

Department of Mechanical Engineering
ME 55 – Applied Hydraulics and Pneumatics

1. Define Hydraulics

The engineering science pertaining to liquid pressure and flow.

2. What is a Fluid Power System?

A system that transmits and controls power through use of a pressurized fluid within an enclosed circuit.

3. Define Pascal's -Law

A pressure applied to a confined fluid at rest is transmitted with equal intensity throughout the fluid.

4. What is the function of hydraulic actuator?

Hydraulic actuators convert the pressure energy of fluid into mechanical output to perform useful work.

5. Define back Pressure.

The pressure encountered on the return side of a fluid system.

6. Define Pump.

A device which causes a liquid to flow against a pressure. It converts mechanical energy into fluid energy.

.7. How pumps are classified?

1. Positive displacement pumps
2. Hydrodynamic (or) Non-positive displacement pumps.

8. Write about positive displacement pumps?

Positive displacement pumps have the internal working elements which make a very close fit together so that there is very little leakage (or) slippage between them. This type of

pumps ejects a fixed quantity of liquid into the hydraulic system per revolution of the' pump shaft.

9. How gear pumps are classified?

1. External gear pump
2. Internal gear pump
3. Lobe pump
4. Screw pump
5. Gerotor pump

10. Define Axial Piston pump & Radial Piston pump

A pump having multiple pistons disposed with their axes parallel to shaft axis.

A pump having multiple pistons disposed radially to the shaft axis, actuated by an eccentric element.

11. Define Gear pump & Vane pump.

A pump having two or more intermeshing gears or lobed members enclosed in housing.

A pump having multiple radial vanes within a supporting rotor.

12. Define Motor

A device which converts .fluid power into mechanical power. It usually delivers Torque and rotary motion to a shaft.

13. Define Viscosity .

A measure of the internal friction or the resistance to fluid flow.

14. Differentiate between liquid pressure and liquid flow rate?

The liquid pressure is responsible for the force developed at hydraulic actuator while the liquid flow rate is responsible for the speed of the hydraulic actuator.

15. How velocity of the hydraulic actuator is calculated?

Velocity of the hydraulic actuator = Input flow rate/ Area of piston

16.State the Bernoulli's principle?

If the flow rate in the system is constant, then the total energy in the system will also be constant irrespective of the variation in the cross section of the fluid passages.

17. What are the factors to be considered for pump selection?

1. Discharge
2. Performance
3. Operating speed
4. Reliability
5. Pressure rating
6. Maintenance
7. C cost
8. Noise

18. How Vane pumps are classified?

1. Unbalance vane pump
2. Balanced vane pump
3. Variable displacement vane pump

19. How piston pumps are classified?

1. Radial piston pump
2. Piston pump with stationary cam and rotating block
3. Axial pump with swash plate
4. Bent axis pump

20. How the displacement of the gear pump is determined? '

The displacement of the gear pump is determined by

1. Volume of fluid between each pair of teeth
2. Number of teeth
3. Speed of rotation

21. Define Accumulator

A container in which liquid is stored under pressure as a source of fluid power.

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22. What are the three basic types of accumulators used in hydraulic systems?

1. Gravity type (or) weight loaded type
2. Spring loaded type
3. Gas loaded type.

23. Name the two types of gas loaded accumulator?

1. Non-separator type
2. Separator type

24. Explain non-separator type gas loaded accumulator?

In this type, the gas is filled at the top and the heavy oil at the bottom of the shell. There is no separator between the gas and oil and thus the pressurized gas pushes the oil directly.

25 . What are the three basic types of separator type gas loaded accumulator?

1. Piston type
2. Diaphragm type
3. Bladder type

26. What are the most common applications of accumulators in hydraulic system?

1. Accumulator is used as an auxiliary power source
2. Accumulator is used as a compensator for an internal (or) external leakage.
3. Accumulator is used as an emergency power source
4. Accumulator is used as a hydraulic shock absorber.

27. What is the function of accumulator?

Accumulator is used as an auxiliary power source. It is a device which stores the potential energy of the fluid. The stored potential energy in the accumulator acts as a quick secondary source of power and does useful work as required by the system.

28. What are the conditions for the two cylinders to be synchronized?

For the two cylinders to be synchronized, the piston area of cylinder 2 must be equal to the difference between areas of the piston and piston rod for cylinder 1.

i.e. $A_{p2} = A_{p1} - A_{R1}$

Also, the pump should be capable of delivering a pressure force $P_1 A_{p1}$ in cylinder 1 to overcome the loads F_1 and F_2 acting on both cylinders. .

i.e. $P_1 A_{p1} = F_1 + F_2$

29. Name three speed control circuits?

1. Meter - out circuit
2. Meter - in circuit
3. Bleed - off circuit

30. What is the use of bleed-off circuit?

Bleed off circuit is used to control the flow of fluid in both directions of flow (or) on a specific line and limits speed in only one direction of the cylinder travel.

31. Name the important auxiliary components used in the hydraulic circuits?.

1. Hydraulic reservoir
2. Filters and strainers
3. Sealing
4. Hydraulic accumulators
5. Pressure intensifiers (or) Boosters.

32 .What are the factors to be considered while designing a hydraulic circuit?

1. Safety of operation
2. Performance of desired function
3. Efficiency of operation

33. What is the use of regenerative circuit?

Regenerative circuit is used to increase the speed of extension stroke of the double acting hydraulic cylinder.

34. What is the circuit for shaping machine?

Quick Return Motion Circuits.

35. What is automatic sequencing circuit?

By sequencing a number of pneumatic cylinders, various machining and tooling operations may easily be obtained in a machine. By using this technique, the cylinders can be actuated one after another in sequences like clamping, feeding and ejecting (or) lifting, pushing and clamping (or) in various other combinations. The pneumatic circuit utilizing this technique is known as automatic sequencing circuit. Correct sequence of motion of each cylinder and the respective cycle time, should be carefully studied before designing such a circuit.

36. What is a sequencing circuit?

Process control pneumatics is also called as sequencing. It means performing number of actions one after another which follows each other in a simple order or with an order determined by sensors.

37. What is pneumatic direction control valve?

Pneumatic direction control valve is used to control the direction of air path. These Valves have generally two, three, four (or) five ports: These ports are designated as

P: Compressor line port

R: Exhaust port (T is case of hydraulics)

A, B: Working ports connected to actuator.

38 What is the use of Time Delay Valves?

Pneumatic time delay valves are used to delay operations where time based sequences are required.

39. What is a fast exhaust valve?

A fast exhaust valve is used to vent cylinder quickly. It is primary used with spring return (single acting) pneumatic cylinders.

40. Differentiate between hydraulic and pneumatic systems?

The working fluid of hydraulic system is water (or) oil (or) any liquid.

The working fluid of pneumatic circuit is air Hydraulic systems are designed for heavy loads where as pneumatic systems are designed for low (or) medium loads.

41. What is the function of pneumatic circuit using quick exhaust valve?

By quickly exhausting the air from the cylinder, the cylinder speed can be exhausted.

42.What is Time delay circuit?

In certain applications, the impulse to the main direction control valve may have to be delayed to pre-determined time for different operational reasons. A pneumatic time delay valve may be used in such cases. A pneumatic circuit using this time delay valve is known as time delay circuit.

43. What is the use of compressor?

A compressor is a machine, which compresses air (or) any other gas from atmospheric pressure to a desired higher pressure level.

44.Name two basic types of compressors?

- 1.Positive displacement compressors
- 2.Dynamic (Turbo) compressors.

45. Differentiate between single acting and double acting compressors.

In a single acting compressor, the compression takes place on one side of the piston for each revolution of crank shaft.

. In a double acting cylinder, compression takes place on both faces of the piston giving two compression strokes for each revolution of the crankshaft.

46. Define FRL unit?

Air is not clean and hence contamination may result in pneumatic circuit. Also, due to time fluctuations, the receiver air pressure does not remain constant. Also, some parts of the pneumatic system have to be lubricated for proper maintenance.

For cleaning the air, regulating the pressure of air and lubricating pneumatic parts, three units 'Filter - Pressure Regulator - Lubricator' (Trio unit) are put together and this combined unit - Trio unit - is called FRL unit.

47. Explain Fluidic Logic Control?

In many plants, closed loop control is achieved by electronic devices based on different logic functions such as AND, OR, NOT and MEMORY.

Logic controls can be defined as design of control system based on reasoning arising out of deductive principle. However, the electronic control system is not only control system used in industries. If the pneumatic control system using low-pressure air is used to achieve the above logic control functions, then it is known as Fluidic Logic Control.

48. What is fluidics?

Fluidics is the technology that utilizes fluid flow phenomena in components and circuits to perform a wide variety of control functions including sensing, logic and many more functions.

49. How pump cavitation is identified?

Cavitation is the inability of a pump to draw a full charge of oil either because of air leaks or restrictions in the inlet line. When a pump starts to cavitate, its noise level increases

and it may become very hot around the shaft and front bearing. Other symptoms of cavitation are erratic movement of cylinders, difficulty in building up full pressure, and a milky appearance of the oil.

50. Write about leakage testing of air cylinders?

Piston seals and rod seals become worn to the point that cylinder performance (or) efficiency is affected. Leakage around the rod seal can easily be detected and the seal can be replaced. At that time, the rod bearing which is usually brass, bronze (or) Teflon, It should also be replaced.

51. What is air receiver?

Air receiver is a large cylindrical vessel used to store high pressure air from the compressor. Large surface area of the receiver dissipates the heat of compression (heat in the compressed air) to the surrounding atmosphere. It will have safety relief valve, pressure indicator and temperature switches.

52. What are the advantages of fluidic elements?

- No wear and tear of elements.
- No actuating force is needed.
- Very little space needed for mounting.
- Insensitive to noise, vibration, temperature, electric noise and radiation.

53. Name the common methods used for designing logic circuits?

- Cascade method
- Classic method
- Step counter method
- KV map method
- Combinational circuit design

54. What is the difference between pressure switch and temperature switch?

Pressure switches open and close contacts based on the system pressure.

Temperature switches sense change in temperature and open and close contacts when a predetermined temperature is reached.

55. How does a limit switch differ from a push button switch?

Push button switches make or break contact only as long as they are held pressed.

But limit switches make or break contact permanently when they are actuated.

56. What is an electric relay?

Electric relay is a switch whose contacts open or close when its coil is energized. Relays are used for energising and de-energising solenoids.

57. What is ladder diagram?

The ladder diagram is a representation of hardware connections between switches, relays, solenoids, etc. The left leg of the ladder is connected to the power and the right to the ground.

58. What is the advantage of using micro electronic control for fluid power compared to electro mechanical control?

When the sequence changes, the hard-wired electro mechanical has to be changed.

This is expensive, but micro electronic control is programmable. So when the sequence changes, the program only has to be changed.

59. What is PLC?

PLC is a digital electronic device that uses a programmable memory to store instructions such as logic, sequencing, timing counting and arithmetic to control machine or process.

60. What are the basic elements of PLC?

- (i) Central processing unit with memory.
- (ii) Input modules.
- (iii) Output modules

PART B

1. Discuss the factors to be considered in the selection of hydraulic fluids
2. Explain the factors which affect the selection of pumps and discuss in detail the classification and performance features of different types of hydraulic fluids
3. With neat sketch explain the hydraulic and pneumatic fluid power system
4. How to calculate frictional losses in common valve and fittings
5. What are the desirable properties of hydraulic fluids? Discuss any eight of them in detail
6. Draw fluid power symbols of any six different types of valves?
7. What is the basic consideration in the design of a hydraulic circuit
8. Explain the hydraulic press circuit in detail
9. What are the factors to be selected in selection of a pump for automobiles lift
10. How will you measure the pump performance? explain each with suitable examples ?
11. What is cylinder cushioning? Explain with diagram
12. What is the theoretical torque required to operate the pump
13. Explain the factors which affect the selection of pumps and discuss in detail the classification and performance features of different types of hydraulic pumps
14. Explain the construction and working of gear pump
15. Explain the working principle of external gear pump and determine its performance Measures.
16. With a neat sketch explain the principle construction working advantages ,limitations and applications of a non-pressure compensated reciprocating vane pump
17. With neat sketch describe the construction and operation of pressure regulated low control valve.
18. A hydraulic pump delivers at 60 bars, 120lpm into a circuit laid on a horizontal plane. There are 4 elbows ($k=0.75$), one globe valve fully open ($k=10$), and a direction control valve (pressure drop=3 bar) with the inside dia of the pipe is 30mm .The total length of the straight run pipe is 20m and the specific gravity of the oil is 0.9. The kinematics viscosity of oil is $.0001 \text{ m}^2/\text{s}$. Determine the pressure in bar at the exist point of the pipe.
19. Explain air over oil intensifier with suitable example.
20. Explain with a circuit how in shaping operation a fast approach, slow feed, and rapid return can be achieved.
21. What is compressor? Explain the working principle of piston type compressor with neat sketch
22. What is the synchronizing? Explain the synchronizing circuit with suitable

approaches?

23. Design an electro hydraulic circuit for the following sequences A+B+A-B- where A & B stand for cylinder (+) indicates extension and (-) indicates retraction of cylinders.

Incorporate provision for auto-manual selector and emergency stop

24. How the PLC is used in fluid power control Explain with suitable example

25. Explain the hydro mechanical servo system with suitable application