FLUID POWER TECHNOLOGY

December 4, 1980

Oakland Community College
Auburn Hills Campus
2900 Featherstone Road
Auburn Heights, Michigan 48057

FLUID POWER TECHNOLOGY

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PROGRAM DESCRIPTION

Mission Statement:

The Fluid Power Technology Program will prepare the student to achieve functional competence, at job entry level as a Fluid Power Technician. The specialty courses involved will cover many aspects of hydraulics, and pneumatics; both the theory and application of these aspects. The student will gain a limited amount of work experience in the hydraulics laboratory, using training aids to construct and operate both hydraulic and pneumatics circuits. The supportive and related instruction will assist the student in understanding basic principles and broaden the scope of understanding in the Fluid Power Industry.

DESIGN CRITERIA I

Program Goals:

P. G. I — The student will gain a basic working knowledge of Fluid ~~Dynamics~~ statics as it relates to automation in industry today.

P. G. II — The student will gain a working knowledge of hydraulic circuit components.

P. G. III — The student will gain a working knowledge of pneumatics circuit components, their functions and applications.

P. G. IV — The student will construct simple, and complex hydraulic circuits, using training aids and modules to demonstrate functional competence as a Fluid Power Technician.

P. G. V — The student will gain specific abilities in mathematics, and applied physics, as well as other related areas to aid in problem solving situations which arise in the Fluid Power Industry today.

P. G. VI — The student will gain a functional knowledge of logic as it relates to the design and operation of various hydraulic and pneumatics circuits and systems, used in industry today.

P. G. VII — The student will perform various objectives in the laboratory; such as the rebuilding of hydraulic and pneumatics components, there by developing and improving manipulative abilities.

Consider the design aspect of the program (courses)
Actually do a design before you do trouble shooting

PART II

CURRICULUM

ASSOCIATE DEGREE AND CERTIFICATE

PROPOSED FLUID POWER
ASSOCIATE DEGREE PROGRAM

REQUIRED SPECIALTY COURSES		CREDITS
*ATF 840	Introduction To Fluid Power (Presently APT 840, Fluid Dynamics)	3
*ATF 843	Hydraulic Components and Circuits (Presently APT 843, Hydraulics)	3
*ATF 847	Fundamentals of Pneumatics (Presently APT 847, Pneumatics I)	3
*ATF 848	Pneumatic Components and Circuits (Presently APT 848, Pneumatics II)	3
*ATF 850	#Fluid Power Forces and Mechanics	3
*ATF 852	#Fluid Power Circuits and Systems	3
*ATF 854	#Fluid Power Fabrication and Techniques	3
*ATF 856	#Fluid Power Logic Systems	3
*APM 811[1]	Geo-Algebra	3
*APM 821[1]	Plane Trigonometry	3

REQUIRED SUPPORTIVE COURSES		
IND 100	Introductory Seminar for Industrial Sciences	2
APT 831	Industrial Safety	2
APD 813	Shop Drawing I	3
ETT 101	Electrical Fundamentals I	3
APP 815	Mechanics I	2
APP 816	Mechanics II	2
APP 817	Mechanics III	2
APP 818	Mechanics IV	2

GENERAL EDUCATION REQUIREMENTS

The student will select 12-16 credit hours in at least three of the following four general areas:

1. Communications/English
2. Humanities
3. Math/Natural Science
4. Social Science

The student must also complete a State requirement with:

POL 151	American Government	3

ASSOCIATE DEGREE. . . . . 63 - 67

*When all the courses marked with an asterisk are completed, the student may apply for a Certificate of Achievement.

#New Courses to be developed.

[1]The student may substitute MAT 155 and MAT 156 or equivalent.

PART III

COURSE DESCRIPTIONS

FLUID POWER TECHNOLOGY
COURSE DISCRIPTIONS

APT 840 FLUID DYNAMICS (48 hours) 3 Credits

A laboratory course that illustrates the application of physical concepts such as Boyle's Law, Charles' Law, Bernoulli's Theorem, Torrecellie's Law, Pascal's Law, K'Arch's Equation, Reynold's Number, pressure drop, density, specifice gravity, efficiency and horsepower through basic pneumatic and hydraulic circuitry. Emphasis on understanding circuit components and how they work.
Lab fee: $3

APT 843 HYDRAULICS (48 hours) 3 Credits

Prerequisite: APT 840 or equivalent
A laboratory course on the use and limitations of hydraulic circuits and their components. Circuits are designed, built and analyzed. Trouble shooting to find instructor-induced errors before proceeding to the next, more complicated circuit.
Lab fee: $5

APT 847 PNEUMATICS I (48 hours) 3 Credits

Prerequisite: APT 840 or equivalent
This course is designed to provide the student with the technical knowledge and practical applications for control of power valves that operate various air-powered devices. Design, installation and trouble shooting control air circuits. Nature of compressed air, compressed air flow, work devices, control devices, circuit diagrams, development of pneumatic control circuits, power source selection and information tables, standard safety procedures, and application of diagramming and blueprint reading. Field trips will be conducted to inspect modern pneumatic equipment, installations and applications.
Lab fee: $5

APT 848 PNEUMATICS II (48 hours) 3 Credits

Prerequisite: APT 847
The course will provide the student with practical knowledge regarding circuit design, the mechanical principles of pneumatic components, build and maintain control panels, repair techniques and trouble shooting. Laboratory experiences will supplement classroom lectures and demonstrations. Field trips will be arranged to inspect modern pneumatic equipment, installations and applications.
Lab fee: $5

Fluid Circuit Design
Pump pressure off, Air

FLUID POWER TECHNOLOGY
NEW COURSE DESCRIPTIONS

* ATF 850 FLUID POWER FORCES AND MECHANICS 3 Credits

The student will gain an understanding of the relationship of forces, motion, work and power and the resulting effects on machine parts. Reactionary forces involved in component fabrication as well as circuit fabrication will be studied. Fluid power actuated mechanical advantage-type clamping and other work devices will be used to demonstrate amplification during energy transfer.

* ATF 854 FLUID POWER CIRCUITS AND SYSTEMS 3 Credits

The student will obtain a working knowledge of how fluid power circuits are designed using appropriate symbols and language. Actual hydraulic, pneumatic and/or electrical components are then assembled and the circuit operation is tested. Techniques of circuit calculations, component selection factors and circuit troubleshooting are covered. Applications of fluid power systems to industrial situations are included.

* ATF 852 FLUID POWER FABRICATION AND TECHNIQUES 3 Credits

This course is designed to provide the student with a working knowledge of metals, elastomers, tools, and other equipment and supplies normally used in the fluid power industry when designing, building or maintaining fluid power equipment. It includes a study of the physical characteristics of both metals and elastomers with respect to their behavior during fabrication and usage. Methods of material removal, elementary aspects of machine tool operation and tooling requirements are studied.

* ~~ATF~~ 856 FLUID POWER LOGIC SYSTEMS 3 Credits

The fundamental principles of logic functions, digital control circuits and data organization are presented. Laboratory experiences serve to confirm and clarify the student's understandings of these principles. The student sees their applications to several modes of control such as pneumatic, fluidic, electro-mechanical and electronic. Typical applications of fluid power logic systems in industry are represented.

* New Courses

FLUID POWER TECHNOLOGY
RELATED SUPPORTIVE COURSES

APD 813 SHOP DRAWING I 3 Credits

This course is the first in a series of drafting classes designed for the apprentice or technical student. It covers basic drawing techniques: linework, geometric construction, orthogonal projection, primary auxiliaries and axonometric projection. Emphasis will be placed upon the relation of reference planes in view solution.
Lab fee.

ETT 101 ELECTRICAL FUNDAMENTALS 3 Credits

Prerequisite: TEM 102 or equivalent
This course introduces the basic theories of electricity as they relate to direct current. Emphasis is placed on safety, tools and materials of the trade, the electron theory, Ohm's Law, conductors and insulators, series circuits, parallel circuits, series-parallel circuits, magnetism, application of magnetism to electromagnetic devices as applied to industrial controls, electrical nomenclature, units of measurement, resistors, and electrical symbols. The correct use of basic measuring instruments (reinforced through laboratory exercises) will include volt-meters, ampere-meters, and ohm-meters. Transparencies, slide films, movies, programmed instruction, and other instructional media is utilized.

APM 811 GEOMETRY-ALGEBRA 3 Credits

Prerequisite: Secondary school algebra or TEM 102
This course will provide the student with the fundamentals of Algebra and Geometry as applied to practical industrial problems that arise in his trade area. Topics include positive and negative numbers, ratio and proportion, simple equations, percentage, taper, square root, formulas and quadratic equations. Geometry principles of axioms, propositions, circle definitions, central angles, and tangents will be applied in the problem solving techniques of actual trade problems.

APM 821 PLANE TRIGONOMETRY 3 Credits

Prerequisite: APM 811 or equivalent
This course provides the student with the basic principles of trigonometry as applied to industrial problems. Topics covered are basic trigonometric functions, functions of angles, relations between trigonometric functions, tables and their uses and solution of right angles. It will also cover the interpolation of angles to the nearest second of a degree, solution of oblique triangles by right triangle methods, Law of Sines and Law of Cosines.

APP 815 MECHANICS I 2 Credits

Prerequisite: APM 811 or equivalent
This course is designed to provide the student or apprentice with the basic fundamentals and applications of physics principles in the field of mechanics as applied to the trade field of his choice. Topics covered are fundamental concepts of matter and energy, measurement and units, simple and compound machines, laws of machines, pulleys, levers and their application, gears, mechanical advantages, work, energy and power, efficiency and friction, and the motion of bodies. Nomenclature, useful formulas, and practical problems are emphasized.

APP 816 MECHANICS II 2 Credits

Prerequisite: APM 811 or equivalent
This course will provide the student or apprentice with the necessary technical knowledge and practical application of static pressure and force in fluids as well as buoyancy (Archimede's Principle), weight and pressure relationship, atmospheric pressure and altitude, barometers and specific weight. The transmission of pressure by fluids (Pascal's Law) as an introduction to fluid dynamics, hydraulics and pneumatics, application of Boyle's Law, production, transmission, reflection and interference effects of sound, dispersion and reflection of color will be studied. Typical problems in each unit of instruction are stressed.

APP 817 MECHANICS III 2 Credits

Prerequisite: APM 811 or equivalent
This course will provide the student or apprentice with the basic technical knowledge and applications of the nature of heat, heat transfer, sources of heat, radiation, and cooling fins. Other topics covered are expansion of solids, liquids and gases, measurement of heat, heat exchangers, change of state, principles of refrigeration and air conditioning,converting heat to work, internal and external combustion engines, diesel engines, and steam engines and turbines.

APP 818 MECHANICS IV 2 Credits

Prerequisite: APM 811 or equivalent
This course will provide the student or apprentice with the technical knowledge and application of magnetism, static electricity, electricity, electric current and circuits, electro-magnetism, electro-magnetic induction, direct current, alternating current, electronics and their application to industrial machines. Material covered is basis for further study in industrial electricity and electronics.

APT 831 INDUSTRIAL SAFETY 2 Credits

The need for safe work habits in related work environment. Guest speakers, lectures and class discussion on safety both on and off the job.

IND 100 INTRODUCTORY SEMINAR IN INDUSTRIAL SCIENCES 2 Credits

The student will elect real or simulated experiences that characterize the functions and operations within the industrial sciences cluster. Further, the student will investigate careers within the industrial cluster such as occupational opportunities, wages, advancement, employee-employer relations and unionism, as well as environmental effect.

PART IV

SURVEY RESULTS

of

NEEDS - STUDY

EMPLOYERS

21 - MAILED
19 - RETURNED

At Oakland Community College we are seeking to identify and develop educational programs that meet the needs of the employment community. The program described in this questionnaire is one that has been outlined to us in an area for which we should provide training. In order for us to identify employment needs, training needs, and curriculum components, please answer the following questions to the best of your ability.

1. Are you aware that Oakland Community College offers:

1. Vocational Counseling	17 YES	2 NO
2. Academic, Liberal Arts Curriculum	18 YES	1 NO
3. Health Occupations Training	14 YES	5 NO
4. Technical Training	16 YES	3 NO
5. Job Placement	14 YES	5 NO
6. Continuing Education	18 YES	1 NO

2. Are you familiar with the educational programs offered by Oakland Community College?

13 YES 6 NO

3. Do you employ any persons with educational background from Oakland Community College?

12 YES 6 NO

FLUID POWER TECHNOLOGY

This is an area designed to prepare technicians knowledgeable in the area of transmission and control of power through hydraulics, pneumatics, fluidics, and electro fluid power.

The following is a list of components for curriculum content. Please rate the level of importance of these items as they relate to the training of persons with this job skill. The rating scale is to be interpreted as follows: 1 - no importance; 2 - little importance; 3 - moderate importance; 4 - high importance; 5 - extreme importance.

1. Controls	(14)	3.79	1 2 3 4 5
2. Circuitry	(14)	3.79	1 2 3 4 5
3. Hydraulic Principles	(14)	3.79	1 2 3 4 5
4. Physics Principles	(13)	2.92	1 2 3 4 5
5. Pumps & Operations	(14)	3.14	1 2 3 4 5
6. Compressors & Operations	(14)	2.86	1 2 3 4 5
7. Maintenance Procedures	(14)	3.14	1 2 3 4 5
8. Instrumentation	(14)	3.36	1 2 3 4 5
9. Trouble Shooting Techniques	(14)	3.71	1 2 3 4 5
10. Control Circuits	(14)	3.64	1 2 3 4 5
11. Electro Hydraulic Systems	(14)	3.71	1 2 3 4 5

Continued on back

	Written Communication	(14)	3.5	1	2	3 4
	Oral Communication	(14)	3.28	1	2	3 4
14.	Applied Mathematics	(14)	3.43	1	2	3 4
15.	Technical Mathematics	(14)	3.21	1	2	3 4
16.	Safety Practices	(14)	4.21	1	2	3 4
17.	Numerical & Logic Controls	(12)	3.92	1	2	3 4
18.	Microprocessor Principles	(13)	3.61	1	2	3 4
19.	FOLLOW INSTRUCTIONS	(1)	5	1	2	3 4
20.	ATTENDANCE	(1)	5	1	2	3 4

1. Would you be willing to hire persons with job training in this field? ___YES ___
2. What is your current employment capacity for persons with this educational background?

   _____
3. How many new employees have you hired in this field in the last year? _____
4. What do you estimate your future employment potential in the terms of new positions for

   the next year_____ the next five years_____
5. How many new people will have to be hired as replacements as a result of resignations, terminations, etc.?

   the next year_____ the next five years_____
6. Do you feel the job market and/or future projection indicates a need for this occupatio

   ___YES ___
7. Do you feel there is a need for educational training in this field? ___YES ___
8. Do you feel that two years of education is appropriate training for job skills in this field?

   ___YES ___
9. Would this type of program provide continuing education to upgrade the skills of your current employees?

   ___YES ___
10. Would you recommend this type program to your present employees? ___YES ___
11. How many persons do you presently employee? Less than 25___; 25 to 49___; 50 to 99___; 100 to 499___; 500 to 2000___; more than 2000___.
12. Would you provide a work/training site for students in this program? ___YES ___
13. Please provide the following hourly salary information:

    $_____starting $_____6 month $_____1 year

13.A Are there other salary intervals of note?

_____

Name and address of company completing questionnaire

See attachment for 1-13

_____

_____

_____

QUESTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Y	?	Y	N	N	?	Y	N	Y	N	N	Y	Y	N	N	Y	N	Y
2.	OPEN	0	0	0	0	–	2	a	b	0	-2	–	1	0	0	?	0	3
3.	6	0	0	-	0	-	0	0	0	0	0	-	0	0	0	5	0	0
4a.	4	0	?	1	0	?	0	0	2	0	0	-	1	0	0	?	UNK	2
b.	10	1	?	3	0	-	1	1	5	0	2	-	2	0	0	?	UNK	4
5a.	4	0	?	1	0	-	0	0	2	0	-	-	0	0	0	?	UNK	1
b.	20	0	?	3	0	?	1	0	?	0	-	-	0	0	0	?	UNK	-
6.	Y	Y	Y	Y	Y[c]	N	Y	Y	Y	N	Y	Y	Y	?	N	Y	N	Y
7.	Y	Y	Y	Y	Y[c]	N	Y	Y	Y	N	Y	Y	Y	?	N	Y	Y	Y
8.	–	Y	Y	Y	Y[c]	Y	Y	Y	–	–	N	N	Y	?	N	Y	Y	Y
9.	Y	N	Y	N	Y[c]	Y	Y	Y	Y	N	?	Y	Y	?	N	Y	N	Y
10.	Y	N	Y	N	Y[c]	N	Y	N	Y	N	N	Y	Y	?	N	Y	N	Y
11.	500-2000	25-49	<25	<25	–	<25	50-99	<25	50-99	<25	<25	100-499	<25	25-49	100-499	500-2000	2000+	25-49
12.	?	N	N	N	Y[c]	N	N	N	N	N	N	N	Y	N	N	?	Y	N
13a.	$7.21	?	$5.00	$4.50-5.00	–	d.	$9.00	–	–	–	–	–	$6.00	$4.50	–	–	–	–
b.	–	?	$6.00	$5.00-5.50	–	?	$9.50	–	–	–	–	–	$7.00	$5.00	–	–	–	–
c.	$8.07	?	$7.00	$6.00-6.50	–	?	$10.00	–	–	–	–	–	$8.00	–	–	–	–	–
A.	–	–	–	–	–	–	e.	–	f.	–	–	–	g.	–	–	–	–	–

* THIS EMPLOYER FELT HE COULD NOT ANSWER THESE QUESTIONS INTELLIGENTLY.

a. OUTSIDE SERVICE USED.

b. NONE NOW, BUT WITH IMPROVED ECONOMY 2-3

c. "NO KNOWN REQUIREMENT FOR THIS SKILL IN DETROIT AREA OPERATIONS"

d. UNSKILLED - $3.50/hr. SKILLED - $8.00/hr.

e. INTERVALS CONTINUE TWICE A YEAR

f. DEPENDS ON CAPABILITY

g. BASED ON MERIT

PART V

SUPPORT INFORMATION

VICKERS

NORTH AMERICAN GROUP
TROY, MICHIGAN 48084

November 26, 1980

Mr. Bill J. Rose
Dean of Career Education
Oakland Community College
Auburn Hills Campus
2900 Featherstone Road
Auburn Heights, Michigan 48057

Dear Mr. Rose:

Fluid power is an industry that has realized its greatest development in the past two or three decades. Since World War II the industry has grown at a hectic pace.

Today, the National Fluid Power Association estimates that hydraulics and pneumatics shipments will exceed $6 billion in 1981, ranking fluid power sales with those of such large capital goods industries as machine tools, industrial trucks, and construction equipment.

Fluid power education opens a broad spectrum of career opportunities because of the wide diversity of hydraulics applications in industry.

For example, hydraulics are used in industrial machines designed for the production of thousands of products, from the automobiles we drive to the plastic toys our children play with.

Hydraulics can be found on such mobile applications as heavy duty construction vehicles and earthmoving equipment, large trucks used in commerce, and farming equipment.

Even more dramatic are hydraulics at work in commercial air travel. From the up-and-down motion of landing gear to the movement of wing flaps, ailerons, and rudders. Today's big jets depend on hydraulics for smooth, safe operation. Hydraulic components can also be found on missiles, tanks, space craft launch vehicles, on the deck of Navy and commercial sea-going vessels, and on submarines.

Hydraulics continues to be one of the most efficient and versatile means known of putting machines to work--even in a world crowded with electrical and mechanical devices.

MY TELEPHONE NUMBER IS (313) 280-3646

VICKERS

Sperry Vickers has been a leading name in the fluid power field for more than 50 years and has pioneered many basic design developments on which modern fluid power systems are based. A division of the New York-based Sperry Corporation, the company employs some 10,000 people worldwide. We are truly a multi-national company with operations in 32 countries and distributorships in 13 more.

Our need for technically trained personnel is obvious. And our support in helping train hydraulics professionals has been substantial.

Since 1945 Sperry Vickers has operated its own Hydraulics School as part of an intensive customer training program. Regularly scheduled courses cover industrial and mobile product applications and servo maintenance programs. Aerospace, marine, and military programs are held when the need arises and are tailored to meet specific customer needs.

Growing from just 78 students 35 years ago, the school today, located in Clawson, Michigan, annually enrolls some 900. More than 17,000 students representing 3,700 companies have completed courses to date.

Sperry Vickers also began offering scholarships in 1978 to the Purdue University School of Technology and the Milwaukee School of Engineering. A total of 11 students in their junior and senior years have received scholarships and are following a program which will lead to employment in the fluid power field.

At Sperry Vickers, we see a growing need for more fluid power programs in formal education and would welcome this expansion of Oakland Community College's curriculum. In our judgment, there is, and will continue to be, a great demand for highly trained and skilled hydraulic professionals.

Sincerely,

A. O. Roberts
Vice President
Staff Engineering

Ingersoll-Rand Company
AUTOMATIC PRODUCTION SYSTEMS
23400 HALSTEAD ROAD
FARMINGTON HILLS, MICHIGAN 48024

TELEPHONE: 313—477—0800 TELEX: 235623 INRYCO FRTN

November 18, 1980

Mr. William J. Rose
Dean of Career Education
Oakland Community College
Auburn Hills Campus
2900 Featherstone Road
Auburn Heights, MI 48057

Dear Mr. Rose:

As a manufacturer of automatic machinery systems to both assemble and test a multitude of items large and small for both domestic and foreign markets, we have a continuing need for people who posses basic and advanced skills in fluid power systems. The needs of our company in this regard are most certainly duplicated in the many similar and allied organizations in this geographical area.

We are therefore, pleased to know that Oakland Community College is undertaking to train young people in fluid power systems in order to fill these needs. By establishing the proposed program, Oakland Community College will be providing available community service and training that will allow students to select from many attractive career opportunities.

You have both our support and commendation in this endevour.

Very truly yours,

INGERSOLL-RAND COMPANY

Gary T. Fortune

Gary T. Fortune
Assistant Engineering Mngr.

RECEIVED
NOV 20 1980
Career Education
Auburn Hills

PART VI

ADVISORY COMMITTEE

FLUID POWER ADVISORY COMMITTEE

Dolph Wright
Senior Project Engineer
Manufacturing Development
G.M. Tech Center
Warren, MI 48090
575-0876

John Pippinger, Vice-Chairman
The Fluid Power Education Foundation
124 Florida Street
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906--337-5167

Steve Coleman
Hydraulics Student
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435-8658

Royce Shari, Manager
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280-3000

Ken Brown
Manufacturing Engineer
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477-0800

Ex Officio Members

Harvey Eschenburg
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852-1000 ext. 212

Bill J. Rose
Dean of Career Education
Oakland Community College
Auburn Hills Campus
2900 Featherstone Road
Auburn Heights, MI 48057
852-1000 ext. 306

A Brief Description of Courses

First Semester

Introduction to Fluid Power

A course designed to familiarize the student with fluid power principles and the fluid power industry. It introduces the student to the many and varied hydraulic and pneumatic applications, the general fluid power system concept, and the principles of applied fluid mechanics.

Technical Mathematics I

The first course in a two course sequence. It includes the following major divisions: fundamental concepts and operations, functions and graphs, the trigonometric functions, systems of linear equations and determinants, factoring and fractions, quadratic equations, the slide rule, trigonometric functions of any angle or number, and vectors and oblique triangles.

Applied Physics I (Mechanics and Heat)

The first of two courses in applied physics. Study of the principles of physics emphasizing mechanics and heat including their applications in fluid power technology is accomplished during the first semester.

Fundamentals of Communications

(Reading, Writing, Speaking and Listening)

A course in which the student learns the fundamentals of these four communications media and improve his skills in each. This course also serves to integrate other subject areas.

Basic Technical Drafting

A basic course which provides freehand drafting experience and the development of basic skills with drafting tools. Includes knowledge of principles and practices, as well as the development of basic techniques.

Second Semester

Hydraulic Components and Circuits

A study of the principles of operations and construction of components comprising a hydraulic circuit. A survey of the available types of components and their functions within circuits are included. Principles of simple circuit design (including proper symbology) and accompanying calculations are also covered.

Fundamentals of Pneumatics

A study of the applications and the physical laws governing the uses of pneumatic power and how they apply to pneumatic compression and distribution systems. It includes an analysis of the properties of air and how air is compressed and distributed. Methods of controlling pneumatic power are investigated by designing circuits and evaluating them in terms of their specific applications. The operating principles and design features of typical pneumatic systems and components are studied and demonstrated. The similarities and differences between pneumatic and hydraulic systems and components are also reviewed.

Technical Mathematics II

A continuation of Technical Mathematics I. It includes the following major divisions: exponents and radicals, the j-operator, logarithms, additional types of equations and systems of equations, inequalities, graphs of the trigonometric functions, additional topics in trigonometry, plane analytical geometry, basic concepts of the derivative, and basic concepts of integration.

Applied Physics II

(Electricity, Sound and Light)

Continuing study of applied physics. This course includes a study of basic electrical principles and the fundamentals of circuitry, including their applications in fluid power technology. The fundamental principles of sound and light are also presented.

Applications of Engineering Mechanics

An introduction to the relationship of forces, motion, work and power and the resulting effects on machine parts.

Third Semester

Fluid Power Circuits and Systems

Fluid power circuits are designed using appropriate symbols and language. Actual hydraulic, pneumatic and or electrical components are then assembled and the circuit operation is tested. Techniques of circuit calculations, component selection factors and circuit troubleshooting are covered. Applications of fluid power systems to industrial situations are included.

Material Fabrication and Fluid Power Shop Techniques

This course is designed to provide the student a working knowledge of metals, elastomers, tools, and other equipment and supplies normally used in the fluid power industry when designing, building or maintaining fluid power equipment. It includes a study of the physical characteristics of both metals and elastomers with respect to their behavior during fabrication and usage. Methods of material removal, elementary aspects of machine tool operation and tooling requirements are studied. The student acquires initial skills with hand tools and with gas welding and brazing, and AC/DC arc welding.

Electricity and Electronics

A basic study of electrical power and controls, and electronic controls as they apply in particular to fluid power systems. Emphasis is made on the practical aspects of these controls. Lecture, demonstration and laboratory experiences are combined to acquaint the student with electrical and electronic components and circuits that are utilized for measurement and control functions.

Computer Applications in Industry

A review of the evolution and the uses and operations of computers and electronic data processing in industry. The student is provided an opportunity to do some fundamental data processing and programming exercises.

Industrial Organizations and Labor-Management Relations

A review and analysis of the roles of labor and management in the development of American industry. Labor-management relations (including the growth of the labor movement, the development and structure of American business management, and the legal framework within which labor-management relationships and responsibilities are conducted) are covered, as well as in introduction to labor economics (i.e. labor supply and demand, unemployment and wage determination). Current practical aspects of an industrial society are emphasized.

Fourth Semester

Logic Systems

The fundamental principles of logic functions, digital control circuits and data organization are presented. Laboratory experiences serve to confirm and clarify the student's understandings of these principles. He sees their applications to several modes of control such as pneumatic, fluidic, electro-mechanical and electronic. Typical applications of fluid power logic systems in industry are represented.

Fluid Power Component and Circuit Performance

This course integrates the previous fluid power courses and laboratory work. It includes the study of performance characteristics of fluid power components, data acquisitions, and the analysis and evaluation of the requirements of fluid power circuits which are currently being adapted to industrial applications. Experiences are provided with measuring and testing instruments and related procedures.

Technical Reporting

A course in the practical aspects of preparing reports and communicating within groups using the basic skills acquired in the previous course "Fundamentals of Communications". This course includes the use of graphs, charts and diagrams in presenting ideas and significant points in formal or informal written and oral reports. The development of an appreciation for precise reporting and the use of audio-visual equipment are included.

Human Relations in Industry

Bases of human relations and the organization of individual and group behavior are

studied. Special emphasis is given to typical industrial relationships in everyday situations. Fundamental relationships between behavior and personal and group forces are examined. The student is stimulated to make an effort to be more effective in his relationships with others.