

Course Title: Fluid Power Transmission And Control Systems	Course Code: 15AT41T
Credits (L:T:P) : 4:0:0	Core/ Elective: Core
Type of course: Lectures	Total Contact Hours: 52
CIE-25 Marks	SEE- 100 Marks

Prerequisites:

Basic knowledge of subjects studied in the previous semesters.

Course Objectives:

To know the concepts of hydraulics & pneumatics, components of hydraulic and pneumatic circuits and applications of hydraulics and pneumatics in automobiles.

On successful completion of the course, the students will be able to attain CO'S:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Understand the purpose and applications of fluid power systems in Automobiles.	<i>R/U/A</i>	1,2,3,10	04
CO2	Explain functions, types, construction and working of different types of valves and actuators.	<i>R/U</i>	1,2,10	12
CO3	Understand purpose, types construction and working of different components of different hydraulic circuits.	<i>R/U</i>	1,2,10	12
CO4	Explain purpose, applications, types, construction and working of different components of pneumatic system.	<i>R/U/A</i>	1,2,3,10	9
CO5	Explain purpose, types, construction and working and maintenance of different components of different pneumatic system.	<i>R/U/A</i>	1,2,3,10	9
CO6	Explain the merits of combination circuits by understanding the construction and working of these systems.	R/U/A	1,2,3,10	06
			Total sessions	52

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Fluid power transmission and control	3	3	3	-	-	-	-	-	-	3

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If $\geq 40\%$ of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If $< 5\%$ of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set			Marks weightage (%)
			R	U	A	
I	Introduction	04		5	5	6.9
II	Valves and Actuators	12		30	5	24.1
III	Design of Hydraulic Circuits	12	5	30		24.1
IV	Pneumatic systems	9	5	15	5	17.2
V	Design of Pneumatic Circuits	9	5	15	5	17.2
VI	Combination Circuits	06			15	10.4
	Total	52		145		100

Legend: R; Remember, U: Understand A: Application

Course Delivery:

The course will be delivered through lectures, presentations and classroom discussions.

Course Content:**UNIT I****INTRODUCTION****04 hr**

Fluid power engineering – definition - importance - areas of application, application in automobiles, fluid-definition- properties, Pascal Law with illustrations, transmission of power - methods, fluid system – types –hydraulics – pneumatics - block diagrams.

UNIT II**VALVES AND ACTUATORS****12 hr**

valves – functions – types – lifting type – sliding/rotary type – poppet – ball – flap – disc – spool valves, requirements - pressure control valve - pressure relief valve – pressure (counter)

balance valve - pressure reducing valves, directional control valves - 2/2 - 3/2 - 4/2 - 5/2 - 5/3, control of valves – manual – mechanical - hydraulic – pneumatic - electro pneumatic, combination valves - hydro pneumatic – electro hydraulic - electro pneumatic, flow control valve, non return/check valves, pilot operated sequence valve.

Actuators –functions, types, cylinder type-ram type, and piston type- single acting cylinder-double acting cylinder- Rotary actuators- Gear- vane- piston- Unidirectional – Bidirectional actuators.

UNIT III

DESIGN OF HYDRAULIC CIRCUITS

12 hr

Hydraulics - definition, properties of hydraulic fluids, pumps - necessity - classification, construction and working of - external gear, lobe, Vane pumps, Piston-radial pumps, Reservoir, Accumulators-weight loaded- spring loaded- gas loaded, Intensifier, pressure switches, pressure regulators.

Hydraulic Circuits-Hydraulic symbols, Port markings- ports and positions, Basic hydraulic circuits- Meter in circuits- Meter out circuits- Bleed off circuits - Accumulator circuits - Regenerative circuits-pressure reducing circuits, Maintenance of hydraulic system- common faults - visual checks of oil- causes of contamination- preventive measures - maintenance schedule.

Hydraulic circuits of systems used in automotive-hydraulic brake-clutch- shock absorber - hydraulic power steering.

UNIT IV

PNEUMATIC SYSTEMS

09hr

Pneumatics – definition - importance - areas of Applications, automotive applications.

properties of air, humidity, Pneumatic Components - Air compressors-necessity-types-reciprocating-diaphragm-vane compressor, requirement of multi stage compressors, reservoirs- functions of reservoirs, air filter - screen type - bowl type, pressure regulators – diaphragm type, lubricator, FRL unit.

Air motors- piston motor, gear motor, sliding vane motor

UNIT V

DESIGN OF PNEUMATIC CIRCUITS

09hr

Pneumatic Symbols, Basic pneumatic circuit -control of double acting cylinder using 4/2 DCV-pilot controlled double acting cylinder 4/2 DCV - speed control circuit for a double acting cylinder - semi-automatic material handling circuit - time delay circuit, pneumatic tool circuit. Maintenance of pneumatic systems - common faults - preventive measures - maintenance schedule.

UNIT VI

COMBINATION CIRCUITS

06hr

Combination circuit - advantages - hydro pneumatic circuits - air over oil circuit- air over oil intensifier circuit - mechanical hydraulic servo system- electro hydraulic servo system, comparison of hydraulic - pneumatic and hydro pneumatic systems - power steering circuit - power brake circuit - hoist circuit.

Resources

Reference books

Sl no	Title of book	author	publisher
1	Hydraulic and Pneumatic Controls	K.Shanmuga.Sundaram	S.Chand & Co
2	Pneumatic Systems	S.R.Majumdar	Tata McGrawhill
3	Pneumatic Controls	Joji P	Wiley India Pvt Ltd
4	Fluid Power with Applications	Anthony Esposito	Pearson india
5	Hydraulics & Pneumatics	Andrew Parr	Jaico publishing house
6	Fluid Power Transmission & Control	A Alavudeen Khalid Hussain Syed N Shanmugum	Charotor Publisher Anand-388001

Web links:-

Pascal's Law Demo

<https://www.youtube.com/watch?v=VxLTDtaRCZk>

Basic Hydraulic System

<https://www.youtube.com/watch?v=KgphO-u7MIQ>

Valves

<https://www.youtube.com/watch?v=3RAxRed7QuE>

Spool Valve

<https://www.youtube.com/watch?v=dnVjKV74sAQ>

Hydraulic Lifters

<https://www.youtube.com/watch?v=lorANZ1Tptw>

4/2 Directional Control Valves

<https://www.youtube.com/watch?v=XOYgnLWCYEc>

Pressure Regulating Valve

https://www.youtube.com/watch?v=sFAYW_D3G_g

Pilot Operated Pressure Relief Valve

<https://www.youtube.com/watch?v=q5NV2gBsryk>

Pressure Relief Valve Working

<https://www.youtube.com/watch?v=DAqnpaHf2Qs>

Pressure Reducing Valve

<https://www.youtube.com/watch?v=YgnwuTJB-wc&list=PL9DA65D90A4561300>

Mechanical Control Valve

<https://www.youtube.com/watch?v=HJRE5EfTPcU>

Non Return/Check Valve

<https://www.youtube.com/watch?v=C-8FKgxSg68>

<https://www.youtube.com/watch?v=StHAmZpDHi0>

<https://www.youtube.com/watch?v=XAltnsUcES0&list=PLDaXKeQT8i0-ojLE8MMzWQXp1HfeJMgc1>

Pumps

<https://www.youtube.com/watch?v=KM3ivQL6W6w>

<https://www.youtube.com/watch?v=bdib6XwxNuc>

Gear Pump

<https://www.youtube.com/watch?v=c6gwU7IHtlo>

Vane Pump

<https://www.youtube.com/watch?v=BnvzPoNSXCg>

Lobe Pump

<https://www.youtube.com/watch?v=vE7y0EIlrgk>

Actuators

<https://www.youtube.com/watch?v=cScz67tWqCY>

Radial Piston Pump

<https://www.youtube.com/watch?v=a58zzqfF5N0>

Air Compressors

<https://www.youtube.com/watch?v=Ue7BkzBARXw>

FRL Unit

<https://www.youtube.com/watch?v=zPTOYDERfy4>

Student Activities to be performed to award five marks in continuous internal evaluation:

Visit any service centres /workshop/ construction company / earth moving vehicle showroom and

1. Prepare a report with materials and manufacturing process of different types of hydraulic valves, pumps and actuators used in earth moving/ construction vehicles.
2. Prepare a report on different types of pneumatic compressors, motors, filters, regulators and lubricators in earth moving and construction vehicles.
3. Draw hydraulic circuits used in Automobile's, construction vehicles and garage equipment/machines.
4. Draw pneumatic circuits used in Automobile's, construction vehicles and garage equipment/machines.

Note:

1. Student should prepare a report on any one of the above/similar activity, which helps in achieving above course outcomes.

2. **The report prepared should be approved by the concerned staff and HOD.**
3. **The activity group should consist of maximum of three students.**

MODEL OF RUBRICS FOR ASSESSING STUDENT ACTIVITY

Note: The dimensions given in below table are representatives; lecturer has to design/decide the dimensions based on the activity given.

Dimension	Scale					Students Score				
	Unsatisfactory 1marks	Developing 2marks	Satisfactory 3marks	Good 4marks	Exemplary 5marks	1	2	3	4	5
1. Research and gather information	Does not collect information relate to topic	Collects very limited information, some relate to topic	Collects basic information, most refer to the topic	Collects more information, most refer to the topic	Collects a great deals of information, all refer to the topic	1				
2.Full fills teams roles and duties	Does not perform any duties assigned to the team role	Performs very little duties	Performs nearly all duties	Performs almost all duties	Performs all duties of assigned team roles	2				
3.Shares work equally	Always relies on others to do the work	Rarely does the assigned work, often needs reminding	Usually does the assigned work, rarely needs reminding	Always does the assigned work, rarely needs reminding.	Always does the assigned work, without needing reminding	3				
4. listen to other team mates	Is always talking, never allows anyone to else to speak	Usually does most of the talking, rarely allows others to speak	Listens, but sometimes talk too much,	Listens and talks a little more than needed.	Listens and talks a fare amount	4				
Grand Average/Total=1+2+3+4/4=10/4=2.5=3						3				

Course Assessment and Evaluation Scheme:

Method	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE(Continuous Internal Evaluation)	IA	Students	Three IA Tests; (Average of three Tests)	20	Blue books	1,2,3,4,5,6
				Activity	05	Activity reports	1,2,3,4,5,6
	SEE (Semester End Examination)	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2 &3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5&6 Effectiveness of Delivery of instructions & Assessment Methods

*CIE – Continuous Internal Evaluation

*SEE – Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks			
Ex: I test/6 th week of sem 10-11 Am	I/II SEM		20			
	Year:					
Name of Course coordinator : CO's: _____			Units: __			
Question no	Question		MARKS	CL	CO	PO
1						
2						
3						
4						

Note: Internal choice may be given in each CO at the same cognitive level (CL).

MODEL QUESTION PAPER (CIE)

Note: The lecturer has to follow the question paper blue print given in above table to prepare CIE question paper also.

Test/Date and Time	Semester/year	Course/Course Code	Max Marks			
Ex: I test/6 th week of sem 10-11 Am	IV semester	Fluid power transmission and control	20			
	Year: 2015-16	Course code:15AT41T				
Name of Course coordinator : Units:1,2 Co: 1,2						
Note: Answer all questions						
Question no	Question		CL	CO	PO	
1	Classify the valves based on their function.	5marks	A	1	1,2,3,10	
2	List the applications of fluid power engineering in industries.	5marks	U	1	1,2,10	
	Or	Explain Pascal's law with example.				
3	Explain the construction and working of poppet valve with a neat sketch.	10marks	U	2	1,2,10	
	Or	Explain working of bidirectional actuator with a neat sketch.				

LEGEND: R; REMEMBER, U: UNDERSTAND A: APPLICATION

MODEL QUESTION BANK

CO1: Understand the purpose and applications of fluid power systems in Automobiles.

FIVE MARK QUESTIONS

1. Explain fluid power engineering. (U)
2. Mention the importance of fluid power engineering in industries. (A)
3. List the applications of fluid power engineering in industries. (A)
4. List the applications of fluid power engineering in automobiles. (A)
5. Explain Pascal's law with example. (U)
6. Explain power transmission methods. (U)
7. Sketch block diagram of hydraulic system and label the parts. (U)
8. Sketch block diagram of pneumatic system and label the parts (U).

TEN MARK QUESTIONS

1. Explain the properties of fluids. (U)
2. List and mention the functions of hydraulic system components with block diagram. (R)
3. List and mention the functions of pneumatic system components with block diagram. (R)

CO2: Explain functions, types, construction and working of different types of valves and actuators.

FIVE MARK QUESTIONS

1. Write the functions of valves. (A)
2. Classify the valves by construction. (A)
3. Classify the valves by function. (A)
4. Draw a neat sketch of poppet valve and label the parts. (U)
5. Draw a neat sketch of ball valve and label the parts. (U)
6. Draw a neat sketch of flap valve and label the parts. (U)
7. Draw a neat sketch of rotary disc valve and label the parts. (U)
8. Draw a neat sketch of rotary spool valve and label the parts. (U)
9. Draw a neat sketch of sliding spool valve and label the parts. (U)
10. Draw a neat sketch of pressure control valve and label the parts. (U)
11. Draw a neat sketch of pressure relief valve and label the parts. (U).
12. Draw a neat sketch of pressure reducing valve and label the parts. (U).
13. Draw a neat sketch of pressure balance valve and label the parts. (U)
14. List the different methods used to control the valve. (R)
15. Define the actuator and write the classification of actuators. (R/A)

TEN MARK QUESTIONS

1. Explain the construction and working of poppet valve with a neat sketch. (U)
2. Explain the construction and working of ball valve with a neat sketch. (U)
3. Explain the construction and working of flap valve with a neat sketch. (U)
4. Explain the construction and working of rotary disc valve with a neat sketch. (U)
5. Explain the construction and working of rotary spool valve with a neat sketch. (U)
6. Explain the construction and working of sliding spool valve with a neat sketch. (U)
7. Explain working of pressure control valve with a neat sketch. (U)
8. Explain working of pressure relief valve with a neat sketch. (U)
9. Explain working of pressure reducing valve with a neat sketch. (U).
10. Explain working of pressure balance valve with a neat sketch. (U)
11. Explain working of 2/2 direction control valve with a neat sketch. (U)
12. Explain working of 3/2 direction control valve with a neat sketch. (U)
13. Explain working of 4/2 direction control valve with a neat sketch. (U)
14. Explain working of 5/2 direction control valve with a neat sketch. (U)
15. Explain working of 5/3 direction control valve with a neat sketch. (U)
16. Explain working manually controlled valve with a neat sketch. (U)
17. Explain working mechanically controlled valve with a neat sketch. (U)
18. Explain working hydraulically controlled valve with a neat sketch. (U)
19. Explain working pneumatically controlled valve with a neat sketch. (U)
20. Explain working hydro pneumatically controlled valve with a neat sketch. (U)
21. Explain working electro hydraulically controlled valve with a neat sketch. (U)
22. Explain working electro pneumatically controlled valve with a neat sketch. (U)
23. Explain working flow control valve with a neat sketch. (U)
24. Explain working non-return control valve with a neat sketch. (U)
25. Explain working non-return/check control valve with a neat sketch. (U)
26. Explain working pilot operated sequence valve with a neat sketch. (U)
27. Explain actuator and write the classification of actuators. (U)
28. Explain working of single acting actuator with a neat sketch. (U)
29. Explain working of double acting actuator with a neat sketch. (U)
30. Explain working of rotary/gear actuator with a neat sketch. (U)
31. Explain working of bidirectional actuator with a neat sketch. (U)

CO3: Explain purpose, applications, types, construction and working of different components of pneumatic system.

FIVE MARK QUESTIONS

1. Explain hydraulics and its applications. (U)
2. Write the requirements of hydraulic fluids? (A)
3. Write the classification of hydraulic pumps. (A)
4. Draw hydraulic system components symbol for: –
Pumps unidirectional, bidirectional-hydraulic flow line-reservoir vented-fixed restriction flow-single acting cylinder-double acting cylinder-electric motor-accumulators spring loaded, gas loaded-filter-heater-cooler-intensifier-check valve-shut off valve-pressure relief valve-lever operated valve. (U)
5. Explain the importance of hydraulic accumulators. (A)
6. Explain working of spring loaded accumulator with a neat sketch. (U)
7. Explain working of gas loaded accumulator with a neat sketch. (U)
8. Explain construction of hydraulic reservoir with a neat sketch. (U)
9. Explain the symbolic method of ports and position marking. (U)
10. List the common faults in hydraulic system. (A)
11. Explain the visual check procedure of oil. (U)
12. Write the causes for contamination of oil. (A)
13. List the preventive measures of hydraulic system. (R)
14. Write maintenance schedule of hydraulic system. (U)

TEN MARK QUESTIONS

4. Explain working of gear pump with a neat sketch. (U)
5. Explain working of vane pump with a neat sketch. (U)
6. Explain working of lobe pump with a neat sketch. (U)
7. Explain working of Piston-radial pump with a neat sketch. (U)
8. Explain working of hydraulic intensifier with a neat sketch. (U)
9. Explain the symbolic method of ports and position marking. (U)
10. Explain working of meter in circuit. (U)
11. Explain working of meter out circuit. (U)
12. Explain working of bleed-off circuit. (U)
13. Explain working of accumulator circuit. (U)
14. Explain working of regenerative circuit. (U)
15. Explain working of pressure reducing valve circuit. (U)
16. Draw hydraulic brake system circuit of an automobile and label the parts. (U)
17. Draw hydraulic clutch system circuit of an automobile and label the parts. (U)
18. Draw hydraulic steering system circuit of an automobile and label the parts. (U)
19. Draw hydraulic shock absorber circuit of an automobile and label the parts. (U)

CO4: Explain purpose, applications, types, construction and working of different components of pneumatic system.

FIVE MARK QUESTIONS

1. Explain pneumatics and mention its importance. (U)
2. List the different areas of applications of pneumatics in industries. (R)
3. List the different applications of pneumatics in automobiles. (A)
4. Explain humidity. (U)
5. Write the classification of air compressors. (A)
6. Mention the need for multi stage compressor. (A)
7. Explain the functions of air reservoir. (A)
8. Explain the functions of air lubricator. (A)
9. Explain working of FRL and write its symbolic representation. (U)

TEN MARK QUESTIONS

1. Explain properties of air. (U)
2. Explain working of reciprocating type air compressor with a neat sketch. (U)
3. Explain working of diaphragm type air compressor with a neat sketch. (U)
4. Explain working of vane type air compressor with a neat sketch. (U)
5. Explain the construction of air reservoir with a neat sketch. (U)
6. Explain working of screen type air filter with a neat sketch. (U)
7. Explain working of bowl type air filter with a neat sketch. (U)
8. Explain working of diaphragm type pressure regulator with a neat sketch. (U)
9. Explain working of air lubricator with a neat sketch. (U)
10. Explain working of piston motor with a neat sketch. (U)
11. Explain working of gear motor with a neat sketch. (U)
12. Explain working of vane motor with a neat sketch. (U)

CO5: Explain purpose, types, construction and working and maintenance of different components of different pneumatic system.

FIVE MARK QUESTIONS

1. Draw Pneumatic system components symbols for: –
Air compressor - air motor – single acting cylinder – 2/2 valve - 3/2 valve -4/2 valve -5/2 valve – 5/3 valve – non return valve – pressure intensifier – adjustable flow control – silencer – accumulator – filter – water separator – lubricator – push button control. (R)
2. Draw a basic pneumatic circuit and label the components. (U)
3. List the common faults in pneumatic system. (R)
4. List the preventive measures of pneumatic system. (A)
5. Write maintenance schedule of pneumatic system. (U)

TEN MARK QUESTIONS

1. Explain control of double acting cylinder using 4/2 DCV with circuit diagram. (U)
2. Explain pilot controlled double acting cylinder using 4/2 DCV with circuit diagram. (U)
3. Explain speed control circuit of double acting cylinder (U)
4. Explain semiautomatic material handling circuit. (U)
5. Explain time delay circuit. (U)
6. Explain pneumatic tools circuit. (U)

CO6: Explain the merits of combination circuits by understanding the construction and working of these systems.

FIVE MARK QUESTIONS

1. List the advantages of combined system. (A)
2. List different combined systems with examples. (R)
3. Compare features of hydraulic and pneumatic system. (A)
4. Design power steering circuit of automobile. (hydraulic/Electric) (A)
5. Design power brake circuit of automobile. (A)
6. Design service station hoist circuit of automobile. (A)

TEN MARK QUESTIONS

1. Explain working of air over oil system with circuit diagram. (U)
2. Explain working of air over oil intensifier circuit with circuit diagram. (U)
3. Explain working of mechanical hydraulic servo system with circuit diagram. (U)
4. Explain working of electro hydraulic servo system with circuit diagram. (U)

FLUID POWER TRANSMISSION AND CONTROLTime: **3 Hours**][Max Marks: **100****Note:** Answer any SIX from Part A and any SEVEN from Part B**Section A**

1. Explain Pascal's law with examples .
2. Mention the importance of fluid power engineering in Industries.
3. Draw a neat sketch of poppet valve and label the parts.
4. Define the actuator and write the classification of actuators
5. Explain working of gas loaded accumulator with a sketch.
6. Explain the visual check procedure of oil.
7. Write the classification of air comparisons.
8. Write the maintenance schedule of pneumatic system.
9. List the common faults in pneumatic system

Section B

1. Explain working of 3/2 direction control valve with a neat sketch.
2. Explain working of bidirectional actuator with a neat sketch.
3. a. Write the functions of valves. 5marks
b. Draw the symbols for following hydraulic components. 5marks
 - Unidirectional pump.
 - Double acting cylinder
4. Explain working of gear pump with a sketch.
5. Explain working of regenerative circuit.
6. a. List the different areas of applications of pneumatics. 5marks
7. b. Explain working of FRL unit. 5marks
8. Explain the working of air lubricator with a neat sketch.
9. a. Draw a basic pneumatic system and label the components. 5marks
10. b. Design power steering circuit of automobile. 5marks
11. Explain the speed control circuits of double acting cylinder.
12. Design circuit diagram of mechanical hydraulic servo system and explain its working.