SJQU-QR-JW-033（A0）

**Syllabus**

**Fluid Mechanics and Hydraulics and Pneumatics**

一、**Basic information**

**Course code：**【2080429】

**Course credit：**【4】

**Major：**【**Mechanical Engineering and Automation**】

**Course nature：【Department Core Course】**

**College: Mechanical and Electronic Engineering**

**Textbook References：**

**Jianming Zuo, Hydraulic and Pneumatic Transmission, Mechanical Industry Press, 2016**

**Pre-requisite：**【Theory of machines】

【Machine design】

二、**Course Description**

This course is a professional foundation course for undergraduates majoring in mechanical design, manufacturing and automation. The teaching content of this course is divided into two parts: hydraulic transmission and pneumatic transmission. The hydraulic transmission part mainly introduces the basic knowledge of hydraulic fluid mechanics, hydraulic power components, actuators, control components and auxiliary components, hydraulic transmission basic circuit, and typical hydraulic transmission system. The pneumatic transmission part mainly introduces the basic knowledge of pneumatic transmission, air source device and pneumatic components, pneumatic basic circuit and common circuit. The hydraulic transmission part is the main teaching content.

三、**Course advice**

This course is suitable for mechanical students who have completed the professional basic courses of mechanical engineering disciplines such as mechanical principles and mechanical design, and have mastered the relevant knowledge of mechanics and mechanical principles and mechanical design.

四、**Course Content**

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| **Teaching Contents** | **Knowledge point** | **Abilities requirements** | **Teaching difficulties** |
| 1.Fundamentals of Fluid Mechanics (6 classes theory) | 1. Master the working principle of hydraulic and pneumatic transmission; Pascal principle.  2. Understand the physical properties of working oil.  3. Understand the basic theoretical knowledge of hydrostatics; basic theoretical knowledge of fluid dynamics; equation of continuity; Bernoulli equation; equation of momentum.  4. Understand the pressure loss of fluid flow, and hydraulic shock and cavitation. | 1. Analyze the basic working principle of hydraulic and pneumatic transmission.  2. Analyze the working properties of hydraulic oil. | The working principle of hydraulic and pneumatic transmission. |
| 2. hydraulic transmission (36 classes theory, 12 classes experiment) | 1. Master the working principle, structural characteristics and calculation of main performance parameters of gear pump, vane pump and piston pump.  2. Master the working principle, structural characteristics and calculation of main performance parameters of hydraulic motor and hydraulic cylinder.  3. Understand the basic concepts, classification and application of hydraulic valves.  4. Understand the working principle, structural characteristics and performance parameters of directional control valves, pressure operated valves, flow control valves.  5. Understand the type and function of auxiliary components for hydraulic systems.  6. Understand the classification, composition and working principle of the hydraulic basic circuit. | 1. Analyze the working principle of hydraulic pumps, hydraulic motors and hydraulic cylinders.  2. Calculate the main performance parameters of hydraulic pumps, hydraulic motors and hydraulic cylinders.  3. Analyze the basic working principle and structural characteristics of the hydraulic valves. | 1. Calculation of the main performance parameters of hydraulic pumps, hydraulic motors and hydraulic cylinders.  2. The basic working principle and structural characteristics of the hydraulic valves.  3. The working principle of the hydraulic basic circuit. |
| 3.Pneumatic transmission（6 classes theory, 4 classes experiment） | 1. Understand the working principle and structural characteristics of the air source device and pneumatic accessories.  2. Understand the working principle and structural characteristics of pneumatic actuators and pneumatic control components.  3. Understand the composition, working principle and characteristics of the basic pneumatic circuits. | Distinguish and apply pneumatic components. | Characteristics of pneumatic transmission. |

五、**Experiments and Basic Requirements**

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| **Item** | **Name of Experiment** | **Contents** | **Class** | **Type of experiment** | **Remarks** |
| 1 | Control boiler door hydraulic circuit experiment | Function of hydraulic control check valve | 6 | Verification |  |
| 2 | Hydraulic clamping circuit principle of double-acting hydraulic cylinder | Clamping circuit characteristics | 6 | Verification |  |
| 3 | Pneumatic speed control circuit | Air pressure one-way throttle valve speed regulation characteristics | 4 | Verification |  |
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六**、Assessment**

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| Marks （1+X） | Assessment | Weightage |
| 1 | Exam (open-book,120 minutes) | 50% |
| X1 | Mid-Term Exam | 10% |
| X2 | Homework | 10% |
| X3 | Attendance | 10% |
| X4 | Experiment | 20% |

七、**Teaching schedule**

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| **week** | **Contents** | **Methods** | **Assignment** |
| 1 | Working principle of hydraulic and pneumatic transmission;  physical properties of working oil;  theoretical knowledge of hydrostatics;  Pascal principle | Lecture |  |
| 2 | theoretical knowledge of hydrostatics;  equation of continuity;  Bernoulli equation;  equation of momentum;  Gap flow; orifice flow;  pressure loss of fluid flow;  hydraulic shock and cavitation | Lecture |  |
| 3 | working principle of hydraulic pump;  calculation of main performance parameters of hydraulic pump;  structural characteristics of gear pump, vane pump and piston pump;  working principle of gear pump, vane pump and piston pump | Lecture |  |
| 4 | working principle and performance of Hydraulic motor ;  parameter calculation of Hydraulic motor;  Classification of hydraulic cylinders;  working principle of piston cylinders, plunger cylinders and other hydraulic cylinders; | Lecture |  |
| 5 | overview of hydraulic valves;  working principle of check valve;  working principle of directional valve | Lecture |  |
| 6 | structure of directional valve;  working principle of pressure valve;  Structure of relief valve, pressure reducing valve and sequence valve | Lecture |  |
| 7 | working principle of trottle valve and control valve;  working principle of crtridge valve and servo valve;  function and structure of oil tank;  function and basic requirements of filter | Lecture |  |
| 8 | composition and working principle of the pressure regulating circuit;  composition and working principle of the decompression circuit;  composition and working principle of the unloading circuit;  throttle orifice speed-regulating circuit;  volume speed-regulating circuit;  volume- throttle speed-regulating circuit | Lecture |  |
| 9 | fast-speed movement circuit;  hydraulic system of power-slipway | Lecture |  |
| 10 | air supply devices;  working principle of cylinder and air motor;  pneumatic control valve | Lecture |  |
| 11 | direction control valve;  pressure control valve | Lecture |  |
| 12 | review | Lecture |  |
| 13 | Control boiler door hydraulic circuit experiment | Practice | Report |
| 14 | Hydraulic clamping circuit principle of double-acting hydraulic cylinder | Practice | Report |
| 15 | Pneumatic speed control circuit | Practice | Report |
| 16 |  |  |  |

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