesis of mechanical principle^[1] and mechanical design^[2]. It mainly involves the working principle, structural characteristics and application of common mechanism and general mechanical parts. This course takes the common mechanism and common parts in general machinery as the object of study. It expounds the working principle, structural characteristics, motion and force transmission characteristics of common mechanism and common parts, and the basic theoretical knowledge and methods of motion scheme design^[3]. The purpose is to enable students to master the design principles, methods and general rules of mechanism and general mechanical parts, and to cultivate students to establish correct design ideas^[4].

This course is mainly for non-mechanism or near-mechanism major. It has the characteristics of strong comprehensiveness, less class hours. Also the students majoring in teaching have the weak basic mechanical knowledge^[5-6]. There are some problems in the actual teaching of the courses. The teaching methods and measures need to be improved according to the curriculum characteristics and the existing problems.

Characteristics Analysis of Mechanical Design Basis Course

Content of This Course is Comprehensive, Covers a Wide Range and is Difficult. it belongs to the synthesis of mechanical principles and mechanical design, covering the basic knowledge of mechanical design and mechanical principles, involving the structure, characteristics, design and calculation of many mechanical parts. The content is complex and abstract.

Course Hours are Relatively Short, and Most of the Teaching Majors are Non-Mechanical Majors. the courses offered by the majors of this course are arranged for fewer hours. And compared with the students of mechanism majors, the mechanical knowledge of the students of near-machine majors is weak.

Teaching Content of Course has Strong Practicality and Applicability. an important goal of the course is to cultivate students' engineering practice ability, and to analyze and solve engineering problems.

Problems in Teaching of Mechanical Design Foundation

Insufficient Understanding of Importance of This Course by Non-Mechanical Majors. Most of the majors which study the course of mechanical design basis are close to mechanical majors. The students think that the course has little relevance to their majors and is not a professional course. As a result, many students do not really realize the importance of this course. Then they learn with a coping psychology in the process of learning, which leads to the course's poor learning effect.

Content of the Course is Many and Complex, But the Class Hours are Few. The course includes basic knowledge of mechanical principle, such as calculation of degree of freedom of mechanism, drawing of mechanical principle sketch, etc. It also includes structural analysis, design and calculation of typical parts in mechanical design, such as characteristics, selection and design calculation of typical transmission parts such as gears, belts and sprockets. The content of the course is cumbersome and complex, but the courses offered by the specialty are fewer hours, which is equivalent to the content of two courses being taught by one course.

Examples Used in the Course are Unfamiliar for Non-Mechanical Students. The course emphasizes the students' ability to analyze and solve practical engineering problems. Therefore, a large number of teaching cases of practical engineering problems need to be set up in this course teaching. However, many teaching cases used are totally unrelated to the students' specialty, and students do not understand engineering cases, which leads to difficulties in understanding knowledge in the course of learning.

Students are Weak in Basic Mechanical Knowledge. Before learning this course, students are required to take mechanical drawing, theoretical mechanics, mechanics of materials and other courses. However, for non-mechanical majors, these pre-training courses involves less content, and many of basic knowledge needed in this course is not covered, resulting in students' weak mechanical basic knowledge and hard learning process in learning this course.

Teaching Improvement Measures of Mechanical Design Course Basis

Emphasizing on the Purpose and Significance of This Curriculum and Its Application in Professional Fields. In the course of teaching, first of all, let the students realize the importance of the course of mechanical design basis and also the importance for their majors. Only by making students aware of the purpose and significance of this course, can students pay enough attention to the course. For example, when the course is set in the building energy major, the professional value of this course can be highlighted through the practical application of mechanical principle and mechanical design in their professional field. For example, their familiar air conditioning can be taken as an example to illustrate the typical mechanical principle of the drive mechanism. So students would naturally attach importance to the study of the course.

Reasonable Arrangement of Teaching Contents in Accordance with Major Teaching Requirements. In view of the characteristics of less class hours and more teaching contents, teachers can refine the syllabus of courses, know the teaching objectives, definite the professional application of courses, and then arrange the teaching contents of this course reasonably according to the teaching requirements. For example, if teaching students majoring in building energy, the mechanical parts or transmission mechanisms commonly used in their specialty can be focused, while other mechanical parts or mechanisms can be used as after-class learning content. On the one hand, these do not occupy the time of class; on the other hand, the focus of teaching can be highlighted. At the same time, these can meet the requirements of teaching hours, and achieves the setting purpose of this course for their specialties.

Teaching of Courses Should be Based on the Cases with Major Characteristic. The course of mechanical design basis emphasizes the practicality of engineering, and many teaching examples and engineering problems will be involved in the teaching process. On one hand, case teaching related with the students' majors can improve students' interest; on the other hand, it is more convenient for students to understand the knowledge points. For example, when students majoring in building

energy study how to calculate the degree of freedom of mechanism, the air conditioning often mentioned in their major can be used as the object of analysis and teaching cases to analyze the degree of freedom of the air conditioning ventilator mechanism. So the students can deepen their understanding of calculation of the freedom degree of mechanism.

College Setting This Course Should Emphasize the Knowledge Connection Between This Course and Other Professional Courses. The course of mechanical design basis is closely related to the pre-course, which requires a higher mastery of the knowledge of the pre-course. In the course arrangement of the college setting this course, attention should be paid to the knowledge connection between this course and other professional courses, and the class hours for the courses of mechanical drawing, theoretical mechanics and material mechanics should be increased. At the same time, in the teaching of mechanical design foundation, more cases related to the follow-up professional basic courses can be introduced, so that students can creatively use the basic knowledge of mechanical design to solve the engineering practice problems related to their specialty while learning this course.

Attention Should be Paid to the Supplement of the Basic Knowledge Related to This Curriculum. Teachers should supplement relevant basic knowledge pertinently in the teaching process. For example, when teaching the drawing sketch of mechanism, the relevant basic knowledge of mechanical drawing according to the characteristics of students before teaching can be supplemented. When teaching the structural characteristics and design calculation of typical transmission mechanism, the required theoretical mechanics knowledge can be provided. The knowledge of mechanics of materials should be briefly reviewed and introduced. These can help students better understand the teaching knowledge points of the course of mechanical design basis.

Combining and Deepening of Practical Teaching to Theoretical Teaching. The course of mechanical design basis has strong practicality and engineering applicability. The theoretical teaching can be supplemented and deepened through practical teaching links, so that students can deepen their understanding of the course content. For example, through the structural analysis and disassembly experiment of the reducer, students can understand the structural characteristics and functions of shafting, bearing, gear and other parts learned in the basic course of mechanical design. Through the involute gear generation, students' understanding of gear parameters can be deepened. It is benefit to facilitate students' understanding of gear forming principle, parameter calculation, and so on.

Teaching Improvement Effect

The teaching improvement measures of the course of mechanical design basis are applied to the students' teaching majoring in building energy. From the teaching effect, students' awareness of the importance of this curriculum has been significantly improved, and students' interest and enthusiasm in curriculum learning has been significantly enhanced. It is easier for students to understand what they have learned in this course. Combining with the teaching examples of their majors, it is more suitable for students' professional interests, enhances students' learning enthusiasm. To sum up, the students reflect that they can combine the basic course contents of mechanical design with the practical problems of professional engineering, and have a significant improvement in the ability of engineering design analysis.

Summary

(1) Characteristics of mechanical design basis course are analyzed. This paper points out the problems existing in the basic course of mechanical design: the content of this course is too much and complicated, and the class hours are too few; teaching examples are relatively unfamiliar for non-mechanical students; students' basic knowledge of mechanical design is weak, etc.

(2) In view of these problems, this paper points out some measures to improve the teaching of basic mechanical design course: arranging the teaching content reasonably; examples related to student's major should be adopted; paying attention to the combination and deepening of practical teaching to theoretical teaching, etc.

(3) The practical teaching of course of mechanical design basis in the major of building energy proves that: the teaching improvement measures proposed in this paper have significantly improved the teaching effect of this course.

Acknowledgements

This research is funded by Self-construction Project about General Education Elective Courses of Suzhou University of Science and Technology (2018TSY-52); Comprehensive Teaching Reform Project of Suzhou University of Science and Technology(2018KJZG-55); Teaching Reform and Research Project of "Undergraduate Teaching Engineering" in Suzhou University of Science and Technology(2017JGMZ-10).

References

- [1] H. Sun and Z.M. Chen Mechanical principles (8th Edition) [M]. Beijing: Higher Education Press, 2013.
- [2] Ugural. Mechanical design: an integrated approach[M]. Yhe McGraw-Hill Companies, Inc, 2003.
- [3] Robert L.Norton. Design of machinery (Third Edition)[M]. Higher Education Press, 2007.
- [4] Y. Yang, J.L. Jiang and D.X. Wang, et al. Construction of innovative teaching system and mode for mechanical principle course facing ability target of international engineering education[C]// International Conference on Modern Management, Education Technology, and Social Science. 2017.
- [5] Y.Z. Zhao Discussions on experimental teaching reform of basic mechanical design[J]. Electronic Testing, 2016(1): 145-146.
- [6] Y.Y. Gao, M. Wang and H.P. Liu. Teaching reform research and practice of basic mechanical design course [J]. Education and Teaching Forum, 2016 (11): 157-159.