Beni Suef Technological University

Pneumatics and Hydraulics Practice

Syllabus

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Course Title: Pneumatics and Hydraulics Practice

Course Code: N/A

Course Followers: Students of Mechatronics Department in 2nd year of 1st semester

(Students of Mechatronics Department in 1st semester of 2nd year)

Course Meeting Times

Labs: 1 session / week, 4 hours / session

Course Credits: 3

Course Introduction

It is very important for Mechatronics technicians to master the basic knowledge and skills necessary to design the hydraulic system that is the basis of automation. Pneumatic and hydraulic actuators are power transmission media that use pneumatic air or hydraulic fluid to generate force and movement. This course deal with the operation principle of pneumatic and hydraulic components such as pneumatic actuators, by experiencing various hydraulic power circuits through experiments, and using commercial software such as "PH-Lab", Festo, Etc.…...

Course Objectives

After successfully studying this course, students will learn:

1. Basic laws of hydraulics and pneumatics
2. Power in hydraulic system.
3. Hydraulic Circuits Components
4. Electrical Control in Hydraulics
5. Hydraulic System Installation
6. Pneumatic Actuators and Valves
7. Basic Pneumatic Circuit
8. Logic Control Circuit
9. Installation of Pneumatic System
10. How to implement Pneumatic and Hydraulic experimental projects using simulation software.

Learning Outcomes

1. Understand the basic principles of Pneumatics and Hydraulics.
2. Master the operating principles of pumps, valves and actuators, and their circuits.
3. Design pneumatic and hydraulic circuits and predict the responses.

Prerequisites

Student Should Pass the following Courses

1. Communication Skills in Technology: Reading Technical Information/ Drawings (1st year,1St Semester)
2. Electric Circuits (1st year,2nd Semester)
3. Basic Mechatronics Workshop (1st year,2nd Semester)

Textbooks

The course textbooks are:

1. Frank Ebel, G. Prede, M. Pany, D. Scholz, **Electropneumatics textbook basic Level**, Festo Didactic, 2003
2. Peter Croser,Frank Ebel, **Pneumatics textbook basic Level**, Festo Didactic, 2002.
3. D. Waller, H. werner, Pneumatics work book basic Level, Festo Didactic, 2002.
4. Andrew Parr MSc., CEng., MIEE, MlnstMC, **Hydraulics and Pneumatics A technician's and engineer's guide Second edition**, Butterworth-Heinemann, 2006.
5. Igor L. Krivts, German V. Krejnin, P**neumatic Actuating Systemsfor Automatic Equipment Structure and Design,** CRC Press Taylor & Francis Group,2006.

Labs (or Tutorials/Exercise, Workshop)

- Labs will be conducted during the weeks shown in the schedule. Each lab assignment involves one or more accomplishments which must be checked off by an instructor in the lab. The instructor will be available for help and lab check-off during those weeks in which a lab is in progress.
- Students must successfully complete a series of lab assignment works throughout the course. The instructor will gather a collection of work that demonstrates evidence of a range of techniques in this course.
- Lab assignments must be done on your own. Skipping the lab and submitting work copied from someone else is a serious breach of ethics, and will be handled by the Committee on Discipline.
- Lab assignments will be graded on a scale of 0 to 3 (3: lab complete, works, good job on pre- and post-lab; 2: lab mostly complete, reasonable job on pre and post lab; 1: lab partially done, marginal to poor job on pre- and post-lab; 0: lab not done, poor job on pre- and post-lab).

Lab Books

- You must obtain the contents of a few pages for every lab (from Lab #1 to lab #15) for recording measurements, observations and graphs of data taken during the in-lab exercises.
- Written pre-lab and post-lab exercises are also to be completed in your own papers.

Midterm Exam

- One midterm exam for testing the learning outcomes will be given in this term. The exam will take place few days after Lab #7 for a four-hour duration.
- Students have to demonstrate that the learning outcomes from Lab #1 to Lab#7 have been achieved.

Final Exam

- A four-hour final exam will be given during the end-of-term exam week.
- Students have to demonstrate that the learning outcomes from Lab activities after the midterm exam had been achieved.

Calendar

The calendar provides information on the course's lecture class (L), lab (Lab #), and exam (E) sessions.

SES #	TOPICS	KEY DATES
Lab #1	Basic laws of hydraulics and Power in hydraulic system	Lab report #1 in
Lab #2	Pumps and motors	Lab report #1 out Lab report #2 in
Lab #3	Electrical circuit diagram and Symbols	Lab report #2 out Lab report #3 in
Lab #4	Experimental Projects of Electrical Hydro-Control 1 Project 1: Lamp Control, Project 2: Relay control and self-holding and Project 3: Cylinder control with a single solenoid valve	Lab report #3 out Lab report #4 in
Lab #5	Experimental Projects of Electrical Hydro-Control 2 Project 4: Cylinder control with a double solenoid valve, Project 5: Cylinder control using self-holding circuit, Project 6: Cylinder control by logic and Project 7: Cylinder control with a timer	Lab report #4 out Lab report #5 in
Lab #6	Hydraulic System Installation (General information, Initial Setting)	Lab report #5 out Lab report #6 in
Lab #7	Hydraulic Circuits experimental projects: Project 1: Control of single-acting cylinder Project 2: Control of double-acting cylinder Project 3: Mid-position stop control of hydraulic cylinder Project 4: Speed control of hydraulic cylinder Project 5: Pressure compensation	Lab report #6 out Lab report #7 in
E1	**Midterm Exam**	

SES #	TOPICS	KEY DATES
Lab #8	Pneumatic System (Comparison Between Hydraulic and Pneumatic Systems)	Lab report #7 out Lab report #8 in
Lab #9	Fundamentals of Pneumatic Circuit (Circuit Diagram)	Lab report #8 out Lab report #9 in
Lab #10	Logic Control Circuit	Lab report #9 out Lab report #10 in
Lab #11	Installation of Pneumatic System Experimentally	Lab report #10 out Lab report #11 in
Lab #12	Pneumatic Circuits experimental projects 1 Project 1: Control of single acting cylinder Project 2: Control of double-acting cylinde	Lab report #11 out Lab report #12 in
Lab #13	Project 3: Flow control	Lab report #12 out Lab report #13 in
Lab #14	Project 4: Control of single-acting cylinder with a logic valve	Lab report #13 out Lab report #14 in
Lab #15	Project 5: Automatic control of double-acting cylinder Project 6: Time delay	Lab report #14 out Lab report #15 in
E2	**Final Exam**	

Grading (or Assessment) Policy

Initial grading will be based on the following weighting:

ACTIVITIES	PERCENTAGES
Labs (performance & reports)	60%
Midterm	20%
Final exam	20%

- Lab assignments will be graded on a scale of 0 to 3

i) 3: lab complete, works, good job on pre- and post-lab;

ii) 2: lab mostly complete, reasonable job on pre- and post-lab;

iii) 1: lab partially done, marginal to poor job on pre- and post-lab;

iv) 0: lab not done, poor job on pre- and post-lab.

- Midterm & Final Exam will be grade on a scale of 0 to 3 according to the degree of achievement in each learning outcome.

i) 3: complete achievement in learning outcome;

ii) 2: mostly complete, reasonable achievement in learning outcome;

iii) 1: partially done, marginal to poor achievement in learning outcome;

iv) 0: not done, poor achievement in learning outcome.

Lecture notes

This section contains lab notes from every chapter of the practice manual, "1. Farag Ragab,

Pneumatics and Hydraulics (Practice Manual), BST, 2020"

LEC #	TOPICS	LECTURE NOTES (BOOK I FOR L1 TO L12 & BOOK II FOR L13)
L1	-Introduction to Hydraulics -Basic laws of hydraulics -Power in hydraulic system -Exercises	
L2	**Hydraulic Circuits Components** - Pumps and motors -Directional control valves -Types of different valves -Types of cylinders and hydraulic symbols -Exercises	
L3	**Electrical Control in Hydraulics** Electrical circuit diagram and Symbols-Components of Hydro-Electrical system-Exercises	
L4	**Hydraulic Circuits experimental projects 1** Project 1: Lamp Control Project 2: Relay control and self-holding Project 3: Cylinder control with a single solenoid valve	Module 4
L5	**Hydraulic Circuits experimental projects 2** Project 4: Cylinder control with a double solenoid valve	Module 4

LEC #	TOPICS	LECTURE NOTES (BOOK I FOR L1 TO L12 & BOOK II FOR L13)
	Project 5: Cylinder control using self-holding circuit Project 6: Cylinder control by logic Project 7: Cylinder control with a timer	
L6	**Hydraulic System Installation** -General information -Initial setting -Pressure setting -Exercise procedure	Module 5
L7	**Hydraulic Circuits experimental projects** Project 1: Control of single-acting cylinder Project 2: Control of double-acting cylinder Project 3: Mid-position stop control of hydraulic cylinder Project 4: Speed control of hydraulic cylinder Project 5: Pressure compensation	Module 6
L8	**Pneumatic System** -Comparison Between Hydraulic and Pneumatic Systems -Types of Pneumatic Actuators -Types of Pneumatic Valves -Exercises	**Module 7**
L9	**Fundamentals of Pneumatic Circuit** -Circuit Diagram -Notation of Pneumatic Components -Controlling a Single Acting Cylinder -Controlling a Double Acting Cylinder -Forward/Backward Control of a Double Acting	**Module 8**

LEC #	TOPICS	LECTURE NOTES (BOOK I FOR L1 TO L12 & BOOK II FOR L13)
	Cylinder -Positioning Systems -Intermediate Stop Circuit -Self-Holding Circuit -Alternating Control Circuit -Exercises	
L10	**Logic Control Circuit** -YES Logic -NOT Logic -AND Logic -OR Logic -Application of Logic Control -Exercises	**Module 9**
L11	**Installation of Pneumatic System** - Initial setting procedure	**Module 10**
L12	**Pneumatic Circuits experimental projects** Project 1: Control of single acting cylinder Project 2: Control of double-acting cylinder	**Module 11**
L13	Project 3: Flow control	**Module 11**
L14	Project 4: Control of single-acting cylinder with a logic valve	**Module 11**
L15	Project 5: Automatic control of double-acting cylinder Project 6: Time delay	**Module 11**

Lab notes (or Practice Manual)

This section contains lab notes from every chapter of the practice manual,

LAB #	TOPICS	LAB NOTES (PRACTICE MANUAL CHAPTER)
Lab #1	Introduction to Hydraulics	**Module 1 (Lab#1)**
Lab #2	Hydraulic Circuits Components	**Module 2 (Lab#2)**
Lab #3	Hydraulic Circuits Components	**Module 3 (Lab#3)**
Lab #4	Experimental Projects of Electrical Hydro-Control part1	**Module 4 (Lab#4)**
Lab #5	Experimental Projects of Electrical Hydro-Control part2	**Module 4 (Lab#5)**
Lab #6	Hydraulic System Installation	**Module 5 (Lab#6)**
Lab #7	Hydraulic Circuits experimental projects	**Module 6 (Lab#7)**
Lab #8	Pneumatic System	**Module 7 (Lab#8)**
Lab #9	Fundamentals of Pneumatic Circuit	**Module 8 (Lab#9)**
Lab #10	Logic Control Circuit	**Module 9 (Lab#10)**
Lab #11	Installation of Pneumatic System Experimentally	**Module 10 (Lab#11)**
Lab #12	Pneumatic Circuits experimental projects 1,2	**Module 11 (Lab#12)**
Lab #13	Pneumatic Circuits experimental projects 3	**Module 11 (Lab#13)**
Lab #14	Pneumatic Circuits experimental projects 4	**Module 11 (Lab#14)**
Lab #15	Pneumatic Circuits experimental projects 5,6	**Module 11 (Lab#15)**