OIL HYDRAULICS AND PNEUMATICS

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INTENDED AUDIENCE : All Engineering College Students, Professional of Industries and working scientists in R & D institutions

INDUSTRIES APPLICABLE TO : BEML, HAL, VSSC, Eaton, Ashok Leyland, Caterpillar, L&T etc.

COURSE OUTLINE :

Preamble: Fluid Power is the technology that deals with the generation, control, and transmission of power, using pressurized fluids. Both liquids and gases are considered fluids. Fluid power is the muscle of the industry used to push, pull, regulate, or drive virtually all the machines of modern industry. For example, fluid power steers and brakes automobiles, launches spacecraft, harvests crops, mines coal, drives machine tools, controls airplanes, processes food, drills teeth, and even transport and delivers drugs to the infected areas in the human body efficiently and effectively. In fact, it is almost impossible to find a manufactured product that hasn't been fluid powered in some way at some stages of its production or distribution. Currently, a revolutionary change has taken place in the field of fluid power technology due to the integration of electronics as a control medium for fluid power components and systems. Due to the increased sophistication of fluid power and allied fields of engineering, the fluid power-driven machines are now able to generate more power and higher accuracy in speed, force, and position control. Hence this course is essential in engineering and technology to cope in modern industry to tackle a variety of problems and search for better solutions in power transmission and control.

Learning Objectives: This course provides a comprehensive introduction to fluid power, including both oil hydraulics and pneumatics, by focusing on the following learning objectives. Upon completion of a course, the student will

• Understand the underlying theoretical concepts

• Be familiar with the construction and function of the components

• Know how the components are selected and integrated into a system

• Understand the operation of basic circuits, and

• Know how to read basic circuits, troubleshoots and analyze

ABOUT INSTRUCTOR :
Prof. Somashekhar S is currently working as an Associate Professor in the Department of Mechanical Engineering, IIT Madras, Chennai. He has produced 11 Ph.D., 5 M.S. (By research), and 38 M.Tech. Students as of now. He has more than two decades of Teaching and Research Experience. He teaches Oil Hydraulics and Pneumatics, Microprocessors in Automation, Instrumentation, and Control, Mechatronics System Design, Robotics, and Artificial Intelligence in Manufacturing. He has published several research papers in International and National journals and conferences. Last but not least, he is a member of several professional bodies in India and abroad.

COURSE LAYOUT

Week 1: Introduction to Oil Hydraulics and Pneumatics, Learning Objectives, Course Content, References, Power Transmission Methods, Merits, Demerits, Brief History, Basic Components. Research Challenges, Status and Developments: Stationary hydraulics and Mobile hydraulics

Week 2: Basic Laws and Symbols : Pascal's law, Hydraulic jack, Hydraulic brake , Pressure Intensifier, Bernoulli equation, Venturi, Torricelli theorem, Siphon, Continuity equation, Flow configuration, Concept of pressures, Gas laws and Numerical. Fluid Power Symbols for Hydraulic lines, Color Coding, Hydraulic Pumps, Hydraulic Motors, Cylinders, Air Compressors, Pneumatic Motors and Orifices, Filters, Check Valves, DCVs, Spool Actuation methods, PCV, Miscellaneous, Port Configurations

Week 3: Hydraulic Pumps, Classifications, Pumping theory, Ideal pump, pump losses, efficiency curve, Constructional features and Operations of External Gear pump, Internal Gear Pump, Gerotor Pump, Screw Pump and Vane Pumps

Week 4: Constructional features and Operations of Piston Pumps- Hand Pump, Bent axis axial piston pump, Swash plate axial piston pump, Radial piston pumps- Pump failure and cavitations, Pneumatic Control and Pneumatic Power Source: Air preparation, Compressor, Classification, Air Receiver and Control Methods ,Construction and operation of Single and Multi-stage Piston Pump, Rotary Vane Compressor, Twin Lobe Air compressor, Screw Compressor, Liquid Ring Compressor and Selection Criteria.

Week 5: Pneumatic Pressure Drop, Energy Loss and Cost Break Down in Air Preparation Process, Pressure Drop and its Effect , What causes Pressure Drop?, Minimising Pressure Drop, Air Distribution System- Sizing of Pipes, Tubes, Materials and Fittings, Important Air Flow Parameters, Pressure drop Predictions using Various Empirical Formulae and Nomogram, Best Practices for Compressed Air Piping System and Installation Tips, Air Dryers, Need for Air Dryer, Analysis of Moisture Removal from Air, Typical Air Drying Methods, Basic Types of Air Dryers, Construction and Operation of Refrigerated Air dyers, Absorption Dryer, Adsorption Dryer, Membrane Dryer, How to Choose the Right Air Dryer?

Week 6: Control Elements- Constructional details, Operations and Application areas of various types of Directional Control Valves, Pressure Control Valves and Flow Control Valve, Numerical

Week 7 : Actuators: Rotary and Linear Actuators - Types, Characteristics, Operations, Efficiencies, Torque and Power, Numerical

Week 8 : Subsystems: Reservoirs, Hydraulic Fluids, Seals, Filters, Accumulators, Maintenance

Week 9 : Circuit Design and Analysis: Development of Single Actuator Circuits, Development of Multiple Actuator Circuits, Cascade Method for Sequencing

Week 10: Hydrostatic Transmission and Control: Different Configurations and Analysis, Pump and Motor Characteristics

Week 11 : Servo and Proportional Valves: Constructional Details, Operations, and Applications

Week 12: Role of Modeling and Simulation in Hydraulic Components- Case Studies