K.S.R. COLLEGE OF ENGINEEIRNG (Autonomous)

Vision of the Institution

- We envision to achieve status as an excellent Educational Institution in the global knowledge hub, making self-learners, experts, ethical and responsible engineers, technologists, scientists, managers, administrators and entrepreneurs who will significantly contribute to research and environment friendly sustainable growth of the nation and the world.

Mission of the Institution

- To inculcate in the students self-learning abilities that enable them to become competitiveand considerate engineers, technologists, scientists, managers, administrators andentrepreneurs by diligently imparting the best of education, nurturing environmental and social needs.
- To foster and maintain mutually beneficial partnership with global industries and Institutions through knowledge sharing, collaborative research and innovation.

DEPARTMENT OF AUTOMOBILE ENGINEERING

Vision of the Department

- To build long tradition of excellence to be the leading Automobile Engineering program in partnership with our students, alumni, industry and government. The department shall provide the students with educational experiences that will enable them to become leaders in their profession and society. The department shall also maintain and develop world-class research programs that complement our educational mission, address the evolving needs of industry and society, and contribute to economic and social development in the State of Tamil Nadu, across the nation, and around the world.

Mission of the Department

- To serve students, industry and society by fulfilling the missions of discovery, learning, and engagement through the creation and dissemination.
- To apply Engineering methods, knowledge, and professional standards relevant to the practice of Automobile Engineering in the many aspects of modern life where it plays a crucial role.

Programme Educational Objectives (PEOs) of B.E. - Automobile Engineering

PEO 1: Employability and Higher Studies: Graduates are knowledgeable in the areas of Automobile industries and successful in their professional career.

PEO 2: Sustainable Engineering Solutions to the Society: Graduates continue significant work in their chosen career, and demonstrate social and ethical responsibility.

PEO 3: Interpersonal and Ethical Proficiency: Graduates perform both independently and as a member of a team in project management.

COURSE FACULTY **HoD** **PRINCIPAL**

K.S.R. COLLEGE OF ENGINEEIRNG (Autonomous)
DEPARTMENT OF AUTOMOBILE ENGINEERING

Course Name: **HYDRAULICS AND PNEUMATICS**
Course Code: **18ME777** **Year/Semester: III/VI**

Course Outcomes: On completion of this course, the student will be able to

C01: Understand the fundamentals of fluid power system.
C02: Describe the types, working performance study of pumps and actuator in fluid power systems.
CO3: Classify different types of hydraulic, pneumatic valves & servo valves.
C04: Develop and analyze the hydraulic and pneumatic circuits of simple industrial application.
C05: Categorize the fluidic devices and PLC application in fluid power system.

Program Outcomes (POs)
Engineering Graduates will be able to:

PO1 **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6 **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7 **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9 **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11 **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12 **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 **Proficiency Core:** Apply the concepts of electro-mechanical systems, analyse the various automobile components and use design tools specific to automobile industry.
PSO2 **Problem Troubleshooting Skills:** Diagnose the automotive system failures and repair / replace the components / systems.

COURSE FACULTY **HoD** **PRINCIPAL**

K.S.R.COLLEGE OF ENGINEERING, TIRUCHENGODE-637215

DEPARTMENT OF AUTOMOBILE ENGINEERING

Year/Sem: III/VI

Subject Code & Name: 18ME777 & HYDRAULICS AND PNEUMATICS

Faculty Name: Mr.P.Vignesh

COURSE/LESSON PLAN SCHEDULE

A) TEXT BOOK

T1. R.Srinivasan, "Hydraulic and Pneumatic Controls", Second Edition, Tata McGraw-hill, 2011.

T2. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.

B) REFERENCE BOOK

R1. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995.

R2. Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.

R3. Shanmugasundaram K, "Hydraulic and Pneumatic controls", chand & Co, 2006.

R4. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

C) LEGEND

L-Lecture
T-Tutorial
OHP- Over Head Projector
Tx-Reference

PPT-Power Point
BB -Black Board
PP-Pages
Ex- Extra

Sl.No	Lecture Hour	Topics to be Covered	Teaching Aid Required	Book. No /Page. No
		UNIT-I FLUID POWER SYSTEMS AND FUNDAMENTALS		
1.	L1	Introduction to fluid power, Advantages of fluid power	BB	T1/PP 1.1-1.5
2.	L2	Application of fluid power system. Types of fluid power systems	PPT	T1/PP1.6-1.6.2
3.	L3	Properties of hydraulic fluids	BB	T1/PP 2.1
4.	L4	General types of fluids – Fluid power symbols	PPT	T1/PP2.1
5.	L5	Basics of Hydraulics	BB	T1/PP 3.1
6.	L6	Applications of Pascal's Law	PPT	T1/PP 1.7

7.	L7	Laminar and Turbulent flow	PPT	T1/PP 3.1
8.	L8	Reynolds's number – Darcy's equation	BB	T1/PP 3.2-3.3
9.	L9	Losses in pipe, valves and fittings	BB	T1/PP 3.4-3.5
		UNIT-II PUMPS AND ACTUATORS		
10.	L10	Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane pump	PPT	T1/PP 4.1-4.3
11.	L11	Piston pump, construction and working of pumps	PPT	T1/PP 4.7-4.7.3
12	L12	pump performance – Variable displacement pumps	BB	T1/PP 4.8-4.8.3
13	L13	Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders	BB	T1/PP 5.2-5.2.3
14	L14	Single acting, Double acting special cylinders like tandem, Rod less, Telescopic	PPT	T1/PP 5.3.1-5.3.4
15	L15	Cushioning mechanism	BB	T1/PP 5.3.2
16.	L16	Construction of double acting cylinder	PPT	T1/PP 5.3.2
17.	L17	Rotary actuators – Fluid motors	BB	T1/PP 5.1
18.	L18	Gear, Vane and Piston motors.	BB	T1/PP 5.1.1-5.1.3
		UNIT-III DESIGN OF HYDRAULIC CIRCUITS		
19.	L19	Construction of Control Components : Direction control valve – 3/2 way valve	PPT	T1/PP 6.1-6.2.1
20.	L20	4/2 way valve – Shuttle valve – check valve	BB	T1/PP 6.2.1-6.2.2
21.	L21	Pressure control valve – pressure reducing valve	PPT	T1/PP 6.7
22.	L22	Sequence valve, Flow control valve	BB	T1/PP 6.4, 6.8.1-6.8.2
23.	L23	Fixed and adjustable, electrical control solenoid valves	BB	T1/PP 16.1.1-16.1.4
24.	L24	Relays, ladder diagram, Accumulators and Intensifiers	PPT	T1/PP16.1.3, 16.2.1-16.2.4
25.	L25	Types of accumulators – Accumulators circuits	BB	T1/PP 8.1-8.4.5
26.	L26	Sizing of accumulators, intensifier	BB	T1/PP 8.5
27.	L27	Applications of Intensifier – Intensifier circuit	PPT	T1/PP 10.1-10.4

UNIT-IV PNEUMATIC SYSTEMS AND CIRCUITS				
28.	L28	Pneumatic Components: Properties of air – Compressors	PPT	T1/PP 12.1-12.4.3
29.	L29	Filter, Regulator, Lubricator Unit	PPT	T1/PP 12.7-12.9
30.	L30	Air control valves, Quick exhaust valves	PPT	T1/PP 12.10.1-12.10.6
31.	L31	Pneumatic actuators	BB	T1/PP 12.11.1
32.	L32	Fluid Power Circuit Design	BB	T1/PP 12.13
33.	L33	Speed control circuits	BB	T1/PP 12.13.2
34.	L34	Synchronizing circuit	BB	T1/PP 10.3
35.	L35	Pneumo hydraulic circuit	BB	T1/PP 13.1-13.3
36.	L36	Sequential circuit design for simple applications using cascade method	BB	T1/PP 15.2
UNIT-V ADVANCED FLUID POWER SYSTEMS				
37.	L37	Servo systems – Hydro Mechanical servo systems	BB	T1/PP 16.1
38.	L38	Electro hydraulic servo systems and proportional valves.	BB	T1/PP 14.4.1-14.4.2
39.	L39	Fluidics – Introduction to fluidic devices	BB	T1/PP 14.4.3
40.	L40	Simple circuits	BB	T1/PP 14.4.3-14.4.4
41.	L41	Introduction to Electro Hydraulic Pneumatic logic circuits	PPT	T1/PP 16.2.1-16.2.3
42.	L42	Ladder diagrams	PPT	T1/PP 17.2.1
43.	L43	PLC applications in fluid power control	PPT	T1/PP 17.1,17.3
44.	L44	Fluid power circuits	PPT	T1/PP 10.7.4,10.9
45.	L45	Failure and troubleshooting	PPT	T1/PP 18.3-18.4

PREPARED

P.Vignesh

HOD/AE

KSR COLLEGE OF ENGINEERING, TIRUCHENGODE
DEPARTMENT OF AUTOMOBILE ENGINEERING
18ME777 & Hydraulics and Pneumatics
YEAR: III SEMESTER: VI
QUESTION BANK

UNIT – I FLUID POWER SYSTEMS AND FUNDAMENTALS
Part – A: 2 MARK QUESTIONS

1. **Define Fluid Power. (Dec 2005)**
   Fluid Power technology means to convert, transmit, control and apply fluid energy to perform useful work. Since the fluid can be either a liquid or a gas, fluid power in general includes hydraulic and pneumatic. Oil hydraulics employs pressurized liquid and pneumatics employs compressed air.

2. **State four advantages of fluid power .(Dec 2007)**
   - ❖ The fluid power deceives are more compact than a mechanical drive because iT eliminates the need for linkages like cams and gears.
   - ❖ Multiplication of small forces to achieve greater forces for performing work.
   - ❖ Accuracy in controlling small or large forces with instant reversal is possible with hydraulic system.
   - ❖ The parts of hydraulic system are lubricated with the hydraulic liquid itself.

3. **What is low cost automation?(Dec 2007)**
   Low cost automation is defined as a technology that creates some degree of automation around the existing equipment tools and methods using the standard equipment available in the market.

4. **Define fluidics? (Dec 2007)**
   Fluidics is fluid logics. It is based on jet interaction. Fluidics elements have no mechanical moving parts.

5. **Name any five applications of fluid power system?**
   Agriculture,Aviation, Fabrication industry, Machine tools, Oil industry and pharmaceuticals.

6. **Classify fluid power system? State its advantages and applications?**
   Fluid power system can be categorized in different ways
   1. Based on control system
      a. Open loop system
      b. Closed loop system
   2. Based on type of control
      a. Fluid logic control
      b. Electrical control
      c. Electronic control

For the advantages of fluid power system have no mechanical moving parts. So smooth operation can be done.

It can be applied for in numerous fields like Agriculture, Automation, and Aviation etc…,

7. What are the properties of hydraulic fluids?

i. Viscosity
ii. Oniclation stability
iii. Demulsibility
iv. Lubricity
v. Viscosity index
vi. Rust prevention
vii. Flash and fire point
viii. Neutralization Number.

8. How fluids are classified? Explain?

A number of fluids are used in various industrial hydraulic systems.

1. Water
2. Petroleum Oils
3. Water Glycols
4. Water Oil Emulsion
5. Phosphate Estors
6. Silicones

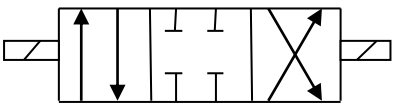
9. What are the fluid power symbols? What are its uses?

The fluid power applied component like pumps, cylinder, fluid models, DC valve, Actuator, flow control and pressure valves etc…, It can be represented by suitable symbols. These the symbols are mainly used to simplify the drawing for hydraulic assembly.

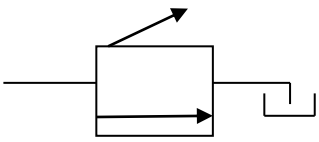
10. Name any 4 drawbacks of fluid power systems?

- Initial and maintenance cost is very high when compared to pneumatic systems.
- Maintenance should be followed in hydraulic system.
- To care about the selection of hydraulic fluid.
- The speed of hydraulic system is limited when compared to other systems.

11. Draw the symbol of 3-position 4-way closed center solenoid operated DCV.



12. Draw the symbol of pressure relief valve. (Dec 2005)



13. Define Pascal's law and explain with a sketch.

Pascal's law is the basic law used in fluid power. According to Pascal law, the pressure generated at one point in a confined liquid acts equally in all diction.

14. Define Laminar and turbulent flow.

Laminar flow or stream line flow occur when the fluid flow smoothly in even layers and functional losses ace at a minimum

If the velocity is increased and it reaches a crucial value, the flow becomes turbulent in this fluid particles move in random manner.

15. What is Reynolds number - explain.

Osborne Reynolds applied the dimensional analysis on valuables and introduced a dimensional not called Reynold's number

$R_e = \rho V D / \mu$

$R_e = VD / \upsilon$; $\upsilon = \mu / \rho$

P=Density of fluid (Kg/m^3)

V=Velocity of flow (m/s)

D= inside diameter of pipe (m)

μ = Absolute viscosity fluid (Ns/m^2)

=Kinematic viscosity (m^2/s)

16. Write the Darcy's Equation? Explain its application.

The energy losses due to friction in a hydraulic system result in a loss of potential energy. Pressure or head loss due to friction in pipes carrying fluids are desired using the Darcy – Weisbach equation.

H_L – Head loss

f – Friction factor

l – Length of pipe

D – Inner diameter of pipe

v – Velocity of flow

g – Acceleration due to gravity

It is employed for predicting the values of "f" in lubricant flow.

17. What are the different losses in pipelines?

The different losses in pipelines are pressure drop is valves, expansions, contractions, Bends, Elbows, tees and pipe fittings friction losses.

18. Write about valves and fittings used in fluid power systems.

- The losses in valves and fitting in hydraulic systems are frequently computed in terms of equivalent length of hydraulic tube.
- Global valve - factor
  - Full open - 10.0
  - ½ open - 12.5

- Check valve
  - Poppet valve - 3.0
  - Ball type - 4.0
- Return bend - 2.2
- Standard tee - 1.8

19. Name any 5 Hydraulic fluids.

Hydraulic fluids are

1. Water
2. Petroleum oils
3. Water Glycols
4. Water oil Emulsion
5. Phosphate Esters
6. Silicones

20. **Define Demulsibility.**

The ability of a hydraulic fluid to separate rapidly from moisture and successfully resist emulsification is known as "Demulsibilty'.

UNIT – 1: FLUID POWER SYSTEMS AND FUNDAMENTALS

Part – B: 16 MARK QUESTIONS

1. What are the desirable properties of hydraulic fluids? Discuss any eight of them in detail. (Dec – 2007)
2. What is Reynolds number? How is Reynolds number determined? Draw Fluid power symbols of any six different types of valves. (Dec – 2007)
3. State different types of fluids used & properties of fluids. (Apr – 2004)
4. Classify fluids. Explain the merits of fluid power systems over other power transmission systems**.**
5. Explain any 10 applications of fluid power systems with neat sketches.
6. How fluid power systems are classified? Explain.
7. Tabulate all the Fluid power symbols.
8. State Pascal's law. Explain its Working principle with a neat sketch.
9. Explain with neat sketch laminar and turbulent flow.
10. Explain the importance of Reynold's number in fluid power design.
11. What is Darcy's equation? Explain its significance.
12. Explain about losses in pipe, valves and fittings.

UNIT – II PUMPS AND ACTUATORS

Part – A: 2 MARK QUESTIONS

1. Differentiate between pilot operated and direct operated pressure relief valve?

Pilot operated pressure relief valve	Direct operated pressure relief valve
1. It is a two way valve	1. It is a one way valve
2. It allows air in both direction	2. It allows air in only one direction

2. What are the major components of Hydraulic system?

The following are the major component of hydraulic system

- ❖ Hydraulic pump
- ❖ Control valves
- ❖ Actuators

3. What is the function of pump in a hydraulic system?

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.

4. Name the three popular construction types of positive displacement pumps.

a) Gear pumps b) Vane pumps c) Piston pumps

5. How gear pumps are classified?

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

6. Why gear pump cannot be used as a variable displacement pump?

In the gear pump, the displacement depends on the design parameters of gears and they cannot be changed. So the displacement cannot be varied in gear pumps.

7. How can the unbalanced vane pump be used as a variable displacement pump?

In unbalanced vane pump, the displacement depends on eccentricity between rotor and cam ring. By mechanically varying the eccentricity, the pump delivery is varied.

8. What is meant by a balanced design vane pump?

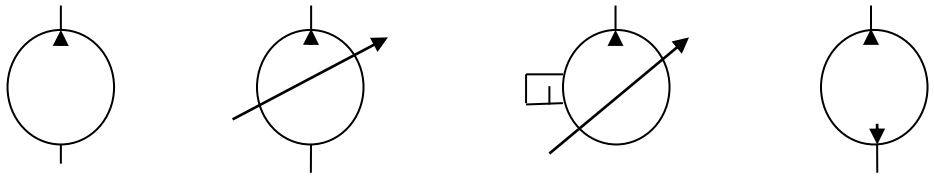
In balanced design vane pump, there are two inlet and outlet ports which are diametrically opposite to each other. Because the pressure ports are opposite to each other, a complete hydraulic balance is achieved.

9. Name the different designs of gear pump.

a) External gear pump b) Internal gear pump c) Lobe pump d) Screw pump

10. Draw the graphic symbols for the following pumps.

a) Fixed displacement b) Variable displacement c) Pressure compensated d) Bidirectional



(a) (b) (c) (d)

11. When is Lobe pump preferred?

This pump operation is similar to the external gear pump. But unlike the gear pump, both lobes are drive externally, so that they are not in actual contact with each other. Thus they are quite when compared to other types of gear pumps.

12. 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.

13. Define Gear pump & Vane pump.

A gear pumps having two or more intermeshing gears or lobed members enclosed in housing.
A vane pumps having multiple radial vanes within a supporting rotor.

14. 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.

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

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

16. What is the purpose of hydraulic motor and how does it differ from the hydraulic pump.

The motors are actuated by the fluid. The fluid forces the motor to create the rotary motion. The motor is mechanically linked to the load and develops torque. So a hydraulic motor converts hydraulic energy into mechanical energy. But a pump converts the mechanical energy into hydraulic energy.

17. What is a positive displacement pump?

Positive displacement pump ejects a fixed quantity liquid in every pump shaft rotation. The pump outlet flow is constant and is not dependent on system pressure. So they are well suited for fluid power systems.

18. What are the different sources of hydraulic power?

There are two types of hydraulic power sources,

- Based on Control system
- Based on type of Control

19. What is pumping theory?

A pump, which is the heart of hydraulic system, converts mechanical energy into hydraulic energy. The mechanical energy is delivered to the pump via prime mover such as an electric motor.

20. How pumps are classified?

There are two types of pumps as identified by the fluid power industry.

1. Hydro dynamic (or) Non-positive displacement pumps
2. Hydrostatic (or) Positive displacement pumps

21. Name any four desirable characteristics of hydraulic pumps.

- A pump is the heart of hydraulic system converts mechanical energy into hydraulic energy
- Mechanical energy is delivered to the pump via a prime mover such as an electric motor

- ❖ Due to mechanical action, the pump creates a partial then pushes the fluid into hydraulic system.

22. What is pump performance? Explain.

Pump manufactures run tests and collect performance data for their various types of pumps. The overall efficiency of a pump can be computed by comparing the power supplied at input. Overall efficiency can be classified into two distinct components called volumetric and mechanical efficiencies.

23. What are fluid power actuators? How are they classified?

The fluid discharged by the pump is created to the hydraulic actuator. This actuators is converts the pressure energy of the fluid into mechanical energy.

There are three basic types of hydraulic actuators

1. Rotary(Continuous rotation) – hydraulic motor
2. Rotary (limited angle of movement) – semi-rotary actuator
3. Linear motion – hydraulic cylinder

24. 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.

25. Where is external gear motors used?

It is used when relatively high speed and low torque used.

26. What is a semi-rotary actuator?

Semi-rotary actuator converts pressure energy into torque, which turns through only limited angle.

27. List few applications of semi-rotary actuator?

The semi-rotary actuators are used for lifting, tilting, opening, closing, indexing, swinging and bending applications.

28. How is single acting cylinder retracted?

The single acting cylinder is retracted using gravity or by the inclusion of a compression spring at the rod end of single acting cylinder.

29. For what application, a double rod cylinder is best suited?

The double rod cylinders are suitable when work has to be performed at either or both ends and operating speed must be equal in both directions.

30. What is the advantage and disadvantage of tandem cylinder?

The tandem cylinder provides increased output force when the bore size of the cylinder is limited. But the length of the cylinder is more than a standard cylinder and also requires a large flow rate to achieve a speed.

31. What is a telescoping cylinder? When is it normally used?

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.

32. Linear Hydraulic Actuators(Hydraulic Cylinders)

A hydraulic cylinder is a device, which is used to convert the fluid power into linear mechanical motion and force.

Types of linear hydraulic actuators

1. Rack and Pinion semi rotary actuator
2. Lever arm semi rotary actuator
3. Chain and sprocket semi rotary actuator
4. Helical screw semi rotary actuator
5. Hydraulic cylinders

33. Types of Hydraulic Cylinders.

1. Single acting Cylinder
2. Double acting Cylinder
3. Telescoping Cylinder
4. Special Cylinder
    i. Double rod Cylinder
    ii. Tandem Cylinder

34. Write about special cylinders

Tandem Cylinder:

It consists of two pistons operating in separate section along the same amis with a common piston rod. Since the available force is doubled, this design is useful when large forces are required.

Rod less Cylinders:

Rod less cylinders are cylinder without piston. The piston movement is transmitted to an external guided carriage in number of ways. The main types of Rod less cylinders given below:

1. Magnetic Cylinder
2. Band Cylinder

Telescoping cylinder:

When pressure is applied to the left side, the inner cylinder acts as a piston & extends. Once it reaches the end of its stroke, the innermost piston being to extend. The available stroke is almost double when compared to a normal cylinder having same retracted length.

35. Cushioning in Hydraulic Cylinders?

As long as the piston is moving in the middle range of the cylinder, nothing will hit the piston head. But due to the inner forces of the moving parts at the end of the piston travel, the pistons will hit the cylinder head at full speed.

To overcome this, the designers provide a “Cushioning” arrangement by which the hydraulic can be slowly returned or cushioned during the fast portion of the stroke.

36. Rotary Actuators: (Hydraulic Motors)

Instead of pushing on the fluid as pumps do, motors are actuated by the fluid. The fluid forces the motor to create a rotary motion of the motor is mechanically linked to the work load.

Types:

1. Gear type motor
2. Vane type motor
3. Piston type motor
   a. Axial type
   b. Radial type

37. Types of FLUID MOTORS

1. Gear type motors
2. Vane type motors
3. Piston type motors
   a. Axial
   b. Radial

38. Function of Reservoir:

- The reservoir is used to store the high pressure air/oil.
- To maintain the constant pressure at outlet

UNIT – II PUMPS AND ACTUATORS
Part – B: 16 MARK QUESTIONS

1. i) Explain the working principle of external gear pump and determine its performance measures (12)

   ii) Write short notes on variable displacement pumps (4)

2. With a neat sketch explain the principle construction working advantages, limitations and applications of a non-pressure compensated reciprocating vane pump (16)

3. i)How the capacity of a variable displacement vane pump is adjusted? Explain with a diagram (8)

   ii) What is cylinder cushioning? Explain with diagram (8)

4. i) Explain with a diagram the working of a telescopic cylinder (8)

   ii) Explain with a diagram the working of a vane pump (8)

5. (i) How will you measure the pump performance? Explain each with suitable examples? (8)

6. What are the factors to be selected in selection of a pump for automobiles lift (8)

7. i) A pump have a displacement volume of 98.4 cm^3 .It delivers 0.00152 m^3/s of oil at 1000rpm And 70 bars. If the prime mover input torque is 124.3 N-m

   What is the overall efficiency of the pump?

   What is the theoretical torque required to operate the pump? (8)

ii) A pump has a displacement volume of 0.0819 *10-3 m3 it delivers 0.0758 m3 /min at 1000rpm at 67 bars if the prime mover input torque is 100 N- m .What is the overall efficiency.

What is the theoretical torque required to operate the pump (8)

8) (i) Explain the factors which affect the selection of pumps and discuss in detail the classification and performance features of different types of hydraulic pumps (8)

(ii) How are the pumps classified? Explain with suitable sketch the working of unbalanced vane pump (8)

9. i) A gear pump have a displacement of 60,000 m^3 .It delivers 100 liters per Minute at 1440rpm and 8 N/mm^2 .If the prime mover input torque is 75 N-m Find

a) Overall efficiency of the pump b) Theoretical torque required to operate the pump (8)

ii) Explain the construction and working of gear pump (8)

10. (i) Draw a neat sketch and explain the working of a bent axis piston pump (8)

(ii) Name the different types of semi-rotary actuators and explain any two with neat sketch.

11. A pump has a displacement volume of 100 xl0-6 m". It delivers 1.5 x 10-3 m3/s at 1000 rpm and 70 xl05 N/m2 pressure. If the prime mover input torque is 120 N.m.

(i) What is the overall efficiency of the pump? (3)

(ii) What is the theoretical torque required to operate the pump? (3)

(iii) Discuss any two types of cylinder mountings with neat diagrams. (10)

12. Name the different types of hydraulic motors and explain vane type motors and piston type motors with neat sketch.

UNIT – III DESIGN OF HYDRAULIC CIRCUITS

Part – A: 2 MARK QUESTIONS

1. **Classify direction control valves (Dec – 2005)**
   i. According to the construction of the internal moving parts, direction control valves can be mainly classified under two categories
      1. Sliding spool type
      2. Rotary spool type

   ii. Direction control valves may be further classified as one way, two way, three way and four way valves, depending on the number of part connections available.

   iii. On the basis of actuating devices, it can be classified as manually operated, mechanically operated, solenoid operated and pilot operated.

2. **What is two-way valve? (APR – 2005)**
   A pilot operated valve is a design of a two way valve. This type of check valve allows free flow in one direction, but prevents reverse flow until the pilot pressure is applied at the pressure part of the valve.

3. **What are control components in a hydraulic system?**
   The control components in a hydraulic system are
   1. Pressure control valve
   2. Direction control valve
   3. Flow control valve
   4. Deceleration valve
   5. Modular valve
   6. Pressure reducing valve.

4. **Classify Valves**

a. Pressure control valves

1. Pressure relief valves
2. Compound relief valves

b. Directional control valves

1. Two way valves
2. Actuating devices
3. Rotary spool valves

c. Flow control valves

1. Non-pressure compensated flow control valves
2. Pressure compensated flow control valves

5. **What are the control functions of different valves in hydraulic systems? (Dec – 2007)**

Pressure Relief Valve:

Its function is to limit the pressure to a specified maximum valve by diverting the pump flow back to the tank.

Direction Control Valve:

It is used to control the direction of flow in a hydraulic circuit.

Flow Control Valve:

It is used to regulate the rate of flow to the actuators.

6. **What is the function of an accumulator? (Dec – 2005)**

A Hydraulic accumulator is a device that stores the potential energy of an incompressible fluid held under pressure by an external source against some dynamic force. Functions are leakage compensation, shode suppressor etc.

7. **What is an intensifier?(Dec -2007)**

An intensifier is a device, which convert low pressure fluid power into high pressure fluid power

8. **What is mean by inter-lock contacts? (APR – 2005)**

Interlock contacts are the contacts which is held inside the electrical switch when the pressure or temperature changes.

9. **What are Relays?**

- ❖ Relays are switches whose contacts (one or more) open or close when no space their corresponding coils are energized.
- ❖ Relays are used for energizing and de-energizing solenoids which operate at a high level.

10. **What is meter-in-circuit? What is its limitation?(APR – 2004)**

In meter-in type, the flow control valve is located in the pressure line leading to the work cylinder. This type is used when load characteristics are constant and positive.

11. What is the use of an accumulator?

The stored potential energy in the accumulator is a quick secondary source of fluid power capable of doing useful work as required by the system.

12. What is meant by sizing of accumulators?

In order to fully utilize the potential energy of the practically in compressible fluid and compressed gas stored in the accumulator, the size of the accumulator must be properly calculated.

13. What are the functions of intensifier and accumulators in hydraulic circuits (APR – 2004)

- An intensifier is a device which converts low pressure fluid power into high pressure fluid power. Intensifiers are used when a great force is needed for a relatively short distance.
- Functions of accumulator are leakage compensation, auxiliary power source, emergency power source, short suppressor, thermal expansion compensator.

14. Explain about intensifier circuit.

- The intensifier circuit is used for the punch-press application when the direction control valve is shifted to the left position the oil flows to the rod end of the cylinder.
- The intensifier should be installed near the cylinder to keep the high pressure lines as short as possible.

15. Give the rule of thumb used in the sizing of reservoirs (APR – 2004)

i. If there is no volume change in the system, the minimum reservoir capacity should be twice the pump delivery pressure.
ii. For mobile application, the reservoir capacity should be 3 – 4 times the pump delivery per minute.
iii. For high pressure system, the reservoir capacity should be 2 – 15 liters per installed horse power.

16. How do you select hydraulic pipes for a hydraulic system?(Dec – 2005)

- Tubing size is indicated by the outside diameter with a range of wall thickness for the various working pressures. But the designer is interested in the inside diameter which has to be suitable for the flow rate. The choice of wall thickness is based on the strength and flow rate.
- Society of Automotive Engineers (SAE) has recommended standard (SAE J 517) for hydraulic hoses 100R numbers from R1 to R11 are used to indicate hose construction and performance abilities.

17. What is a ladder diagram? (Dec – 2005)

A 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.

18. What are the functions of bleed-off circuits?(APR – 05)

- ❖ The feed control valve is not installed directly in the feed line but is connected with its outlet port which is connected to the reservoir.
- ❖ The valve regulates the flow to the work cylinder by directing an adjustable amount of pump delivery to the reservoir.

19. What is a hydraulic fuse?

Hydraulic fuse is nothing but it is used to prevent the damage in hydraulic system when pressure or any other circumstances increases or exceed the limit.

20. State the need for synchronization of hydraulic cylinders? (Dec – 2005)

Many times in hydraulic machines, some object or platform is to be lifted with the help of two or more hydraulic cylinders simultaneously. In such cases it becomes absolutely necessary that both the cylinders move in unison.

UNIT – III: DESIGN OF HYDRAULIC CIRCUITS
Part – B: 16 MARK QUESTIONS

1. a. How does a pilot operated direction control valve function? Explain with a diagram.
   b. Discuss with a diagram the working of a non-return valve. (Dec-2007)
2. a. Two hydraulic cylinders have to work in sequence. Design a suitable circuit.
   b. A. hydraulic cylinder is used for an industrial application. It has been decided to Use an accumulator as leakage compensator. Design a circuit to fulfill these requirements. (Dec 2007)
3. Distinguish between unloading valve and sequence valve. (Apr-2004)
4. Sketch any 8 neutral positions for 3-position 4 ways valve. (Apr-2004)
5. Explain a hydraulic press circuit, which employs double pump unloading principal (8) (Apr-2004)
6. Draw single cylinder continuous reciprocation circuit-using suitable components and briefly explain. (Apr-2004)
7. Draw any two circuits using accumulator for different application (8) (Apr-2004)
8. With sketches explain the construction and operation of a shuttle valve and flow control valve. Also give their symbols. (Apr-2004)
9. When designing a hydraulic circuit, what are the important factors that must be taken in to account? (Dec-2005)
10. Explain the working of a four-way two-position direction control valve. (Dec-2005)
11. With a sketch describe the construction and operation of a pressure compensated flow control valves (Dec-2005)
12. Describe a hydraulic circuit for synchronizing two cylinders with flow control valve. (Dec-2005)
13. Design a hydraulic sequence circuit for a milling machine with one cylinder for operating the power vice jaw and the other for controlling the cutter travel.(Dec -2005)
14. Briefly describe the construction of any two types of accumulators. (Dec – 2005)

15. The power and load carrying capacity of a hydraulic cylinder (Extension) are 10KW and 20,000N respectively. Find the piston velocity during extension. Also if the area of piston side and rod side is 2; 1, find the retraction speed. The pump delivers oil at 0.2 m^3 / min. (Apr – 2005)
16. Draw and explain hydraulic cylinder sequence circuit. (Apr – 2005)
17. Explain the working principle of a failsafe circuit with over load protection. (Apr – 2005)
18. Draw and explain the hydraulic circuit used in a milling machine. (Apr – 2005)
19. Discuss the applications of hydraulic circuits in press and planner. (Apr – 2005)
20. Explain with neat block diagram, an air pilot control circuit for a double – acting cylinder. (Apr – 2005)

UNIT-IV PNEUMATIC SYSTEM AND CIRCUITS
Part – A: 2 MARK QUESTIONS

1. Define Pneumatics

Pneumatic system uses pressurized air to transmit and control power. Air is used as the fluid because it is safe, less expensive and it is readily available. Pneumatics is widely used for material handling operations, high speed clamping and in robotic power drives for arms and grippers.

2. How is the air compressors classified?

The air-compressors are classified into three types. They are

1. Piston Compressors
2. Vane Compressors.
3. Screw Compressors.

3. What are the differences between hydraulic and Pneumatic System?

S.No	Hydraulic	Pneumatic
1	Resistance to fluctuating loads	Very high speed is possible
2	Speed is limited	Very high speed is possible
3	Suitable for feed movement in Machine tools	Unsuitable for feed movement
4	Weight to pressure ratio is very Small	Weight to pressure ratio is large.

4. Define AIR

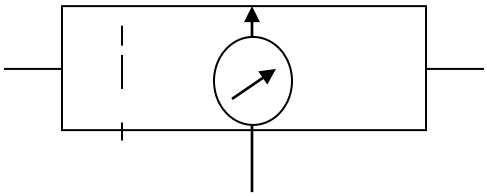
Air is a mixture of gases and is composed of 21% of O_2, 78% of Nitrogen and 1% of other gases such as carbon dioxide and argon

5. What are the reasons for pressure drop in Pneumatic lines?

When air flows through the pipe, due to friction in the pipe line, there is always pressure loss in the outgoing air.

6. **Give the standard symbol of a FRL unit?**

F.R.L. Unit is a combined unit of Fitter-Regulator-Lubricator.



7. What are the important pneumatic components?

Some of the important pneumatic components are compressor, primary air filters, Receiver, FRL unit, pneumatic valves, Actuators and mufflers.

8. What are the properties of air?

Some of the properties of air are

- Air is a mixture of gases and is composed of 21% oxygen, 78% of nitrogen and 1% of other gases.
- Air has mass and exerts pressure on the surface of the air.
- The measure of this atmosphere pressure at normal sea level is 1.013 bar.

9. Classify compressors.

Compressors are classified as

i) piston compressor ii) Vane compressor. Iii) Screw compressor.

10. What is the purpose of regenerative circuits?

A regenerative circuit is used to speed of a double acting hydraulic cylinder. Both ends of the hydraulic cylinder are connected in parallel so that one point of the four way valve is blocked.

11. Write about filter, regulator and lubricator (FRL) unit?

The function of a FILTER is to remove contaminants from air before it reaches the pneumatic components such as valves and actuators.

The main function of this valve is to regulate the incoming pressure to the system so that the desired air pressure is capable of flowing at a steady condition.

The function of the lubricators is to insert drops of oil into the air stream.

12. What is air oil intensities?

Compressed air can be used as a source of high pressure hydraulic oil by employing an air oil intensities circuit

The working principle involves feeding compressed air to the blank end of the intensities.

13. What are air controlled valves?

Air control valves are used to regulate the rate of flow of air. Control of flow is extremely important because the speed of the hydraulic actuators depends on the rate of flow of it.

14. Mention any two roles of pneumatic systems in low cost automation?

In this pneumatic circuits are extremely popular for LCE, DME to these.

- Low cost
- Easy of fabrication
- Safe operation

15. Write about pneumatic actuators.

Pneumatic system makes use of actuators in a fashion similar to that of hydraulic system. Pneumatic cylinder construction makes extensive use of aluminum and other non-ferrous alloy materials to reduce weight and to improve heat transfer capabilities.

16. What are the advantages of speed control circuit?

The motion and speed of a double acting cylinder can be controlled Smoothen the jumping motion of pneumatic actuators.

17. Write about synchronizing circuit?

Many times in hydraulic machines some object or platform is to be lifted with the help of two or more hydraulic cylinder simultaneously .In such case it becomes absolutely necessary that both the cylinder move in union, so that the circuit can be synchronized.

18. What are the difference between compressor and pump?

S.No	compressor	pump
1.	A compressor gives high pressure air by changing its volume	Pump is a device used to convert mechanical. Power in to fluid power
2.	Different types of compressor used are: 1.Piston compressor 2.Vane compressor 3.Screw compressor	Different types of pump used are: 1.Gear pump 2.Vane pump 3.Piston pump

19. What is meant by single shot sequencing?

A hydraulic circuit having two or more cylinders has some kind of sequence operation the sequencing of hydraulic cylinder motion may be accomplished in number of ways.

UNIT-IV PNEUMATIC SYSTEM AND CIRCUITS
Part – B: 16 MARK QUESTIONS

1. a. Discuss the working principle of an air compressor.
   b. Discuss the function of FRL unit.
2. a. Explain the working of a pneumatic speed control circuit.
   b. What is a time delay circuit? Discuss with an example. (Dec – 2007)
3. Design and develop a sequential circuit using cascade method for the following sequence $A^+ B^+ A^- B^-$. (Apr – 2004)
4. Describe various pneumatic actuators with neat sketches. (Dec – 2005)
5. Enumerate the various criteria for the selection of pneumatic components. (Dec – 2005)
6. A rotary vane air motor has a displacement volume of 80 cm^3/ rev and operates at 1750RPM using 700KPA gage pressure air. Calculate the standard m^3/ min rate of consumption and KW power output of the motor. Assume the temperature remains constant. (Apr – 2005)
7. Describe the function of an air pressure regulator with neat sketch. (Apr – 2005)
8. Describe various selection criteria for pneumatic components.
9. Explain the application of hydraulic and pneumatic system for low cost automation with suitable example. (Apr – 2005)
10. Write a note on power packs. (Apr – 2005)

UNIT-V ADVANCED FLUID POWER SYSTEMS

Part – A: 2 MARK QUESTIONS

1. What do you understand by the term power pack?

Power pack consists of a pump, electrical motor, reservoir and associated valuing assembled to one unit to supply pressurized fluid. They are relatively small size and provide packs are available as standard commercial power packs or custom built power packs.

2. How do microprocessors differ from PLC'S (Dec-2005?)

	PLC'S	**Microprocessors**
Interfacing	PLC'S come with input and input modules available for different voltage levels, especially designed to connect in the industrial environment. PLC'S are easily interfaced with hundreds of input and output lines.	Microprocessors can be interfaced with external equipment using special circuit cards and interfaces moreover it is difficult to interface hundreds of input and output lines in microprocessors
Programming	PLC'S are usually programmed using relay ladder logic diagrams and high level language.	Microprocessors are programmed using machine language assembly language and high level language.
Data processing and calculation	PLC'S are able to accept analog data and perform simple arithmetical	Microprocessors not able to accept analog data: they require A/I converts. They can perform complicated mathematical calculation.
Application	PLC'S are especially designed for industrial environment where they can be exposed to heat, humidity, corrosive atmospheric, mechanical shock, vibration, electromagnetic noise, voltage spikes etc.	General purpose microprocessors are not built to operate reliability under industrial conditions. On the other hand they are preferable where a great deal of data processing is required, such as robot control and where the number of I / O lines is limited.

3. What is pneumatic hydraulic circuit?

It should be made clear that although the two fluids are used in the circuit, they are not to be mixed.

4. What is sequential circuit?

A hydraulic circuit having two or more cylinders has some kind of sequence operation. This sequencing of hydraulic cylinder motion may be accomplished in a number of ways. Whatever means are utilized, it is important to remember that while designing a sequential circuit the least number of component that are required to do the job satisfactorily should be employed.

5. What is a regenerative system in a pneumatic circuit? (Dec - 2007)

A regenerative circuit is used to speed up the extending speed of a double acting pneumatic cylinder. Both ends of the pneumatic cylinder are connected in parallel. So that one part of the four ways valve is blocked.

When the DCV is shifted to its left mode, the fluid by passes the DCV and enters into the rod end of the cylinder. Fluid in the blank end drains back to the tank through the DCV as the cylinder retracts. When the DCV is shifted into its left mode, the cylinder extends. The speed of extension is greater for a regular double acting cylinder.

6. What is cascade method?
The cascade method is simple to apply and result in reliable and easily understood circuits.

7. Write about servo systems?
The actuator will precisely follow the movement of the control mechanism, reproducing. It's speed and position exactly. Such a mechanism is known as "servo systems".

8. What are hydro mechanical servo systems?
In this design, a small input force shifts the speed of the servo valve to the right by the specified amount. The oil flows through the port P, retracing the hydraulic cylinder to the right. The feedback links is connected to the rod of the piston. So the action of the feedback link shift the sidings sleeve to the right unit it blocks the hydraulic cylinder. Thus, a given input motion produces a specified and a controlled amount of output motion.
This type of valve is used in hydraulic power steering system of automobiles and other transportation type vehicles.

9. What are electro hydraulic servo systems?
The electro hydraulic servo valves operate due to an electrical signal given to its torque motor which position the speed of the direction control valve.

10. Compare hydraulic and pneumatic circuits with respect to their characteristics?

HYRAULIC CIRCUITS	PNEUMATIC CIRCUITS
A Hydraulic circuit is an arrangement of interconnected components, selective to achieve the desired work output.	In the pneumatic circuits no return lines are used because the air is released directly in the atmosphere.
The energy input that is available to perform work	There is no input device is used because most pneumatic circuits use a centralized compressor as their source of energy.

11. What are proportional valves?
If the valve can be gradually closed (or) opened as a manually operate gate valve, it results in a gradual transition between fully opened and fully closed conditions. For this proportional valves are used.

12. Write about low cost automation (LCA)?
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.

14. What is air motor?
To generate rotational motion in the pneumatic system, an air motor is used. It has been found to provide very high rotational speeds, which sometimes go up to 10,000 rpm.

15. Give the Harrts formula used to determine the pressure drop in pipes for pneumatic circuits. (APR-2004)

$$P_f \quad 1600\ Q^{1.85}L$$

16. Write about general circuit problems?
(i)Pump delivery is insufficient
(ii)Pump making noise
(iii)Excessive wear

17. What is the function of a servomotor?
Servomotor is used to control the speed of the system.

18. Classify switches used in fluid power systems?
(i)Push button switches
(ii)Pressure switches
(iii)Limit switches
(iv)Temperature switches

UNIT-V ADVANCED FLUID POWER SYSTEMS

Part – B: 16 MARK QUESTIONS

1. a. What are the selection criteria for pneumatic components?
   b. What are the factors considered during the installation of pneumatic systems?
   c. What are the advantages of using fluidic systems?
2. a. What is coanda effect? Explain with a diagram.
   b. Design a circuit with air pilot control of a double acting cylinder.
   c. Explain with a circuit diagram how is the control of an air motor is achieved. A flow control valve is used to adjust the speed of the motor. (Dec – 2007)
3. Develop a continuous cylinder reciprocation circuit using suitable pneumatic valves. (Apr – 2004)
4. Develop a pneumatic two-step speed control circuit which gives the cylinder the following operation. Fast forward, slow feed and quick return. Also give the full description of valves used in this circuit. (Apr – 2004)
5. Explain the important factors in the maintenance of hydraulic and pneumatic systems. (Apr – 2004)
6. Develop an electro pneumatic circuit for the following sequence. A^+ B^+ A^- B^- where A and B stand for cylinder, + indicates extension and – retraction. Incorporate provision for auto-manual selector and emergency stop. (Dec – 2005)
7. What are PLCs? Explain their application in low cost automation. (Dec – 2005)
8. Give the procedure of the cascade method of designing sequencing circuits. (Dec -2005)
9. Describe any one of the electro-hydraulic circuits used in robotic systems. (Apr – 2005)
10. What are the advantages of programmable logic controllers? Explain the working principle of a PLC with neat block diagram and explain how does a PLC differ from microprocessor?

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