



MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.



MUST KNOW CONCEPTS

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




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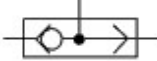
Course Code & Course Name : 19MZC01/19RAC01 & Applied hydraulics and Pneumatics

Year/Sem : II/ III

UNIT – I FLUID POWER SYSTEMS AND FUNDAMENTALS

S.No	Term	Notation Symbol)	Concept/Definition/Meaning/Units / Equation/Expression	Units
1	Fluid power		Fluid power technology is a means to convert, transmit, control and apply fluid energy to perform useful work	
2	Hydraulics		Hydraulics is used for the generation, control, and transmission of power by the use of pressurized liquids	
3	Pneumatic		The compressed air or pressurized gas is usually filtered and dried to protect the cylinders, actuators, tools and bladders performing the work.	
4	Applications off Fluid power		Agriculture, Aviation, Fabrication industry, Machine tools, Oil industry and Pharmaceuticals.	
5	Primary functions of hydraulic fluid		(i) Transfer fluid power efficiently. (ii) Lubricate the moving parts.	
6	Properties of a hydraulic fluid		Viscosity, Viscosity Index ,Oxidationstability, Demulsibility, Flash point and fire point	
7	Problems of high viscous oil.		1.The viscous oil may not be able to pass through the pipes 2. The consumption of power will increase.	
8	Problems of low viscous oil.		1. The internal and external leakage will increase. 2. It cannot lubricate properly and will lead to rapid wear of the moving parts.	

9	Viscosity Index		The rate of change of viscosity with temperature is indicated on an arbitrary scale called Viscosity Index	
10	Demulsibility		The ability of a hydraulic fluid to separate rapidly from moisture and successfully resist emulsification is known as demulsibility.	
11	Neutralization number of hydraulic fluid		The neutralization number is a measure of acidity or alkalinity of a hydraulic fluid.	
12	Examples of Fire resistant fluids		(i) Water glycols (ii) Water oil emulsions (iii) Phosphate esters	
13	Types of Fluid logic system		AND/NAND, OR/NOR, and FLIPFLOP, logic capability.	
14	What does the circular symbol denotes in hydraulic and pneumatic circuits?		Pump, Motor	
15	What does the square symbol denotes in both hydraulic and pneumatic circuits?		One square - pressure control function. Two or three adjacent squares - directional control.	---
16	What does the diamond symbol denotes in both hydraulic and pneumatic circuits?		Diamond - Fluid conditioner (filter, separator, lubricator, heat exchanger)	
17	What does Triangle Symbols in both hydraulic and pneumatic devices denotes?		Solid - Direction of Hydraulic Fluid Flow Open - Direction of Pneumatic flow	
18	Draw the Symbols of rotary actuator used in both hydraulic and pneumatic circuits	 (hydraulic)  (pneumatic)	- -	
19	Symbol used for Single acting cylinder			
20	Symbol used for Double acting cylinders			
21	Symbol used for Directional control valve (2 ports / 2 positions) is			
22	Symbol used for Directional control valve (3 ports / 2			

	positions)			
23	Symbol used for Directional control valve (4 ports / 2 positions)			
24	Symbol used for Directional control valve (4 ports / 3 positions)			
25	Symbol used for Shuttle valve			

UNIT II HYDRAULIC SYSTEM & COMPONENTS

26	Basic components of hydraulic system		(i)Pump (ii)Hydraulic Valves (iii)Hydraulic actuators	
27	Positive displacement pump		Positive displacement pump, the outlet flow is independent of system pressure	
28	Function of pump in a hydraulic system		A pump converts mechanical energy into hydraulic energy. Mechanical energy is given to the pump via a prime mover such as an electric motor.	
29	Types of positive displacement pumps		Gear pumps, Vane pumps, Piston pumps	
30	Types of gear pumps		External gear pump ,Internal gear pump ,Lobe pump, Screw pump	
31	Types of vane pump		Unbalanced vane pump, Balanced vane pump.	
32	Balanced vane pump		Balanced vane pump, there are two inlet and outlet ports which are diametrically opposite to each other. Because the pressure ports are opposite to each other, a complete hydraulic balance is achieved.	
33	Two types of piston pumps		Axial piston pump, Radial piston pump.	
34	Volumetric efficiency of pump	Q_A/Q_T	Actual flow rate produced by the pump/ Theoretical flow rate the pump should produce.	
35	Overall efficiency of pump		Volumetric efficiency x Mechanical efficiency.	
36	Hydraulic actuator		The actuator is a hydraulic element which converts the pressure energy of the fluid into mechanical energy.	

37	Types of hydraulic actuators		1. Hydraulic motor—continuous rotary motion 2. Semi-rotary actuator-limited angle movement 3. Hydraulic cylinder-linear motion.	
38	Types of hydraulic motors		1. Gear type hydraulic motors 2. Vane type hydraulic motors 3. Piston type hydraulic motors	
39	External gear motors uses.		External gear motors are used when relatively high speed and low torque is needed	
40	Single acting cylinder uses		The single acting cylinder is retracted using gravity or by the inclusion of a compression spring at the rod end of single acting cylinder	
41	Mechanical efficiency of a pump		Theoretical power required to operate the pump / Actual power delivered to the pump	
42	Overall efficiency of a pump		Power output by the pump/ Actual power input to the pump	
43	Volumetric efficiency of a hydraulic motor		Theoretical flow rate required to drive the motor/ Actual flow rate into the motor	
44	Mechanical efficiency of a hydraulic motor		Actual power given by the motor/ Theoretical power delivered by the motor	
45	Cylinder		A cylinder is one of the most basic curved geometric shapes, with the surface formed by the points at a fixed distance from a given line segment, known as the axis of the cylinder	
46	Tandem Cylinder		The same amount of fluid and force is used to move the piston a certain distance in either direction. Tandem Cylinders. A tandem actuating cylinder consists of two or more cylinders arranged one behind the other but designed as a single unit.	
47	Telescoping cylinder		A telescoping cylinder is a cylinder employing several pistons which telescope into each other. This cylinder is used where a relatively long working stroke is needed for a short cylinder length.	
48	Pressure-reducing valve		The operation of a pressure-reducing valve that uses a spring-loaded spool to control the downstream pressure.	

49	Counterbalance valve		The purpose of a counterbalance valve is to maintain control of a vertical cylinder to prevent it from descending due to gravity. The primary port of this valve is connected to the bottom of the cylinder, and the secondary port is connected to a directional control valve. (DCV)	
50	Flow Control Valves		Flow control valves are used to regulate the speed of hydraulic cylinders and motors controlling the flow rate to these actuators	

UNIT III: DESIGN OF HYDRAULIC CIRCUITS


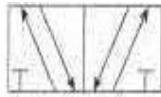

51	Function of relief valve in a hydraulic system		The function of a relief valve is to limit the system pressure to a specified maximum value by diverting the pump flow back to the tank	
52	Function of an unloading valve		The unloading valve is useful to control the amount of flow at any given time in systems having more than one fixed delivery pump.	
53	Function of a sequence valve		Sequence valves are used to perform number of operations one after the other after the set pressure is reached.	
54	Pressure reducing valve uses		Pressure reducing valve is used to maintain reduced pressure in specified locations of hydraulic system.	
55	Application of a counter balance valve		The counterbalance valve is used to maintain back pressure on a vertical cylinder to prevent it from falling due to gravity.	
56	Check valve		The check valve is a one way valve, which allows flow in one direction, on the other direction the flow is not permitted	
57	3 – Way valves		The purpose of a 3-way control valve is to shut off water flow in one pipe while opening water flow in another pipe, to mix water from two different pipes into one pipe.	
58	Actuation valve		A valve actuator is a mechanical device that uses a power source to operate a valve. This power source can be electric, pneumatic (compressed air), or hydraulic (the flow of oil)	
59	Solenoid valve		A solenoid valve is an electromechanically operated valve.	

			Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid	
60	What is the purpose of 3 position-4 way closed center solenoid operated direction control valve.		A 3-position, 4-way valve stops an actuator or allows it to float. A 3-position, 4-way valve is more common in hydraulic circuits.	
61	3 - ways of applying flow control valves		Meter-in, Meter-out, Bleed-off.	
62	Intensifier		An intensifier is a device which converts low pressure fluid power into high pressure fluid power	
63	Accumulator		An accumulator is a device that stores potential energy of an incompressible fluid held under pressure by an external source against some dynamic force.	
64	Types of accumulators		Weight loaded type, Spring loaded type , Gas loaded type.	
65	Hydro static drive		A hydrostatic drive consists of a positive displacement pump, driving a positive displacement hydraulic motor	
66	Applications of Filter		1.Filter Circuits are used to eliminate background Noise 2.They are used in Radio tuning to a specific frequency 3. Used in Pre-amplification, Equalization, Tone Control in Audio Systems.	
67	Sequencing circuits		Sequencing circuits automatically move actuators in a predetermined sequence. Electrical control - Limit switches moment actuated by the cylinders control the solenoid valves	
68	Difference between hydraulic tubing and hoses		Tubes are constructed of cold drawn steel and they are used where high pressures are encountered. Hose is made up of rubber or thermoplastic tube reinforced with steel wire or textile braiding.	
69	List the parameters affecting the selection of a pump		Maximum operating pressure, maximum delivery, pump drive speed, type of fluid, fluid contamination, pump pulsation, pump noise, size and weight of pump, efficiency and cost	
70	Function of a fluid Reservoir		1. To provide a chamber in which any change in volume of the fluid in the	

			hydraulic circuit can be accommodated. 2.To provide a radiating surface for allowing the fluid to cool	
71	Synchronous circuit		A synchronous circuit is a digital circuit in which the changes in the state of memory elements are synchronized by a clock signal. In a sequential digital logic circuit, data is stored in memory devices called flip-flops or latches.	
72	Quick exhaust valves		Quick exhaust valves are valves that are designed to allow direct exhaust or expulsion of compressed air, the displacement speed of the cylinder rod increases which reduces the cycle time.	
73	Air control valves		Air control valves are fundamental components of any pneumatic system. Selecting the right air control valves to regulate system pressure, direction of flow, and rate of flow is crucial when designing fluid power circuit.	
74	Lubricator Unit		A pneumatic lubricator injects an aerosolized stream of oil into an air line to provide lubrication, A lubricator should always be the last element in an FRL (Filter-Regulator-Lubricator) unit.	
75	Regulator		A device for controlling the rate of working of machinery or for controlling fluid flow, in particular a handle controlling the supply of steam to the cylinders of a steam engine.	

UNIT IV: PNEUMATIC SYSTEMS AND COMPONENTS

76	Strainer		Strainer is a device for the removal of solids from a fluid wherein the resistance of motion of such solids is in a straight line	
77	Filter		Filter that removes particles and impurities from the air ,to improve the quality of circulating air by filtering out impurities Once the air is returned to the furnace fan, it is pulled through air filters to remove dust and dirt	
78	Filter media		Woven wire cloth, Paper filter, Woven cloth media , Sintered metal powders, Ceramic and plastic media	
79	Types of airmotors		Piston type motors -Axial, Radial Vane type motors-Non-reversible, Reversible and Turbine motors	

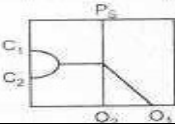
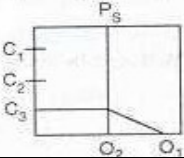
80	Running torque		Torque generated when the motor is rotating at a particular speed	
81	Starting torque		The maximum torque the motor can produce when starting under load	
82	Stall torque		The torque required to stop the motor at a particular supply pressure	
83	Purpose of a two-pressure valve		The two-pressure valve delivers an output when both input signals are present.	
84	Purpose of a shuttle valve		The shuttle valve delivers an output when one input is present or when both are present	
85	Graphic symbol of Four-way, two position DCV		-	
86	Graphic symbol of Five-way, two position DCV		-	
87	Need for mufflers		The muffler is used to reduce the energy of exhausted air, thereby reducing the noise	
88	F-R-L unit		F-R-L unit is a combined unit of Filter-Regulator-Lubricator	
89	Purpose of a pressure regulator		The purpose of the pressure regulator is to regulate the incoming pressure to the desired pressure	
90	Multi stage compressor		A compressor that draws in air and compress it to its final pressure in two or more stages is called multistage compressor	
91	Filtering method used in hydraulic system		Surfacetype, Depthtype, Edgetype	
92	Suction cups		Suction cups can be used to pickup and hold work pieces with smooth and impervious surfaces	
93	Advantages of air motor		<ol style="list-style-type: none"> 1. Do not require electrical power 2. Can be used in volatile atmospheres. 3. Can stall under full load for indefinite periods of time 4. Speed can be regulated through simple flow control valve 	
94	Pneumatic cylinders classification		Single acting cylinder, Double acting cylinder, Tandem cylinder, Three position cylinder, Through rod cylinder, Adjustable stroke cylinder, Telescoping cylinder	
95	Purpose of a lubricator		Air is not a good lubricant. So to lubricate the moving parts in the	

			pneumatic system, a fine mist of oil is discharged into the air by a lubricator	
96	Function of an air filter		The function of an air filter is to remove contaminants from air before it reaches the pneumatic components such as valves and actuators	
97	Function of a dryer		The purpose of the dryer is to reduce the relative humidity and dew point of the compressed air from the compressor	
98	Multistage compressor		A compressor that draws in air and compress it to its final pressure in two or more stages is called multistage compressor	
99	Types of positive displacement compressors		Reciprocating piston type (ii) Rotary vane type (iii) Rotary screw type	
100	Main reason for pneumatics preferred over hydraulics		Pneumatics is preferred, over hydraulics when high speed and lower forces are required and do not require high precision	

UNIT V: DESIGN OF PNEUMATIC CIRCUITS

101	Hydro pneumatics		Systems use air and oil are hydro pneumatics systems	
102	Types of Hydro pneumatic circuits		i) Air-oil reservoir ii) Air-oil cylinder iii) Air-oil intensifier.	
103	Low-Cost Automation		Low-cost automation is defined as a technology that creates some degree of automation around the existing equipment, tools and methods, using mostly the standard equipment available in the market	
104	Trouble shooting		Troubleshooting means an organized and systematic study of the problem and a logical approach to the difficulty faced in the system	
105	Causes of noisy pump		1.Misalignment of pump and prime mover 2.Air remains in pump casing 3.Pump bolts very loose 4.Very high viscosity of oil 5.Pump running too fast.	
106	Causes for low or erratic pressure in a hydraulic system		1.Very low relief valve setting 2.Leakage of pump delivery within the system 3. Pump slipping its entire volume.	
107	Causes of erratic motion in pneumatic cylinder		1.Valve sticking or binding 2.Cylinder sticking or binding	

108	Methods of entering the program in PLC		<ol style="list-style-type: none"> 1. Ladder diagram based. 2. Low-level language based on Boolean expressions 3. Functional blocks 4. High-level languages. 	
109	Basic elements of PLC		<ol style="list-style-type: none"> 1. Central processing unit with an associated memory 2. Input modules 3. Output modules. 	
110	Programmable Logic Controller		Programmable Logic Controller is defined as a digital electronic device that uses a programmable memory to store instructions such as logic, sequencing, timing, counting and arithmetic to control machine or processes	
111	Ladder diagram		The ladder diagram is a representation of hardware connections between switches, relays and solenoids etc., which constitute the basic components of an electrical control system. The left leg of the ladder connected to the power and the right to the ground.	
112	Purpose of an electrical timer		Timers are used to control the time duration of a working cycle. In this way, a dwell can be provided when needed	
113	Electrical relay		Electrical relay is a switch whose contacts open or close when its coil is energized. Relays are used for energizing and de-energizing solenoids	
114	Push button switch		Push button switches are momentary switches. They make or break contact only as long as they are held pressed	
115	Limit switch		Limit switches make or break contact permanently when they are actuated.	
116	Pressure switch		Pressure switches open or close contacts based on the system pressure.	
117	Temperature switch		Temperature switches sense change in temperature and open or close contacts when a predetermined temperature is reached.	
118	Step counter		A step counter is a digital modular counter constructed from stepping units. A stepping unit is built from memory valve and a pre-switched and valve with two inputs.	
119	Common methods for designing logic circuits		<ol style="list-style-type: none"> 1. Classic method 2. Cascade method 3. Step counter method 4. KV map method 5. Combinational circuit design. 	

120	Symbol for fluidic AND element		-																									
121	Truth table for fluidic AND element		<table border="1"> <thead> <tr> <th colspan="4">Truth Table</th> </tr> <tr> <th>C₁</th> <th>C₂</th> <th>O₁</th> <th>O₂</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>	Truth Table				C ₁	C ₂	O ₁	O ₂	0	0	0	1	1	0	0	1	0	1	0	1	1	1	1	0	
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124	Moving part logic elements (MPL)		The MPL elements are miniature pneumatic elements. These elements are available as AND, OR, NOT logic elements. The elements use moving parts such as diaphragms, springs, disk, balls, poppet's.																									
125	Advantages of fluidic elements		<ol style="list-style-type: none"> 1. A wear and tear of elements. 2. No actuating force needed. 3. Very little space needed for mounting. 4. Quite insensitive to temperature, vibration, shock, electric noise and radiation 																									

QUESTIONS FOR PLACEMENT TRAINING

126	What are the leading companies in automation field?		<ul style="list-style-type: none"> • Rockwell Automation. • Titan Automation Solution. • Voltas Limited. • GE India. • Honeywell India. • Larsen & Toubro. • Siemens Limited. • ABB Limited. 	
127	Give some examples of pneumatic fittings that we use in our daily life.		<ul style="list-style-type: none"> • Bicycle/ball pumps • Tire pressure gauges • Nail guns • The handicapped-access buttons which operate automatic doors • Vacuum cleaners 	
128	Pneumatic systems usually should not exceed		1 HP	
129	Which gas is used in gas charged accumulator?		Nitrogen	
130	How is pressure of fluid under piston calculated in a weighted accumulator?		Pressure of fluid = (weight added / piston area)	
131	Why the pilot is operated check valve used in clamping operation?		A. To reduce leakage in spool valve B. To avoid decrease in pressure during clamping	
132	When comparing operating cost of hydraulic systems to pneumatic systems, which system is cost effective?		Pneumatic system	
133	Initial setup cost of Pneumatic systems are generally?		Less expensive	
134	The most common hydraulic fluid is		Water	
135	Leakage in rotary chucks can be compensated by ----- -----		Accumulator	

136	Why is fluid power preferred in mobile vehicles?		Power can be transmitted without any delay When overloaded, fluid power systems stop without damaging the components Fluid is non-compressible	
137	Pressure of 1 bar is		14.5 psi	
138	What types of pneumatic conveying systems are typically used?		Dilute phase systems and dense phase systems	
139	What effect does overloading have on fluid power and electrical systems?		A. Electrical components get damaged in electrical systems b. Fluid power system stops working without damaging the components	
140	Fluid power circuits use schematic drawings to		Simplify component function details	
141	Generally liquids are non-compressible but when a large pressure of 70 bar is applied, petroleum oil can be compressed up to		0.5% of its original volume	
142	The resistance offered to the flow of fluid inside a piston develops into?		Pressure	
143	What is the relation between speed and flow rate for fixed displacement vane pump?		Flow rate increases with increase in speed of rotor	
144	Which type of motion is transmitted by hydraulic actuators?		A. Linear motion B. Rotary motion	
145	What is the function of electric actuator?		Converts electrical energy into mechanical torque	
146	Which energy is converted into mechanical energy by the hydraulic cylinders?		Hydrostatic energy	

147	What is the advantage of using a single acting cylinder?		Piston seals are not required	
148	Which stage in two stage direction control valve is solenoid operated?		Pilot stage direction control valve	
149	What does the numbers in 4/2 valve mean?		4 ways and 2 positions	
150	Which type of solenoid has more chances of coil failure?		AC solenoid	