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| **Subject Code : ME8694 Year/Semester : III / 06** | |
| **Subject Name : Hydraulics and Pneumatics** | |
| **Unit- I Fluid Power Principles And Hydraulic Pumps** | |
|  | **PART–A** |
| **1.** | **Define the term fluid power.** |
|  | Fluid power may be defined as the technology that deals with the generation,  control and transmission of power using pressurized fluids. |
| **2.** | **Compare hydraulic and pneumatic system.** |
| DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING AND TECHNOLOGY  Mamallapuram, Chennai-603104.  DEPARTMENT OF MECHANICAL ENGINEERING  **QUESTION BANK** | |  |  |  | | --- | --- | --- | | **S.No** | **Hydraulic System** | **Pneumatic System** | | 1. | It employs a pressurized  liquid as a fluid. | It employs a compressed gas  usually air as a fluid. | | 2. | Hydraulic systems are designed as closed system. | Pneumatic systems are usually designed as open system. | | 3. | System get slow down if  leakage occurs. | Leakage does not affect the  system much more. | |
| **3.** | **What are the functions of hydraulic fluid?** |
|  | 1. To transmit fluid power efficiently to perform useful work. 2. To lubricate the moving parts to minimize wear and friction. 3. To absorb, carry and dissipate the heat generated within the system. 4. To prevent rust and corrosion 5. To remove unwanted and harmful impurities from the system. |
| **4.** | **Explain the importance of viscosity and what happens if viscosity is too high (or) too**  **low?** |
|  | Viscosity is the most important property of a hydraulic fluid, as it determines the ability of a fluid to be pumped and transmitted through the system.  Too high viscosities (Heavy weight fluids) have the following effects.   1. High resistance to flow, which causes sluggish operation (Difficult to flow). 2. Increases power consumption.   Too low viscosities (Light weight fluids) have the following effects.   1. Less precision control and slower responses. 2. Increases Leakage losses past seals. |
| **5.** | **List the applications of fluid power. (April / May 2021)** |
|  | There are many applications of fluid power and some of them are   1. Agriculture: Hydraulically driven farm equipments. 2. Automobile: Fluid power steering and braking systems.   Defence: Missile Launch Systems, navigation controls. Iv Transportation: Hydraulically powered overhead sky tram |

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| **6.** | **List the advantages and disadvantages of hydraulic system.** |
|  | Advantages of Hydraulic system   1. Large load capacity with almost high accuracy and precision. 2. Smooth movement. Disadvantages of Hydraulic system 3. Hydraulic Elements needs to be machined to a high degree of precision. 4. Leakage of Hydraulic oil poses problems to hydraulic operators. |
| **7.** | **List the advantages and disadvantages of pneumatic systems.** |
|  | Advantages of Pneumatic system   1. Low inertia effect of pneumatic components due to light density of air. 2. System is light in weight. Disadvantages of Pneumatic systems 3. Suitable only for light loads or small loads. 4. Availability of the assembly components is doubtful. |
| **8.** | **What is the function of compressor in pneumatic system?** |
|  | It is use to compress the incoming atmosphere air above 5 bar which is used as  medium in pneumatic system. |
| **9.** | **Name three basic methods of transmitting power***.* |
|  | 1. Electrical power transmission, 2. Mechanical power transmission, and 3. Fluid power transmission, Hydraulic power transmission, and Pneumatic power transmission. |
| **10.** | **In comparison with hydraulic systems, why are pneumatic systems are**  **Suitable only for low load and low power applications?** |
|  | Since pneumatic pressures are quite low due to the compressor design, the pneumatic systems are suitable only for low load and low power applications. It is compressible in nature and not suitable for high load application. |

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| **11.** | **What are the basic components that are required for a hydraulic system?** |
|  | The six basic components of a hydraulic system are :   1. Reservoir (or tank), 4. Valves, 2. Pump, 5. Actuator, and 3. Prime mover 6. Fluid-transfer piping |
| **12.** | **What is demulsibility? Write its significance.** |
|  | The property of a hydraulic fluid to separate rapidly and completely from moisture and to resist emulsification is known as demulsibility. **Significance:** This property is significant because the operation of many hydraulic systems are conducive to the forming of moisture or of stable water-in-oil emulsions. |
| **13.** | **What is oxidation stability?** |
|  | Oxidation stability is defined as the ability of a liquid to resist reaction with oxygen or oxygen-containing compounds. |
| **14.** | **List few required properties of a good hydraulic fluid.** |
|  | 1) Stable viscosity characteristics. 2) Good lubricity. 3) Compatibility with system materials.4) Stable physical and chemical properties. |
| **15.** | **State the law that govern the fluid power system*.*** |
|  | Pascal's law states that the pressure generated at any point in a confined fluid acts equally in all directions.  P1= P2  F1/A1 = F2/A2 |
| **16.** | **Differentiate between laminar and turbulent flow.** |
|  | A laminar flow is one in which paths taken by the individual particles do not cross one another and moves along well-defined paths. The laminar flow is characterized by the fluid flowing in smooth layers of lamina. A turbulent flow is that flow in which fluid particles move in a zig-zag way. The turbulent flow is characterized by continuous small fluctuations in the magnitude and direction  of the velocity of the fluid particles. |
| **17.** | **List out the various energy losses when liquid flows through a pipe.**  There are two main losses of energy when liquid flows   1. Major energy losses occur due to friction   2. Minor losses - These losses are due to losses in valves and pipe fittings. Sudden enlargement/Contraction of pipe. *(Hi)* Bend in pipe, etc |
| **18.** | **Name any four hydraulic fluids that are commonly used.** |
|  | 1. Petroleum oils. 2. Water-in-oil and oil-in-water emulsions. 3. Glycols. 4. Phosphate esters. |
| **19.** | **Pump do not pump pressure. Justify the statement.** |
|  | In pump, fluid flow in the inlet line always takes place at negative pressure and hence a relatively low flow velocity is needed here. This causes the fluid to be pushed up and creates it to lift. Due to the resistance offered by the system to fluid flow, the pressure get raises to the required level. So, pumps do not pump  pressure but, they produce fluid to flow. |
| **20.** | **List the advantages of hydrostatic pumps over hydrodynamic pumps.** |
|  | * They are capable of generate high pressure (over 690 bar). * They are relatively small and compact in size. * High volumetric efficiency due to less leakages. |
| **21.** | **What are the advantages of screw pumps than other gear pumps?** |
|  | * Screws are continuous, most reliable. * No pressure pulsation will occur. * High speed operation is possible with less noise. * No pump turbulence and oil churning. |
| **22.** | **How the vane pump / piston pump can be made as variable displacement unit?** |
|  | Variable displacement units can be made by either varying the eccentricity of rotor with respect to cam ring, in case of vane pumps or by varying the  offset angle, in case of piston pumps. |
| **23.** | **Why are positive displacement pumps universally used in fluid power**  **industries?** |
|  | Positive displacement pumps are primarily used where pressure development is  the prime requirement. This type of pumps are capable of delivering high pressure fluid, so it is universally used in fluid power system. |

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| **24.** | **Mention different types of pumps used in fluid power system.**  Based on the construction, Hydrostatic pumps are classified as  **1.Gear pumps (Fixed displacement only)**   * External Gear pump * Internal Gear pump * Lobe pump * Screw pump * Gerotor pump   **2. Vane pump (Fixed or variable displacement)**   * Balanced vane pump * Unbalanced vane pump   **3. Piston pump (Fixed or variable displacement)**   * Axial design * Radial design |
| **25.** | **What are piston pumps? Name the two basic types of piston pumps.** |
|  | In piston pumps, the pumping action is affected by a piston that moves in a reciprocating cycle through a cylinder.  Types:   1. Axial piston pumps and 2. Radial piston pumps. |
| **26.** | **How can you vary the displacement in an axial piston pump?** |
|  | The variable displacement in an axial piston pump can be achieved by altering the angle of the swash plate (or offset angle). Because in axial pumps, this swing angle determines the piston stroke and hence the pump displacement. |
| **27.** | **Why fluid power system is called muscle of the industry? (April /May**  **2021)** |
|  | The fluid power system is called muscle of the industry because it perform various activities associated with automation such as remote and direct control  of production operations, manufacturing processes and material handling |

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|  | Also it offers many advantages such as   * Force or torque can be held constant * Multi-functional control * High horse power-to-weight ratio * Safety in hazardous environment. |
|  | **PART B** |
| **1.** | Compare between hydraulic, pneumatic and electromechanical power system. |
| **2.** | What types of fluids are available for hydraulic system? Explain each of them. |
| **3.** | What are the desirable properties of hydraulic fluids? Discuss them in detail. |
| **4.a.**  **b.** | State and explain Pascal’s law  List the disadvantages of both hydraulic and pneumatic power system. |
| **5.** | With neat sketch explain the hydraulic and pneumatic fluid power systems. |
| **6.a.**  **b.** | How to calculate frictional losses in common valves and fittings  Differentiate between laminar and turbulent fluid flow. |
| **7.** | Explain the construction and working of a gear pump. |
| **8.a.**  **b.** | A gear pump has a 80 mm outside diameter, a 55 mm inside diameter and a 25 mm width. If the actual pump flow at 1600 rpm and rated pressure is 95 Lpm, what is the volumetric efficiency?  Explain the radial piston with advantages and disadvantages of piston pump. |
| **9.** | With neat sketch explain the working of screw pump and internal gear pump  with advantages and disadvantages. |
| **10.** | With a neat sketch explain the principle and working of unbalanced vane pump  and derive the expression for the output of vane pump. |
| **11.** | List out the selection procedure of oil in industrial hydraulic application. **(April**  **/ May 2021)** |
| **12.** | Explain with neat sketch construction and working of external gear pump.  **(April / May 2021)** |

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| **13.a.**  **b.** | A pump has a displacement volume of 100cm3. It delivers 0.0015m3/sec at 1000rpm and 70 bar. If the prime mover input is 120Nm.Calculate  i) overall efficiency ii) theoretical torque required to operate the pump.  With neat sketch explain the working of lobe pump and Gerotor pump with advantages and disadvantages |
| **14.** | Explain the working of bent axis and swash plate design of piston pump with  advantages and disadvantages. |
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|  | **Unit II- HYDRAULIC ACTUATORS AND CONTROL COMPONENTS** |
|  | **PART A** |
| **1.** | **Define fluid power Actuator. Explain its types.** |
|  | Fluid power actuators are devices that perform useful work by extracting energy from the fluid and convert it to mechanical energy. Actuators transmits and controls the fluid power efficiently to provide correct force and speed for any job ranging from simplex to complex. Fluid power actuators may be either linear type or rotary type. There are two types of fluid power actuators.  They are (1) Linear actuators (2) Rotary actuators. Linear actuators provide  linear motion while rotary actuators provide rotary mechanical motion. |
| **2.** | **Name different types of hydraulic cylinders.** |
|  | Single acting cylinders, Double acting cylinders, Telescoping cylinders,  Tandem cylinder and Through rod cylinders. |
| **3.** | **By what means, single-acting cylinders are retracted?** |
|  | The single-acting cylinders are retracted using gravity or by the inclusion of  compression spring at the rod end of the cylinders. |
| **4.** | **Why are double-acting cylinders known as differential cylinders?** |
|  | Since the piston rod is attached at one side only, the cylinder exerts greater force when extending [F = P x Apiston] than when retraction [F = P x (Apiston - Arod)]. This results in different pressure levels on either side of the piston and that is the reason that double-acting cylinders are also called as differential  cylinders. |

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| **5.** | **What is meant by cylinder cushioning? (April / May 2021)** |
|  | When the pressurized fluid is allowed to enter inside the cylinder, the piston accelerates and travels in the cylinder barrel. If the piston is allowed to travel at the same speed till the end of the stroke, it will hit the end cap with a great impact. To avoid this impact, the piston needs to decelerate at the end of the travel. The arrangement made at the end caps to achieve the same  is called cylinder cushion. |
| **6.** | **What do you mean by double-rod cylinder?** |
|  | A double-rod cylinder, also known as through-rod cylinder has piston rods extending from both ends of the cylinder. These cylinders produce equal force  and speed on both sides of the cylinder. |
| **7.** | **What do you mean by a limited rotation hydraulic motor?** |
|  | The limited-rotation motors provide rotary output motion over a finite angle.  Usually rotation of the shaft of these motors is 90°, 180°, or 270°. |
| **8.** | **Name the basic types of rotary actuators.** |
|  | Types:  1. Continuous rotary actuator:  (a) Gear motor, (b) Vane motors, and (c) Piston motors.  2. Limited rotation hydraulic motors:  (a) Vane type, and (b) Piston type. |
| **9.** | **What are fluid power symbols?** |
|  | Fluid power symbols are used to represent individual components in fluid power  Circuit diagrams, which identify components and their functions uniquely. |
| **10.** | **List any four types of pressure control valves.**   * Pressure-compensated valves * Unloading valves * Pressure relief valve * Sequence valves * Counterbalance valves * Pressure reducing valve |

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| **11.** | **What are actuation devices and list them?** |
|  | Actuation devices are components used in hydraulics/pneumatic circuits that are used for shifting the valve spool from one position to another. The types of actuation devices are:   * Manual actuation devices * Mechanical actuation devices * Pilot operated actuation devices * Solenoid operated actuation devices |
| **12.** | **What is two-way valve?** |
|  | This particular valve has two ports, labeled P and A. P is connected to the  pump line and A is the outlet to the system. |
| **13.** | **What is shuttle valve?** |
|  | A valve that has two inlets and one outlet is known as shuttle valve. The outlet receives the flow from the inlet whichever is at a higher pressure.  Shuttle valve also known as double check valve, are used when control is  required from more than one power source. |
| **14.** | **Classify the control valves**. |
|  | Based on the function, control valves are classified into three types.   * Direction control valves * Pressure control valves * Flow control valves |
| **15.** | **What are the functions of control valves?** |
|  | The main functions of control valves are   * To regulate the pressure through a system * To control and limit flow to the actuator * To maintain contact pressure ratio between output and input to actuator. |
| **16.** | **What is the difference between pressure relief valve and pressure reduce**  **valve? (April / May 2021)** |
|  | The main differences between pressure relief valve and pressure reducing valve  are as follows. |

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|  | **S.**  **No** | ***Pressure reducing valve*** | ***Pressure relief valve*** |
| **1.** | It is type of hydraulic pressure control valve that controls the maximum pressure in a branch of a  circuit. | It is a type of pressure control valve that limits the maximum pressure in a hydraulic or pneumatic circuit. |
| **2.** | The reducing valve reads  the pressure downstream. | The relief valve reads the pressure  upstream. |
| **3.** | The pressure reducing valve  has an external drain. | The pressure relief valve does not have an  external drain. |
| **17.** | **What** i**s the use of sequence valve?** | | |
|  | It is a type of hydraulic pressure control valve that is used to force two actuator to be operated in a pre-determined sequence.  These valves permit several operations to be completed in sequential order. | | |
| **18.** | **What are the three types of control valves based on their configuration?** | | |
|  | 1. Poppet (or seat) valves 2. Sliding spool valve 3. Rotary spool valves | | |
| **19.** | **What is the use of a pressure relief valve in a hydraulic system?** | | |
|  | The pressure relief valve protects a system from excessive fluid pressure over  and above the design pressure limit. | | |
| **20.** | **Name various types of pressure control valves.** | | |
|  | 1. Pressure limiting (or relief) valves 2. Pressure reducing valves, 3. Sequence valves 4. Counter balance valves 5. Unloading valves | | |
| **21.** | **What is the purpose of a pressure reducing valve?** | | |
|  | A pressure reducing valve is used to supply a prescribed reduced outlet pressure in a circuit and to maintain it at a constant value. | | |

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| **22.** | **Name one application of a counterbalance valve.** |
|  | The counterbalance valve is used to maintain back pressure on a vertical cylinder to prevent it from falling due to gravity. It is used to permit free flow  in one direction and restrict flow in the opposite direction. |
| **23.** | **What are flow control valves? Why are they referred as speed-control**  **valves?** |
|  | Flow control valves, also known as volume-control valves, are used to regulate the rate of fluid flow to different parts of a hydraulic system. Since control of flow rate is a means by which the speed of hydraulic machine elements is governed, therefore flow control valves are also referred as speed-control  valves. |
| **24.** | **What is the function of servo system?** |
|  | Generally, hydraulic direction control valves are working with many actuating devices, especially solenoids. Solenoids can be operated under two states: shifted and not shifted. So, solenoid valve can be shifted open to allow flow or closed to block flow. But servo systems are able to precisely position the valve spool between the open and closed positions. This allows the flow to be throttled (metered) through the valve and provides precise flow control as well  as direction control. Simply, servo systems are integration of DCV with FCV. |
| **25.** | **What are proportional control valves?** |
|  | It is an infinite variable position valves. They use a variable force direct current solenoid to control the output from the main spool. |
|  | **PART B - C 313.2** |
| **1.** | How cylinder cushioning takes place in cylinders? Explain with diagram. |
| **2.** | The power and load carrying capacity of a hydraulic cylinder extension are 10kW and 20000N respectively. Find the piston velocity during extension. If the area of piston side and rod side is 2:1, find the retraction speed. The pump  delivers oil at 0.2 m3/min. |
| **3.** | A cylinder with a bore diameter of 80 mm and a rod diameter of 25 mm is to be used in a system with a 60lpm pump. What are the extensions and retraction  speeds? |

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| **4.** | | Explain the construction and working in detail of single and double acting  hydraulic cylinder with neat diagram. |
| **5.** | | With neat sketches explain the working of simple check valve and pilot  operated check valve. |
| **6.** | | How position valves can be classified? Explain each of them. |
| **7.** | | Explain with neat sketches of simple pressure relief valve and compound relief  valve. |
| **8.** | | In detail write the working of pressure reducing valve and sequence valve with  neat sketches. |
| **9.** | | Explain the sequence circuit using sequence valve in drilling operation. |
| **10.** | | Explain in detail the different types of FCV. |
| **11.** | | Explain the construction, working of gear type motor and vane type motor.  **(April / May 2021)** |
| **12.** | | List and sketch the fluid power ANSI symbol for the five basic  classifications.**[Probable Part C]** |
| **13.** | | With neat sketch explain the construction of Telescopic cylinder and double  rod cylinder, also state its application with example.**[Probable Part C]** |
| **14.** | | A hydraulic motor has a displacement of 150 cm3 and operates with a pressure of 120 bar and a speed of 2500rpm. The actual flow rate consumed by the motor is 0.00781m3/s the actual torque delivered by the motor is 250Nm. Find   1. Volumetric efficiency 2. Mechanical efficiency c. Overall efficiency   d. Power delivered by the motor. **[Probable Part C]** |
| **UNIT-III- HYDRAULIC CIRCUITS AND SYSTEMS** | | |
|  | **PART A - C313.3** | |
| **1.** | **What is the function of accumulator?** | |
|  | Accumulators are temporary storage devices that stores the potential energy of a hydraulic fluid under pressure and acts as a secondary source as demanded by  the system. | |
| **2.** | **What are the types of accumulator?** | |
|  | Based on the source of dynamic force to maintain pressure, the accumulators are | |

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|  | classified as   * Weight or gravity-loaded accumulator * Spring-loaded accumulator * Gas-loaded accumulator   The first two are categorized as mechanical accumulators and third one as hydro- pneumatic accumulator. |
| **3.** | **What is electromechanical relay?** |
|  | A relay is an electrically actuated switch which open or close when its corresponding coil is energized. These relays are commonly used for energizing  and de-energizing the solenoids as they require high current to operate. |
| **4.** | **What is the use of intensifier? (April / May 2021)** |
|  | A pressure intensifier or booster is a device which generates pressures to greater  value than the pump discharge pressure by using fluid power. |
| **5.** | **What type of gas is used in gas loaded accumulators and why oxygen not**  **used for this purpose?** |
|  | Inert gas is used in gas loaded accumulators.  Oxygen is not used for this purpose because it catches fire and cause explosion. |
| **6.** | **What is the use of air-to-hydraulic pressure booster?** |
|  | The air-to-hydraulic pressure booster is a device used for converting compressed  air into the higher hydraulic pressure, which is required for operating hydraulic cylinders. |
| **7.** | **What are the basic requirements for parallel cylinder synchronizing**  **system?** |
|  | Two cylinders must be identical, but no cylinders are really identical, as  manufacturing tolerances may vary. Load should be divided equally for both cylinders to extend in exact synchronization. |
| **8.** | **What are the constituents of hydraulic power pack?** |
|  | The important constituents of hydraulic power pack are   * Hydraulic oil * Reservoir * Valves * Fluid transfer piping |

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| **9.** | **What is air-oil intensifier?** | |
|  | An air-oil intensifier circuit, which drives a cylinder over a large distance at low pressure and then over a small distance at high pressure.  In some applications, hydraulic and pneumatic circuits are coupled to get the  advantage of both air and oil mediums. | |
| **10.** | **What is hydraulic fuse?** | |
|  | Hydraulic fuse is a device used in hydraulic systems to prevent hydraulic  pressure from exceeding an allowable value in order to protect circuit components from damage. | |
| **11.** | **What is the function of bleed-off circuit?** | |
|  | Bleed off circuits control the fluid flow rate by bleeding off the excess flow back to the tank. This is accomplished by providing a additional line parallel to the system pressure line. To slow down the actuator, some of the flow is bled off through this line, thereby reducing the flow to the actuator. It may be noted that, opening a bleed off FCV, slows down the actuator, whereas, opening a meter in  or meter out FCV increases the actuator speed. | |
| **12.** | **What is the difference between meter-in circuit and meter-out circuit?** | |
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| **Meter - in Circuit** | **Meter - out Circuit** |
| 1. In this system the flow control valve is  placed in the line leading to the inlet port of | In this system the flow control  valve is placed in the outlet line of |
| 2. It controls the oil flow rate into the  cylinder. | It controls the oil flow rate out of  the cylinder. |
| 3. Less pressure is developed in the rod end  of the cylinder while it is extending | Excessive pressure is developed in  the rod end of the cylinder while it |
| 4. If meter-in is desired point the arrow  toward the cylinder port. | If meter-out is desired point the  arrow away from the cylinder port. |
| **13.** | **What is the use of a regenerative circuit?** | |
|  | A regenerative circuit is used to speed up the extending speed of the double-  acting cylinder. | |
| **14.** | **What is the purpose of a fail-safe circuit?** | |
|  | Fail safe circuit is designed to safeguard the operator, the machine, and the | |

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|  | workpiece. It prevents any possible injury to the operator or damage to the  machine and the workpiece. |
| **15.** | **What are hydro pneumatic circuits?** |
|  | In some applications, the hydraulic and pneumatic circuits are coupled to get best use of the advantages of both oil and air mediums. These combination circuits  are known as hydropneumatic or pneumohydraulic circuits. |
| **16.** | **What is meant by an air-over-oil system?** |
|  | The air-over-oil system was both air and oil to obtain the advantages of each medium. By the use of these two media, the quick action of air and the smooth  high-pressure action of oil can be blended. |
| **17.** | **Name the three ways of applying flow control valves in a fluid power circuit.** |
|  | 1. Meter-in circuit 2. Meter-out circuit 3. Bleed-off circuit. |
| **18.** | **Why is extension stroke faster than retraction stroke in a regenerative**  **circuit?** |
|  | This is because oil flow from the rod end regenerates with the pump flow to provide a total flow rate, which is greater than the pump flow rate to the blank  end of the cylinder. |
| **19.** | **What do you mean by sequencing of cylinders? Name some application where it would be desirable to have sequencing of two cylinders.(April /**  **May 2021)** |
|  | In many applications, the operation of two hydraulic cylinders is required to be performed in sequence one after another. This is known as sequencing of cylinders.  Applications: (i) In a drilling machine, clamping and drilling operations should be performed in a sequence.  ii) In a punching machine, clamping and punching operations should be  performed in a sequence. |
| **20.** | **List any two advantages of employing hydro pneumatic circuits.** |
|  | * Using the combination circuit, the quick action of air and smooth, high   Pressure action of oil can be blended.   * These circuits increase the performance of the equipment |

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| **21.** | **List the applications of an intensifier.** |
|  | * Burst testing machines * High pressure clamping devices * Moulding machines * Spot-welding machines * Riveting machines * Hydraulic pressing * punching machines |
| **22.** | **What is an intensifier?** |
|  | Intensifer is an ancilliary part used in hydraulic system to increase the pressure of hydraulic liquid. Intensifier is a device which generates pressures to greater value than the pump discharge pressure by using fluid power. |
|  | **PART B - C313.3** |
| **1.** | With neat sketch, write the different types of accumulator with advantages and  disadvantages that are used in hydraulic system. **(April / May 2021)** |
| **2.** | Explain with suitable circuit, how an accumulator can be used  a) as leakage compensator b) As emergency power source. c) Shock absorber  d) auxiliary power source.**(April / May 2021)** |
| **3.** | Draw and explain the air over oil circuit used in hydraulic circuit. **(April / May**  **2021)** |
| **4.** | Explain the working of a pressure intensifier with advantages and applications. |
| **5.** | Draw a circuit sketch showing an intensifier in a punching press application. |
| **6.** | Explain the two handed safety circuit. |
| **7.** | Explain the speed control circuit of hydraulic system. |
| **8.** | How synchronizing of cylinder is possible in parallel and series piping? |
| **9.** | Explain the pneumohydraulic circuit. |
| **10.** | Explain the automatic cylinder reciprocation circuit. |
| **11.** | With an example how electro hydraulic servo system works**. [Probable Part C]** |

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| **12.** | Draw and explain the Counterbalance circuit used in the hydraulic  circuit.**[Probable Part C]** |
| **13.** | Discuss the construction and working of a Mechanical hydraulic servo system  with a diagram. **[Probable Part C]** |
| **14.** | Develop a circuit for punch- press application. **[Probable Part C]** |
| **UNIT IV- PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS** | |
|  | **PART A-** |
| **1.** | **What is a quick exhaust valve?** |
|  | Quick exhaust valve is a special purpose three way pneumatic valve that increases the cylinder rod speed by dumping the exhaust air directly to the atmosphere from the cylinder. Use of quick exhaust valves, permits increased cylinder velocities and needs smaller, less expensive DCV. This eliminates the need for exhaust air to travel from the cylinder to the main control valve through  long restricted pipe lines. |
| **2.** | **Name the factors to be considered for designing fluid power circuits.** |
|  | Any fluid power circuit design should involve these three major considerations   1. Safety of system/operation 2. System performance of function/operation. 3. Efficiency of system/operation. |
| **3.** | **What is the purpose of fluid conditioners?** |
|  | The purpose of fluid conditioners is to make the compressed air more acceptable  and suitable fluid medium for the pneumatic system components as well as for operating personnel. |
| **4.** | **How do pneumatic actuators differ from hydraulic actuators?** |
|  | Generally pneumatic actuators are of lighter construction and of lesser weight when compared to that of hydraulic actuators. This is because the pneumatic  actuators are used mostly for low or medium pressure applications only. |
| **5.** | **What is a FRL unit? (April / May 2021)** |
|  | The combination of filter, regulator, and lubricator is often labelled as FRL unit or service unit. Filter is used to filter the incoming atmosphere air, regulate to regulate the air pressure and lubricator to lubricate the air before the air reaches  the pneumatic system. |

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| **6.** | **What is the purpose of a shuttle valve in a pneumatic circuit?** |
|  | Shuttle valves are used when control is required from more than one power source. They are generally used to shift the fluid flow from the second and back  up source, when the main source becomes inoperative. |
| **7.** | **What is fluidics?(April / May 2021)** |
|  | Fluidics is the technology that utilizes fluid flow phenomena in components and circuits to perform a wide variety of control functions. Fluidic control systems  are applied to perform a wide variety of control functions |
| **8.** | **What advantages does fluidics offer?** |
|  | * Fluidic devices offer exceptional thermal, physical stability and ruggedness. * They are completely insensitive to radiation, even of extremely high loads. * They are not affected by severe vibration and shock. * They are not susceptible to wear and tear. |
| **9.** | **Where are fluidic control systems preferred than other control systems?** |
|  | Fluidic control systems are preferred over other control systems in areas subject to nuclear radiation, magnetic flux, temperature extremes, vibration, and  mechanical shock. |
| **10.** | **State the Coanda effect.** |
|  | It states that, "When a stream of fluid meets other stream, the effect is to change  its direction of flow and effect is the fluid sticks to the wall." |
| **11.** | **Name four fluidic devices.**   1. Bistable flip-flop 2. Flip-flop with start-up preference 3. SRT flip-flop 4. OR/NOR gate |
| **12.** | **What is a bistable flip-flop?** |
|  | A bistable flip-flop provides controlled assurance as to which of the two output ports will deliver the power stream. It is normally used as a memory device. |

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| **13.** | **What is a monostable device?** |
|  | A monostable device is required to perform monostable function which is analogous to spring return function. In this device, when the control signal is  removed, the device will switch back to the favoured output. |
| **14.** | **When do you use a flip-flop with start-up preference?** |
|  | A flip-flop with start-up preference is used in applications where a specific output is required when the power supply is first turned ON and all controls are  OFF. |
| **15.** | **What is the use of truth table in logic devices?** |
|  | A truth table helps to describe the functioning of that particular logic device. |
| **16.** | **Give the truth table for fluidic OR and NOR gate**. |
|  | |  |  |  |  | | --- | --- | --- | --- | | **Inputs** | | **Output** | | | **A** | **B** | **OR** | **NOR** | | 0 | 0 | 0 | 1 | | 1 | 0 | 1 | 0 | | 0 | 1 | 1 | 0 | | 1 | 1 | 1 | 0 | |
| **17.** | **What is Boolean algebra? Write its two functions relative to fluid power**  **systems.** |
|  | Boolean algebra is algebra of logic. This is the algebra of proportions where only two possibilities - true or false - are allowed.  Boolean algebra provides the following two functions:   * It provides a means by which a logic circuit can be reduced to its simplest form. * It allows for the quick synthesis of a circuit that is to perform desired   logic operations. |
| **18.** | **Name four fluid sensors that are used in fluid power systems.** |
|  | Fluid sensors used in fluid power systems are:   * Back-pressure sensor * Cone-jet Proximity sensor * Interruptible-jet sensor * Contact sensing |

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| **19.** | **Define Ladder diagram.** |
|  | It is a special standard schematic representation of the physical components arrangement and its way of connections made between them. It is so called because the circuit devices are connected in parallel across the AC line form  something looks like a ladder. |
| **20.** | **What is a PLC?** |
|  | A programmable logic controller (PLC) is a user-friendly electronic computer designed to perform logic functions such as AND, OR, or NOT for controlling the operation of industrial equipment and processes. Three PLC components are:  processor, power supply, and an input/output (I/O) section. |
| **21.** | **List any four advantages that PLCs provide over electromechanical relay**  **control systems**. |
|  | 1. PLCs are more reliable and faster in operation. 2. They are smaller in size and can be more readily expanded. 3. They require less electrical power. 4. They have very few hardware failures. |
| **22.** | **What is a solenoid?** |
|  | It is electromechanical electromagnets that convert the electrical power into mechanical force to operate fluid power valves remotely. It consists of a coil wrapped removable iron core (Armature). When the solenoid is energized, the  magnetic created causes the armature to shift the valve spool. |
| **23.** | **Define relay.** |
|  | Relay is an electrically actuated switch which open or close when its corresponding coil is energized. These relays are commonly used for energizing  and de-energizing the solenoids as they require high current to operate. |
| **24.** | **Write few applications of electrohydraulic servo valve.** |
|  | It is employed in more sophisticated control systems such as on tape controlled  machine tools, high speed printing presses, press brakes etc. |
| **25.** | **What is cascade method in pneumatics?** |
|  | It involves dividing the sequence into groups with each group’s manifold (power or main pressure line) being supplied with pneumatic power (pressure) one at a  time and in sequence. |

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|  | **PART B - C313.4** |
| **1.** | Explain the working of reciprocating and rotary compressor with advantages and  disadvantages. |
| **2.** | Explain the FRL trio unit in pneumatic system. |
| **3.** | What are the factors to be considered in pneumatic cylinder? |
| **4.** | Explain the electrical control circuit of regenerative circuit with ladder diagram  in Pneumatic system. |
| **5.** | Design a system in which cylinder A is used to clamp the workpiece, cylinder B is used for punching and cylinder C removes the workpiece from the station  using cascade method. |
| **6.a** | Explain the construction and working of bistable flip-flop with truth table. |
| **b.** | Explain the principle of wall attachment effect. |
| **7.** | How the control of air cylinder using preferenced flip-flop is made? |
| **8.** | Explain the fluidic sequence control of two pneumatic cylinders. |
| **9.** | How the reciprocation of a hydraulic cylinder using fluidic controls is made. |
| **10.** | Explain the elements of PLC with neat diagram. |
| **11.** | Explain with ANSI symbols a) all types of actuators used in pneumatics. b)  quick exhaust valve and 5/2 direction control valve.**(April / May 2021)** |
| **12.** | With the aid of circuit diagram explain the working principle of impulse  operation circuit in pneumatics.**(April / May 2021)** |
| **13.** | Define coanda effect. Discuss how this effect useful to develop a monostable and  bistable- flip flop device. **[Probable Part C]** |
| **14.** | Explain the various approaches for entering the program into the PLC.  **[Probable Part C]** |
| **15.** | Develop a ladder diagram to perform a drilling operation.**[Probable Part C]** |
| **16.** | Three pneumatic cylinders A, B, C are used in automatic sequence of operation. A cylinder extends, B cylinder extends, B cylinder retracts and then A cylinder retracts, C cylinder extends and C cylinder retracts. Develop pneumatic circuit by cascade method. Sketch also travel step diagram and explain briefly. **(April / May 2021) [Probable Part C]** |

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|  | **UNIT V- TROUBLE SHOOTING AND APPLICATIONS** |
|  | **PART A - 313.5** |
| **1.** | **What is trouble shooting in hydraulic system?** |
|  | Finding the faults in various components of hydraulic system like pump, strainer,  valve, cylinder and taking remedies to work in proper condition. |
| **2.** | **Define Drilling operation.** |
|  | Drilling is the operation of producing a cylindrical hole of required diameter and  depth by removing metal by the rotating edge of a cutting tool called drill. |
| **3.** | **List any two selection criteria of pneumatic systems.** |
|  | The force or Load required to work must be light or medium and suitable for  light weight applications. |
| **4.** | **Name any two faults that can be found in hydraulic systems.** |
|  | Common Faults that can be found in hydraulic systems are:   1. Excessive loss of system pressure 2. Reduced speed of travel 3. Excessive leakage in the hydraulic cylinder 4. Slow response |
| **5.** | **What is a tree-branching chart?** |
|  | Tree-branching chart is a chart used to simplify the troubleshooting process. This chart asks a question which has only two possible answers-Yes or No. The answer determines the next step to be taken in fault analysis. This chart helps to  develop a logical and rapid approach to fault diagnosis. |
| **6.** | **List any two selection criteria of hydraulic systems.** |
|  | Pressure or force produced at the output should be high and the usage of hydraulic system occupies more floor space.  It also depends on  (i) Purpose (ii) Stroke requirement (iii) Thrust (iv) Speed   1. Acceleration and deceleration 2. Cylinder mountings 3. Special seal requirement. |
| **7.** | **Define a low cost automation. (April / May 2021)** |
|  | Low cost automation is a technology that creates some degree of automation |

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|  | around the existing equipment, tools, methods, people etc. using mostly standard component. A wide range of activities such as loading, feeding, clamping, machining, welding, forming and packing can be subjected to low cost  automation. |
| **8.** | **Describe a power pack.(April / May 2021)** |
|  | Power pack consists of a pump, electric motor, reservoir and associated valving assembled to one unit to supply pressurised fluid. They are relatively small in size and provide functions of pressure, direction and flow control within the  basic package. |
| **9.** | **What are the benefits of low cost automation?** |
|  | Benefits of low cost automation are:   * Reduce manual controls without changing the basic set up. * Low investment * Increased labor productivity * Consistent quality * Better utilization of material. |
| **10.** | **List five things that can cause a 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. |
| **11.** | **List three 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. |
| **12.** | **If a pneumatic cylinder has erratic motion, name the causes.** |
|  | A pneumatic cylinder has erratic motion and the probable causes are   1. Valve sticking or binding 2. Cylinder sticking or binding. |

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| **13.** | **How do you select hydraulic pipes for a hydraulic system?** |
| The hydraulic pipes are selected based on the following factors:   1. System pressure 2. Velocity of fluid flow 3. Fluid compatibility 4. Environmental conditions |
| **14.** | **How do you specify a pump?** |
| A pump can be specified by   1. Capacity or Discharge/ flow rate 2. Discharge pressure 3. Speed of rotation |
| **15.** | **What is the difference between pressure switch and a temperature switch?** |
| * Pressure switch is used to sense the change in pressure and open or close contacts based on the system pressure. * Temperature switches used to senses change in temperature and open or close contacts when a predetermined temperature is reached. |
| **16.** | **Define the terms Lap and Null With respect to the servo valves.** |
| **Valve lap,** or valve overlap, refers to the amount of spool travel from the centre position required to start opening between the powered input port and the work (output) port or the tank port. A zero lapped valve is one in which any tiny, differentially small amount of spool shift either way, starts the opening. However, there is no contact between the OD of the spool and ID of the bore. And even zero lapped valves have some slight amount of overlap.  **Valve null** is a specific point of a servo valve’s pressure metering curve where the two deadhead (blocked port) work port pressures are equal. Servo valves are equipped with a mechanical adjusting device so that with no electrical power applied (connector disconnected from the valve), a spring or magnetic force can be changed to make the two work port pressures equal. That is normally where the factory adjusts a valve during final test, assuming  it will be used on an equal area cylinder. |

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| **17.** | **What is pump cavitations? How can you avoid it?** |
| Cavitation is the formation of bubbles or cavities in liquid, developed in areas of relatively low pressure around an impeller. The imploding or collapsing of these bubbles triggers intense shockwaves inside the pump, causing significant damage to the impeller and/or the pump housing. Pump cavitations can be avoided by :   1. Lower the temperature. 2. Raise the liquid level in the suction vessel. 3. Change the pump. 4. Reduce motor RPM if possible. 5. Increase the diameter of the eye of the impeller. 6. Use an impeller inducer. 7. Use two lower capacity pumps in parallel |
| **18.** | **Why screw pumps generate less noise while running?** |
| * Screw pumps typically run silently with low pulsations, for low to medium, but not high-pressure duty. * screw pumps generate less noise, because of rolling action of the screw spindles * Also in the screw pump the fluid does not rotate but moves linearly. |
| **19.** | **Mention the area in a pneumatic system, which should be given higher**  **Importance during maintenance?** |
|  | * Always ensure that you have an accurate circuit as well as the functional diagram of the pneumatic system. If any changes are made after installation, ensure that they are made in the directions as well. * Do take care that the impulse valves of the system is protected from excess of dirt, mechanical shocks and cooling water. * Imprints of the elements and the units should be accurate and easily visible. * The valve openings that are given by the manufacturers should only be used. |

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| **20.** | **State any four common causes for hydraulic system breakdowns.** |
| Common causes for hydraulic system breakdowns are:   1. Inadequate supply of oil in the reservoir 2. Clogged or dirty oil filters 3. Leaking seals 4. Loose inlet lines that cause the pump take in air |
| **21.** | **What is the need for temperature compensation in flow control valves?** |
| As the viscosity of oil varies with temperature, the oil becomes less viscous when temperature increases. As the less viscous fluid flow more readily through an orifice, the increase in temperature causes increase in flow for a valve setting. So temperature compensation is needed to offset the effect of such temperature variation. |
| **22.** | **How does Microprocessor differ from PLC and List out any two PLC applications in fluid power control?** |
| * PLC is type of computer designed specifically for industrial applications * A Microprocessor is the central processing unit (CPU) of a computer * All PLCs contain one or more microprocessors, but not all microprocessors are used in PLCs   **PLC applications**   * PLC is used to control a double acting hydraulic cylinder * PLC is used in fluid power circuits replacing electromechanical relays. |
| **23.** | **What is the function of 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. * The unloading valve allows pressure to build up to an adjustable setting, and then bypasses the flow as long as a remote source   maintains the preset pressure on the pilot port. |
| **24.** | **List the components associated with PLC system** |
| Programmable Logic Controllers (PLC) has three components. These three PLC |

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|  | components are: processor, power supply, and an input/output (I/O) section. The processor is the brain of the PLC system, is a solid-state device designed to perform a wide variety of production, machine tool, and process-control functions. |
| **25.** | **How does a servo valve differ from proportional valve?** |
|  | Servo valve — any continuously variable, electrically modulated, directional control valve with less than 3% centre overlaps.  Proportional valve — any continuously variable, electrically modulated,  directional control valves with more than 3% centre overlaps. |
|  | **PART B - C313.5** |
| **1.** | Explain failure and troubleshooting of hydraulic system.**(April / May 2021)** |
| **2.** | List the causes, faults and how trouble shooting can be done in pneumatic  system. |
| **3.** | Explain how drilling circuit can be designed for any drilling operation. |
| **4.** | How surface grinding can be used by hydraulic circuit. |
| **5.** | Design a hydraulic circuit for planning machine operation. |
| **6.** | How a fork lift can be operated using hydraulic circuit? |
| **7.** | Describe the basic concepts of low cost automation with suitable example. |
| **8.** | Design and develop a robot system to pick and place object. |
| **9.** | How would you show and describe a hydraulic circuit to actuate a shaping machine ram. Incorporate the following features in the circuit. i) rapid tool  approach ii) slow cutting iii) rapid tool retraction / return. **(April / May 2021)** |
| **10.** | Design and draw a circuit using the hydraulic components for the Shaping  operation. **[Probable Part C]** |
| **11.** | Design a circuit using the hydraulic components for the Punching & press  operation. **[Probable Part C]** |
| **12.** | Explain in detail about various selection criteria for pneumatic components.  **[Probable Part C]** |
| **13.** | Design and explain the fluid power circuit for a drilling machine to discuss the following functions i) Clamping the workpiece ii) Drilling the work piece iii)  Unclamping the work piece. **(April / May 2021).[Probable Part C]** |