

Construction of the Online Course “Automotive Engine Structure and Principles” under the Background of Building a First Class Undergraduate Program

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Abstract

Guided by the concept of “first-class undergraduate education” and centered on “students”, the original teaching curriculum system, course introduction, teaching outline, teaching plan, teaching contents, multimedia courseware and other teaching resources of “Automotive Engine Structure and Principles” course are optimized and reconstructed in this paper. At the same time, due to the limited teaching hours and resources of offline course, all of the optimized and restructured electronic resources of this course and teaching videos will be upload to the network platform to establish high-quality online course, so that students can review the course to learn the key and difficult knowledge points contrapuntally at anytime and anywhere.

Keywords: First Class Undergraduate, Automotive Engine Structure and Principle, Online Course.

1. Background of the online course construction of “Automotive Engine Structure and Principles”

Currently, in response to the call of the Ministry of Education to build first-class undergraduate programs, the construction of first-class undergraduate programs in major domestic universities is being carried out in an orderly manner. The concept of the first-class undergraduate program, which is based on the needs of economic and social development and talent cultivation goals, guides the construction of undergraduate courses with new concepts, optimizing and reconstructing teaching contents and curriculum system. As the core course of vehicle engineering major, the “Automotive Engine Structure and Principles” course plays an important role in the student training system. With the rapid development of automotive technology, various mechanisms and systems of the engine have developed a series of new technologies, as well as a series of new component products. These new technologies and related components are not reflected in the existing teaching contents. Therefore, the previous teaching syllabus, teaching plan, and teaching contents can no longer fully adapt to the development requirements of the latest technology, it is also insufficient to cultivate "outstanding engineers" who meet engineering requirements and are competitive.

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In addition, the automotive engines have a wide variety of components. Its structure is very complex. In addition, the corresponding theoretical contents are also strong, which is difficult to be understood. However, the teaching hours of this course are very limited, and there is not enough classroom time for students to learn and understand important and difficult problems. After teaching many knowledge points in class, it is still difficult for students to understand some problems. The survey questionnaire and feedback from the teacher-student symposium at the end of each course indicate that the main issue commonly reported by students is that the offline classroom hours of this course are slightly insufficient, and many key knowledge points need to be reviewed again to fully absorb. Meanwhile, the teaching resources for offline courses are limited, and students do not have relevant platforms to review the relevant teaching content. Therefore, a single offline teaching mode can no longer meet the needs of students to review and learn key and difficult points at anytime and anywhere after class.

Based on the above, taking “new ideas and new concepts” as the guidance, with “industry needs” as the goal, the original curriculum system, course introduction, teaching outline, teaching plan, teaching content, multimedia courseware and other teaching resources of “Automotive Engine Structure and Principles” are optimized and reconstructed in this paper. At the same time, based on the principle of “opening and sharing, building and using”, the optimized and reconstructed teaching videos and other electronic resources related to this course are uploaded to the super star network platform by giving full play to the advantages of modern information technology in teaching activities. So, the high-quality “online courses” can be established and the diversified teaching mode of “digital, shared and open” is formed. It can promote the formation of a new teaching form of “Internet plus education”.

2. Optimization and Reconstruction of the Course Content of “Automotive Engine Structure and Principles”

On the basis of research on the development of modern automotive engine technology, taking the “first-class undergraduate construction” and the “excellent engineer education and training plan” as the guiding ideology of this course teaching, the original teaching syllabus, teaching plan, teaching content, multimedia courseware and other teaching resources are optimized and reconstructed by introducing the Engineering examples and cutting-edge knowledge. The specific measures are as follows:

1) Optimization and Reconstruction of the Teaching Syllabus and Content

Based on the guiding ideology of “first-class undergraduate construction” and “excellent engineer education and training plan”, combined with examples of automotive engine engineering and cutting-edge knowledge in this discipline, the teaching syllabus of “Automotive Engine Structure and Principles” has been optimized and restructured, and the relevant teaching content and time allocation of this course have been readjusted too. The knowledge module of this course has 9 chapters, and the structural section mainly introduces the structure and composition of the crankshaft connecting rod mechanism and dynamics, valve train mechanism, fuel supply system, intake and exhaust system, cooling system, lubrication system, ignition starting system, and starting system. The principle section mainly introduces the basic knowledge and performance, combustion process, gas exchange process, and testing and performance of automotive engines. The total class hours are

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48 class hours. Due to the continuous innovation of engine technology and the emergence of new products, it is necessary to adjust and update the original course content and related knowledge. So it is necessary to delete some outdated contents and add some new knowledge points. The teaching contents and relevant class hour arrangement to be revised are shown in Table 1. The added contents are also shown in red in Table 1. More detailed adjustments, such as the innovation of some components and the emergence of related new technologies, will be reflected in the course presentation. The revised teaching contents and class hour arrangement are shown in Table 1:

Table1 The teaching contents arrangement of “Automotive Engine Structure and Principles” course

Knowledge Module	Contents	Class hours
Basic knowledge and performance of engines	Basic concepts of automotive engine	8
	The working process and principle of reciprocating piston internal combustion engines	
	The overall performance of reciprocating piston internal combustion engines	
	Cycle and evaluation of reciprocating piston internal combustion engines	
	Variable displacement engine (new added)	
Crank linkage mechanism and dynamics	Force analysis of reciprocating piston internal combustion engines	6
	The function and composition of the crank connecting rod mechanism	
	Typical structure of the body group	
	Typical structure of crankshaft group Bias crankshaft technology (new added)	
	Typical structure of connecting rod group	
	Typical structure of piston group	
The Air Exchange Process and Valve Train of a Four Stroke Internal Combustion Engine	The Air Exchange Process of a Four Stroke Internal Combustion Engine	6
	The Valve Train of a Four Stroke Internal Combustion Engine	

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	Continuously variable valve timing system (new added)	
The combustion process and fuel supply system of a four stroke internal combustion engine	The combustion process of a four stroke internal combustion engine	6
	The combustion chamber of an internal combustion engine	
	The fuel supply system of internal combustion engine In cylinder direct injection stratified combustion engine (new added)	
Inlet and exhaust devices and exhaust purification devices	The function, composition, layout, and typical structure of the intake system	4
	Exhaust purification technology, typical exhaust purification device	
	Variable intake manifold technology (new added)	
The cooling system of the engine	The role and requirements of the cooling system, the concept of cooling intensity, the type and structure of the cooling system	4
	Closed circulating water cooling system	
	The function and working principle of coolant, as well as the composition, performance, and grade of the coolant	
The lubrication system of the engine	The concept of lubrication and friction, functions and requirements of lubrication systems, types of lubrication systems	2
	The concept of lubrication method, the function, type, composition, performance, and brand of lubricants, etc	
	The composition and oil circuit layout of the lubrication system, as well as the structure and working principle of	

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	typical components	
The ignition and starting system of the engine	The Function, Type, and Working Principle of Gasoline Engine Ignition System Basic requirements and characteristics of ignition system	6
	The concept of ignition timing, ignition advance angle, and optimal ignition advance angle, ignition system composition and typical structure	
	Concept of starting and starting speed, function, type, and requirements of starting system	
	The composition of the starting system, the structure, composition, and working principle of a typical starter: DC motor, transmission mechanism, and control mechanism	
Automotive Engine Testing and Performance	The basic composition, main equipment, testing instruments, and measurement methods of the engine test bench	4
	Definition of engine load characteristics and testing process of engine load characteristics	
	Definition of engine speed characteristics and testing process of engine speed characteristics	
The hybrid technology	Overview of Oil, Electric, and Hydrogen Hybrid Technology (New added)	2
Total		48

2) Revising the teaching plan.

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According to the revised and improved teaching syllabus and contents, the time allocation of knowledge points of each chapter is optimized, and the key and difficult knowledge points are also clarified in the new modified teaching plan. It can make the teaching content more in line with the development needs of automotive engine technology today, and make the class hour allocation of this course more scientific and reasonable, thereby helping students understand, master, and apply the knowledge of this course.

3) Improvement and optimization of multimedia courseware.

According to the revised and improved teaching syllabus, teaching plan, and teaching contents, the teaching courseware of this course should also be modified and optimize. The courseware contents is added or deleted accordingly based on the teaching contents, and the quality of the courseware is also optimized.

Reduce the use of large text descriptions and add intuitive and vivid images, tables, and animations to make the courseware more intuitive, vivid, and vivid, thereby achieving better teaching results.

4) The construction of the course test question bank.

According to the optimized and restructured chapter contents, a test question bank will be established. The test question bank contains many kinds of question types, such as the choice questions, the fill-in-the-blank questions, true or false questions, short answer questions, essay questions and so on. The question bank can be used for quizzes on classroom knowledge points, homework, stage and final assessments, etc.

5) Recording of course teaching videos.

Based on the revised teaching contents mentioned above, team members are required to record relevant teaching videos according to their division of labor. The knowledge points are required to be taught accurately, the teaching videos are well produced, and engineering examples and cutting-edge knowledge of the subject are combined as much as possible. At the same time, make full use of Internet resources to explore Case method and stimulate students' interest and motivation in course learning.

3. Construction of the Online Course

The online course is mainly conducted on the Super Star learning platform and MOOC platform, which should fully reflect the student-centered teaching philosophy. The online course creates an internet classroom that adapts to students' autonomous learning, and expands the course system structure from a spatial dimension. The teaching teacher uploads teaching materials such as teaching videos, syllabus, teaching plans, multimedia courseware, and test question banks to Super Star Learning platform. Students in our school can learn courses on multiple terminal devices of Learning platform. They can also review the course to learn the key and difficult knowledge points contrapuntally at anytime and anywhere. Secondly, the system has some modules such as check-in module, interaction module, homework module and phased assessment module. These modules are simple and easy to use, and teachers and students can fully utilize these modules for course classes, discussions, homework assignments, and tests. Moreover, teachers can also use this system to access students' learning situation, correct homework, and perform score statistics. At the same time, this online course resource will also be further promoted to the whole society through the construction of a MOOC platform to share course resources. Anyone who wants to learn this course can participate.

4. Acknowledgement

The research is financed by 2022 Shanghai University Municipal Key Course Construction Project——Construction of High Quality Online Course on “Automotive Engine Structure and Principles”

5. References

- [1] Zhong D.H. (2017) Under the Background of New Engineering, the Construction of Embedded System Course Group for Complex Engineering Problems. *Research in Higher Education of Engineering*,3,1-6.
- [2] Wu y. (2018) Emerging Engineering: The Future of Higher Education of Engineering. *Research in Higher Education of Engineering*, 2,1-3.
- [3] Zhang J. (2021) Research on the Construction and Practice of High Quality Online Courses. *Journal of Zhejiang Institute of Communications*, 2,53-56
- [4] Zang J.S., Tang Q.J., Cheng Y.J. (2020) Exploration and Practice of Teaching Reform in Special Processing Course under the Background of New Engineering Construction [J]. *HEILONGJIANG EDUCATION(Theory&Practice)*,4,12-13.
- [5] Chai X.L. (2020) Research and Practice of Online and Offline Mixed Teaching Mode Based on the Introduced High-Quality Online Courses: Taking “Robot Design and Programming” Course as an Example. *SOFTWARE*,41,72-75.