

Fluid Power Control - Web course

COURSE OUTLINE

Fluid power plays an important role in industry. Uses of fluid power include machine tools, off-highway vehicles, aviation control, material testing systems etc.

This course is an advanced level course for UG students and early PG students of Mechanical Engineering. Various aspects of Fluid power are covered in this course which starts with emphasis on fluid mechanics and governing laws. Then, pumps and motors are discussed while elucidating the effect of cavitation and noise.

This will be followed by a discussion on actuators. Once this framework is established, students will then be exposed to fundamentals and specific cases of control valves such as Direction, Pressure and Flow control. Students will also be familiarized with Servo and Electro hydraulic valves briefly. Finally, the course will finish with emphasis hydraulic and pneumatic circuits design and control.

COURSE DETAIL

Modules	Lecture Topics	Hours
Module: 1	Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. Properties of fluids, Fluids for hydraulic systems, governing laws. distribution of fluid power, ISO symbols, energy losses in hydraulic systems. Applications, Basic types and constructions of Hydraulic pumps and motors. Pump and motor analysis. Performance curves and parameters.	11
Module: 2	Hydraulic actuators, types and constructional details, lever systems, control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves. Flapper valve Analysis and Design.	10
Module: 3	Proportional control valves and servo valves. Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Design and analysis of typical hydraulic circuits. Regenerative circuits, high low circuits, Synchronization circuits, and accumulator sizing. Intensifier circuits Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits, accessories used in fluid power system, Filtration systems and maintenance of system.	11
Module: 4	Components of pneumatic systems; Direction, flow and pressure control valves in pneumatic systems. Development of single and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling; Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Will-dependent control, Travel-dependent control and Time-dependent control, combined control, Program Control, Electro-pneumatic control and air-hydraulic control,	10



NP-TEL

NPTEL

<http://nptel.iitm.ac.in>

Mechanical Engineering

Pre-requisites:

The course is aimed at Mechanical Engineering students, typically in the third years of their undergraduate degree programme, who have undergone introductory Mechanics of Fluids course.

Additional Reading:

1. Fundamental of Fluid power control, Watson, Cambridge University press, 2009, ISBN 978-0-521-76250-2.
2. Fluid Power Engineering, M Galal Rabie, McGraw Hill , 2009, ISBN 978-0-07-162246-2
3. Fluid Power Control, Jagadeesha T, Wiley India Limited, ISBN 978-81-265-3954-3, 2013.

Coordinators:

Jagadeesha T
Mechanical NIT Calicut

References:

1. Blackburn, J. F., G. Reethof, and J. L. Shearer, Fluid Power Control, New York: Technology Press of M. I. T. and Wiley.
2. Anthony Esposito, "Fluid Power with applications", Pearson Education.
3. Ernst, W., Oil Hydraulic Power and its Industrial Applications, New York: McGraw Hill.
4. Lewis, E. E., and H. Stern, Design of Hydraulic Control Systems, New York: McGraw Hill.
5. Morse, A. C., Electro hydraulic Servomechanism, New York: McGraw Hill.
6. Pippenger, J.J., and R.M. Koff, Fluid Power Control systems, New York: McGraw Hill.
7. Fitch, Jr., E.C., Fluid Power Control Systems, New York: McGraw Hill.
8. Khaimovitch, "Hydraulic and Pneumatic Control of Machine Tools"
9. John Watton, "Fluid Power Systems: modeling, simulation and microcomputer control", Prentice Hall International.
10. Herbert E. Merritt: Hydraulic control systems, John Wiley and Sons Inc.
11. Ian Mencil, Hydraulic operation and control of Machine tools , Ronald Press
12. Stewart Hydraulic and Pneumatic power for production-Industrial Press.
13. Hasebrink J.P., and Kobler R., "Fundamentals of Pneumatics/electropneumatics", FESTO Didactic publication No. 7301, Esslingen Germany, 1979.
14. Werner Deppert and Kurt Stoll, "Pneumatic Control-An introduction to the principles", Vogel-Verlag.
15. Blaine W. Andersen, "The analysis and Design of Pneumatic Systems", John Wiley and Sons, Inc.