STUDENT HAND BOOK

Bachelor of Technology

Semester- 5th

Study Scheme- 2011 onwards

DEPARMENT OF MECHANICAL ENGINEERING

ASRA COLLEGE OF ENGINEERING & TECHNOLOGY

BHAWANIGARH (SANGRUR)

Department of Mechanical Engineering

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BTAM-500 MATHEMATICS-III

1. Fourier Series Periodic functions, Euler's formula. Even and odd functions,Change of Interval, half range expansions, Fourier series of different wave forms.

2. Laplace Transforms: Definition, Laplace transforms of various standard functions, properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Transform of multiplication and division by t, convolution theorem, Laplace transform of unit step function. Applications to solution of ordinary linear differential equations with constant coefficients.

3. Special Functions: Frobenius method for power series solution of differential equations, Bessel's equation, Bessel functions of the first and second kind, Legendre's equation, Legendre polynomial.

4. Partial Differential Equations: Formation of partial differential equations, Equations solvable by direct integration, Linear partial differential equations, homogeneous partial differential equations with constant coefficients. Solution by method of separation of variables, Applications: Wave equation and Heat conduction equation in one dimension. Solution of two dimensional Laplace equation (Cartesian co- ordinates).

5. Functions of Complex Variable: definition of Limit, continuity, derivative of complex functions, and analytic function. Necessary and sufficient conditions for analytic function (without proof), Cauchy-Riemann equation (Cartesian and polar co-ordinates), harmonic functions, orthogonal system, determination of conjugate functions.Miller's Thosmson method, Applications to fluid flow problems. Brief introduction to basic transformations, Bilinear transformations, complex integration: Line integrals in the complex plane, Cauchy's integral theorem, Cauchy's integral formula for analytic function and its derivatives. Taylor's and Laurent's expansions, singular points, poles, residue, Cauchy's Residue theorem, evaluation of real integrals by contour integration (F(cosx, sinx)

BTME 501 MACHINE DESIGN-I

1. Meaning of design with special reference to machine design, definition and understanding of various types of design, design process, design and creativity, general design considerations, concept of tearing, bearing, shearing, crushing, bending and fracture.

2. Designation of materials according to Indian standards code, basic criteria of selection of material, mechanical properties of materials.

3. Concept of concurrent engineering in design, introduction to 'Design for X' manufacturing considerations in machine design, stress concentration, factor of safety under different loading conditions, design for static loading, design for variable loading for both limited and unlimited life, concept of fatigue and endurance strength.

4. Design of fasteners: Design of rivets for boiler joints, lozenge joints, eccentrically loaded joints. Design of spigot and socket cotter joint, gib and cotter joint and knuckle joint. Design of welded joints for various loading conditions in torsion, shear or direct loads, eccentrically loaded joints

5. Design of shaft and axles: Design of solid and hollow shafts for transmission of torque, bending moments and axial forces, Design of shaft for rigidity, Design of axle.

6. Design of keys and couplings: Design of keys, design of splines, design of sleeve and solid muff coupling, clamp or compression coupling, rigid and flexible flange coupling, design of universal joint.

7. Design of levers and links: Design of levers(foot lever, hand lever, cranked lever, bell crank lever, safety valve lever and shoe brake lever), design of link.

8. Design of pipe joints: Stresses in pipe joints, design of pipe joints with oval flange, square flange, design of seals and gaskets.

BTME 502 COMPUTER AIDED DESIGN AND MANUFACTURING

1. Fundamentals of CAD; Design process with and without computer; CAD/CAM system and its evaluation criteria, brief treatment of input and output devices, Display devices; Functions of a graphics package and Graphics standard GKS, IGES and STEP; Modeling and viewing; Application areas of CAD.

2. Geometric Transformations: Mathematics preliminaries, matrix representation of 2 and 3 dimensional transformation: Concatenation of transformation matrices. Application of geometric transformations.

3. Geometric Modeling: Wireframe model: solid modeling: Boundary Representation (B-rep), Constructive Solid Geometry (CSG), Parametric Modeling Technique ; Mass , volumetric properties calculations; surface modeling, concepts of hidden-line removal and shading: Mechanical Assembly Kinematics analysis and simulation.

4. Representation of curves and surfaces: Non-parametric and parametric representation of curves. Parametric representation of Hermite Cubic, Beizer and B-spline curves; Surface and its analysis.Representation of Analytical and synthetic surfaces.

5. Overview of FEM, Advantages and applications, recent advance in FEM, FEA software Basic principles and general procedure of FEM.

6. NC/CNC Machine Tools; NC machine tools- basic components, coordinate systems; features of NC machine tools. Computerized Numerical Control (CNC): Tooling for NC machines - tool presetting equipment, flexible tooling, tool length compensation, tool path graphics; NC motion control system; Manual part programming, fixed/floating zero. Block format and codes: Computer assisted part programming. DNC and Adaptive Control: Direct numerical control: Adaptive control in machining system; Combined DNC/CNC system.

7. Group Technology (GT): Part families; part classification and coding system: Group technology machine cells: Advantages of GT.

8. Computer Aided Process Planning: Introduction and benefits of CAPP. Types of CAPP systems, machinability, data selection systems in CAPP.

9. Computer Integrated Manufacturing Systems: Basic Concepts of CIM: CIM Definition, The meaning of Manufacturing, Types of Manufacturing systems; Need, Elements, Evolution of CIM; Benefits of CIM; Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations; FMS benefits.

BTME 503 MECHANCIAL MEASUREMENTS AND METROLOGY

1. General Concepts: Need and classification of measurements and instruments; basic and auxiliary functional elements of a measurement system; Mechanical versus electrical / electronic instruments; primary, secondary and working standards.

2. Static and Dynamic Characteristics of Instruments: Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution; speed of response, lag, fidelity and dynamic error, dead time and dead zone. Zero, first and second order systems and their response to step, ramp and sinusoidal input signals.

3. Errors in Measurement: Sources of errors, systematic and random errors; statistical analysis of test-data, probable error and probability tables, rejection of test data, error propagation; Design and planning of experiments and report writing.

4. Metrology: Line, end and wavelength standards; linear measurements - vernier scale and micrometer, vernier height gauge and depth guage; comparators - their types, relative merits and limitations; Angular measurements - sine bar, clinometer, angle guage; concept and measurement of straightness and flatness by interferometry; surface roughness - specifications and measurement, Measurement of major diameter, minor diameter, effective diameter, pitch,

angleand form of threads for internal and external threads; measurement of tooththickness, pitch and checking of profile for spur gears.

5. Functional Elements: Introduction to sensors and transducers, types of sensors, review of electromechanical sensors and transducers - variable resistance, inductance and capacitive pick ups, photo cells and piezo-electric transducers and application of these elements for measurement of position / displacement, speed / velocity /acceleration, force and liquid level. Resistance strain guages, guage factor, bonded and unbondedguages, surface preparation and bonding technique signal conditioning and bridge circuits, temperature compensation, application of strain guages for direct, bending and torsional loads.Introduction to amplifying, transmitting and recording devices.

6. Pressure and Flow Measurement: Bourdon tube, diaphragm and bellows, vacuum measurement - Mcleodguage,thermal conductivity guage and ionisationguage; Dead weight guage tester. Electromagnetic flux meters, ultra-sonic flow meters and hot wire anemometer: flow visualisation techniques.

7. Temperature Measurement: Thermal expansion methods - bimetallic thermometers, liquid-in-glass thermeter and filled-in-system thermometers; thermo-electric sensors - common thermocouples, reference junction considerations, special materials and configurations; metal resistance thermometers and thermistors; optical and total radiation pyrometers; calibration standards.

8. Speed, Force, Torque and Shaft Power Measurement: Mechanical tachometers, vibration reed tachometer and stroboscope; proving ring, hydraulic and pneumatic load cells, torque on rotating shafts; Absorption, transmission and driving dynamo meters.

BTME 504 INDUSTRIAL AUTOMATION AND ROBOTICS

1. Introduction: Concept and scope of automation: Socio economic impacts of automation

Types of Automation, Low Cost Automation

2. Fluid Power: Fluid power control elements Standard graphical symbols Fluid power generators Hydraulic and pneumatic Cylinders - construction, design and mounting; Hydraulic and pneumatic Valves for pressure, flow and direction control:

3. Basic hydraulic and pneumatic circuits:

Direct and Indirect Control of Single/Double Acting Cylinders

Designing of logic circuits for a given time displacement diagram & sequence of operations,

Hydraulic & Pneumatic Circuits using Time Delay Valve & Quick Exhaust Valve

Memory Circuit & Speed Control of a Cylinder

Troubleshooting and "Causes & Effects of Malfunctions"

Basics of Control Chain

Circuit Layouts

Designation of specific Elements in a Circuit

4. Fluidics: Boolean algebra,Truth Tables**,** Logic Gates**,** Coanda effect

5. Electrical and Electronic Controls Basics of Programmable logic controllers (PLC) Architecture & Components of PLC Ladder Logic Diagrams

6. Transfer Devices and feeders: Classification, Constructional details and Applications ofTransfer devices**,** Vibratory bowl feeders**,** Reciprocating tube**,** Centrifugal hopper feeders

7. Robotics: Introduction, Classification based on geometry, control and path movement, Robot Specifications, Robot Performance Parameters**,** Robot Programming**,** Machine Vision, Teach pendants**,** Industrial Applications of Robots

BTME 505 AUTOMOBILE ENGINEERING

1. Introduction: Basic structure, general layout and type of automotive vehicles, Frameless and unitary construction; position of power unit.

2. Power Unit Power requirements - motion resistance and power loss, tractive effort and vehicle performance curves; selection of power unit and engine performancecharacteristics; pollution due to vehicle emission and exhaust emission control system, silencers, types of pistons and rings

3. Fuel Supply System Air cleaner and fuel pumps; Air fuel requirements and carburation; constructional details of Carter carburetors and fuel injection systems; MPFi (Petrol), Diesel fuel system - cleaning, injection pump, injector and nozzles, Common Rail fuel supply system

4. Lubrication and Cooling Systems Necessity of lubrication; Desirable properties of lubricants; various types oflubricants and oil additives; different systems of lubrication - oil filters, oil pumpsand oil pressure indicator; crank case ventilation and dilution. Purpose of cooling, air and water cooling systems; radiator, thermostat, pump and fan.

5. Chassis and Suspension Loads on the frame, considerations of strength and stiffness, engine mounting, independent suspension systems (Mac Pherson, Trailing Links, Wishbone), shockabsorbers and stabilizers; wheels and tyres, tyre wear types, constructional details of plies

6. Transmission system Basic requirements and standard transmission systems; constructional features of automobile clutch, gear box, differential, front and rear axles; overdrives, propeller shaft, universal joint and torque tube drive; Rear wheel vs front wheel drive, principle of automatic transmission

7. Steering System Requirement and steering geometry; castor action, camber and king pin angle, toe-in of front wheels, steering linkages and steering gears; wheel alignment; power steering, Ball re-circulating mechanism

8. Braking System General braking requirements; Mechanical, hydraulic, vacuum power and servo brakes; Weight transfer during braking and stopping distances

9. Electric System Classification, Introduction to Conventional and transistorized ignition systems; Charging, capacity ratings and battery testing; starter motor and drive arrangements: voltage and current regulation

10. Maintenance Preventive maintenance, trouble shooting and rectification in different systems; engine tuning and servicing, major tools used for maintenance of automobiles

BTME506 COMPUTER AIDED DESIGN AND MANUFACTURING LAB

1. Introduction to modeling (using any CAD software):

1. 2D drawing using sketcher – 2 Drawings

2. 3D modeling using 3D features (Modeling of Crane Hook, Bench Vice, Screw Jack components)

3. Assembling and drafting (any 2 above mentioned assemblies) with proper mating conditions and interference checking.

4. Surface modeling – (Computer mouse, Plastic bottles with spraying Nozzle)

2. Computer Aided Manufacturing:

1. Manual part programming on CNC Lathe and CNC Milling – (4 programs, 2 for

each)

2. Computer Aided Part programming for CNC Lathe and CNC Milling to generate tool path, NC code, and Optimization of tool path (to reduce machining time) using any CAM software.

BTME 507 MECHANICAL MEASUREMENTS AND METROLOGY LAB

1. Measurement of an angle with the help of sine bar

2. Measurement of surface roughness of a machined Plate, Rod and Pipe

3. Measurement of gear elements using profile projector

4. Measurement of effective diameter of external threads using Three wire method

5. Measurement of thread element by Tool makers microscope 6. Calibration of a pressure guage with the help of a dead weight guage tester

7. Use of stroboscope for measurement of speed of shaft

8. Use of pitot tube to plot velocity profile of a fluid through a circular duct

9. Preparation of a thermocouple, its calibration and application for temperature measurement

BTAM-500 MATHEMATICS-III

Assignment No. 1

Topic: Fourier series

1) Find the Fourier series of $f(x) = x+x^2$ in the interval $-\pi < x < \pi$.
2) Find the Fourier series of sine terms only if $f(x) = x$ in the interval $0 < x < \pi$.
3) Find the Fourier series of cosines terms only $f(x) = \pi-x$ in the interval $0 < x < \pi$.
4) Find the Fourier series of $f(x) = e^{ax}$ in the interval $-\pi < x < \pi$.
5) Write down the Fourier series of **Square Wave Form**
6) Find the Fourier series of modified **Saw Toothed Wave Form**.
7) Find the Fourier series of **Full Wave Rectifier Form.**

8) Obtain the Fourier series for the triangular wave form.

9) Find the half range cosine form for the function $f(x) = (x-\pi)^2$ in the interval $0 < x < \pi$.

10) Find the Fourier series of $f(x) = \cos x$, $-\pi < x \leq \pi$.

11) Expand $f(x) = x\sin x$,$0< x < 2\pi$ in Fourier series.

12) Derive Euler's formulae.

Assignment No. 2

Topic: Laplace transform

1) Find the Laplace transform of the following:

a) $\sqrt{t}$

b) $e^t \sin 2t$

c) $\sin^2 h(t)$

d) Cosh (at).cos(at)

e) cost.cos2t

f) Sin(3t + 2)

g) $2t^2 - 6t + 8$

2) Using the shifting theorem, calculate the Laplace transforms of the functions:

   a) $e^{ax}\sinh(kx)$

   b) $e^{ax}\cosh(kx)$

   c) Cosh(x) sin(x)

   d) $[e^{4t}(t^2 + 3t + 5)]$.

3) Find the Laplace transform of $\frac{\cos at - \cos bt}{t}$.

4) Determine the inverse Laplace transform of $\frac{12}{s^2(s+2)}$

5) Determine the inverse Laplace transform of $\frac{s}{s^4+a^4}$.

6) Determine the inverse Laplace transform of $\frac{3s+1}{(s+1)^2}$

7) State and prove convolution theorem.

8) Find the inverse of the equation by convolution theorem $(s+2)/ (s^2+4s+5)^2$.

9) Solve the differential equation $x'' - 3x' + 2x = 1-e^{2t}$; $x(0) = 1, x'(0) = 0$.

10) Solve the differential equation $y'' + y' - 2y = t$; $y(0) = 1$, $y'(0) = 0$.

11) Use Laplace transforms technique to solve the initial value problem

12) $y'' - 4y = e^{3t}$, $y(0) = 0$, $y'(0) = 0$.

Assignment No. 3

Topic:Partial Differential Equation & Applications OfPde

Solve the following equation:-

1) $(x^2-y^2-z^2)p+2xyq=2xz$
2) $px-qy=y^2-x^2$
3) $p+q=\sin x+\sin y$
4) $p^2=zq$
5) $z=p^2x+q^2y$(**by Charpit's method**)
6) Solve $(D+2D')(D-3D')^2z=0$
7) $\frac{\partial^4 z}{\partial x^4} + \frac{\partial^4 z}{\partial y^4} = \frac{2\partial^4 z}{\partial x^2 \partial y^2}$
7) Solve $r+2s+t=2(y-x)+\sin(x-y)$
8) $(D^2-6DD'+9D'^2)z=12x^2+36xy$
9) Write the wave equation to find solution and solve a problem.
10) Write the solution of heat equation and solve a problem.
11) Write the solution of laplace equation and solve a problem.
12) A bar 10 cm long, with insulated sides, has its ends a and b maintained a temperature 50 c resp. Until steady state conditions prevails. The temperature at a is suddenly raised at 90 c at the same time at b is lowered to 60 c. Find the temperature distribution in the bar at time t.

Assignment No. 4

Topic:Functions of Complex Variable

1) Define analytic function. Write necessary and sufficient condition for a given function to be analytic.
2) Define harmonic function.
3) Show that the function $h(x,y)=3x^2y-y^3+4$ is harmonic and find its harmonic Conjugate.
4) Show that the function coshz is analytic and find its derivative.
5) State Cauchy integral theorem.
6) State and prove Cauchy integral formula and

7) Evaluate $\oint(sin\pi z^2 + cos\pi z^2)/\{(z-1)(z-2)\}$dz.

8) Evaluate $\int \frac{e^{-z}}{(z+1)^3}$dx, where C is the |z|=2.

9) Evaluate $\oint_c \frac{z^2-z-1}{z-1} dz$, where C is the |z|=1/2.

10) Evaluate $\oint \frac{z-1}{(z+1)^2(z-2)}$dz where C is the |z-i|=2.

11) Find $\int_0^{1+i}(x - y + ix^2)$dz along the straight line from z=0 to z= 1+i.

12) Define singularity and write types of singularity with example.

13) Define poles and zeros of a function f(z) with example.

14) State Cauchy Residue Theorem and determine poles and residue at each pole of the function f(z) = $\frac{z^2}{(z+1)^2(z-2)}$ and evaluate $\oint_c f(z)dz$, where C: |z|=5/2.

15) Find the residue of f(z) = $cosec^2z$ at z=0.

16) Define order of zero and further find the zeros of the function F(z)= z $\tan^2 z$. Also find the order of the zeros.

17) State Taylor series and Laurent series.

18) Discuss the nature of the singularity of f(z) = $\frac{z-sinz}{z^3}$ at z = 0

19) Using Contour Integration, prove that $\int_{-\infty}^{\infty} \frac{dx}{(1+x^2)^2} = \frac{\pi}{2}$. Hence evaluate $\int_0^{\infty} \frac{dx}{(1+x^2)^2}$

20) Expand the function in Laurent's series f(z) = $\frac{e^z}{(z-1)^2}$ about z = 1.

21) Expand the function f(z) = $\frac{1}{(z+1)(z+3)}$ in the regions $1 < |z| < 3$.

Assignment No. 5

<u>Topic:</u>Special Functions

1) Evaluate $\int J_5(x)$ dx

2) Prove that $d/dx J_n(x) = n/x\ J_n(x) - J_{n+1}(x)$.

3) $J_{-1/2}(x) = \sqrt{2}/\pi x \cos x$.

4) Define orthogonality of Bessel Function.

5) Define Error Function and also its properties.

6) Show that : (a) erf 0= 0 , (b) erf_c 0 = 1 , (c) erf ∞ =1 , (d) $erf_c\infty$ = 0.

7) Prove that erf(-x) = - erf(x).

8) write the singular points of the differential equation:$x^3(x-1)y''+2(x-1)y'+y=0$

9) Prove that: $J_{-n}(x) = (-1)^n J_n(x)$.

10) Prove that: $2J_n(x) = J_{n-1}(x) - J_{n+1}(x)$

BTME 501 DESIGN of MACHINE ELEMENTS-I

Assignment no. 1

1. Define machine design & Explain the various phases involved in the process of designing of machine elements.
2. Explain the various considerations influencing the machine components design.
3. Explain the types of failure of mechanical components.
4. Find the diameter of a rod subjected to max. tensile load of 70 KN having permissible tensile stress of 40 N/mm^2
5. Explain the various factors influencing the selection of material.
6. Define the following terms
   a. Toughness and resilience
   b. Plasticity and Hardness
   c. Strength and stiffness
   d. Ductility and Malleability
7. State the major alloying elements added to steel and their influence on properties of steel.

Assignment no. 2

1. What is concurrent engg? What is its significance in product design?
2. Define stress concentration? What are the various causes of the stress concentration? Discuss the method s of reducing stress concentration?
3. The principal stress at a point in a body are σ_1=200 MPa(tensile); σ_2=100 MPaand σ_3=0 If the yield strength is 500 MPadetermine the factor of safety and maximum shear stress?
4. Draw the modified Goodman's diagram for fluctuating torsional shear stress.

Assignment no. 3

1. Find the tearing efficiency of riveted joint having tensile strength of 80 N/mm^2, pitch of 43.5 mm and diameter of rivet hole as 19.55 mm.

2. Two steel plates, 120 mm wide and 12.5 mm thick, are joined by means of double transverse fillet welds. The maximum tensile stress for the plates and weld material should not exceed 110 N/mm^2. Find the required length of weld. If the strength of the weld is equal to the strength of the plates.
3. With the help of neat sketches, explain the procedure for the design of knuckle joint.
4. A gib and cotter joint is used to connect two rods of square cross- section and is subjected to a tensile load of 100 KN. Design the joint such that load carrying capacity is 1.25 times the external load . assuming the following stresses:
    1. Allowable tensile stress = 120 N/mm^2
    2. Allowable shear stress = 75 N/mm^2
    3. Strength in compression can be taken as twice the strength in tension

Assignment no. 4

1. Define key? Explain the types of keys in detail?
2. Compare the strength of solid shaft with the hollow shaft?
3. A shaft used for transmitting 7.5kw power at 200 rpm., is supported by two bearing A and B which are2 m apart. The pulley C of 400mm diameter and pulley D of 500mm diameter are mounted at distance of 0.4m and 1.5m respectively from the left bearing. The power received by the pulley C is along the horizontal whereas power delivered by the pulley Dis along 30^0 vertical downward towards belt of pulley C. if the tension ratio for both the pulleys is 2, design the shaft. Take τ_{all}= 65 N/mm^2 and σ_{all}=80 N/mm^2
4. It is required to design a rigid type flange coupling to cannel two shafts and transmits 37.5kw power at 180 r.p.m. The service factor is 1.5 select materials for various parts of the coupling and design the coupling
5. Define coupling and different types

Assignment no.5

1. What do you understand by lever ?Classify the lever
2. Explain the procedure for the design of bell crank lever?
3. Sketch and explain the following pipe joints
    1. Socket or coupling
    2. Nipple joint
    3. Union joint
    4. Spigot joint and socket joint
    5. Expansion joint
    6. Flanged joint
4. Design a square flanged pipe joint for pipes of internal diameter 50mm subjected to an internal fluid pressure of 7N/mm^2. The maximum tensile stress in pipe material is not to exceed 21 MPa
   And in bolt material not to exceed 28 MPa
5. Explain the procedure of design of foot lever?

BTME 502 COMPUTER AIDED DESIGN AND MANUFACTURING

ASSIGNMENT:-1

1.Define the design process used in the CAD system
2.Define operator input devices & explain three of them
3. Explain Functions of a graphics package.
4. Explain Graphics standard GSK, IGES and STEP.
5. Explain Application areas of CAD

ASSIGNMENT:-2

1. Explain 2-D and 3-D transformation in Detail.
2. Explain Application of geometric transformations.
3. What isBoundary Representation?
4. Explain Constructive Solid Geometry (CSG).
5. Explain Surface modeling.

ASSIGNMENT:-3

1. Explain Non-parametric and parametric representation of curves
2. Explain Hermite curve.
3. Explain Beizer curve
4. Explain B-spline curves.
5. Give Overview of FEM and its Advantages and applications.
6. Explain general procedure of FEM.

ASSIGNMENT:-4

1. Define NC Machine & Discuss the Basic components of NC System.
2. Explain tool presetting equipment and Flexible tooling,
3. Explain tool length compensation and tool path graphics
4. Define Floating Zero, Fixed Zero, Absolute Positioning and Incremental Positioning
5. Explain the Manual Part programing along with Program..
6. What are the applications & Advantages of NC Machine

ASSIGNMENT:-5

1. Explain Group Technology and its advantage.
2. Explain CAPP and Types of CAPP systems
3. Explain data selection Systems in CAPP.
4. Define CIM and its benefits.
5. Explain Flexible Manufacturing Systems and its benefits.

BTME 503 MECHANCIAL MEASUREMENTS AND METROLOGY

ASSIGNMENT NO:-1

1. Define Accuracy, Error and Correction.
2. What is Scale Readability?
3. Define Repeatability and Reproductively.
4. Define Drift and its types.
5. Define Linearity, Hysteresis, Dead Zone and dead time.
6. Define Span, Range and Backlash.

ASSIGNMENT NO:-2

1 What are Error and its types?
2 Define Gross Errors and Random Errors.
3 Write a note on Systematic Errors.
4Write a note on sources of errors.
5 Describe the Rejection of test Data-Chauvenes's Criterion.

ASSIGNMENT NO:-3

1What is transducer and its types?
2 Explain the construction and principle of working of linear variable differential transformer.
3 What is the principle of capacitive transducers and application?
4 What are piezoelectric transducers? List its advantage and disadvantage.
5 What is a strain gauge? Explain briefly any two with diagrams

ASSIGNMENT NO:-4

1 What are manometers? How are these classified?
2 Describe the construction, working and theory of McLeod gauge.
3 Describe the construction, working and theory of Dead Weight Tester.
4 What are the difference between Venturimeter and Orifice meter?
5 Describe the construction and working of Bourdon tube pressure gauge.

ASSIGNMENT NO:-5

1 What is tachometer? How are these classified?
2 Give description of capacitive pick-up tachometer.
3 What is a proving ring? How it is used to measure force?
4 What is torque? How it can be measure?
5 What is a dynamometer? Describe prony brake dynamometer and rope brake dynamometer.

BTME 504 INDUSTRIAL AUTOMATION AND ROBOTICS

Assignment No. 1

1. Identify the major socio-economic considerations favoring automation.
2. Write short notes on "Low Cost Automation."
3. Differentiate between mechanization and automation.
4. Identify some of the major reasons of automation.

Assignment No.2

1. Distinguish between hydraulic and pneumatic systems.
2. Compare different types of compressors.
3. List the characteristics of gear and vane pump.
4. List various differences between single acting and double acting cylinders.
5. What is a cylinder cushion? State the purpose of cushioning of cylinders.

Assignment No.3

1. Differentiate between the spool and seat valves.
2. Draw the standard graphical symbols for Hydraulic and Pneumatic Valves.
3. With the help of a neat sketch explain the working of check valve.
4. Differentiate between throttle in and throttle out circuit in pneumatics with the help of a neat sketch.
5. A pneumatic circuit is to be designed for the following sequence:
    - Clamping a job and maintaining its position while clamping
    - Moving the tool for machining
    - Returning the tool
    - Unclamping the job.

    Sketch the movement diagram and explain the complete circuit.

Assignment No. 4

1. Identify the various components of a PLC. Describe a PLC with the help of a schematic diagram.
2. What is a Coanda Effect? Describe with a diagram.
3. What is PLC Programming? What are Ladder Logic Diagrams?

Assignment No.5

1. What is material transport system? List the various types of material transport equipment.
2. Compare transfer devices with feeders.
3. Classify robots based on their geometry. Explain them with neat sketches
4. Define Machine vision. What are the components of Machine Vision?

BTME 505 AUTOMOBILE ENGINEERING

Assignment No. 01

Q.1What is an Automobile?
Q.2 Write the classification of an Automobile.
Q.3 What type of components are mounted on chassis frame?
Q.4 Explain the method of checking the alignment of chassis frame.
Q.5 What do you mean by transmission system?

Assignment No. 02

Q.1 What is the main difference between I.C Engine and Steam Engine?
Q.2 Explain about MPFI system in Diesel Engines.
Q.3 Explain about CRDI system.
Q.4 What is carburetor? Explain its function.
Q.5 Explain the concept of double overhead cam and single overhead cam.

Assignment No. 03

Q.1 What is differential? Explain its function.
Q.2 What is the function of an overdrive?
Q.3 Explain the constructional features and working of multiplate clutch.
Q.4 Explain about Toe in, toe out, camber, caster.
Q.5 Write the necessity, function and working of a propeller shaft.

Assignment No. 04

Q.1 Explain function and working principle of steering system.
Q.2 Explain the types of steering systems.
Q.3 What is power steering? Explain about its working principle.
Q.4 Explain about Ackerman and Davis steering systems.
Q.5 Write down the reasons of excessive steering play and its remedies.

Assignment No. 05

Q.1 What do you mean by ABS? Explain its working.
Q.2 Explain the constructional details and working of the following braking systems.
a.) Mechanical Brakes. b.) Hydraulic Brakes. c.) Air Brakes. d.) Vacuum Brakes.
Q.3 Differentiate between the function of spring and shock absorber.
Q.4 Sketch the diagram of Air suspension system and explain its working.

BTME 507 MECHANICAL MEASUREMENTS AND METROLOGY LAB

Experiment No. 1

To study the working principle and construction details of VernierCalliper

AIM
Internal, external measurement of given jobs with VernierCalliper

1. THEORY
VernierCalliper is a linear measuring device invented by Sir Pierre Vernier in 1631. It is a simple instrument which is used for the measurement of accuracy more than the engineer's scale. VernierCalliper is widely used for precision measurement of thickness, length, depth, diameter

etc.

Working Principle

The principle of VernierCallipers is based on the difference between two scales or divisions, which is nearly but not exactly equal. The difference between them can be utilized to enhance the accuracy of measurement.

Least Count

The difference b/w 1 scale division and 1 vernier division is called the verniercontant or least count of the vernier.

Zero Error

When two jaws touch each other the zero of the vernier scale coincide with zero of the main scale. If it is not so, there is zero error which must be accounted for.

Construction

The Vernier Caliper consists of two scale; one is fixed and the other is movable. The fixed scale, called main scale is calibrated on L-shaped frame and carries a fixed jaw. The movable scale, called vernier scale, slides over the main scale and carries a movable jaw. The movable jaw as well as the fixed jaw carries measuring tip. When two jaws are closed the zero of the vernier scale coincides with the zero of the main scale. For precise setting of the movable jaw an adjustment screw is provided. The graduation is engraved on main scale and vernier scale. The value of division determines the accuracy. According to IS: 3651-1974,three types of vernier calipers are recommended. These are designated as type A, type B, and type C.

2. PROCEDURE

1. First of all, check the zero error of vernier by closing the two jaws. In this position the zero of vernier scale should exactly match with zero of main scale.
2. The linear dimensions may be taken by placing the work piece between fixed and moveable jaw.
3. The workpiece must be exactly perpendicular to the measuring surface.
4. The internal dimension may be taken by using upper measuring jaws.
5. To obtain the reading, first count the number of divisions on main scale. The vernier scale is then examined to determine which of the division coincides with a division on main scale. Now calculate the value as,
6. Total reading = Main Scale Reading + no. of division which exactly coincides with the main scale* Least count of vernier caliper.

3. OBSERVATIONS

JOB No.1

S.No.	Dimensions (a)			Dimension (b)			Dimension (c)		
	Main Scale Reading (M.S.)	Vernier Scale Reading (V.S.)	Total = [M.S+ L.C.*V.S.]	M.S.	V.S.	Total	M.S.	V.S.	Total
1									
2									

3									

4. SOURCES OF ERROR

1. The error may be due to the incorrect location of work piece between measuring jaws. The caliper should be perpendicular to the workpiece.
2. The accuracy of measurement depends upon condition of jaws. The jaws should be free from wear and other surface defects.
3. There should not be any play between sliding jaw and main scale.
4. The accuracy depends upon the straightness of the beam and the squareness of the sliding jaw with respect to beam. Any deviations in these parameters may lead to inaccurate results.

5. PRECAUTIONS

1. The stationary caliper jaw of vernier caliper should be used as the set point and measured point is obtained by advancing or withdrawing the sliding jaw.
2. While measuring outside diameter with vernier caliper the plane of measuring tips of the vernier must be perpendicular to the center line of the work piece. The caliper should not be tilted or twisted.
3. Move the caliper jaws on the work with light touch. Do not apply undue pressure.
4. It should not be treated or used as a wrench or hammer because these are not rugged instrument.
5. It should be wiped free from grit, chips and oil.
6. Zero error should be checked before measurement.
7. No play should be there b/w the sliding jaw on scale, otherwise accuracy will be lost.
8. Grip the vernier calipers near or opposite the jaws; one hand for stationary jaw and other hand generally supporting the sliding jaw

6. VIVA VOCE

1. What is the working principle of vernier caliper?
2. How verniercaliper are classified?
3. How would you calculate the least count of the vernier caliper?
4. What is the least count of instrument used in your workshop?

Experiment No. 2

AIM:Measurement of external and internal measurements with External and Internal Micrometer

1. THEORY

In 1848, first micrometer was devised by Sir Jean Palmer. It is a linear measurement device, which is used to measure diameter of wires, thickness of strips etc. This is used for precise measurement, as the accuracy of micrometer is greater than that of vernier caliper.

Working Principle

It works on the principle of screw and nut. If we rotate screw by one rotation then it advances in

axial direction by a linear distance equal to pitch of threads. If the circumference of screw is divided into an no. of equal divisions, then for one division or rotation, the screw will advance by a very small distance which will be equal to (pitch/n). This is the minimum amount of length that can be measured. Hence it is also called Least Count.

Least Count

Least Count (L.C.) = Screw pitch / No. of division on thimble

Construction

The micrometer consists of Frame, Anvil, Spindle, Sleeve, or Barrel, Thimble, Ratchet and Locknut.

1. Frame: The micrometer consists of U shaped or C Shaped cast steel or malleable cast iron frame. It holds all the other parts of micrometer together.
2. Anvil: Fixed anvil is provided at one side of frame. The anvil is accurately lapped and it is exactly parallel to the surface of spindle. The diameter of anvil is equal to diameter of the spindle.
3. Spindle: It is a movable measuring face. The spindle engages with the nut. There should be no backlash between the spindle screw and nut.
4. Sleeve or Barrel: The barrel is attached to the frame. On the barrel, a datum line is graduated. It serves as a main scale having accurately divided divisions at 0.5mm spacing.
5. Thimble: The thimble can be moved over the barrel. It has equal divisions around its circumference.
6. Ratchet: It is provided at the end of the thimble. It prevents the application of excessive pressure to the micrometer. When the spindle reaches near the work surface, the ratchet slips and thus, it prevents the application of too much pressure.

2. PROCEDURE

1. Check the zero error of micrometer.
2. To measure linear dimensions, first place the work piece between anvil and spindle and then move the spindle by rotating the thimble until the anvil and spindle touches the work surface. The correct method of taking reading is shown in figure.
3. Make the fine adjustment by using the ratchet.
4. Now note the main scale reading by counting the divisions just below reference line.
5. Take the circular scale reading by counting the division which coincides the reference line on main scale.
   Total Reading = Main Scale Reading + (Least Count * Circular Scale Reading)
6. Repeat the procedure three to four times.

3. OBSERVATIONS

S.No.	Dimension(a)			Dimension (b)		
	Main Scale Reading	Circular Scale Reading	Total= [M.S+ (L.C.*C.S.}	Main Scale Reading	Circular Scale Reading	Total= [M.S+ (L.C.*C.S.}
1						
2						

3						

4. PRECAUTIONS

1. The zero error of micrometer must be checked before starting the experiment.
2. The measuring surface of anvil and spindle must be free from dust, dirt and oils.
3. The measuring surfaces must be flat and square to the measuring spindle.
4. Use the ratchet to avoid error due to application of excessive pressure.
5. Use the micrometer gently. Do not apply excessive pressure.
6. Clean, oil and put the micrometers in protective boxes when not in use.

5. VIVA VOCE

1. What is the principle of micrometer?
2. How would you specify micrometer?
3. What is the role of Ratchet in micrometer?
4. List the different components of micrometer?
5. What is the least count of instrument available in your lab?

Experiment No. 3

Aim: Measurement of angles with Sine bar

Instrument used:

1. Sine bar
2. Surface plate
3. A set of slip gauges
4. Height gauge
5. Dial gauge

Working Principle: It is based on trigonometric function, sineα = side opposite angle/hypotenuse

Theory of Sine bar: The sine bar is precision measuring device, which is used to measure the angles. It consists of a rectangular section bar of steel, which has accurately grounded pins of equal diameter. The sine bar is specified as per distance between two centers of the pins. The distance between the centers of these pins is arranged to be a standard i.e. 125mm, 200mm, 250mm, 500mm etc.

The sine bar is based on the principle that in a right angled triangle the length of hypotenuse is kept constant. The sine of different angles can be obtained simply by varying the length of the perpendicular.

Procedure:

To measure unknown angle

1. Clean the surface plate
2. Clean the sine bar

3. Clean the workpiece and ensure that there are no damages and burrs on the surface of workpiece.

(for large size workpiece)

4. Place the workpiece on surface plate.
5. Place the sine bar on tapered surface of work piece with the roller of sine bar in upward direction.
6. Set the dial indicator on the height point of one of the sine bar roller and put some pressure on dial indicator.
7. Note the reading of dial indicator.
8. Set the dial indicator on second roller of sine bar.
9. Note the reading of dial indicator.
10. Calculate the difference of two height gauge readings which will give the height (H) of one roller with respect to other.
11. Dial gauge may be set on height gauge in case the value of H is large.
12. The center distance between the two rollers (L) is known for a standard sine bar.
13. Divide the height by center distance between two rollers. This will give the sine of taper angle sine α = H / L
14. Using sine tables the value of taper angle can be calculated.

(for small size workpiece)

4. Place component to be measured over the sine bar surface. If required component may be clamped with the angle plate.
5. Mount the dial indicator on stand or on height gauge. Now set the dial indicator on one side of the components.
6. Move the dial indicator with height gauge along the upper surface of the component.
7. If there is variation in parallelism of the upper surface of the component and the surface plate, it will be indicated by the dial indicator in the form og deflection of pointer.
8. The combination of slip gauge should be so adjusted that the upper surface of the component is truly parallel with the surface plate.
9. Note the height obtained by slip gauge (H). The distance between the roller is constant for particular sine bar.(L)
10. Divide H by L and use the sine table to calculate taper angle.
11. Use the formula **α = Sin-1 (H/L)** to calculate the value of angle in degree.

Observations:

Least count = mm

S. No.	**Height (H)**		**sine α = H / L**	**α = Sin-1 (H/L)**
	H1	**H2**		
1 **2** **3**				

Average angle α = degree

Sources of error

1. Improper cleaning of instrument or workpiece.
2. Damaged workpiece surface.
3. Improper setting of instrument.
4. Error in flatness of upper surface of the bar.
5. Error in size of roller or in parallelism of roller axis with each other.
6. Wrong observation of dial gauge / height gauge reading.

Limitation of Sine bar

1. Sine bar should not be used for angle greater than 45 degree. It is fairly reliable for angle less than 15degree. As the angle increases the inaccuracy also increases.
2. Slight error in sine bar causes larger angle in angular measurement.
3. As for as longer sine bar should be used because using longer sine bars reduces many errors.

Precautions

1. All the instruments should be cleaned properly.
2. Any burrs on the surface should be removed.
3. Zero error in height gauge should be checked and if so correct it.
4. The perfect adjustment of slip gauge is essential, therefore use proper method of making combinations of slip gauges.
5. The wringing of gauges should be done without applying undue pressure to avoid the damage of the surface.
6. The minimum no. of slip gauges should be used for building up size combination.
7. Reading should be taken carefully.

Viva Voce

1. A sine bar is specified by:
    a) its total length
    b) the center distance between the two rollers
    c) size of the rollers
    d) weight of the sine bar
2. Which of the following is not the angle measuring device
    a) angle plate
    b) sine bar
    c) bevel protector
    d) angle gauge
3. Sine bar is used for measuring tapers:
    a) with the help of height gauge
    b) with the help of vernier caliper
    c) with the help of bevel protector
    d) without any accessory
4. Name the various instruments used for angular measurements.
5. What is angle gauges ?
6. Why sine bar should not be used for angle more than 45 degree.
7. Differentiate between the following instruments:

a) Sine bar b) Sine table c) Sine center

Experiment No. 4

Measurement of Speed with Stroboscope

AIM: Measurment of speed of Grinder

1.Theory

Stroboscope The Stroboscope utilizes the phenomenon of vision when an object is viewed intermittently. The human sense of vision is so slow to react to light stimuli that it is unable to separate two different light impulses reaching the eye within a very short period of time (less than0.1 sec) A succession of impulses following one another at such brief intervals are observed by the eye as a continuous unbroken sequence.

1.1 Working Principle:

An Electrical stroboscope provides the intermittent illumination by a neon gas discharge lamp. The flashing rate is controlled y a variable frequency electronic oscillator, the frequency of which can be either read off a dial attached to the oscillator tuning co directed on to a rotating a reciprocating or an oscillating member, the rate of flashing is so adjusted that the member appears stationary. This apparent stopping of the motion occurs when illumination frequency equals the frequency of motion of the target. Thus a cycle motion occurring 1800 times a minute will appear stand still if viewed against uniformly spaced light flashes occurring 1800 times per minute.

Consider the following cases:

1) Single mark on the shaft: A single distinguishing mark on the rotating shaft takes a certain time to complete one revolution, This mark will be illuminated in the same position at each flash and appear to b stationary when the time between flashes is equal to the time for one revolution. Evidently at this condition, the flashing rate will be a measure of the angular velocity. That is

fr=ff

wherefr is the frequency of rotation and ff is the flashing frequency. But a stationary image does not guarantee shaft speed with certainly because the mark will also appear to be stationary if the shaft speed is any whole multiple of flashing frequency (conversely when the flashing frequency is an integral submultiples of the rotational frequency). Thus for a single stationary image

fr=nff

Where n=1,2,3,4,…….etc,

A single mark on a shaft which is turning at 1800rpm will make two revolutions between flashes if these are at the rate of 900 rpm, the shaft may make any umber of complete revolution and thus appear to be stationary at 1800 flashes per minute and also at 900,600,450……etc. This problem will, however, not arise when the rotational frequency is less than the flashing frequency (fr<ff), i.e., when fr is a submultiples of ff. Multiple stationary images would then be obtained as indicated in fig

Let it be pressured that a flash occurs when the mark is at A. With fr=ft/2 the next flash will occur after half a revolution (i.e. when the mark is at B) and again at A when the revolution has been completed subsequently the cycle would be repeated. Apparently the mark will be illuminated at two position 180-digree apart causing a double image to appear.

With fr=ft/3 the subsequent flashe will occur after one third of revolution (mark at B), after two third of revolution (mark at B) after two- third of revolution (mark at C) and after the completion of revolution i.e. when the mark is again at A. Subsequently the cycle would be repeated. Apparently the mark will be illuminated at three position 120-digree apart causing a treble stationary image to appear. This argument can be extended for cases *fr=ft/4, ft/5……*etc. Where 4,5 …….. Stationary images are seen for one distinguishing mark made on the rotating shaft.

2.PROCEDURE:

When speed measurements are to make be stroboscopic methods, we generally work with a single distinguishing mark and proceed to find the highest flash frequency at which a true stationary image is seen. The approach based on the fact that if the frequency of the flashing light is twice the shaft speed, a single mark on the rotating shaft appears to be two standing marks 180° apart. According the flash frequency is gradually increased from a low value until the rotating member appears to be stationary. The flash frequency is noted and then increased to twice its value. If there is still only one apparent stationary image the flash frequency is doubled again. This procedure is continued until two image appear 180° apart when two images are observed for the first time, frequency is twice the speed of rotation.

Consider a stroboscopic light flashing 3600 times per minute, focused upon the end of rotating shaft with a single key way in it. In case, there appear to be four keyways 90°apart. Then the shaft is rotating at 900rpm. Further, if the keyways appear to be slowly rotating under this light, then the shaft speed is either slightly more or slightly less than 900 rpm. The apparent revolution of keyways is then counted per unit time and the relative rotational speed called slip, is determined. If the keyways to be rotating in a direction opposite to the direction of shaft rotation, then slip is negative and it must be subtracted from the synchronous 900 rpm

3.Use of Stroboscope: In additional to checking and measuring spends of rotation of shafts and other parts machinery, stroboscopes are also used for high speed photography and apparently slowing down periodically repetitive motions and thus enable those to be observed more conveniently. The device is especially valuable where it is inconvenient to make a connection with rotating shaft or for low-powered machinery where any load to drive a tachometer would affect the operation of the machine. Commercial stroboscopes are available to read angular velocities between 600 and 20000 rpm. The device however, can not be used where the ambient light is above and certain value; the stroboscope requires a subdued surrounding light for its efficient operation.

4. OBSERVATIONS:

Speed of grinding wheel =
Speed of surface grinder =
Speed of cutter blade=

5. PRECAUTIONS:

1. Stroboscope should not be used in surrounding where the ambient light is above a certain level.
2. If stationary image is not obtained of the given mark then suitably note down the slip which may be positive or negative.
3. Take reading carefully on the instrument.
4. Gradually increase or decrease the flashing frequency in order to get the steady mark image.

VIVA VOCE

1. What are the advantage and disadvantage of stroboscope?
2. Compare stroboscope with tachometer.
3. What is the working principle of stroboscope?
4. What is the least count of stroboscope used in your workshop?
5. What is slip?
6. List other instruments used for speed measurement.
7. what are different uses of stroboscope?

EXPERIMENT No. 5

Measurement of Surface Roughness

AIM: Measurement of surface roughness of given jobs

EQUIPMENTS REQUIRED: Surface plate, Talysurf instrument, Jobs

1.THEORY

The irregularities on the surface of the part produced can be grouped into two categories:

1) Roughness and primary texture
2) Waviness and secondary texture

1)Primary surface (Roughness): The surface irregularities of small wavelength are called primary texture or roughness. These are caused by direct action of the cutting elements on the material i.e. cutting tool shape, tool feed rate or some other disturbances such as friction, wear and corrosion.

These are micro-geometrical errors in which the ratio lr / hr denoting the micro errors is less than 50, where lr = length along the surface and hr = deviation of surface from the ideal one.

2) Secondary texture (Waviness): The surface irregularities of considerable wavelength of a periodic character are called secondary texture or waviness. These irregularities results due to inaccuracies of slides, wear of guides. misalignment of centers, non linear feed motion, deformation of work under the action of cutting forces, vibration of any kind etc.

These are macro-geometrical errors; the ratio of lw / hw denoting the macro-error is more than 50. Where lw = length along the surface and hw = deviation of surface from ideal one.

Thus any finished surface can be considered as the combination of two forms of wavelength superimposed upon each other. These two forms of irregularities superimposed on each other tend to form a pattern or texture of the surface.

Factors affecting surface roughness

- Vibration
- Material of the workpiece
- Type of machining
- Rigidity of the system consisting of machine tool, fixture cutting tool and work
- Type, form, material and sharpness of cutting tool
- Cutting conditions; feed, speed, depth of cut
- Types of coolant used

Evaluation of surface finish

A numerical assessment of surface finish can be carried out in a number of ways. In practice, the following three methods of evaluating primary texture of a surface are used:

1) Peak to valley height method
2) The average roughness
3) Form factor or bearing curve

1) Peak to Valley height

This method is largely used in Germany and Russia. It measures the maximum depth of the surface irregularities over a given sample length, and largest value of the depth is accepted as a measure of roughness.

2) Average Roughness: For assessment of average roughness the following three statistical criteria are used:

a) **C.L.A. Method:** In this method, the surface roughness is measured as the average deviation from the nominal surface.

Centre line average or arithmetic average is defined as the average values of the ordinates from the mean line, regardless of the arithmetic signs of the ordinates.

C.L.A value = (h1+h2+h3+h4+…+hn) / n

C.L.A = (A1+A2+A3+…….An) / n

b) **R.M.S. Method** : In this method , the roughness is measured as the average deviation from the nominal surface. Root mean square value measured is based on the least squares.

R.M.S value is defined as the square root of the arithmetic mean of the values of the squares of the ordinates of the surface measured from a mean line. It is obtained by setting many equidistant ordinates on the mean line (y1,y2, y3,….) and then taking the root of the mean of the squared ordinates.

Let us assume that the sample length ‘L’ is divided into ‘n’ equal parts and y1, y2, y3,……yn are the heights of the ordinates erected at these points.

RMS average =

c) **Ten Point Height Method**: In this method, the avg. difference between the five

highest peaks and five lowest valleys of surface texture within the sampling length, measured from the line parallel to the mean line and not crossing the profile is used to denote the amount of surface roughness.

Mathematically,

$$R = \text{ten point height of irregularities}$$
$$= 1/5 \left[(R1 + R2 + R3 + R4 + R5) - (R6+R7+R8+R9+R10) \right]$$

This method is relatively simple method of analysis and measures the depth of surface irregularities within the sampling length. But it does not give any sufficient information about the surface, as no account is taken of frequency of the irregularities and the profile shape.

Statement of Surface Roughness

a) Surface Roughness Value: It is expressed as Ra value in microns. If a single Ra value is stated it is understood that any Ra value from zero to that stated is acceptable.

b) Limiting values: when both minimum and maximum Ra values needed to be specified these shall be expressed as

Ra 8.0/16.0 or Ra 8.0-16.0

c) Sampling length: The sampling length is indicated in parenthesis following the roughness value as follow: Ra 8.0 (2.5)

d) Lay : It is sometimes necessary to specify the direction of lay. It is expressed in accordance with the following example

Ra 1.5 lay parallel

Unless otherwise specified, it is assumed that the surface roughness shall be across the direction of lay.

e) Process : When it is necessary to limit the production of a surface to the use of one particular process, the process shall be stated.

Conventional Method of Designing Surface Finish

a) Roughness value Ra value in microns
b) Machining allowance in mm
c) Sampling length
d) Machining / Production method
e) Direction of lay in the symbol form as =,⊥

Direct Instrument Measurement: These are method of quantitative analysis. These method enables to determine the numerical value of the surface finish of any surface bu using instrument of stylus probe type operating on electrical principles. In these instrument the output has to be amplified and amplified output is used to operate recording or indicating instrument.

Working of Surface Meter (Taylor-Hobson-Talysurf): Talysurf is a stylus and skid type instrument working on carrier modulating principle. The measurement of the instrument consists of simply pointed diamond stylus of about 0.002 mm tip radius and skid or shoe which is drawn across the surface by means of a motorized driving unit.

In this instrument the stylus is made to trace the profile of surface irregularities and the oscillatory movement of the stylus is converted into changes into electric current by the arrangement shown in fig.1. The arm carrying stylus forms an armature which pivots about the

centre piece of E-shaped stamping. On two legs of (outer pole pieces) the E shaped stamping there are coils carrying the a.c. current. These two coils with other two resistances form an oscillator. As the armature is pivoted about the centre leg, any movement of the stylus causes the air gap to vary and thus the amplitude of the original a.c. current flowing in the coil is modulated. The output of the bridge thus consists of modulation only. This is further demodulated so that the current now is directly proportional to the vertical displacement of the stylus only.

Stylus type instruments generally consists of the following units:

1) Skid or shoe
2) Finely pointed stylus or probe
3) An amplifying device for magnifying the stylus movement
4) Recording device to produce a trace
5) Means for analyzing the trace.

PROCEDURE:

1. Properly set instrument and the job over the surface plate.
2. Skid or shoe is drawn slowly over the surface by motor drive. It follows the general contours of the surface and provides a datum for measurements. The stylus moves over the surface with a skid. It moves vertically up and down to surface roughness
and records the micro-geometrical form of the surface. The stylus movement may be amplified by a amplifying device and recorded to produce a trace.
3. Note down the reading in terms of Ra or Ry.

PRECAUTIONS:

1. The instrument and job is to be properly set over the surface plate so that stylus could move without any problem.
2. There should not be any burr on the job.
3. The job must be cleaned from any oil, dirt or dust.
4. Surface plate should be free from any oil, dust or dirt.

VIVA VOCE

1. What is the difference between primary and secondary texture?
2. What are the different methods for surface roughness measurement?
3. What is working principle of surface tester used in your lab?
4. Name the different factors, which affect surface roughness.
5. What do you mean by sampling length?

EXPERIMENT: 6

Measurement of Gear elements using profile projector

AIM:

Measurement of Gear elements

PROFILE PROJECTOR

1. THEORY

1.1 CONSTRUCTION

It has a swiveling turret above the stage for mounting the projection lenses. This enables different magnification to be selected fairly rapidly. The magnification available are ×10, ×20, ×50 and ×100 and illumination can be simply switched from shadow to surface by a selector on the front of the instrument. The handwheel on the right hand side will raise or lower the stage and so position component placed on it at the focal point of the lens. A sliding hood can be positioned to prevent extraneous light shining onto the screen.

The optical system is illustrated and it can be seen that when used for shadow illumination, collimated light is transmitted up through the translucent stage, backlighting any object placed on it. Alternatively when surface illumination is selected, the light strike a half reflecting mirror placed below the projection lens, which reflect it down on onto the object on the stage. This is reflected back and when traveling in this direction, is refracted by a mirror. Whichever means of illumination is used , the image is projected by the lens, via. The two mirrors in the upper part of the instrument, onto the screen.

The circular screen can be swiveled and a vernier scale on its periphery can be used to measure angles on the projected image, with the aid of cross wires engraved on the surface of the screen. The stage can be moved on its longitudinal and transverse axis and the movement is controlled by micrometers.

1.2WORKING PRINCIPAL:

Profile projector is an optical device which is used for measuring linear dimensions (length, width, diameter etc) and to measure angles. The thread or gear forms can also be compared with the help of profile projector. The different types of measurements may be taken from profile projector. Some of them are as under ;

- **i.** The relative position of two points can be measured by measuring the distance traveled by work table required to transfer a second point to the position previously occupied by first point.
- **ii.** Thread forms can be compared with respect to standard forms marked on glass template.
- **iii.** The angles can be measured by setting fiducial line (located on the focal plane of eyepiece) along image of the angle and taking readings from protractor scale.

2. GEAR TERMINOLOGY

Addendum Circle: The circle which limits the top of the gear teeth and represents its maximum diameter is called the addendum circle.

Addendum: It is the radial height of the tooth from the pitch circle to the tip of the tooth.

Dedendum: It is the radial depth of tooth from the pitch circle to the root of the tooth.

Tooth thickness: It is the thickness of the tooth, measured along the pitch circle.

Whole depth: It is the sum of the addendum and dedendum of the tooth.

Circular Pitch: It is difference measured along the pitch circle from a point on one tooth to a corresponding point on the adjacent tooth.

Circular pitch = $(\pi * d) / T = \pi m$

d – pitch circle diameter

T- no. of teeth

m- module

Diametral Pitch: It is the no. of teeth per unit length of the pitch circle diameter.

Diametral Pitch = No of teeth / pitch circle diameter = T/d

Module: It is a linear distance in mm that each tooth of the gear would occupy, if the gear teeth were spaced along the pitch diameter.

Module = Pitch circle diameter / No. of teeth = d/T

3. PROCEDURE:

1. To determine the distance between two points, first of all, set the microscope at first point. Now slide the table with the help of micrometers attached with table so that the second point occupies the position of first point. The distance between them can be measured by measuring slide of table.
2. To measure angle, set fiducial line situated in the focal plane of the eye piece. Now turn the fiducial line and set it on the second arm of angle. The turn can be noted with the help of protractor scale attached with this. Hence angle can be measured.
3. To compare the thread form, use template. Compare the image with profile outline of standard template and measure discrepancies.

4. PRECAUTIONS:

1. The screw of table must be moved in one direction only while measuring to avoid backlash error.
2. Fiducial line must be properly set
3. The microscope should be handled carefully

VIVA VOCE

1. What are the advantages of optical instrument over mechanical instrument?
2. Give the elements for specifying the gear.
3. Differentiate between diametral pitch and circular pitch.

EXPERIMENT 7

Calibration of pressure measuring equipments with Dead weight gauge tester.

AIM: Study of Dead weight gauge tester.

1.THEORY

This tester is a primary standard for pressure measurement. It provides a good calibration facility over a wide pressure range.

1.1 CONSTRUCTION

It consists of an accurately machined and finished piston which is inserted into a close fitting cylinder; both of known cross sectional areas. At the top of the piston is provided a platform to hold standard weights of known accuracy.

1.2 WORKING

1. The chamber and the cylinder of the tester are filled with clean oil.
2. The gauge to be tested is fixed at its appropriate place and piston inserted in the cylinder.

3. A weight is placed on the piston. Consequently the pressure is exerted on the oil and the pressure is transmitted to the gauge deflecting its pointer. In order to get the desired setting of the gauge pointer, the weights are adjusted.
4. Then forcing the plunger in, by moving the handle, varies pressure. The movement of the handle is continued till enough pressure is built up to lift the piston weight combination. The piston weight combination floats freely under these conditions. Thus the equilibrium is established with fluid force balanced against the gravitational force of the weights plus the friction drag.

$$p * A = Mg + Fd$$

M – Mass, Kg
g– Acceleration due to gravity
Fd – Friction drag, N
A – Effect area of piston cylinder combination

The effect of equivalent area (A) depends on such factors as piston cylinder clearance, pressure level, temperature and is normally taken as the mean of the cylinder and piston area.

2. APPLICATION

Many kinds of pressure measuring devices may be calibrated such as:

- Engine indicator
- Industrial pressure gauges
- Piezoelectric pressure transducers

3. SOURCES OF ERRORS

1. Friction between the piston and cylinder: The friction force is reduced by having good surface finish and fit between cylinder and the piston. The friction force is also reduced by rotation of piston so the kinetic friction is applied rather than static friction.
2. Uncertainty of value of the effective area (A): The area upon which the weight force acts is neither area of piston nor the area of cylinder. The value of effective area is somewhere in between two values. The effective area depends upon the clearance spacing and viscosity of oil.
3. Uncertainty of gravitational constant (g): The tester is calibrated initially by the manufacturer for a particular value of g, usually the standard 9.80665 m/s^2 but since the local value of g different from this, correction should be applied to get better accuracy.
4. Thermal expansion and elastic deformation of piston and cylinder
5. Air buoyancy on the weights
6. Fluid buoyancy on the weights

It is, therefore, desirable to evaluate these effects and apply corrections thereof so that magnitude of the overall measurement error is reduced to minimum.

VIVA VOCE

1. Differentiate between absolute pressure, gauge pressure and vacuum.
2. What are the factor affecting the accuracy of dead weight gauge testers?
3. What is the other method of calibration of pressure measuring instrument?
4. What do you mean by static calibration?
5. What are different pressure measuring instrument which could be calibrated by Dead weight gauge tester?

EXPERIMENT 8

Use of Pitot tube to plot velocity profile of a fluid through a circular duct

1. THEORY:

It is a device used for measuring the velocity of flow at any point in a pipe or a channel.

1.1WORKING PRINCIPLE: It is based on the principle that if the velocity of flow at a point becomes zero, the pressure there is increased due to conversion of kinetic energy into pressure energy.

The Pitot tube consists of glass tube, bent at right angles. The lower end, which is bent through 90 degree, is directed in the upstream direction. The liquid rises up in the tube due to conversion of kinetic energy into pressure energy. The velocity is determined by measuring the rise of liquid in the tube.

Consider two points (1) and (2) at the same level in such a way that point (2) is just at the inlet of the pitot tube and point (1) is far away from the tube.

Let

P1= intensity of pressure at point (1)
V1= velocity of flow at (1)
P2= intensity of pressure at point (2)
V2= velocity of flow (2)
H1= depth of tube in the liquid
H2= rise of liquid in the tube above the free surface (H1+h)

Apply Bernoulli's equation at points (1) and (2) we get

$P1/w + (V1)^2/2g + Z1 = P2/w + (V2)^2/2g + Z2$

But Z1 = Z2 as point (1) and (2) are at the same line and V2=0

P1/w = pressure head at (1) =H1
P2/w = pressure head at (2) = H1+h

Substituting these values we get

$H + (V1)/2g = (H + h)$
$V1 = \sqrt{2gh}$

Velocity at a point $V1= Cv\sqrt{2gh}$

Here Cv coefficient of velocity

1.2 CONSTRUCTION:

It is a pitot static tube, which consists of two circular concentric tubes one inside the other with some annular space in between as shown in figure. The outlet of two tubes are connected to the differential manometer where the difference of pressure head 'h' is measured by knowing the difference of the levels of manometer liquid say x

Then $h = x (Sm/Sf - 1)$

Sm- specific gravity of manometric fluid

Sf- specific gravity of fluid

2.PROCEDURE

1. Set with the help of adjusting knob the open end of pitot tube at one end of the pipe and note down the value of x.
2. Now gradually adjusting towards the other end and note down the values of x.
3. Calculate velocity at different points across the section corresponding to value of x.
4. Draw the velocity profile.

3.PRECAUTIONS

1. Take reading on Manometer carefully.
2. There should not be any burr at the opening end of the pitot tube.

VIVA-VOCE

1. What is the difference between Pitot tube and Pitot-static tube?
2. What should be desirable characteristics of manometer fluid?
3. Sketch different arrangement of Pitot tube.
4. What is the working principle of Pitot tube?
5. What is the difference between static and dynamic pressure?

EXPERIMENT:9

Measurement of thread parameters by using tool maker'smicroscope.

INSTRUMENTS USED:

i. Tool maker's microscope.

ii. A threaded bolt with some standard forms.

1.THEORY

1.1WORKING PRINCIPAL:

Tool makers microscope is an optical device which is used for measuring linear dimensions (length, width, diameter etc) and to measure pitch and thread angle. The thread forms can also be compared with the help of tool makers microscope. The different types of measurements may be taken from tool maker's microscope. Some of them are as under ;

iv. The relative position of two points can be measured by measuring the distance traveled by work table required to transfer a second point to the position previously occupied by first point.

v. Thread forms can be compared with respect to standard forms marked on glass template.

vi. The angles can be measured by setting fiducial line (located on the focal plane of eyepiece) along image of the angle and taking readings from protractor scale.

1.2 CONSTRUCTION:

The construction of tool makers microscope is:

The tool maker microscope consists of following main parts;

- **i.** Base
- **ii.** Working table
- **iii.** Swingable head
- **iv.** Micrometers
- **v.** Objective lens
- **vi.** Prism
- **vii.** Projection screen
- **viii.** Illumination unit

The tool makers microscope consist of heavy hollow base which accommodates an illumination unit underneath. The work table is mounted on the base on cross slide. The longitudinal and lateral movement can be given to the work table with the help of two micrometers having thimble scale and vernier. The swingable head is attached with base. It consists of optical head having objective lens. The image is projected on projection screen by a system of prisms.

1.3 WORKING:

The light source provided at the back of base provides a horizontal beam of light, which is reflected by a reflector at an angle 90º, towards the table. The beam of light passes through the transparent glass plate on which flat parts to be checked; are placed. Thus a parallel beam of light illuminates the lower side of the work piece. A shadow image of the outline of the contour passes through the objective lens in the way to the prism. The prism deflects the light rays in the direction of the measuring ocular and is projected on screen. Different types of graduated and engraved screens and corresponding eyepiece are used for measuring different elements.

2. SCREW THREAD TERMINOLOGY

1. Screw Thread: A screw thread is a continuous helical groove of specified cross section produced on the external or internal surface of a cylinder or a cone.
2. Crest: Crest is the prominent part of thread i.e, top surface joining the two sides of the thread.
3. Root: Root is the bottom of the groove between the sides of two adjacent threads.
4. Pitch: The distance measured parallel to the axis from a point on a thread to the corresponding point on the next thread is called pitch of the thread.
5. Thread Angle: It is the angle included between the flanks or slopes of the thread measured in an axial plane.
6. Flank Angle: The angle made by the flank of a thread with the perpendicular to the thread axis is called the flank angle.
7. Depth of thread: It is the distance between the crest and root of the thread measured perpendicular to the axis of thread. It can also be defined as a distance measured radially between the major and minor diameter.
8. Major Diameter: It is the diameter of an imaginary co-axial cylinder which would touch the crests of an external thread or roots of an internal thread.

9. Minor Diameter: It is the diameter of an imaginary co axial cylinder which would touch the roots of an external thread or crest of internal thread.
10. Effective diameter: It is the diameter of an imaginary co-axial cylinder which intersects the flanks of the threads such that the width of the thread and width of the spaces between the threads are equal; each being half the pitch.

3. PROCEDURE:

4. To determine the distance between two points, first of all, set the microscope at first point. Now slide the table with the help of micrometers attached with table so that the second point occupies the position of first point. The distance between them can be measured by measuring slide of table.
5. To measure angle, set fiducial line situated in the focal plane of the eye piece. Now turn the fiducial line and set it on the second arm of angle. The turn can be noted with the help of protractor scale attached with this. Hence angle can be measured.
6. To compare the thread form, use template. Compare the image with profile outline of standard template and measure discrepancies.

4. PRECAUTIONS:

3. The screw of table must be moved in one direction only while measuring to avoid backlash error.
4. Fiducial line must be properly set
5. The microscope should be handled carefully

VIVA VOCE

1. What is the working principle of Tool makers microscope?
2. What is the least count of micrometer fitted on toolmakers microscope in your lab?
3. What is effective diameter?
4. Differentiate between single start and multi start thread.
5. Differentiate between right hand and left hand thread.

EXPERIMENT: 10

Measurement of effective diameter of external thread by three wires method.

INSTRUMENT USED:

1. Micrometer
2. Three wires
3. Jobs i.e. whose effective diameter is to be measured

1.THEORY:

In this method three wires of equal and precise diameter are placed in the thread grooves at opposite sides of the screw and measuring the distance M over the outer surface of the wire with the micrometer. Out of three wires in the set two wires are placed on one side and the third on the other side. The wires are held either in hand or secured in the groove by applying grease in

the thread. These wires may also be hung on through thread on a stand. This method ensures the alignment of micrometer anvil faces parallel to the thread axis. Therefore this method of measuring effective diameter is more accurate.
These wires are made of hardened steel and are lapped to sizes suitable for various pitches. For each pitch of thread there is a 'best size' wire; this is of such diameter that makes contact with the flanks of the thread on the effective diameter or pitch line.

$M = De + d (1+ \text{cosec } \alpha/2) – p/2 \cot \alpha/2$
M = distance over the wires
De = effective diameter
R = radius of wire
d = Diameter of wire
Effective diameter:

2. PROCEDURE

1. The three wire method of measuring the effective diameter of a screw thread is shown in figure
2. Three wires of equal and precise diameter are placed on the thread grooved at opposite sides of screw thread.
3. Two wires are placed on one side and one wire at another side. This arrangement of setting wires ensures the alignment of micrometer anvils faces parallel to the thread axis.
4. Micrometer reading over wires is taken. Let it be M.
   Hence effective diameter is calculated as:
   $De = M – Q$
   Where Q is a constant which depends upon wire diameter d and flank angle α

3. PRECAUTIONS:

1. The zero error of micrometer must be checked before using it.
2. The measuring surface of anvil and spindle must be free from dust, dirt or oil.
3. The measuring surface must be square to the measuring spindle.
4. Ensure that wire makes contact with the flanks of the thread on the effective diameter or pitch line.
5. Use ratchet to avoid error due to application of excessive diameter.

VIVA VOCE

1. What do you mean by best wire size?
2. What is the advantage of three wires method over two wires method?
3. What is the material of wires used in the measurement?
4. How three wire method is differ from two wire method?

BTME 508 INDUSTRIAL AUTOMATION AND ROBOTICS LAB

PRACTICAL NO. 01

AIM: - DESIGN AND ASSEMBLY OF HYDRAULIC/PNEUMATIC CIRCUIT.

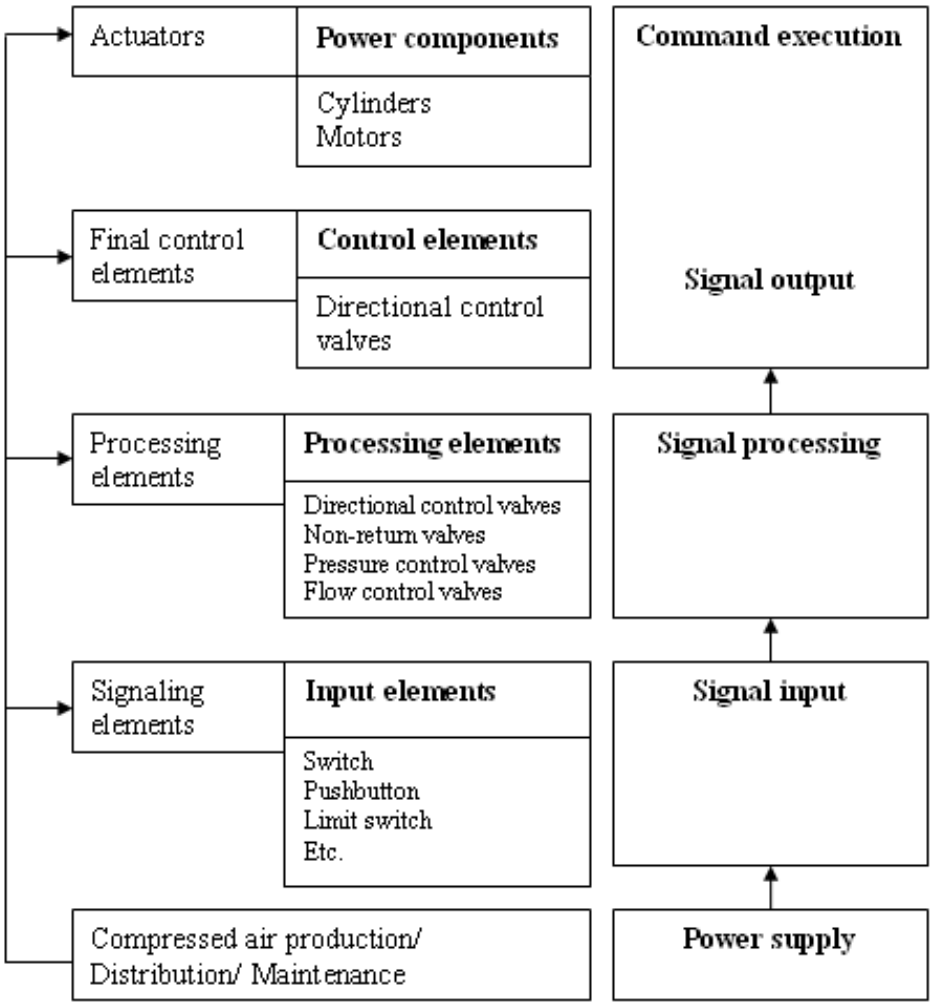
THEORY: -

1.1 INTRODUCTION

The circuit is defined as a pictorial representation of the working of a system using symbols. The hydraulic/pneumatic circuit must essentially include the symbols of the following:

- Power/Pressure source
- Reservoir(In Hydraulic Systems)
- Fluid lines
- Filter
- Lubricator (In pneumatic system)
- Pressure Regulator(For example Relief Valve)
- Direction Control Valves
- Flow Control valves (If speed regulation is desired)
- Special Purpose valves(if required)
- Actuators etc.

The circuit must be a closed in case of hydraulic where incompressible oil is used as an actuating fluid. The circuit must ensure the proper working of the actuators along with a control strategy. The safety aspect must also be taken into consideration. The system should function in a logical manner. The design must be as simple as possible and the logic should be apparently clear. Proper connections must be ensured before releasing the fluid under pressure from the source into the system.



1.2 PROBLEM

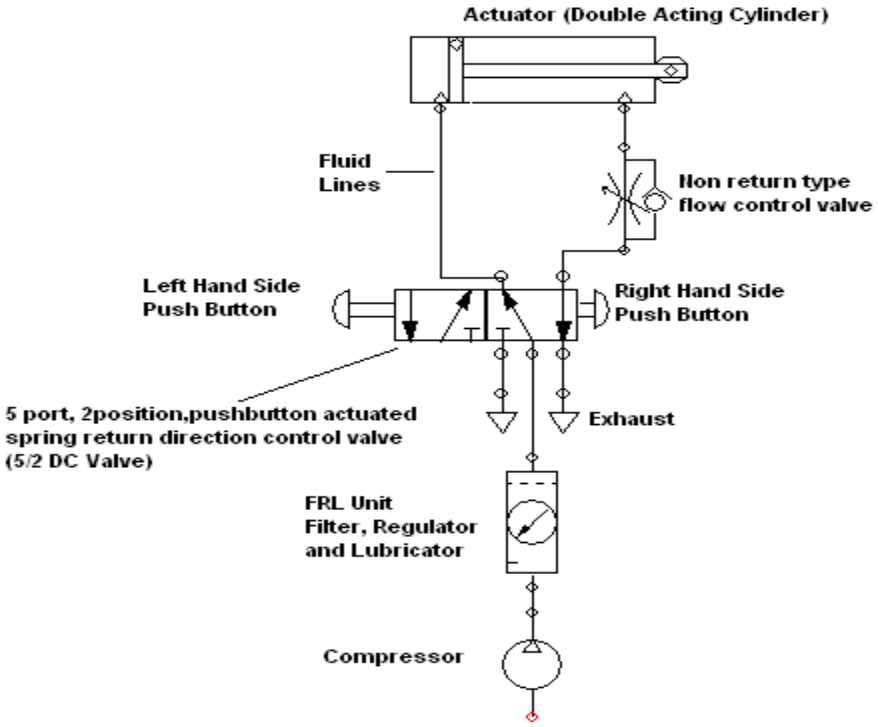
To control a double acting pneumatic cylinder in such a way that during the return stroke the speed of the piston shall be adjusted. There is no stopping of the piston rod in between the terminal points.

(The piston rod of adouble-acting pneumatic cylinder extracts if right hand side push button of the 5/2 DC valve is pressed and the cylinder should retract when the left hand side push button of the DC valve is pressed. Also there should be a provision for speed control of cylinder during the return stroke)

1.3 SOLUTION

To design a circuit, we shall be making use of symbols of various components. First of all compressor is used as a power/pressure source as the problem refers to a pneumatic system. Then the air coming out of the compressor needs to be conditioned. For the same a FRL unit is put in the pressure line of the compressor. As we know that we have to control a double acting cylinder which doesn't have to stop in between so we chose a 5 port,2 position pushbutton actuated, spring return direction control valve. We have to provide an adjustable speed control during the retracting motion of the cylinder, so a non return type adjustable flow control valve is put in between the actuator and the DC valve so as to ensure a *throttling in* speed control of cylinder.

1.4 PNEUMATIC CIRCUIT FOR THE PROBLEM



1.5 THINGS TO REMEMBER

- Physical arrangement of the elements is ignored.
- Draw the cylinders and directional control valves horizontally wherever possible.
- The energy flow within the circuit moves from the bottom to the top.
- Energy source can be shown in simplified form.
- Show elements in the initial position of the control. Identify actuated elements by a cam.
- Draw pipelines straight without cross-over wherever possible.

PRACTICAL NO. 01

AIM: - DESIGN AND ASSEMBLY OF HYDRAULIC/PNEUMATIC CIRCUIT.

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- Special Purpose valves(if required)
- Actuators etc.

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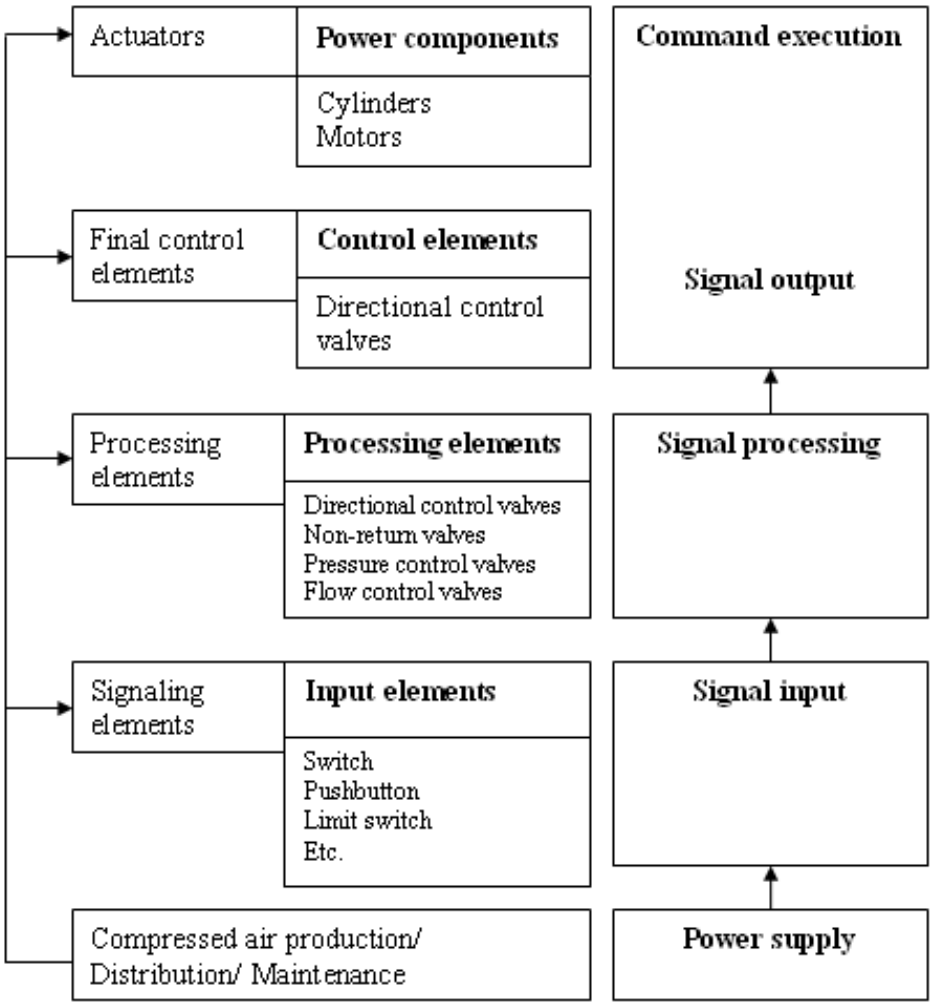


1.2 PROBLEM

To control a double acting pneumatic cylinder in such a way that during the return stroke the speed of the piston shall be adjusted. There is no stopping of the piston rod in between the terminal points.

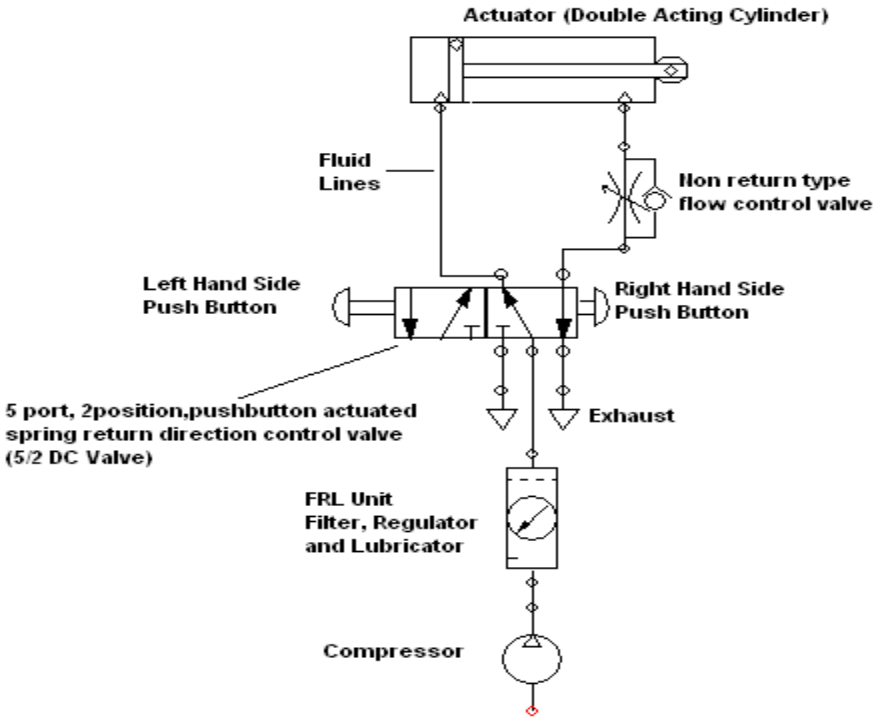
(The piston rod of adouble-acting pneumatic cylinder extracts if right hand side push button of the 5/2 DC valve is pressed and the cylinder should retract when the left hand side push button of the DC valve is pressed. Also there should be a provision for speed control of cylinder during the return stroke)

1.3 SOLUTION

To design a circuit, we shall be making use of symbols of various components. First of all compressor is used as a power/pressure source as the problem refers to a pneumatic

system. Then the air coming out of the compressor needs to be conditioned. For the same a FRL unit is put in the pressure line of the compressor. As we know that we have to control a double acting cylinder which doesn't have to stop in between so we chose a 5 port,2 position pushbutton actuated, spring return direction control valve. We have to provide an adjustable speed control during the retracting motion of the cylinder, so a non return type adjustable flow control valve is put in between the actuator and the DC valve so as to ensure a *throttling in* speed control of cylinder.

1.4 PNEUMATIC CIRCUIT FOR THE PROBLEM



1.5 THINGS TO REMEMBER

- Physical arrangement of the elements is ignored.
- Draw the cylinders and directional control valves horizontally wherever possible.
- The energy flow within the circuit moves from the bottom to the top.
- Energy source can be shown in simplified form.
- Show elements in the initial position of the control. Identify actuated elements by a cam.
- Draw pipelines straight without cross-over wherever possible.

PRACTICAL NO. 03

AIM: - STUDY OF RECIPROCATING MOVEMENT OF DOUBLE ACTING CYLINDER USING PNEUMATIC DIRECTION CONTROL VALVES.

THEORY: -

3.1 INTRODUCTION

A double acting cylinder is to advance when a push button is operated. Upon release of the push button the cylinder is to retract. The cylinder is 250 mm in diameter and consumes a large volume of air.Draw the circuit diagram for the problem. Designate the valves and indicate the numbering system for the connections.

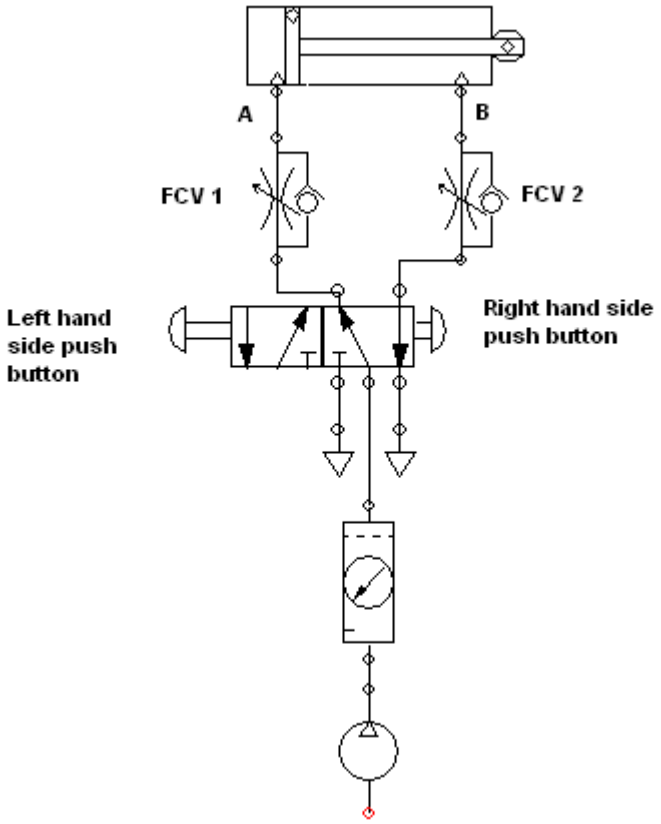
For controlling cylinders at high speed or of large diameter, the air flow required determines that a large size control valve should be used. The operating force to actuate the valve may be relatively large and in this case indirect control is preferable.

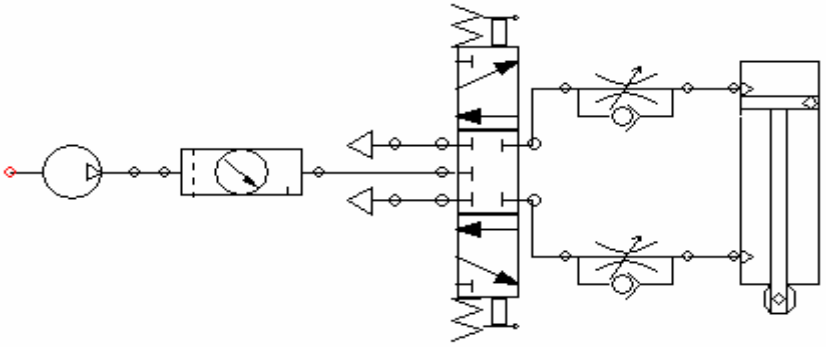
A 4/2-way or 5/2-way direction control valve controls the double acting cylinder if the piston is not to be stopped in between and 4/3 way or 5/3 way direction control valve controls the cylinder in which the piston can be stopped anywhere required.

A signal is generated or reset on the valve, if a push button actuator is pressed or released. The circuit includes:

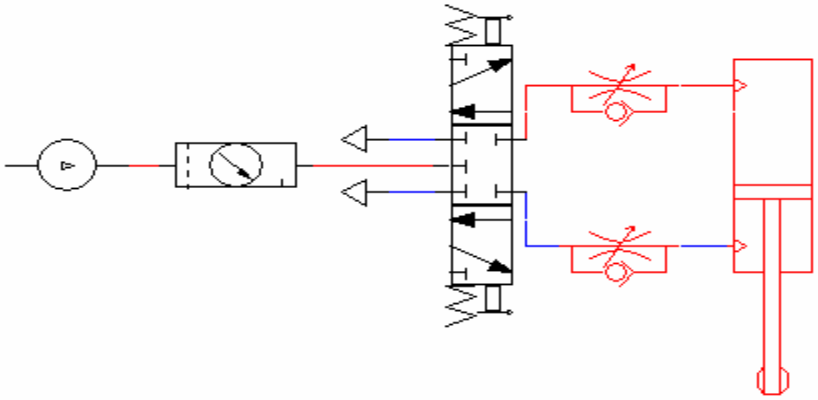
- Supply air source(Compressor)
- Air connections among supply,
- FRL Unit for conditioning of air
- Double acting cylinder
- 4/2-way/5/2-way/4/3-way/5/3-way directional control valve: push button and lever for operation and spring for return force
- Adjustable Non return flow control valves for speed control(throttling out)
- Fluid Lines

3.2 Basic Pneumatic Circuit with a 5/2 DC valve.

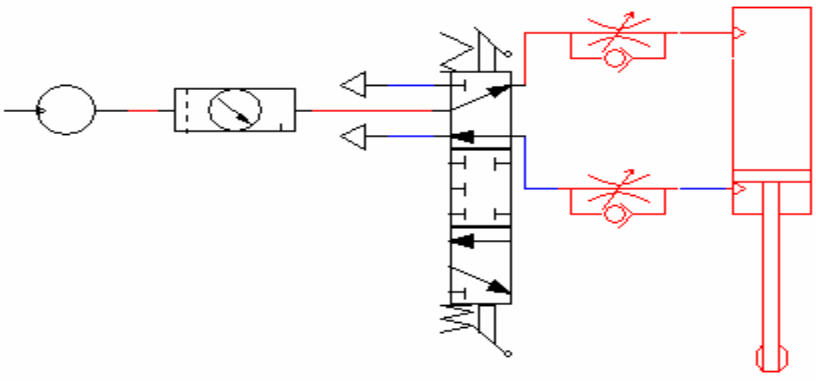




System using 5/3 DC valve with no actuation and the piston is in its initial position(Retracted



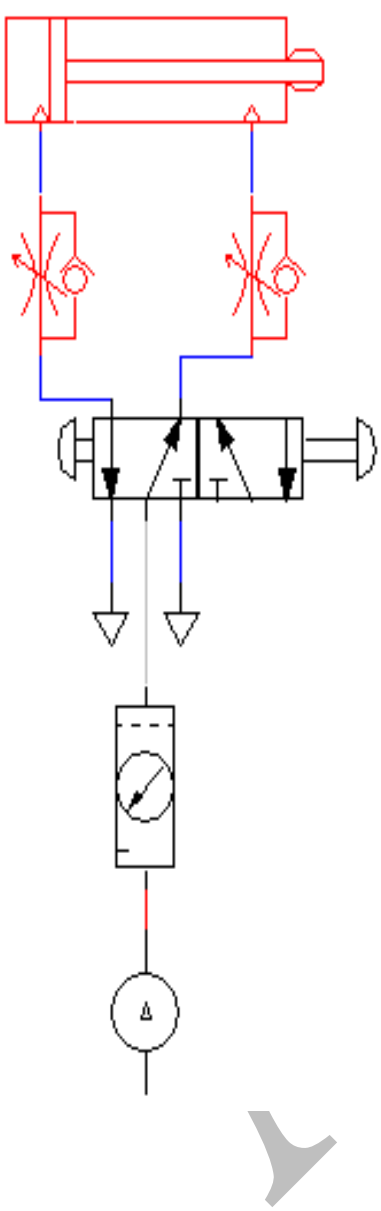
System using 5/3 DC valve with actuation released when the piston is at the middle



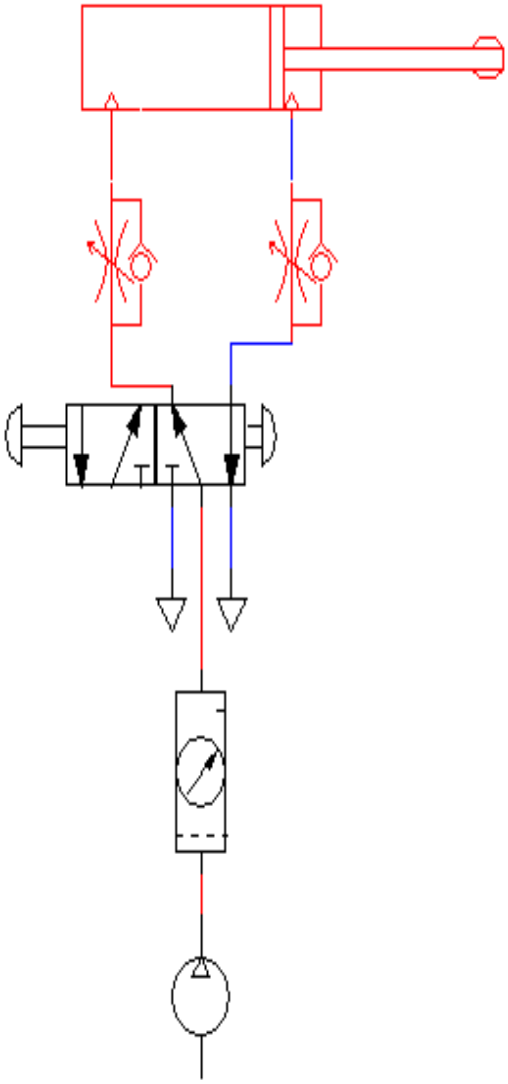
System using 5/3 DC valve with actuation selected and the piston is at the extracted position.

Double acting Cylinder control using a 5/2 DC Valve with push button actuation on one side

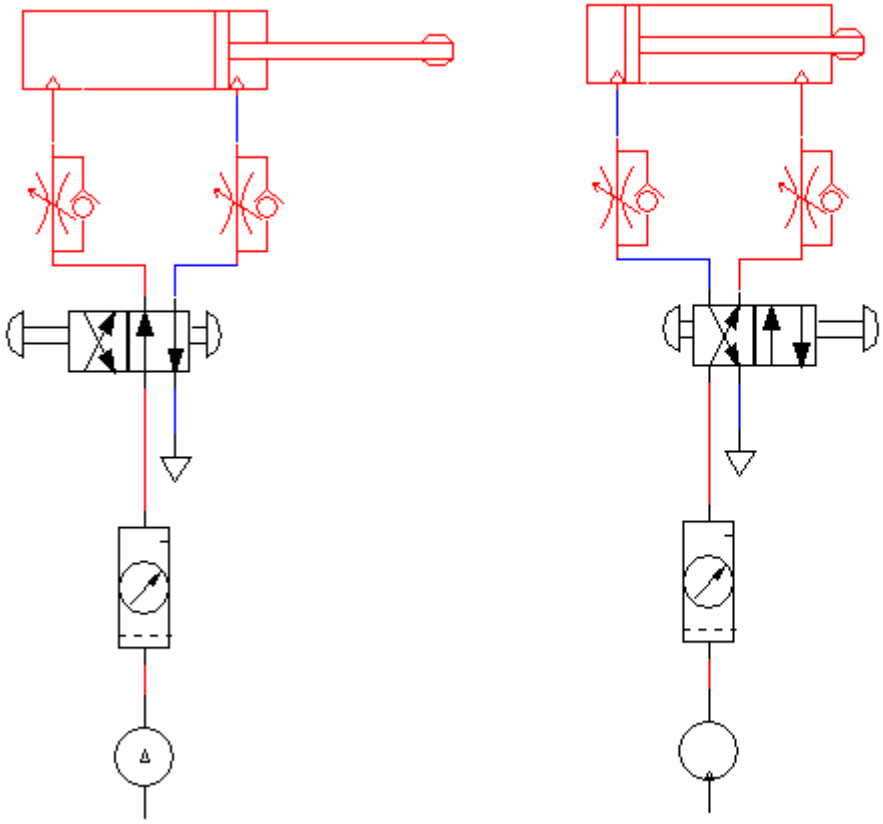
Double acting Cylinder control using a 5/2 DC Valve with push button actuation on other side and piston in extracted position



Double acting Cylinder control using a 4/2 DC Valve with push button actuation on one side



Double acting Cylinder control using a 4/2 DC Valve with push button actuation on other side and piston in extracted position



3.3 PRECAUTIONS

- Draw the cylinders and directional control valves horizontally wherever possible.
- The energy flow within the circuit moves from the bottom to the top.
- Show elements in the initial position of the control. Identify actuated elements by a cam.
- Draw pipelines straight without cross-over wherever possible.

PRACTICAL NO. 04

AIM: - USE OF DIRECTION CONTROL VALVE AND PRESSURE CONTROL VALVES CLAMPING DEVICES FOR JIG AND FIXTURE.

THEORY: -

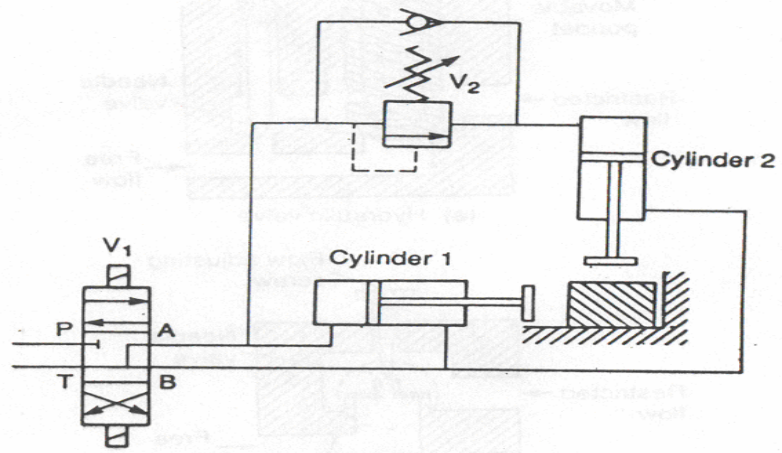
4.1 PROBLEM

A plastic cubical component is embossed using a die driven by a double-acting cylinder 2. The die is to advance and emboss the plastic component only after clamping. The cylinder 1 is to be used for clamping. The cylinder 2 must operate in a sequential way

only when the cylinder 1 has caught hold of the plastic piece. The embossing pressure or working pressure of the cylinder 2 must is to be adjustable.

4.2 SOLUTION

This problem can very easily be tackled by using a sequence valve as shown in the given figure If the piston rod is not in its initial position, the must be reset by operating the manual override on the 5/2-way double pilot valve.



27 Sequence valve

All valves are unactuated in the initial position, pressure is applied at the piston rod side of the cylinder and the piston rod remains in the retracted state. Circuit diagram for solution to this problem is shown in figure 4.1 below. The circuit includes:

- Double acting cylinder
- 5/2-way double pilot directional control valve
- Pressure sequence valve
- 3/2-way push button operated spring return DC valve
- Supply air source
- Air connections among supply, DC valve and cylinder

4.3 PRECAUTIONS

The response pressure set on the pressure sequence valve must be lower than the system pressure in order to ensure reliable switching.

PRACTICAL NO. 05

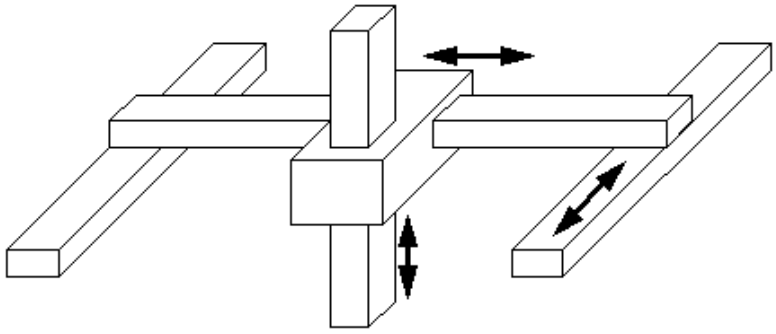
AIM: - STUDY OF ROBOTIC ARM AND ITS CONFIGURATION.

THEORY: -

There are in general 5 basic configurations namely

1. Cartesian
2. Spherical
3. Cylinderical
4. Jointed Arm
5. SCARA

5.1 CARTESIAN CONFIGURATION



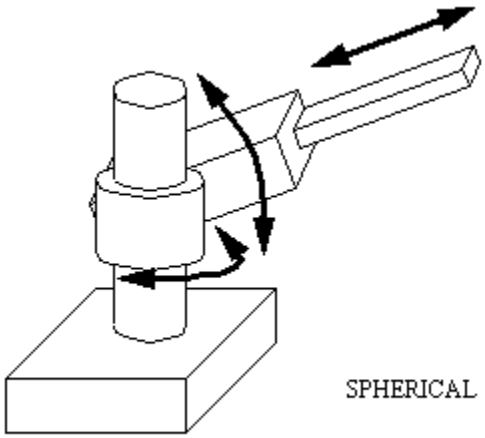
CARTESIAN/RECTILINEAR/GANTRY

Cartesian/Rectilinear/Gantry - Positioning is done in the workspace with prismatic joints. This configuration is well used when a large workspace must be covered, or when consistent accuracy is expected from the robot. It is a PPP configuration & is used for pick and place work, application of sealant, assembly operations, handling machine tools and arc welding. It's a robot whose arm has three prismatic joints, whose axes are coincident with a Cartesian coordinator.

5.2 SPHERICAL CONFIGURATION

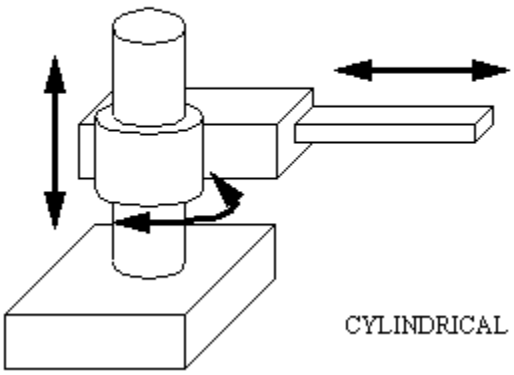
Spherical - Two revolute joints and one prismatic joint allow the robot to point in many directions, and then reach out some radial distance It is a RRP configuration & is used for handling at machine tools spot welding, die-casting, fettling

machines, gas welding and arc welding.



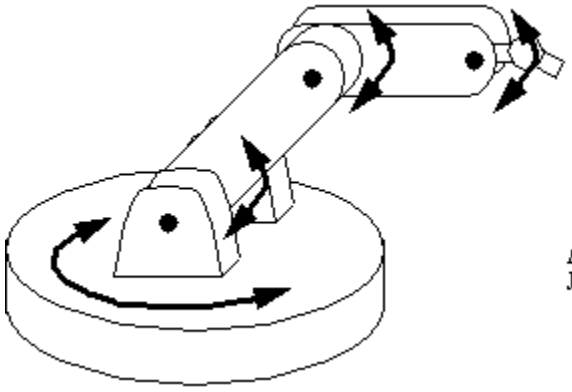
It's a robot whose axes form a polar coordinate system.

5.3 CYLINDERICAL CONFIGURATION



Cylindrical - The robot has a revolute motion about a base, a prismatic joint for height, and a prismatic joint for radius. This robot is well suited to round workspaces. It is a RPP configuration & is used for assembly operations, handling at machine tools, spot welding, and handling at die-casting machines. It's a robot whose axes form a cylindrical coordinate system.

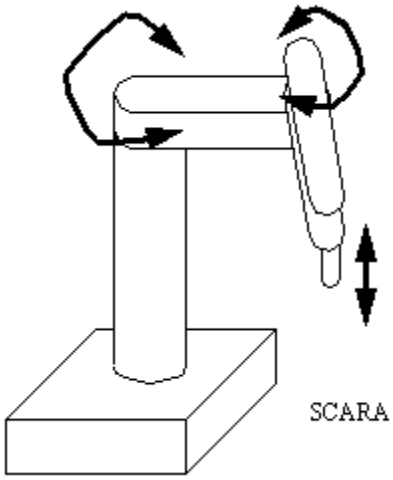
5.4 JOINTED ARM CONFIGURATION



ARTICULATED/REVOLUTE/
JOINTED SPHERICAL

Articulated/Jointed Spherical/Revolute - The robot uses 3 revolute joints to position the robot. Generally the work volume is spherical. This robot most resembles the human arm, with a waist, shoulder, elbow, and wrist. This configuration is RRR configuration & is useful for pick & Place operations. It has got the flexibility to handle the object beneath or above the arm.

5.5 SELECTIVE COMPLIANCE ARTICULATED ROBOTIC ARM (SCARA)

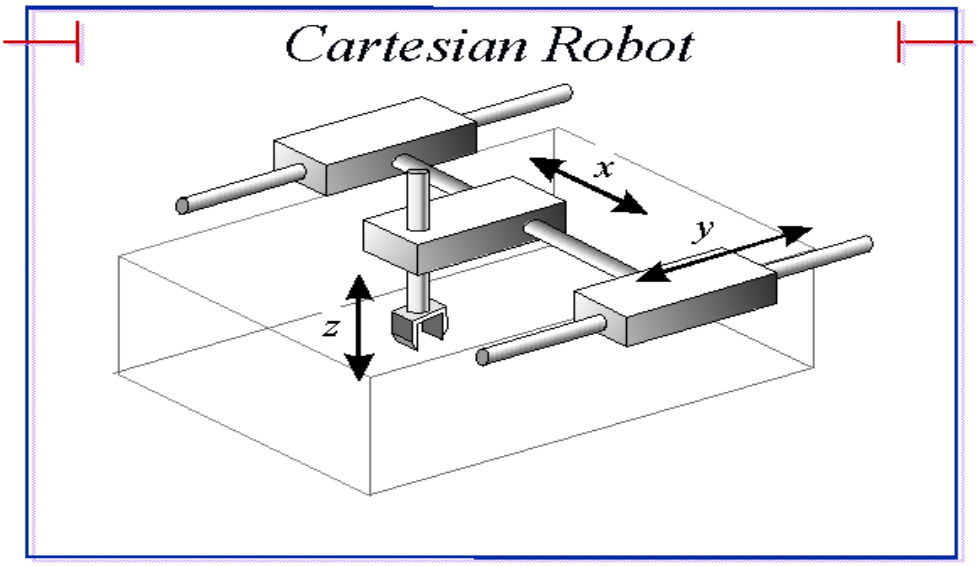


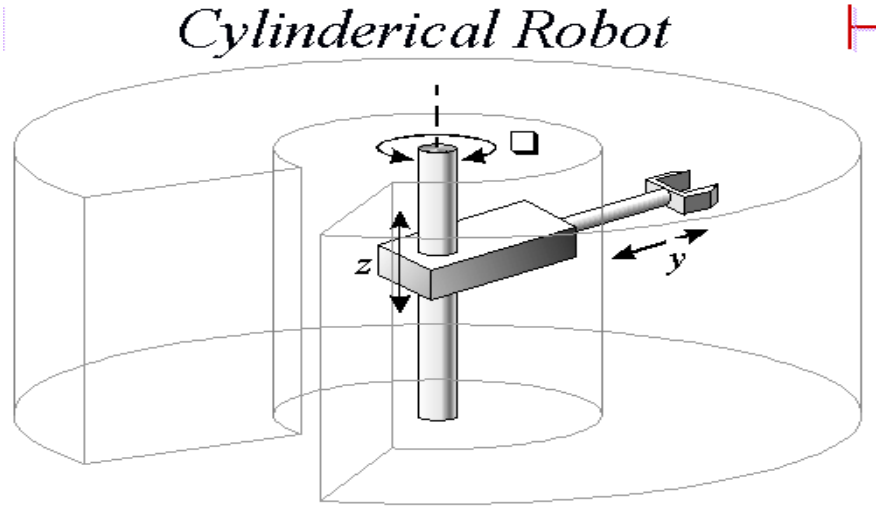
SCARA

This robot conforms to cylindrical coordinates, but the radius and rotation is obtained by a two planar links with revolute joints. It is a RRP configuration & is used for pick and place work, application of sealant, assembly operations and handling machine tools. It's a robot which has two parallel rotary joints to provide compliance in a plane

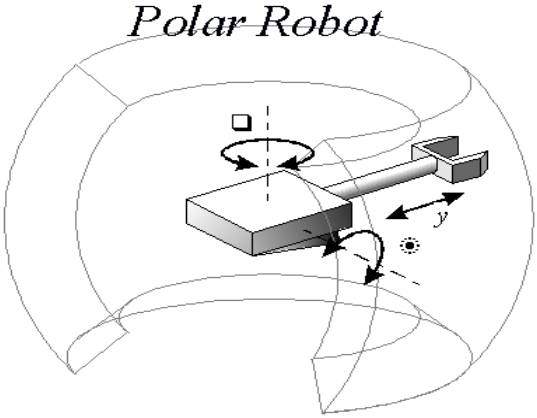
5.6 WORK VOLUMES

Work Volume is defined as the 3 Dimensional Space around the arm where it can reach again & again with a desired accuracy & precision.

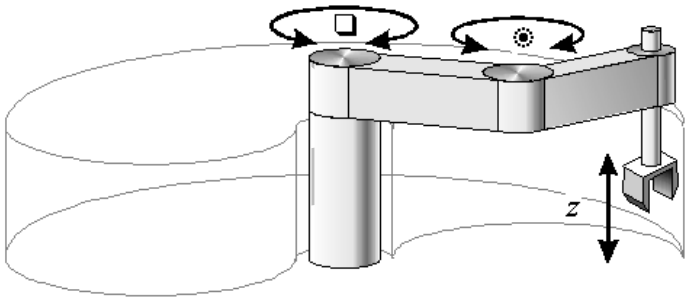




Polar Robot



SCARA Robot



S.NO	Configuration	Joints Type	Advantages /Disadvantages
1	Cartesian	PPP	Advantages 1. Linear motion in 3 dimensions 2. Simple Kinematic Model 3. Rigid Structure 4. Easy to visualize 5. Compatible With pneumatics Disadvantages 1. Requires a large volume 2. Workspace is smaller than robot volume. 3. Unable to reach areas under objects 4. Guiding surfaces are required **5.** Must be covered to prevent ingress of dust
2	Cylinderical	**RPP**	Advantages 1. Simple Kinematic Model 2. Easy to visualize 3. Good access to cavities & machine openings 4. very powerful with hydraulic drives Disadvantages 1. Restricted work space 2. Prismatic guide difficult to seal **3.** Back of robot can overlap work volume.
3	Spherical	**RRP**	Advantages 1. Covers a large volme from a central support. 2. Can bend down to pick up fallen objects. Disadvantages 1. Complex Kinematic model **2.** Difficult to visualize
4	Jointed Arm	**RRR**	Advantages 1. Maximum Flexibility 2. Covers a large work space compared to work volume 3. Revolute joints are easy to seal 4. Suits electric drives 5. Can reach over & under objects Disadvantages

			1. Complex Kinematic model 2. Difficult to visualize 3. Control of linear motion is difficult **4.** Structure not very rigid

PRACTICAL NO. 06

AIM: - STUDY OF ROBOTIC END EFFECTORS.

THEORY: -

6.1 INTRODUCTION

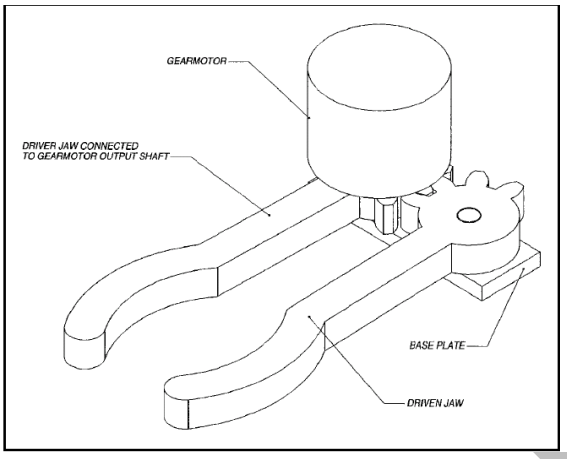
The end of the manipulator is the part the user or robot uses to affect something in the environment. For this reason it is commonly called an end-effector, but it is also called a gripper since that is a very common task for it to perform when mounted on a robot. It is often used to pick up dangerous or suspicious items for the robot to carry, some can turn doorknobs, and others are designed to carry only very specific things like cans. Closing too tightly on an object and crushing it is a major problem with autonomous grippers. There must be some way to tell how hard is enough to hold the object without dropping it or crushing it. Even for semi-autonomous robots where a human controls the manipulator, using the gripper effectively is often difficult. For these reasons, gripper design requires as much knowledge as possible of the range of items the gripper will be expected to handle. Their mass, size, shape, and strength, etc. all must be taken into account. Some objects require grippers that have many jaws, but in most cases, grippers have only two jaws and those will be shown here.

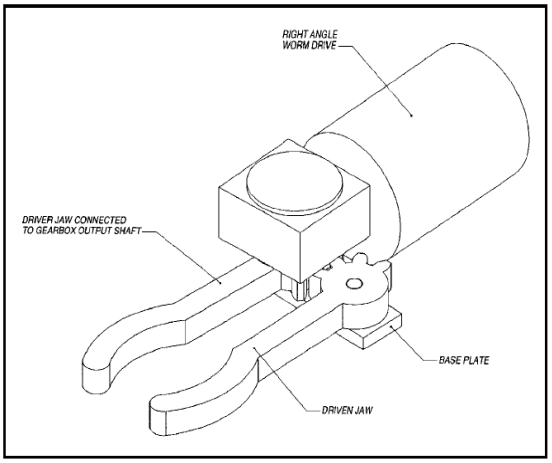
6.2 Types of Grippers

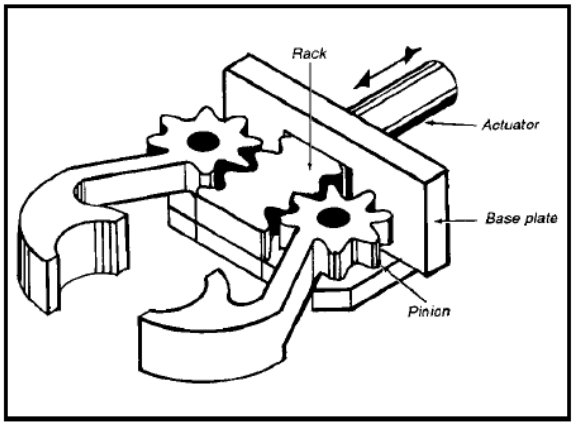
1. Mechanical grippers
2. Collet grippers
3. Vacuum grippers
4. Fragile-object grippers
5. Magnetic grippers
6. Expandable grippers

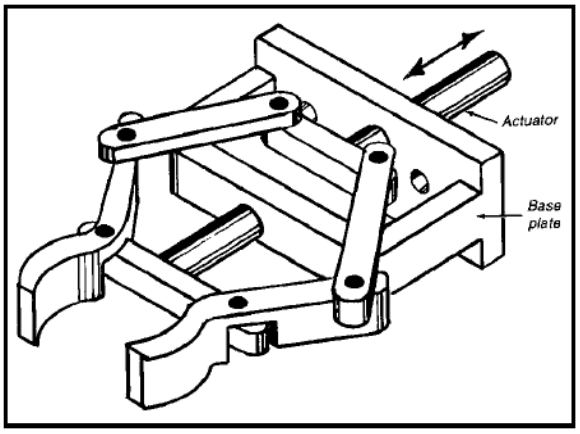
MECHANICAL GRIPPERS

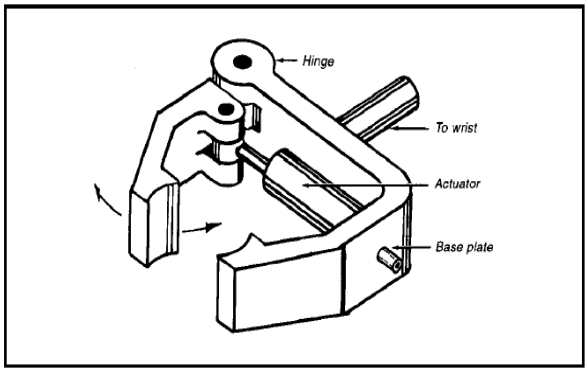
Mechanical grippers are the most common grippers available. They make use of levers, gears, springs etc to hold objects. They can be angular or parallel

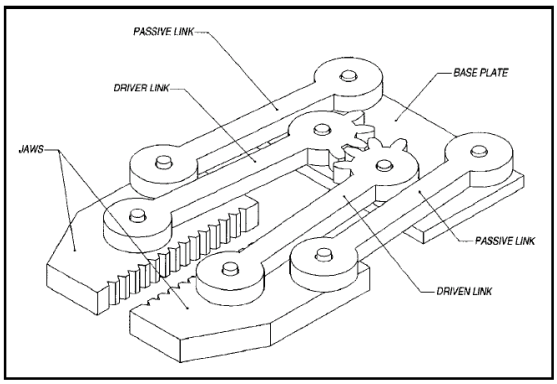


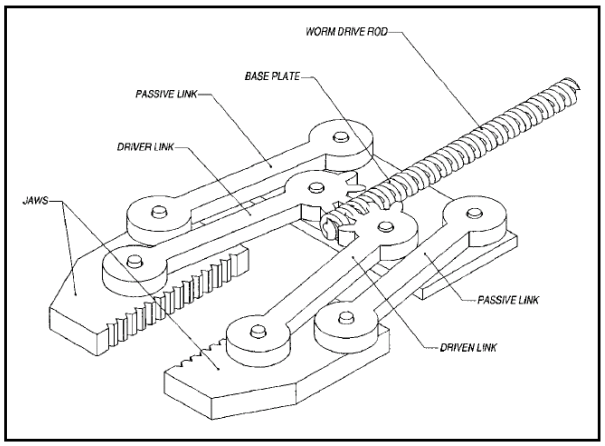


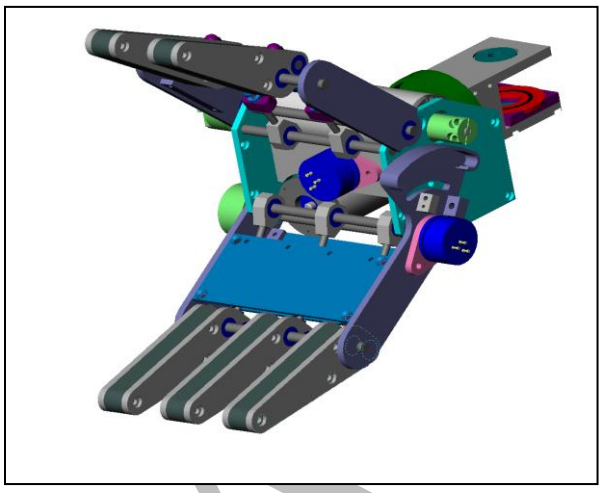


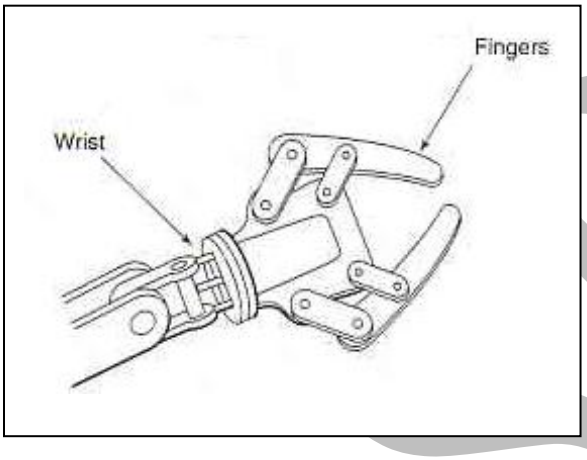


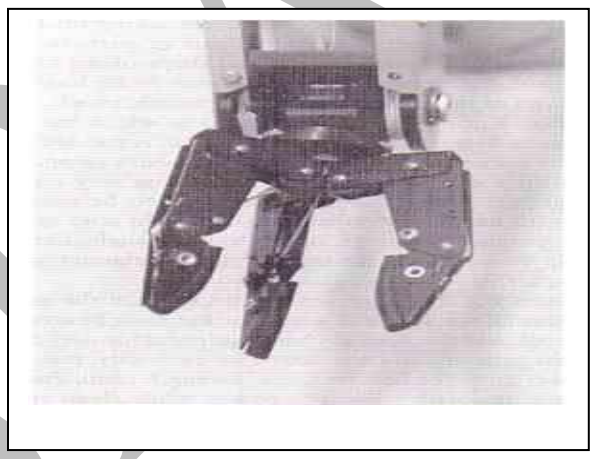








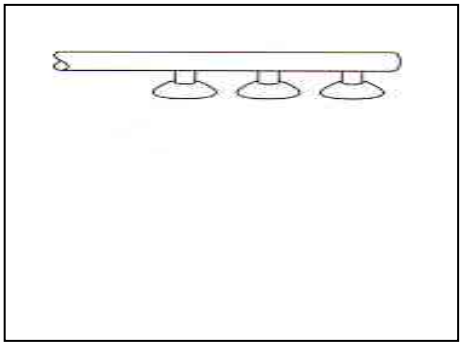




COLLET GRIPPERS

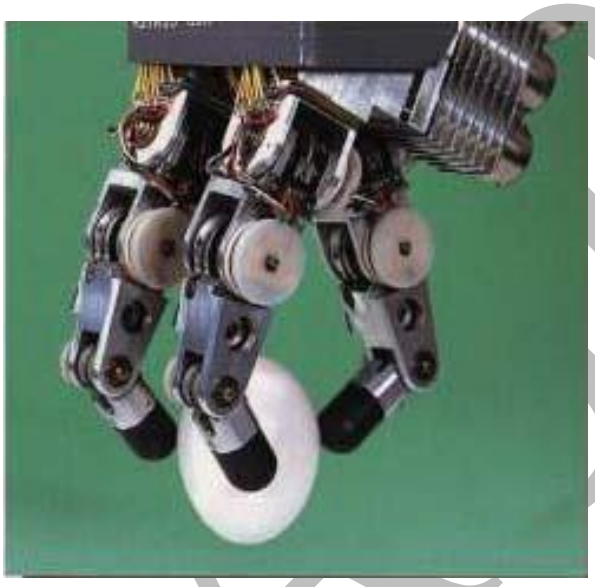
Collet grippers are used to pick and place cylindrical parts that are uniform in size. They are particularly used where the end tooling is required for machining operations etc.360° of clamping contact is achieved in such grippers and round, square or hexagonal shapes can be accommodated.

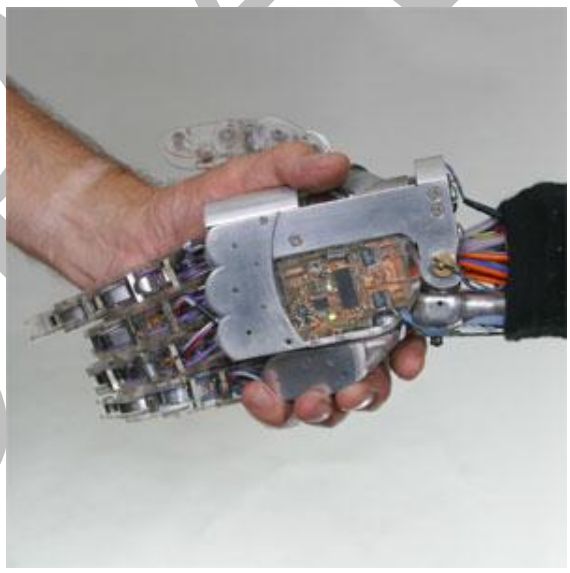
VACUUM GRIPPERS



Vacuum grippers make use of negative pressure to hold the things. Smooth surface can be handled using such grippers. They utilizes suction cups made of natural or synthetic rubber. Number of grippers (cups) determines the size and weight of object to be grasped Handling of fragile parts. Positioning of parts not as critical as with other grippers

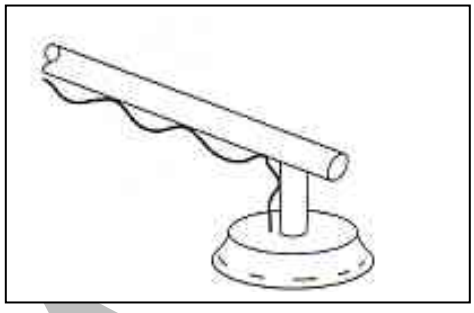
FRAGILE-OBJECT GRIPPERS





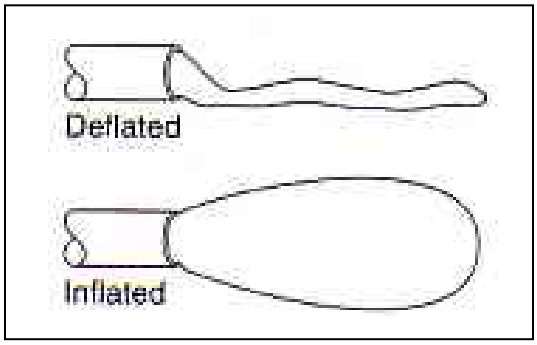
Fragile grippers have got cushioning in their grips along with they are provided with force control system on the grips in the form of load cells or adjustable pressure control so that the object of interest is gripped properly without damage. These grippers are used to handle sophisticated, delicate and prone to fracture objects in which the amount of compliance required is controllable and which plays a great role.

MAGNETIC GRIPPERS



These grippers work on the principle of magnetic effect either from a Electromagnet or permanent magnet. If permanent magnet is used, there needs to be some stripping device to separate part from gripper. Ferrous parts, easier to handle if surface is smooth and clean. Support grippers. Crane-type manipulators have support grippers, e.g. hooks, scoops etc. The main problem is that objects have a tendency to topple over or fall with quick movements. The wire as shown carries the electric supply which makes an scoop or hook as electromagnet thereby attracting the ferrous material.

EXPANDABLE GRIPPERS



These grippers are made up of hollow rubber envelope which expands when pressurized to grasp object. Such grippers are employed where evenly distributed pressure on surface is required for gripping. There are two types of expandable grippers: interior or exterior grasping.

PRACTICAL NO. 07

AIM: - STUDY OF DIFFERENT TYPES OF HYDRAULIC AND PNEUMATIC VALVES.

THEORY: -

7.1 INTRODUCTION

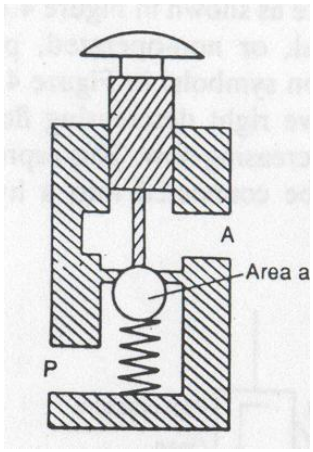
The function of valves is to control the pressure or flow rate of pressure media. The principle of operation of most valves is the same. A valve is a variable area orifice where the orifice area may be controlled by conditions in a circuit, for example a pressure relief valve operates without operator intervention. Alternatively the orifice area may be controlled by an operator as in a directional control valve. Valves are used in hydraulic & pneumatic systems to control the operation of the actuators. Valves regulate pressure by creating special pressure conditions and by controlling how much oil will flow in portions of a circuit and where it will go. The three categories of hydraulic valves are pressure-control, flow- (volume-) control, and directional-control. Some valves have multiple functions, placing them into more than one category. Valves are rated by their size, pressure capabilities, and pressure drop/flow. Depending upon design, these can be divided into following categories:

Direction control valves
Flow control valves
Pressure control valves
Special Purpose Valves
Logic Valve
Servo Valves

7.2 DIRECTION CONTROL VALVES

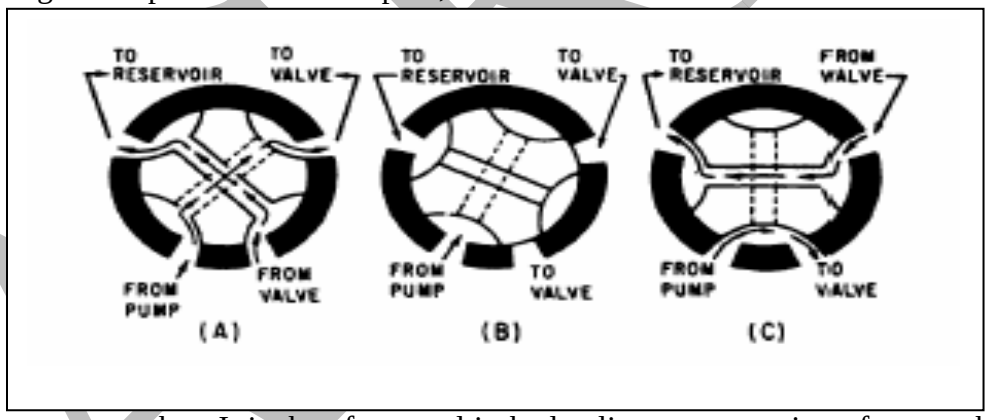
Directional-control valves also control flow direction. However, they vary considerably in physical characteristics and operation. Directional-control valves may also be classified according to the method used to actuate the valve element. A poppet-type valve is usually hydraulically operated. A rotary-spool type may be manually (lever or plunger action), mechanically (cam or trip action), or electrically (solenoid action) operated. A sliding-spool type may be manually, mechanically, electrically, or hydraulically operated, or it may be operated in combination. The valves maybe a

1. Poppet type, in which a piston or ball moves on and off a seat. It consists primarily of a movable poppet that closes against a valve seat. Pressure from the inlet tends to hold the valve tightly closed. A slight



2. force applied to the poppet stem opens the poppet. The action is similar to the valves of an automobile engine. The poppet stem usually has an O-ring seal to prevent leakage. In some valves, the pop-petsare held in the seated position by springs. The number of poppets in a valve depends on the purpose of the valve.

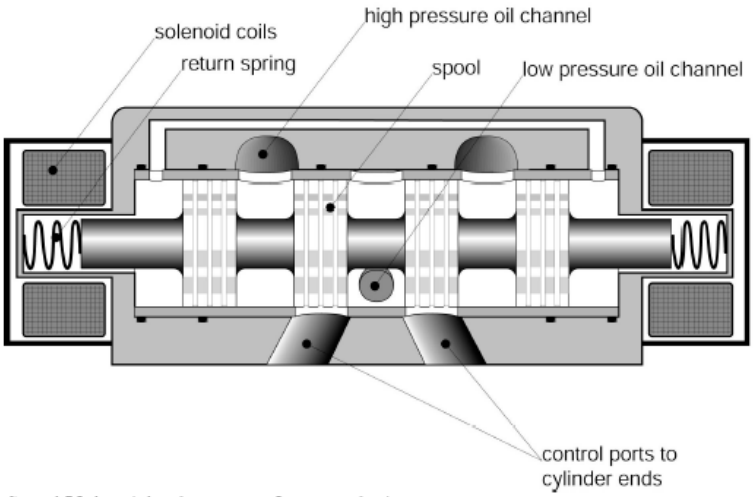
2. Rotary Spool Control type, in which a spool rotates about its axis and the angular displacement of the spool, controls the flow of fluid from one



port to another. It is therefore used in hydraulic power steering of automobiles in which direction of rotation of the steering wheel determines the steering direction of the wheels.

3. Sliding Spool Valve is simplest form of spool is a series of small cylindrical drums on a shaft. Each drum may be called a land. The minimum number of lands in a spool valve is two, but four are often used in more expensive valves, such as the proportional type, to achieve more accurate guidance. The valve body has grooves machined in the bore. The edges of the spool lands and the

grooves in the bore are machined to a vanishing small radius, so the cylindrical ring orifice that is formed by the displacement of the spool on the bore has sharp edges. Spool valves, however, require good maintenance.

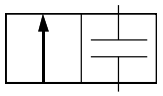


Spool Valve (also known as 3 way valve)

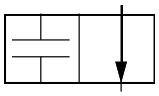
Sliding-spool type, in which a spool slides axially in a bore. In this type, a spool is often classified according to the flow conditions created when it is in the normal or neutral position. A closed-center spool blocks all valve ports from each other when in the normal position. In an open-center spool, all valve ports are open to each other when the spool is in the normal position. .

Directional-control valves may also be classified according to the number of positions of the valve elements or the total number of flow paths provided in the extreme position.

Two way, two position

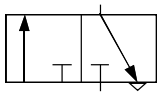


normally closed

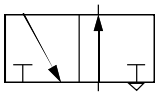


normally open

Three way, two position

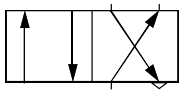


normally closed



normally open

Four way, two position



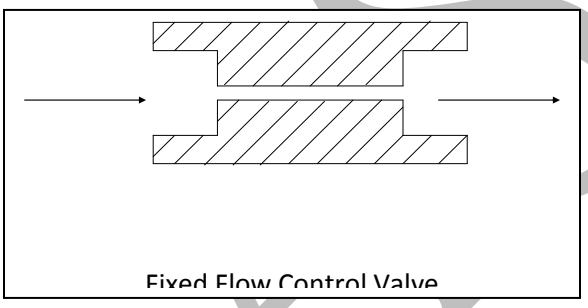
For example, a three-position, four-way valve has two extreme positions and a center or neutral position. In each of the two extreme positions, there are two flow paths, making a total of four flow paths or four way or four ports.

7.3 FLOW CONTROL VALVES

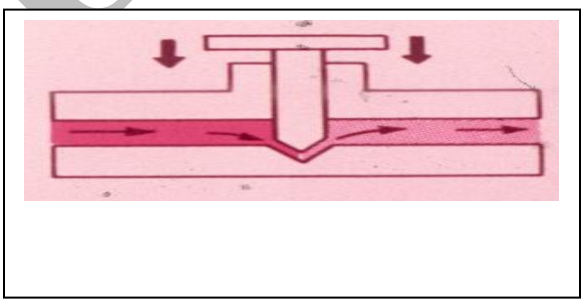
The purpose of flow control in a hydraulic system is to regulate speed of the system. The control the speed of an actuator is carried out by regulating the flow rate of the fluid passing through it. Flow rate also determines rate of energy transfer at any given pressure. The two are related in that the actuator force multiplied by the distance through which it moves (stroke) equals the work done on the load. The energy transferred must also equal the work done. Actuator speed determines the rate of energy transfer (i.e., horsepower), and speed is thus a function of flow rate.

The flow control valves are of two types:

- Fixed flow control valves
- Variable flow control valves

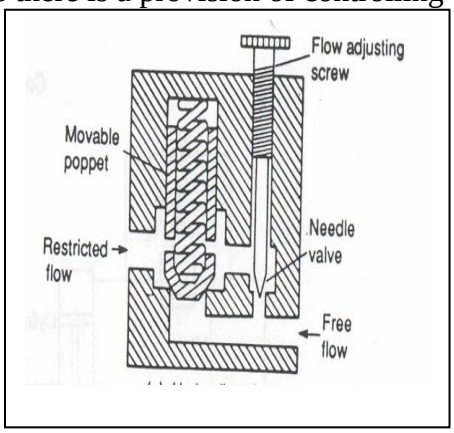


Fixed Flow Control Valve



In fixed flow control types of valves the amount of fluid passing through it remains fixed whereas in the variable flow control valves there is a provision of controlling the flow of fluid passing through it.

One more type of flow control valve is Restricted Flow Control Valve. In this valve the in one direction the flow is free to move and in the other direction the flow can be



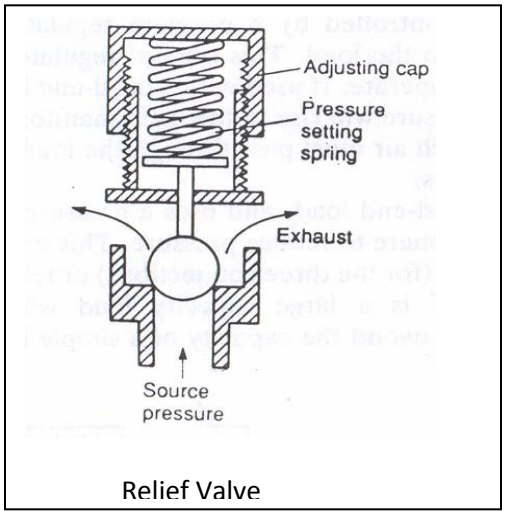
controlled. These are widely used in controlling the speed of various actuators.

7.4 PRESSURE CONTROL VALVES:

A pressure-control valve may limit or regulate pressure, create a particular pressure condition required for control, or cause actuators to operate in a specific order. All pure pressure-control valves operate in a condition approaching hydraulic balance. Usually the balance is very simple: pressure is effective on one side or end of a ball, poppet, or spool and is opposed by a spring. In operation, a valve takes a position where hydraulic pressure balances a spring force. Since spring force varies with compression, distance and pressure also can vary. Pressure-control valves are said to be infinite positioning. This means that they can take a position anywhere between two finite flow conditions, which changes a large volume of flow to a small volume, or pass no flow.

Most pressure-control valves are classified as normally closed. This means that flow to a valve's inlet port is blocked from an outlet port until there is enough pressure to cause an unbalanced operation. In normally open valves, free flow occurs through the valves until they begin to operate in balance. Flow is partially restricted or cut off. Pressure override is a characteristic of normally closed-pressure controls when they are operating in balance. Because the force of a compression spring increases as it lowers, pressure when the valves first crack is less than when they are passing a large volume or full flow. The difference between a full flow and cracking pressure is called override.

The simplest example of a pressure control valve is relief valve. The relief valve is used to release the extra pressure if mounted in the system against the set pressure. It works on the principle of counterbalance of forces. The tension in the controlling spring is adjusted against the pressure of the fluid acting in the system. If the force exerted due to pressure is more than the spring tension

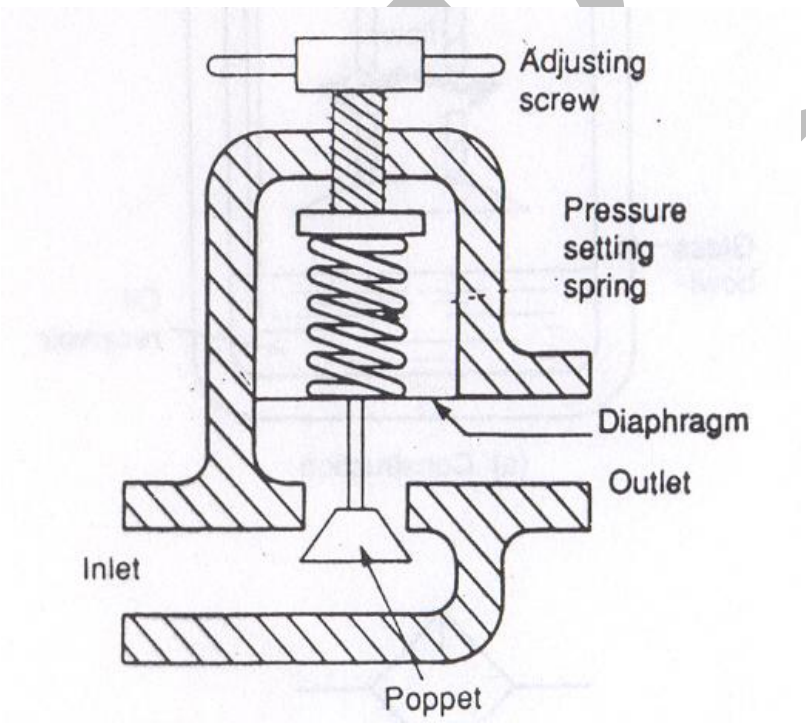


Relief Valve

then the extra pressure is relieved to the atmosphere.

Relief valves come in two forms. In the direct acting type, the pressure to be relieved acts directly on the fluid regulating element. This type is commonly employed in systems with relatively low flow rates. Where high flow rates must be passed, a pilot operated type is commonly employed. In this type the pressure to be controlled acts on a pilot. As soon as this pilot allows flow, the pressure difference across the main regulating element becomes large enough to provide a force that causes the valve to open rapidly because the spring controlling the main element is light.

NON RELIEVING TYPE PRESSURE CONTROL VALVE

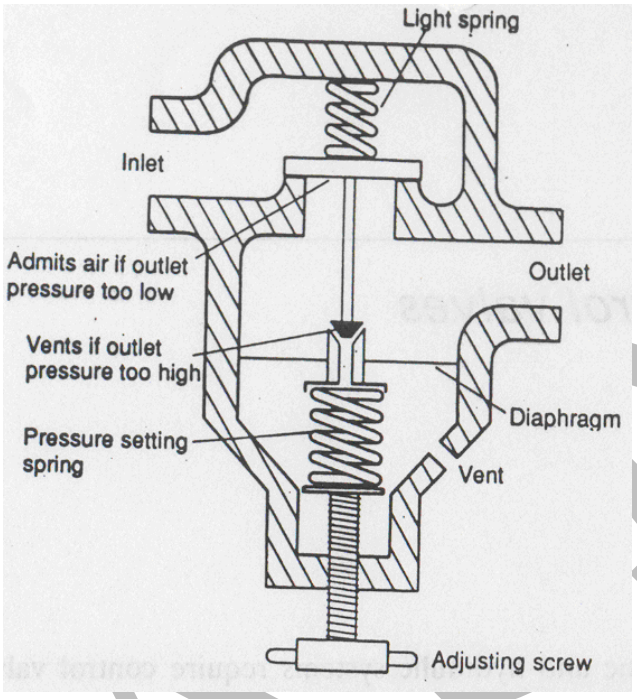


In non relieving type pressure control system the system pressure acts on a diaphragm which is resting on a spring whose tension can be adjusted. As the pressure in the system is less than the spring tension and the system pressure, the poppet will move down and allow more fluid to enter from the pressure line and if the system pressure is low the diaphragm will move up causing the poppet to close on the seat thereby

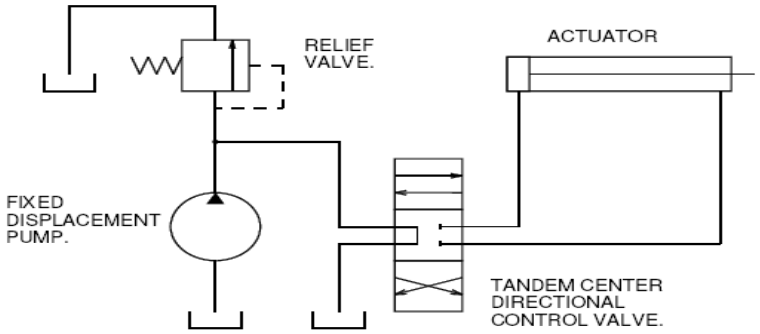
restricting the flow of fluid from the source into the system. In this way the pressure is regulated without relieving the fluid to move out of the system.

RELIEVING TYPE PRESSURE CONTROL VALVE

In this type of pressure regulating device there is an arrangement of vent through which if somehow an extra pressure is maintained in the system, then that can be relieved.

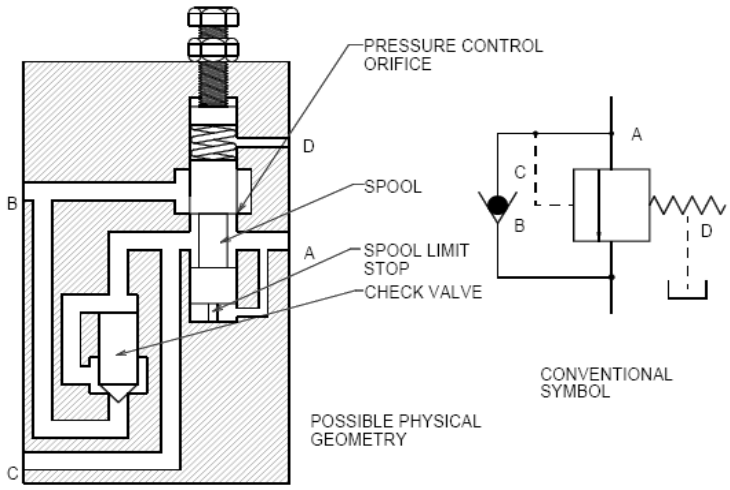


These pressure regulating devices are employed where there is high pressure to deal with and the excessive pressure can be allowed to go back into the reservoir or to be liberated.These pressure regulating devices are provided in the high pressure line between the source and the direction control valves as shown in the figure given below.



Pressure protection of a system with a relief valve.

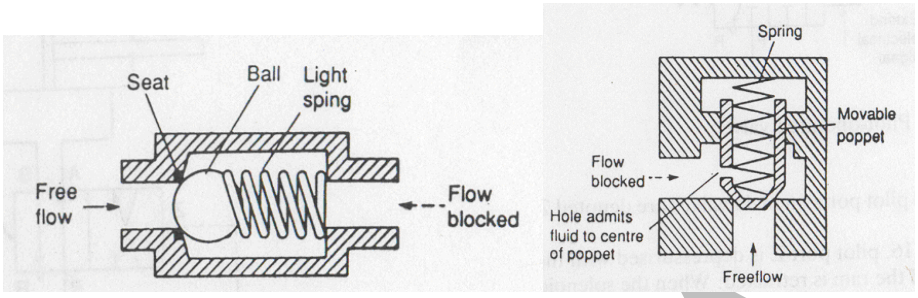
PRESSURE SEQUENCING VALVE



It is often necessary for two actions to take place sequentially. For example, in a machining operation the work piece may be clamped by one actuator and after the clamping action is completed a drill head may be moved by another actuator. At the end of clamping, the actuator extension is blocked and the pressure will rise. This pressure rise can be sensed by a sequencing valve and the flow diverted to a secondary circuit. A sequencing valve is a special application of a direct action relief valve (Figure 7.17). The pressure differential across the fluid control element is between the primary circuit pressure and the reservoir.

7.5 SPECIAL PURPOSE VALVES

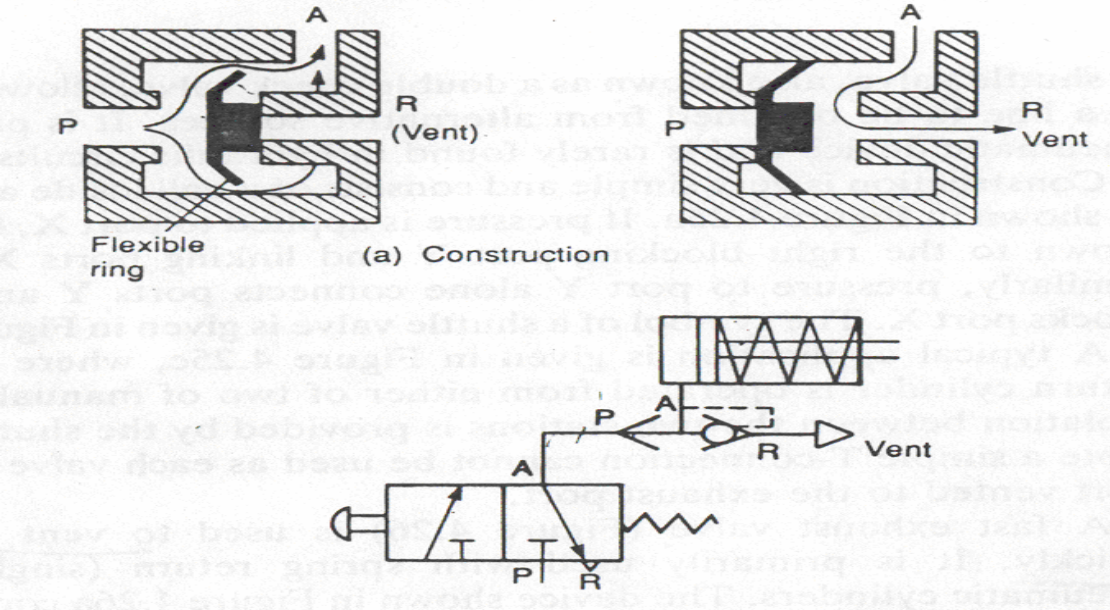
CHECK VALVE



The check valve in the system is to check the direction of fluid flow in the reverse direction. This is also called as unidirectional valve as it allows the flow only in on direction

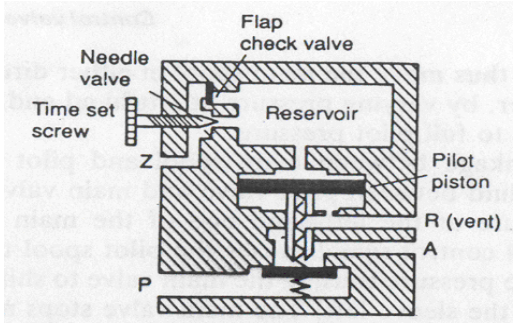
QUICK EXHAUST VALVE

This valve is used when the used air is removed from the actuator in a very short time. In this valve the fluid is allowed to come from a constricted opening from P due to a flexible ring but is allowed to escape from a bigger opening R and thereby venting the fluid from the system in a very small time. To make the unproductive strokes faster such valves are used which can help in reducing the cycle time.

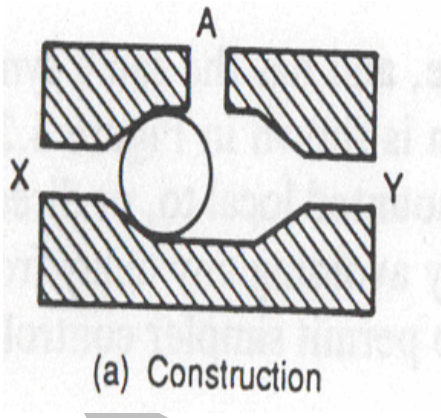


TIME DELAY VALVE

Time delay valve is a valve in which there is an arrangement of three ports. One port is for pressure supply and the other one the output port. The third one is the trigger port and when the pilot pressure is applied on this trigger port, the delay starts .This delay can be adjusted by the movement of the set screw of needle valve. As the delay period is over the pressure line gets connected to the output line.



Time Delay Valve



(a) Construction

7.6 LOGIC VALVES

Logic valves are those valves which work on the principle of gates.

1 Shuttle Valve/ OR Gate:

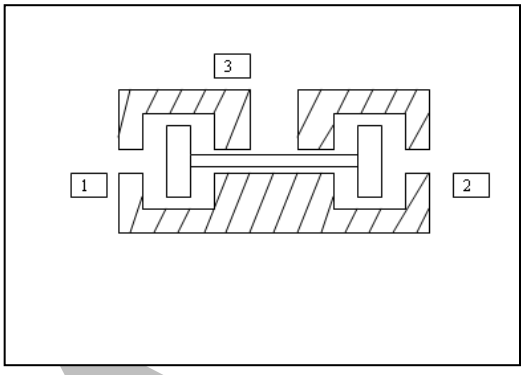
This valve acts like a or gate. Here there are two inputs X & Y and one output A.

When there is supply or input at any of X or Y or both the output can be collected from port A based on OR Logic

Shuttle Valve

2 Twin Pressure Valve/AND Gate:

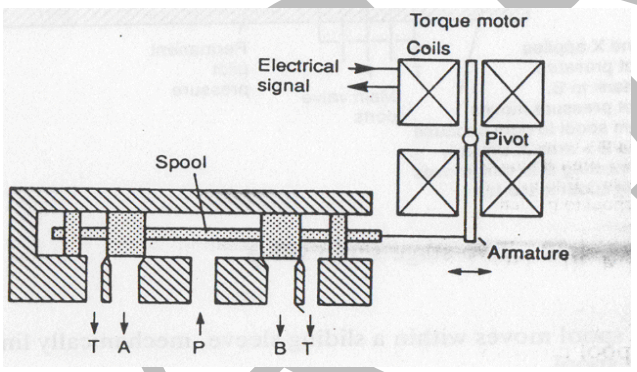
This valve acts like a AND gate. Here there are two inputs X & Y and one output A. When there is supply on both inputs then only the output can be collected from port A based on AND Logic. In this valve 1 and 2 are inputs and 3 is output. Output only occurs when there is an and preposition between the inputs



SERVO VALVES

These are infinite position valve which gives their output on the basis of a feedback signal from the system

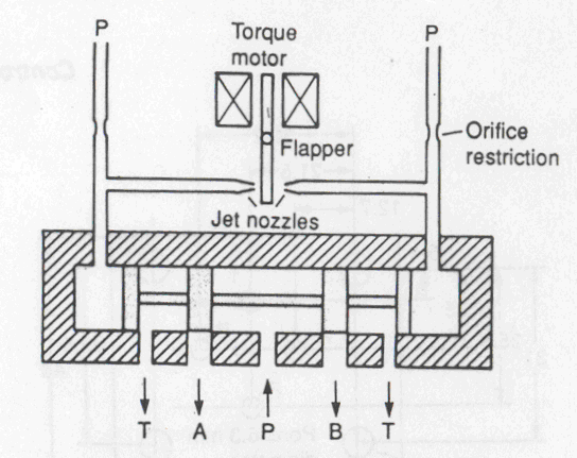
1. Angular displacement Servo Valve



Servo name is associated with the feedback. The spool movement is connected to a angular displacement measuring system which calibrates it in an electrical

signal. The movement of the servo can be controlled using the feedback electrical signal.

2 Jet Flapper Servo Valve

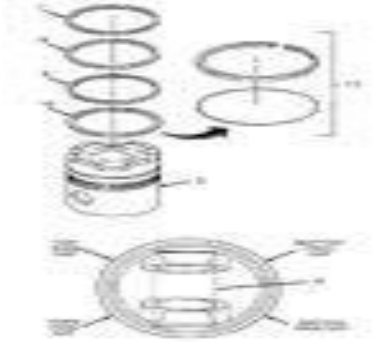


In jet flapper servo valve when the flapper is in the centre the spool is at normal mean position. As there is some variation then the flapper closes the opening of the jet nozzles restricting the release of fluid and a differential pressure is created at the ends of the spool valve. This differential pressure acts on the spool valve and is responsible for the actuation of the spool thereby controlling the fluid.

BTME 509 Automobile Engineering Lab

Experiment no. 1

AIM: Replacing of Piston Ring & Studying the method of replacing piston after repair.



PROCEDURE:

1. **Replacing the piston assembly**

In this step, first is to remove the piston, piston ring and connecting rod assembly from the cylinder head. For this drain the engine oil. The piston, piston ring & connecting rod is designed to be removed from the top of the cylinder. This is an important precaution which must be observed after removing the cylinder head. After this cylinder block should be inspected for ridge at the top, which shows upper limit of the piston travel in the cylinder. This ridge, if formed, must be removed before proceeding further because otherwise the rings are liable to break, if an over attempt is made to take out the piston assembly from top.

The rings are removed by means of ring remover from the piston. This facilitates uniform expansion of the ring avoiding stress concentration at any point so that brittle rings are not broken on this account. However if ring remover is not available, a thin strip is inserted below the rings at its end and is placed in between the piston.

2. Assembling

Piston, Piston Ring & Connecting Rod is assembled in cylinder after repairs.

Dip the piston assembly in SAE-20 oil, drain excess oil. Use a loading sleeve or piston ring compressor to compress the rings into piston ring grooves. Install guide sleeve on the rod bolts or cover the rod bolts with rubber hole. Then push the piston down into cylinder. Tapping the head with the help of hammer, set the piston have a notch or other mark that should be on the face to mark the front of engine on v-type engine, the connecting rod must be installed.

Attach the rod with nuts, and then tap the cap on its crown tightly.

Experiment no. 2

AIM: Demonstration of steering system & measurement of steering geometry angles and their impact on vehicle performance.

Description: primary function of the steering is to achieve line angular motion of the front wheel for turn.

1. To provide direction stability to the vehicle.
2. For perfect steering condition.
3. To minimize tyre wear.

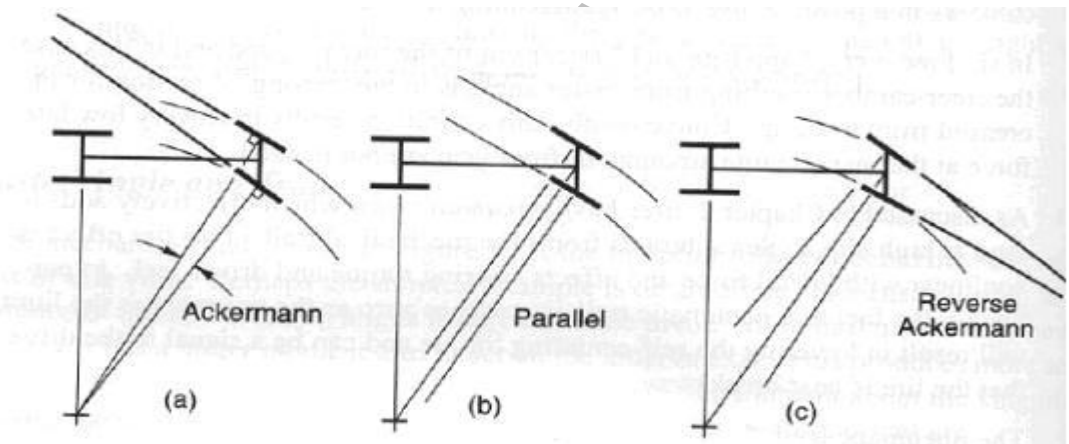


Figure 19.2 Ackermann steering geometry.

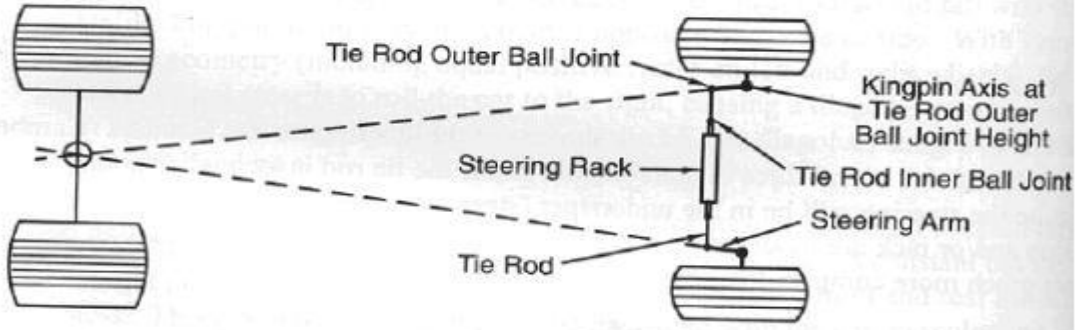


Figure 19.3 Ackermann geometry, with steering rack behind the axle line.

Requirements of Good Steering:

1. The steering mechanism should be very accurate.
2. The effort requirement to steer should be minimum.
3. The steering mechanism should provide direction stability.

STEERING GEOMETRY:

Camber: it is the tilt of the car wheels from the vertical. Camber is positive if the tilt is outward at the top. Initial camber is provided to the wheel.

Kingpin inclination: inclination of the kingpin from the vertical is called kingpin inclination. Steering axes is an imaginary line drawn through the lower & upper steering pivot points.

Combined angle &scrab radius: it is the angle formed in the vertical plane between the wheel centre line & the kingpin centre line in the rear wheel drive vehicle. The attractive force on the wheel pushes the suspension.

Caster: The angle between the kingpin centreline , the vertical in the plane of wheel is called the caster angle. If the kingpin centre line meets the ground acts a point in front of the wheel centre.

Correct steering angle: The perfect steering is achieved when all four wheels rolling perfectly under all conditions of running. While taking turn, the condition of perfect rolling is satisfied if the axes of front wheel meet wheel axes at one point.

Ackerman mechanism: links R(a) & R(b) are integral with the axles. These links are connected with each other through track rod AB. These links are make equal angle with the centre line of the car.

$\mathrm{Sin}(r+\Theta) = y-x$

Steering gear: the steering gear converts the turning motion of the steering wheel into the to and fro motion of necessary leverage so that the driver is able to steer the vehicle without fatigue.

Aim: Fault diagnosis in Transmission System including Clutches, Gear Box Assembly and Differential.

Description: The Transmission System consists of Clutch, Gear Box, Propeller Shaft to transmit the torque from Gear Box to Rear Axle and a Differential Gear Box to distribute the final torque equally between the driving wheels.

Principle function of clutches: Theleft shaft A and disc is revolving at same speed say N r.p.m. Shaft B & disc D to be equal to it, are stationary, initially when axial flow W to the disc D. If W is increased gradually the speed of D will increase correspondingly till the stage comes when the speed D becomes equal to the speed of C. then the clutch is said to be fully engaged

Types of clutches:

1. Cone clutch
2. Single plate clutch
3. Multiplate clutch
4. Semi-centrifugal clutch
5. Centrifugal clutch

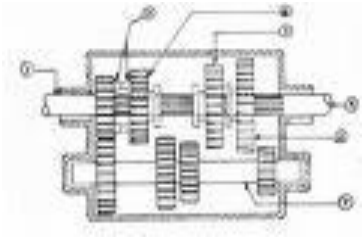
Troubleshooting in clutch

1. incorrect linkage adjustment
2. weak or broken clutch spring
3. worn splines on clutch shaft

4. worn lining
5. clutch paddle bond

Sliding Mesh Gear Box

This is the simplest type of gear box. The power comes from engine to clutch. All gear in lay shaft are fixed to point 3 direct gears and reverse speeds are attainable & are used by selected mechanism.



Trouble shooting in gear box

1. Grinding noise in neutral.
2. damaged spectrometer drive gear
3. lack of lubricant
4. worn bearing

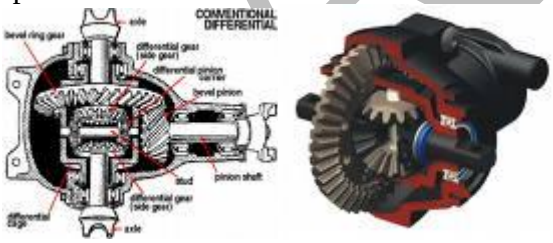
Hard shifting or sticking in gear

1. too long shifter
2. improper clutch adjustment
3. distorted lines on main shaft

Differential

When the outer wheels have to travel greater distance as compared to inner wheels than this differential is used. It consists of crown wheel which gives output to the bevels pinion which in turn has sun gear & planet gears which rotate the output shaft.

When the wheel takes turn then there will be a resistance to motion & the right wheel and as a result differential action, if right wheel rotates at rpm then left wheel will rotate forwarded at n rpm.



Trouble shooting at differential

Humming noise: when vehicle is in motion, it is caused by the worn out bearing which must be replaced. This problem may be due to the excessive clearance between pinion & crown wheel.

Aim: Trouble shooting in cooling system of an automobile vehicle

Cause of loss of coolant

Many leak can be spotted for two reason first the cooling system requires the frequent refining. Second the point of leak can be found at the top

Cause of Engine overheating:

Low coolant level caused the leakage of coolant.

Collapsed hoses which present normal coolant circulation.

Defective thermostat which does not open normally blocking circulation of coolant.

Testing of thermostat

Different car manufactures have different testing procedures for checking thermostat in a solution of 1/3 antifreeze and 2/3 of heater.

The thermostat should closed completely if it does not open and close doing the test it is then defective.

Checking for Exhaust gas leakage

The defective cylinder head gas kit may allow exhaust gas to leak into the cooling system this is very damaging strong acid. This draws on air sample from the cooling system up through the test fluid. The test fluid will change the yellow color. Combustion leaks in the valve area can crack the valve seats and cylinder head.

The coolant is forced away from the cracked area doing heavy acceleration by the leakage of combustion of gases during heavy acceleration by the leak of combustion gases through the leak.

Pressure testing the cooling system

We can use a proper tester to check the cooling system for leaks. To use the tester remove the radiator cap and fill the radiator until the coolant level is about ½ inch if no external leaks are visible in the tester then start the engine.

Pressure testing the radiator cap

The cooling system pressure tester can be used to check the radiator pressure cap. An adapter is attached to the tester pump, such that it will fit the cap. Then the pump is operated to apply the rated pressure against the cap. If the cap will not stand its rated pressure then it should be replaced.

Experiment no. 3

AIM:- Trouble shooting in braking system with specific reference to master cylinder, brake shoes, overhauling of system and the adjusting of the system and its testing.

Principle:

Brakes are required to stop the vehicle with in the system possible distance and this is done by connecting the kinetic energy which is dissipated into the atmosphere.

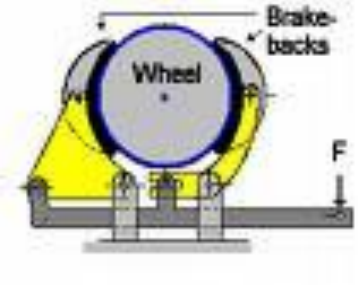
Braking requirement:

The brake must be strong enough to stop the vehicle with minimum distance in an emergency but this should be consist with safety.
The brake must have good anti-fade characteristics i.e. effectiveness should not be decrease with constant prolong applications e.g. while descending hills the requirement demands that the cooling of the brakes should be very efficient.

TYPES OF BRAKES

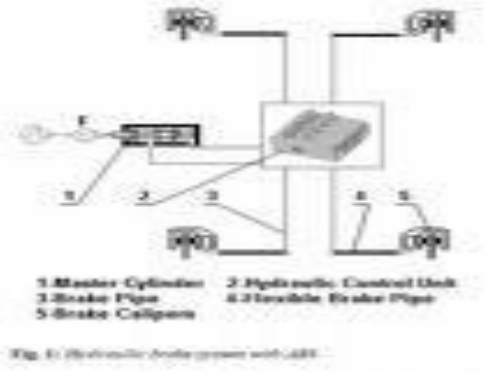
Mechanical brakes

In a motor vehicles the wheel called drum the brake shoes are made to contact the drum. The brake shoes have brake lining that comes in contact with drum as we apply the brakes restoring the springs.



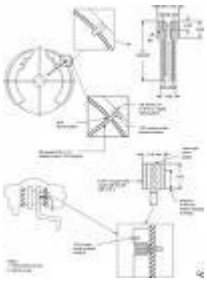
Hydraulic brakes

The hydraulic brakes are applied by the liquid pressure. The pedal force is transmitted to the power brakes shoes by means of combined liquid strength through a system of force transmission. This system is based on Pascal's principle. Hydraulic system consist of two component master cylinder & wheel cylinder.



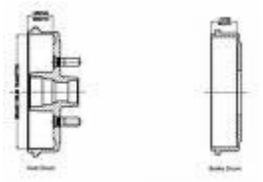
Electric brakes

These types of brakes are not commonly used but on trailers activate the mechanism to expand the brakes shoes when current stops the cams & brakes shoes returned the released position by the retardation springs the security of braking is controlled.



Drum Brakes

Construction of this types of brakes , a brake drum is attached to wheel , where as on the axle easily, is mounted on back plate . Friction lining are mounted on brake shoes. One or two retraction springs are used. Pressure in the master cylinder as same as vacuum is formed the atmospheric pressure in fluid reservoir forced the fluid through intake part & holes in the piston.



Leakage Caliper Cylinder

The leakage cylinder could be due to damaged or worn pistons. It should also be caused by roughness on surface.

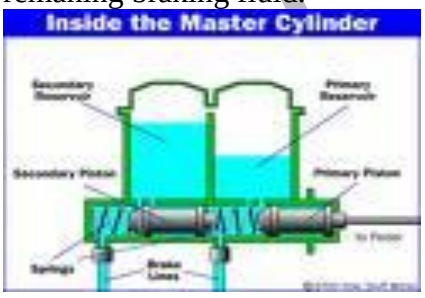
Brake Testing

There are two types of brake tests. The static dynamics one type.static tester has four treat plates at resisteing force at each wheel resisting column force.

Master cylinder service

Master cylinder mayy require to dissemble repair of internal part however. Some technician prefer to install ar new or reburte master.

To service the master cylinder clean the outside then service , then remove the cover seal of any remaning braking fluid.



AIM: Trouble shooting in the ignition system setting of contact breaker points & spark plug gap.

Description:

The function of ignition system is to produce a spark in the engine cylinder towards the end of combustion stroke.

Types of Ignition Systems

Battery Ignition System

The main component are battery ignition coil, contact brakes, condenser, distributor & spark plug.

Battery

The battery supplies current for starting of vehicle as well as to ignition system, lighting system etc. the main components are containers, separator plates, Electrolyte & cell cover.

Ignition Coil

It is a simply transform which sets low volume to high. The primary winding consists of 200-300 turn & flow through condensers & then secondary winding.

Contact Breakers

The function of the contact breakers is to make & break the primary ignition circuit

Condensers

It contacts across the contact breakers

Spark plug

Spark plug is device to produce electric spark to ignite the compressed air fuel mixture inside the cylinder

Magneto Ignition system

Magneto ignition system is of two types i) Rotating armature type ii) Rotating magnet type the primary winding ignition system and other parts of magneto system are similar to battery ignition.

Trouble shooting in ignition system

Engine missing

Defective spark plug, distribution cap or high tension head wrongly set

Engine over heating

Retarded ignition system timings

Engine back firing

Incorrect heat range of spark plug, retarded ignition timings

Methods of setting Breaker gap

By feeler gauge

The distribution cap is removed and the engine is cracking till the breaker gap is maintained. The gap is then checked by means of feeler gauge

By dial gauge The feeler gauge can't be used where contact point is fitted. In such case line dial gauge may be used.