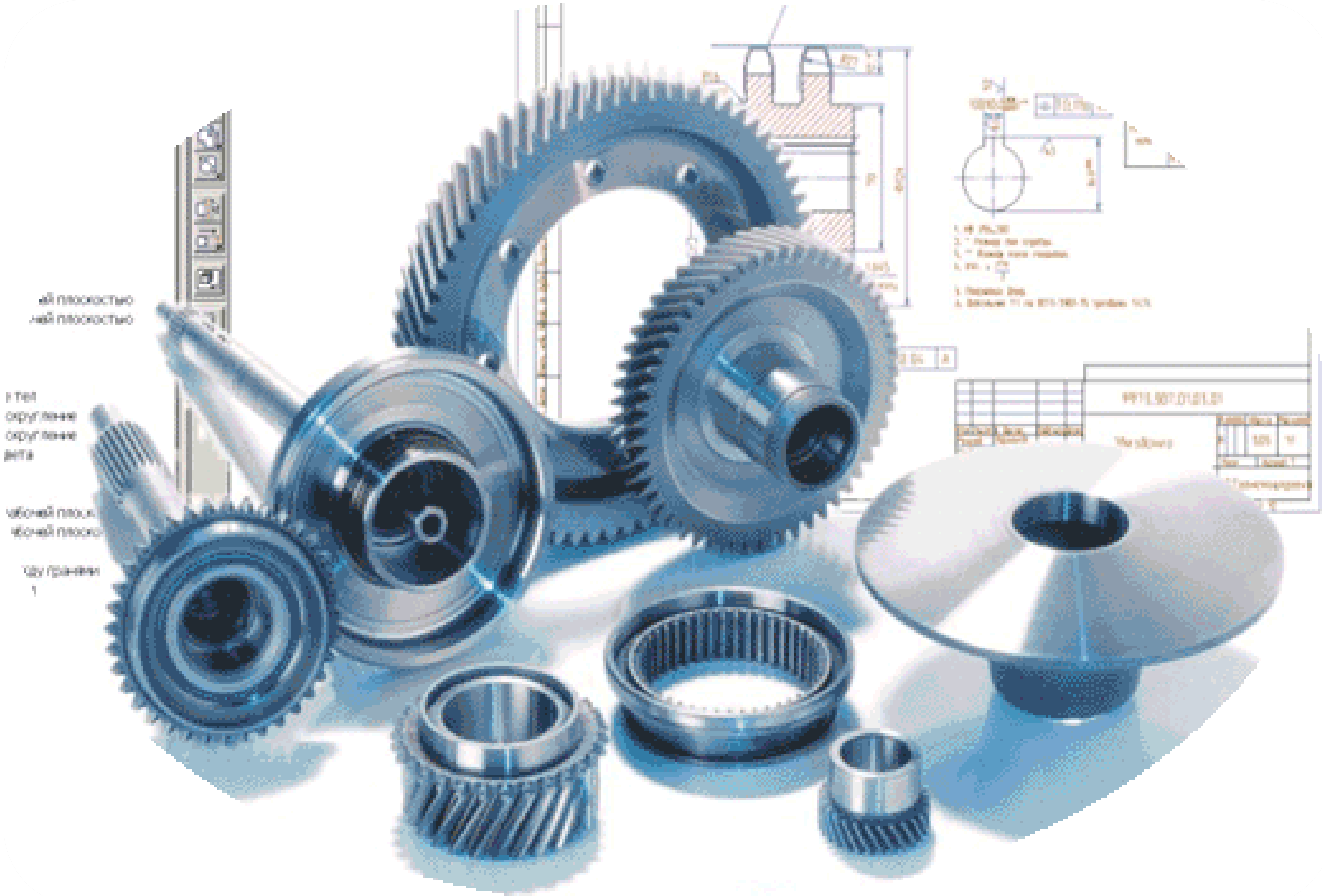
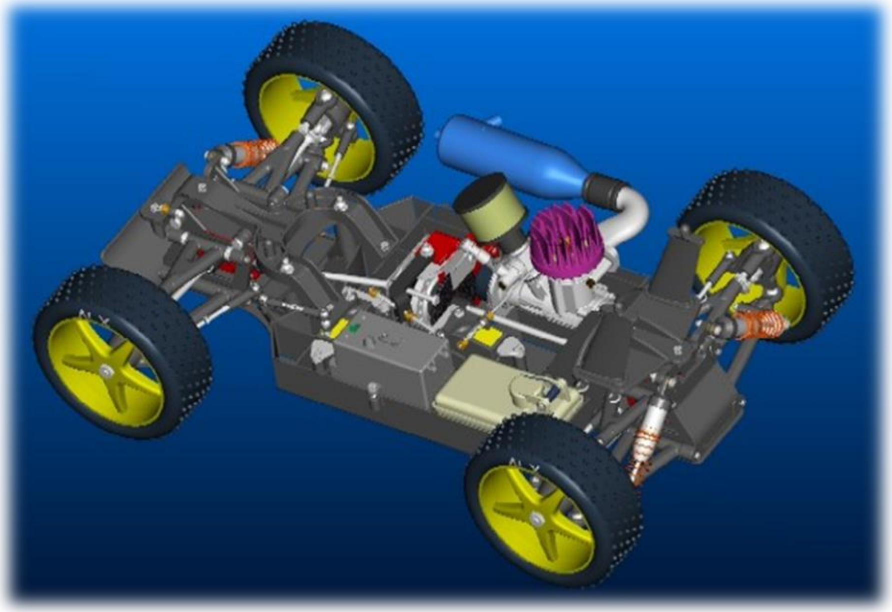
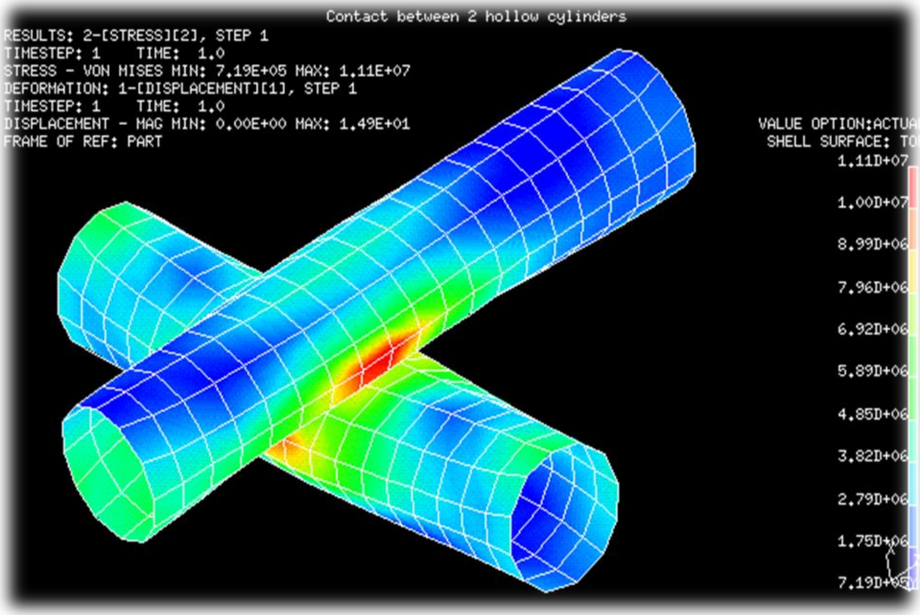


# WELCOME
# TO
# CAD LABORATORY

# VNR LAB PROTOCOL

# CAD LABORATORY





# PURPOSE OF THE LABORATORY

- This lab is to primarily facilitate students to evolve concepts and convert it into a complete product.
- The process of design, analysis and simulation takes place in a digitally integrated environment.

# 1. LEARNING OBJECTIVES

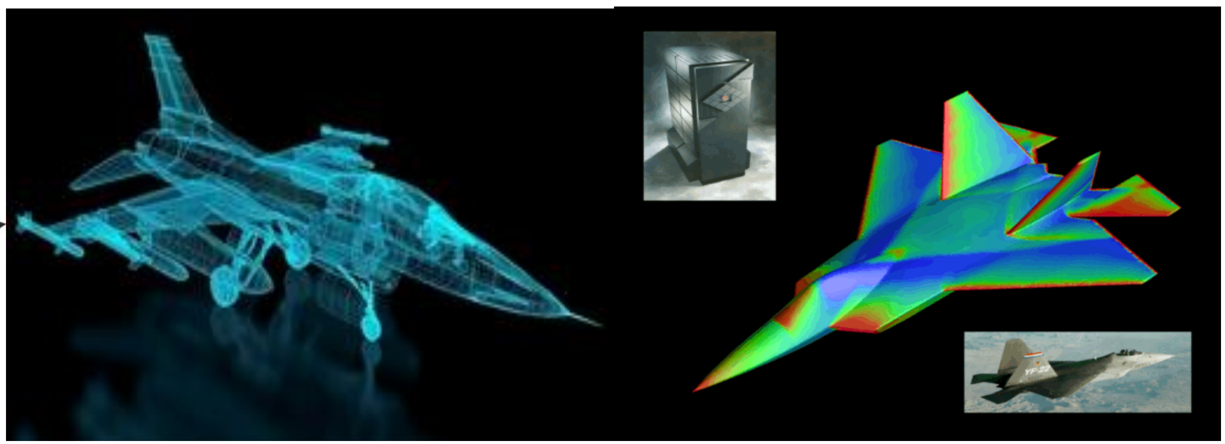
- **Understand the ways in which 2D, 3D, part drawings and assembly drawings are made using appropriate CAD packages.**

- **Understand the determination of stresses and strains in systems like trusses and beams.**

# LEARNING OUTCOMES

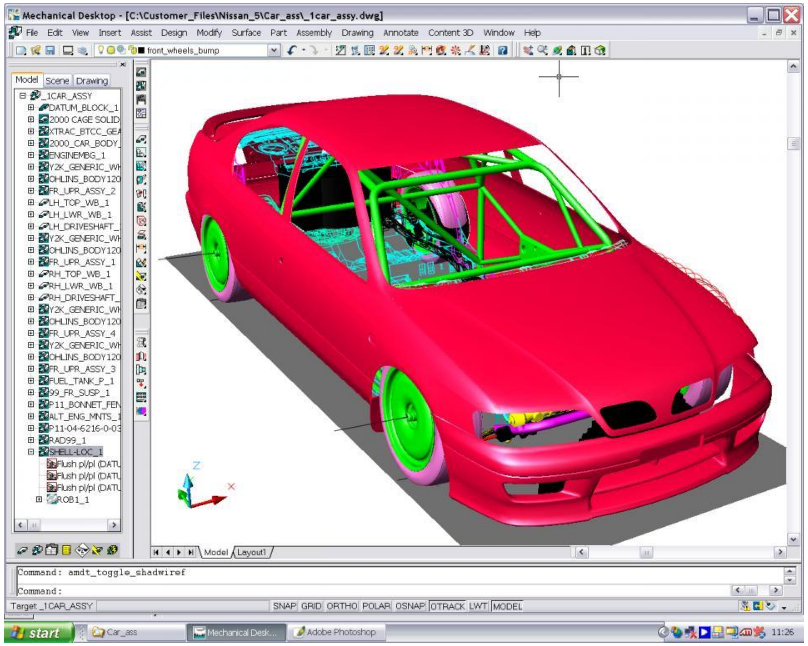
- **Students will be able to:**
  - **Produce part and assembly drawings using CAD packages.**
  - **Determine the stress, strain and elastic properties in components of the structures.**

# WHAT WILL WE STUDY IN THIS LAB?



- COMPUTER AIDED DESIGN
- COMPUTER AIDED ENGINEERING

# 2. BRINGING IN THE REAL WORLD SITUATION

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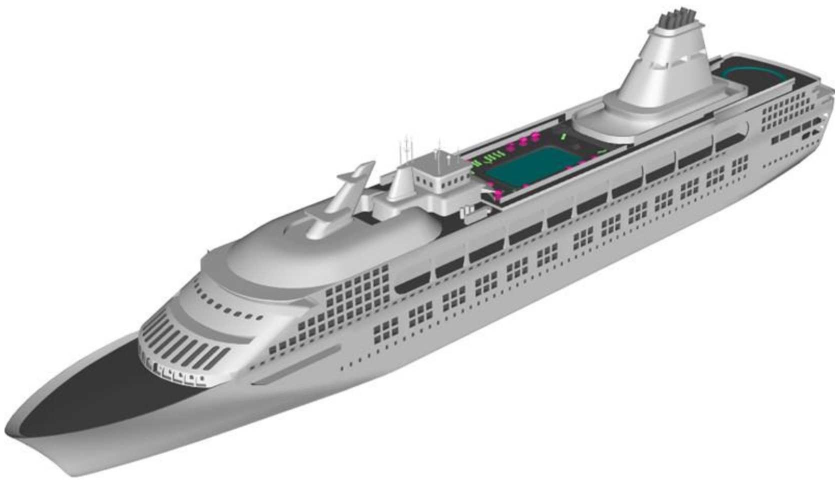

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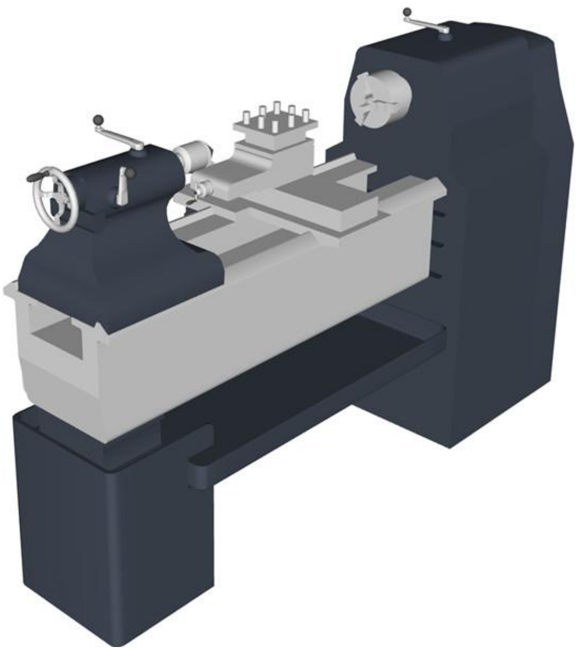

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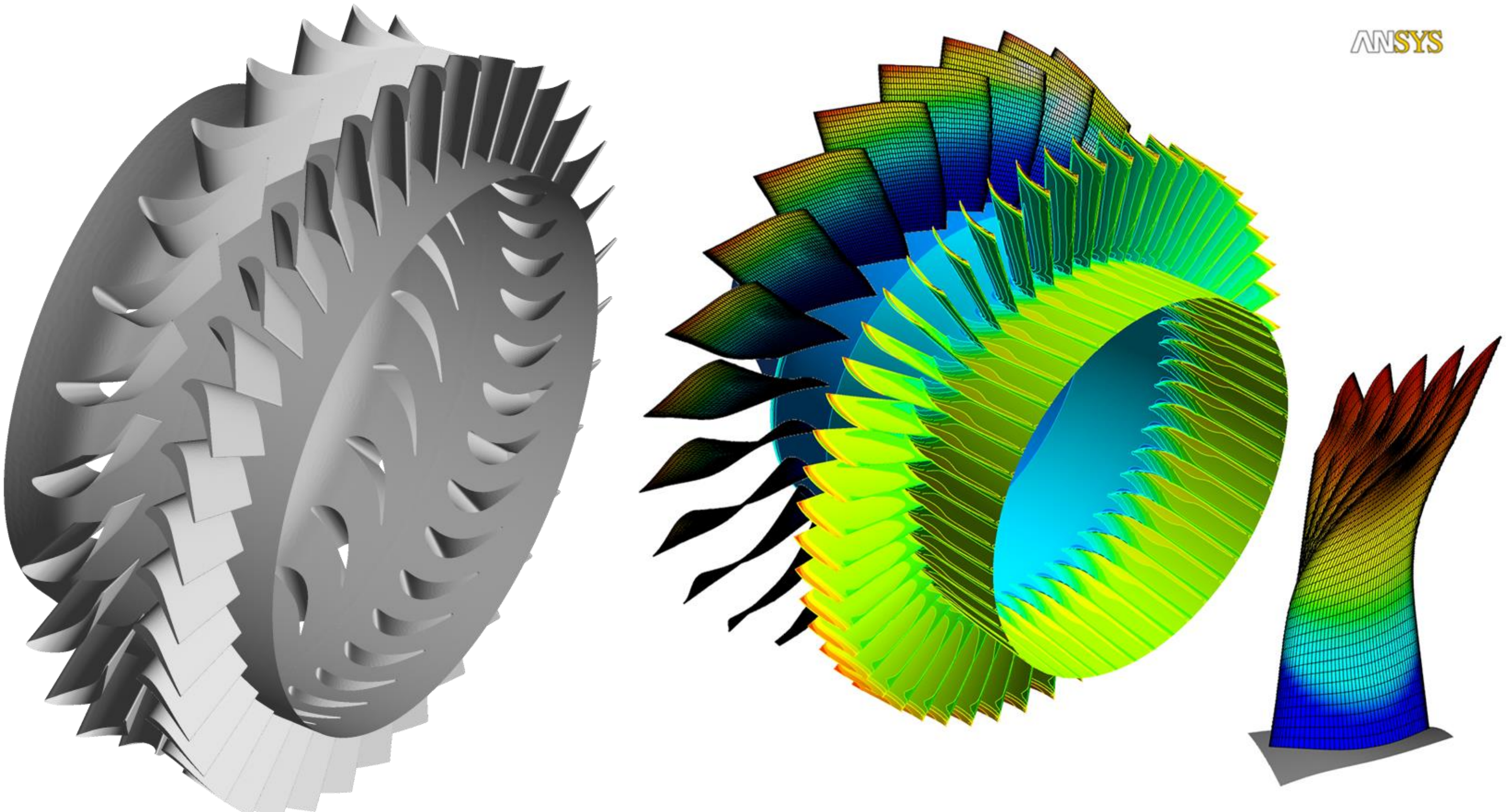

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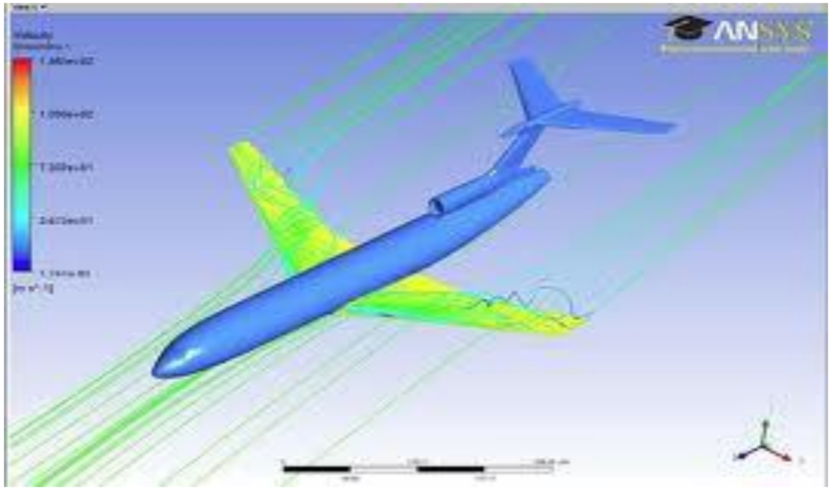


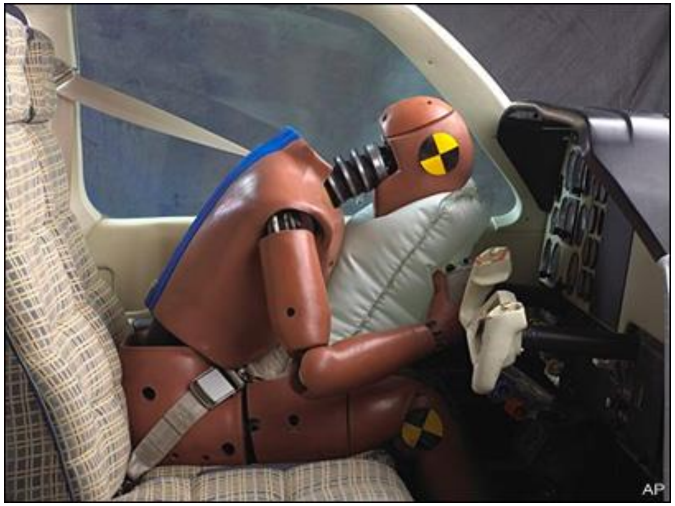

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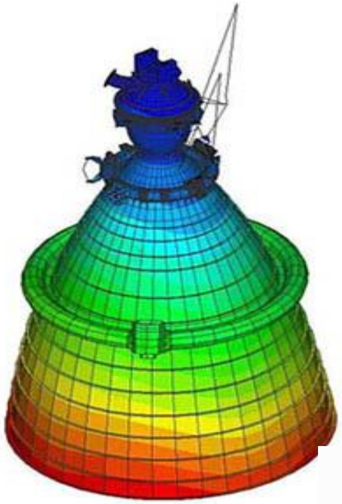
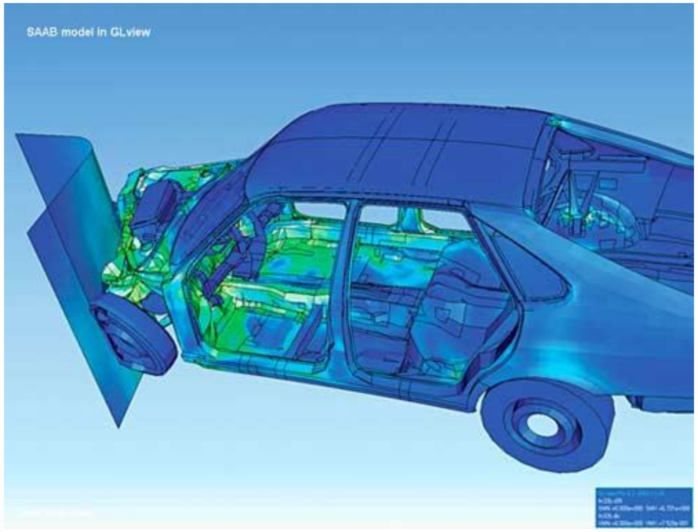
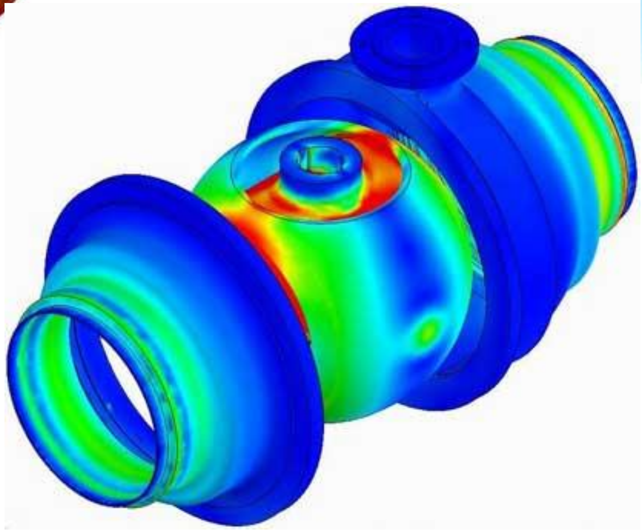




# 2. BRINGING IN THE REAL WORLD SITUATION

Simulation of Mechanical Showel

Simulation of Su-33 Fighter

# 3. FITTING INTO THE SPECTRUM

- ***Increase the Productivity***
  - **Better visualization**
  - **Reduced time & effort**
- ***Improve the Quality***
  - **Reduced design errors**
  - **Greater accuracy**

# 3. FITTING INTO THE SPECTRUM

- ***Improve the Communications***
  - Standardized drawings
  - Fewer drawing errors
  - Greater legibility
  - Better documentation
- ***Create database for Manufacturing***
  - Database like
    - Geometries and dimensions
    - Material specifications
    - Bill of materials

# 4. KEYWORDS IDENTIFIED

- DESIGN PROCESS
- SYNTHESIS
- ANALYSIS AND OPTIMIZATION
- EVALUATION
- PRESENTATION
- MANUFACTURING

# 5. LINKING KEYWORDS WITH CONCEPTS

- COMPUTER AIDED DESIGN
- GEOMETRIC MODELING
- ENGINEERING ANALYSIS
- DESIGN REVIEW AND EVALUATION
- DRAFTING
- COMPUTER AIDED MANUFACTURING

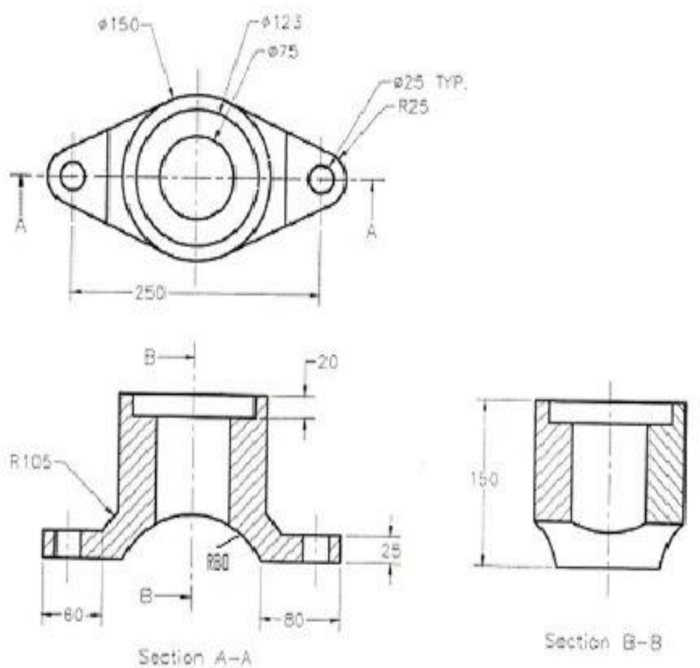
# 6. GENERATION OF EXERCISES

- 2D Drawing using Sketcher workbench
- 3D Part Modeling using 3D features
- Assembly Modeling
- Drafting
- Surface Modeling
- Sheet Metal Working
- Analysis

# 7. FOCUSSING ON PROBLEM/EXERCISE

- **Design and analysis of a given mechanical component**

# 8. DESIGN OF EXERCISE TO SOLVE THE PROBLEM




- To study the given drawing in detail
- To prepare a 2D sketch using suitable commands by considering symmetricity of the part
- To prepare a 3D model of the part using appropriate features like Extrude, Revolve, Hole etc.
- To obtain a drafted view showing all the dimensions, sections, etc.
- To analyze the part by applying the loads at appropriate places.

# 9. VERIFICATION

- To verify the sketches as per the given data.
- To verify the loads, boundary conditions and other details as per the data.

# 10. CONFIRMATION

- To compare the drafted views and 3D model with the given drawing.
- To verify the results obtained by analyzing the component with the theoretical or historical results.

# 11. CONCLUSIONS

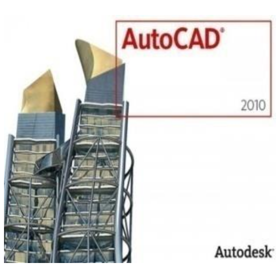
- 2D sketches of the given part are drawn
- 3D model of the same is created.
- Drafted views of the model are obtained.
- Model is analyzed for the stresses induced.

# FACILITIES IN THE LAB

# LIST OF SOFTWARES

## ➢ CAD:

CREO PARMETRIC 2.0  50 Seat Network License




AutoCAD 2015 - 250 Seat Network License

# LIST OF SOFTWARES

## ➢ CAE:


ANSYS – 5 Seat Network License

# LIST OF HARDWARE

## ➢ COMPUTER SYSTEMS:

HP Workstations – 75 Nos.

IBM Server – 1 No.

# LIST OF HARDWARE

## ➢ PERIPHERAL DEVICES:

HP Multi Function Printer – 1 No.

INFOCUS LCD PROJECTOR – 1 No.

# PLEASE NOTE…

**ENTRY INTO LABORATORY**

- *ON TIME*
- *WITH LABORATORY RECORD*
- *WITH OBSERVATION NOTEBOOK*
- *WITH IDENTITY CARD*

# VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

## AUTOMOBILE ENGINEERING

# LAB PROTOCOL

## 18PC2AE02 - AUTOMOTIVE ENGINES LABORATORY


**Faculty**

**Dr. Shaik Amjad**

**Mr. GVL Prasad**

# What will we study in this laboratory?

## Course Objectives

- To show valve and port timing diagrams
- To test performance characteristics of IC engine and compressor
- To estimate optimum cooling and heat balancing of an engine
- To perform dismantling and assembling of an engine

## Course Outcomes

After completion of the course the student is able to

- Illustrate valve and port timing diagrams
- Analyze performance characteristics of IC engine and compressor
- Evaluate optimum cooling and heat balancing of an engine
- Demonstrate dismantling and assembling of an engine

# HEAT ENGINES

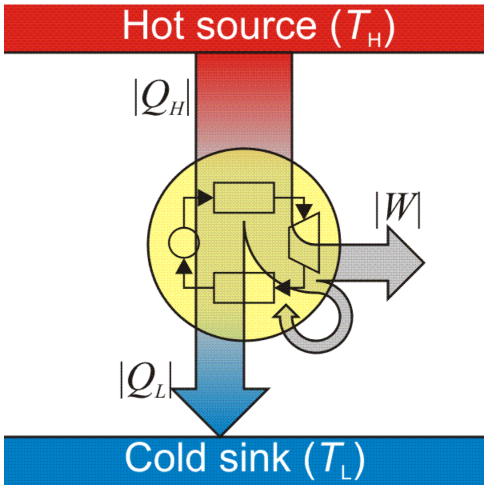
# Heat Engine Introduction

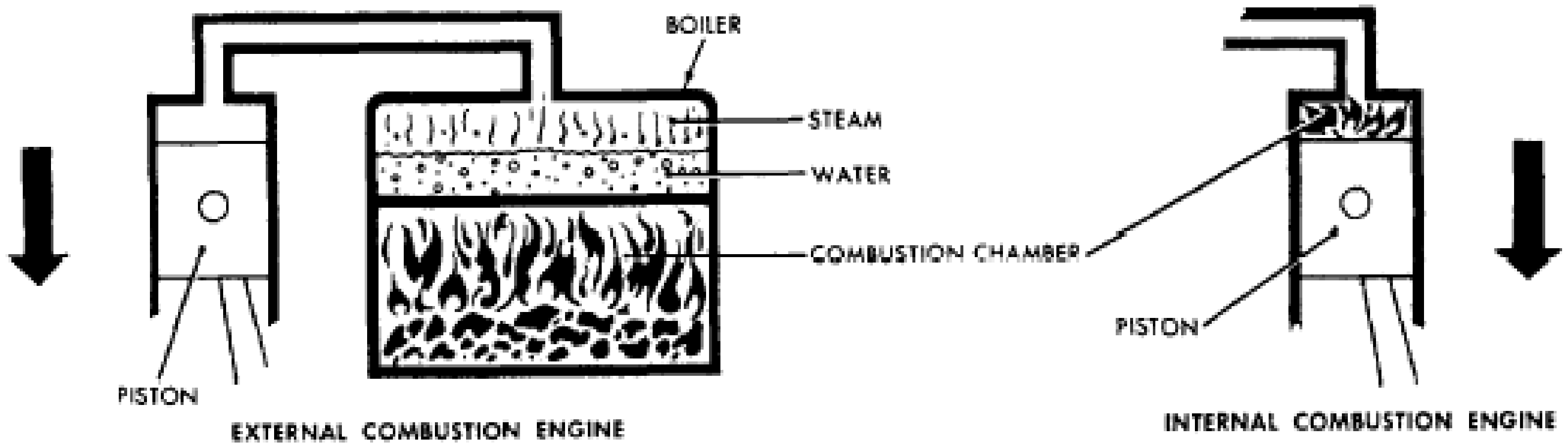
- Transforms one form of energy into another
- Heat engine converts chemical energy into thermal energy which is turned utilized to do mechanical work
- Heat engine two types :

❖ External combustion engine

❖ Internal combustion engine

- IC engine most widely used in automobiles



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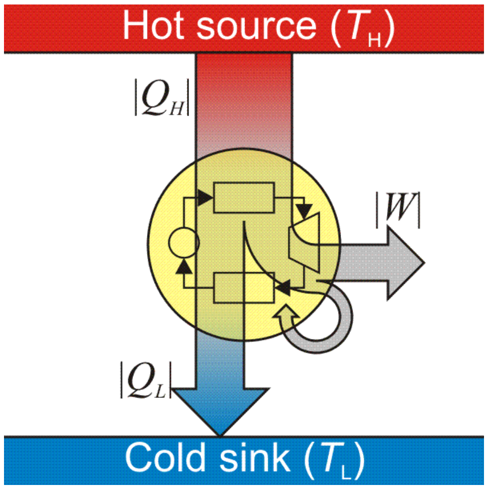
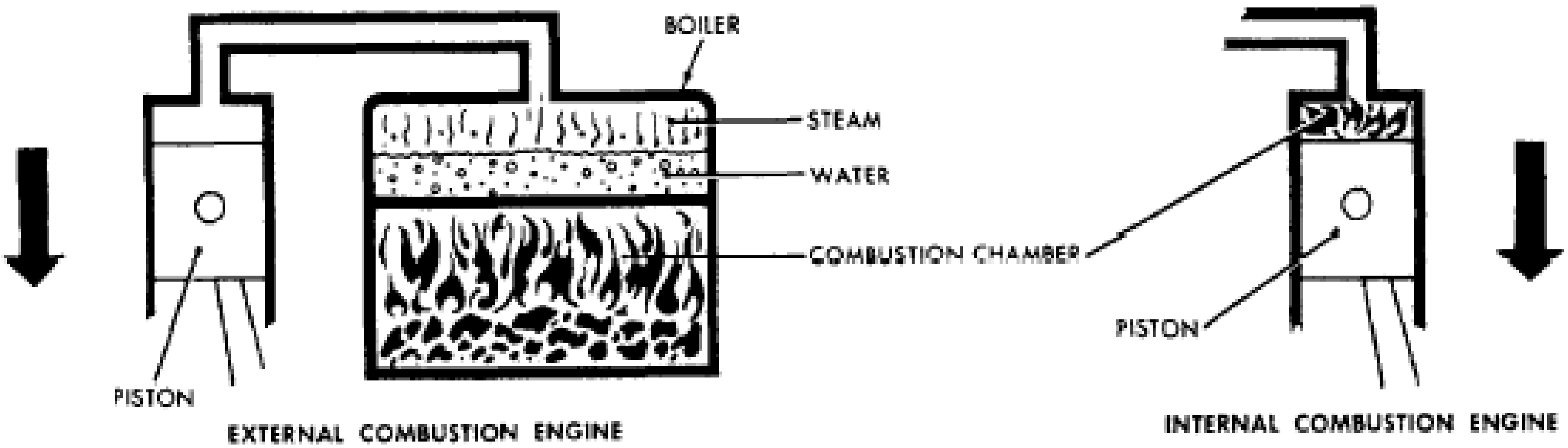


# *Petrol Engine*

Nicolaus August Otto

Born June 10, 1832

Died January 26, 1891

Gas-Motor Engine

Patent No. 4315

Inducted 1885

- Inventor of the four-stroke spark-ignition internal combustion engine
- In 1876 Otto built an engine in which air-fuel mixture could be compressed and ignited by a spark

# Diesel Engine

Rudolf Diesel

(1858 - 1913)

Oil Engine

German

Patent No. 67207

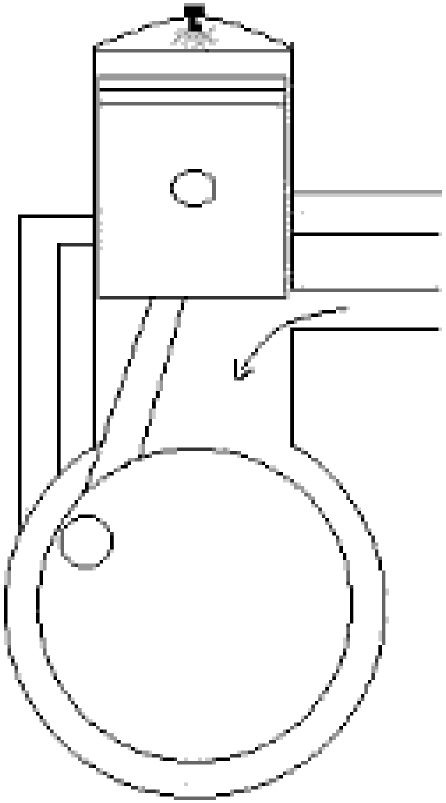
Inducted 1919

- Inventor of the four-stroke Compression-ignition internal combustion engine
- In 1893 Diesel was issued a patent for a proposed engine, in which air would be compressed so much that the temperature would far exceed the ignition temperature of the fuel

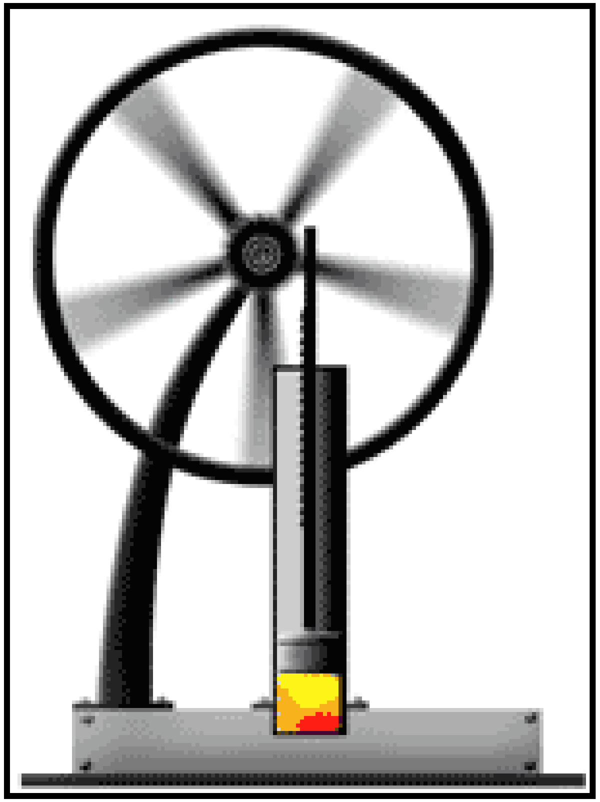
# *2-Stroke Engine*

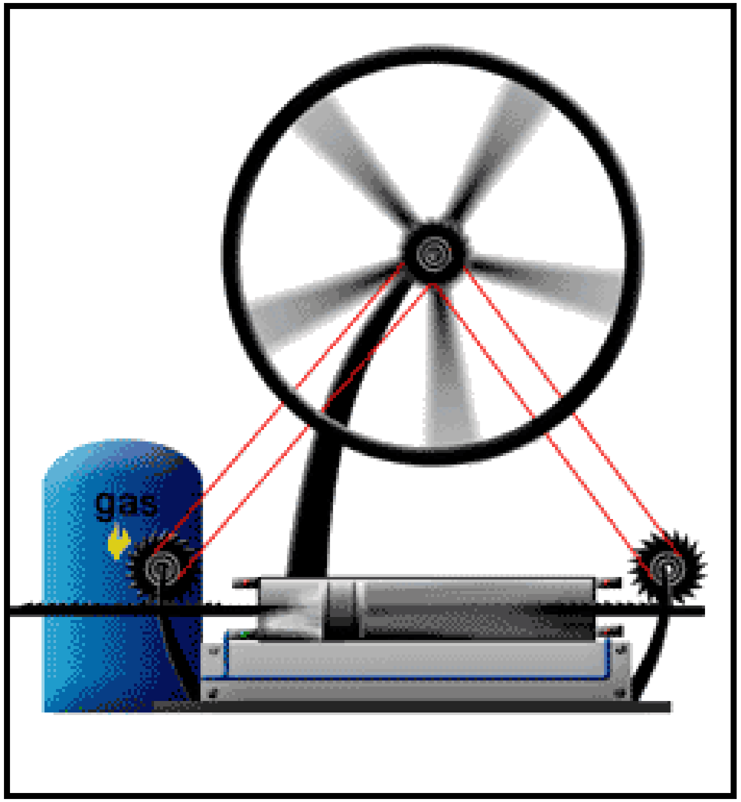
Dugald Clerk

Designed in 1878
and patented it in
England in 1881.



# Simplicity of Early Engines





# Bringing in The Real World Situation


RX100
YAMAHA
RX100
YAMAHA


USAF
FIRE
131
U.S. NAVY


SsangYong


6025
6025

TAMASŌMA JYOTIRGAMAYA



DANGER

Thermodynamic fundamentals will be used to link the processes taking place in the engine for issues of:

- Power generation
- Fuel economy and Fuel Composition
- Effects on engine operation and
- Mechanical limitations of obtaining ideal performance

# Fitting into the spectrum

- As we are aware that the rate of depletion of fossil fuels is alarming.
- Burning of fossil fuels causes green house effect which is harmful to all living beings.
- This issue is being addressed at various forums of environmentalists and summits.
- Due to above reasons, it is desirable to have higher thermal efficiencies of all IC engines.

# Keywords Identified

- Valve Timing
- Port timing
- Testing
- Thermal efficiency
- Specific fuel consumption
- Mechanical Efficiency
- Brake power

# Linking keywords with concepts

- IC engine
- 2-Stroke engine
- 4-Stroke engine
- S I engine
- C I engine
- Air Fuel Ratio
- Valve timing diagram
- Port timing diagram
- Performance characteristics

# Generation of Exercises

- To find the valve and port timing
- To find brake thermal efficiency, indicated thermal efficiency and friction power of the engines.
- To find air fuel ratio, sfc and mep of the engines.
- To find isothermal efficiency of compressor

# Focusing on problem/Exercise

- Whether it is power producing device or a power consuming device
- Then decide measurements of which parameters will reflect the efficiency or performance of the engine

# 8.Design of Exercise to solve the problem

- To draw the valve and port timing diagrams
- To find the speed at which the SFC is minimum.
- To find the variation of efficiency with respective to load at constant speed.
- To find isothermal efficiency of compressor

# Verification

- To compare the results obtained with standard values from the literature/manual.

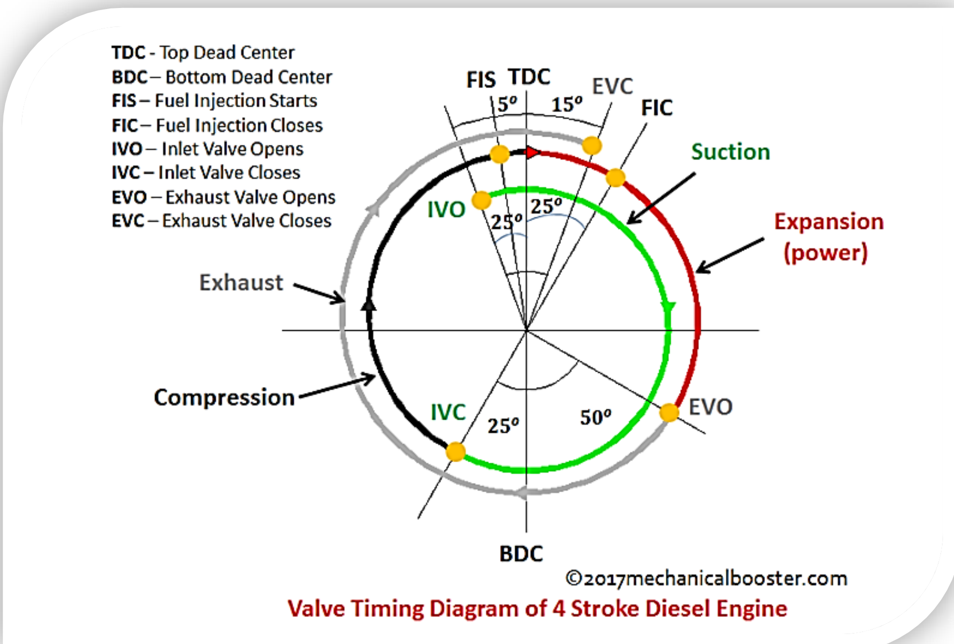
# List of Experiments

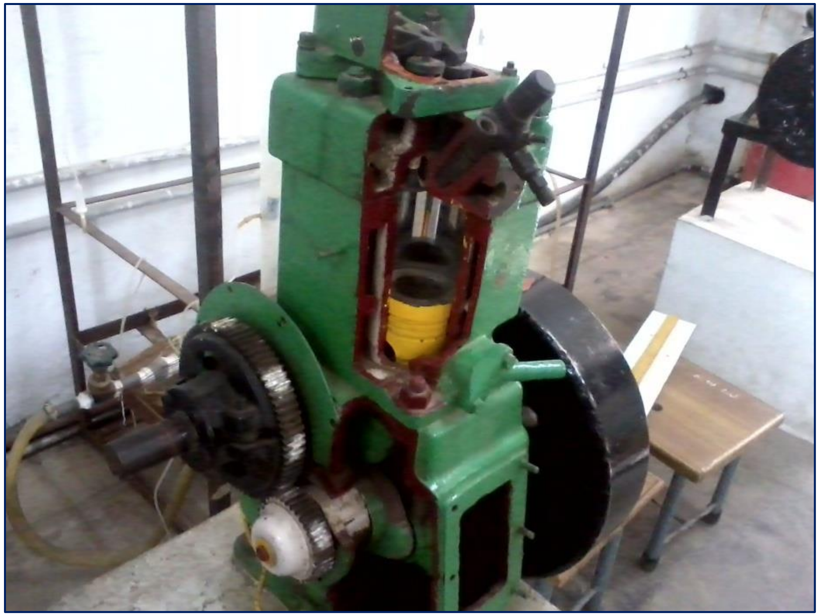
1. Valve timing diagram for 4-stroke Diesel engine
2. Valve timing diagram for 4-stroke petrol engine
3. Port timing diagram for 2-stroke petrol engine
4. Performance test on 4-stroke single cylinder Diesel engine
5. Performance test on 4-stroke single cylinder petrol engine
6. Heat balance test on 4-stroke single cylinder Diesel engine
7. Morse test on multi-cylinder petrol engine
8. Optimum cooling temperature test on single cylinder Diesel engine
9. Performance evaluation on computerized Diesel engine
10. Performance test on reciprocating compressor test rig
11. Dismantling, inspection and assembling of multi-cylinder petrol engine
12. Dismantling inspection and assembling of multi-cylinder Diesel engine
13. Testing of Diesel fuel injector

# FACILITIES

# Valve timing diagram for 4-Stroke Diesel engine

- A valve timing diagram is a graphical representation of the opening and closing of the intake and exhaust valve of the engine, The opening and closing of the valves of the engine depend upon the movement of piston from TDC to BDC.

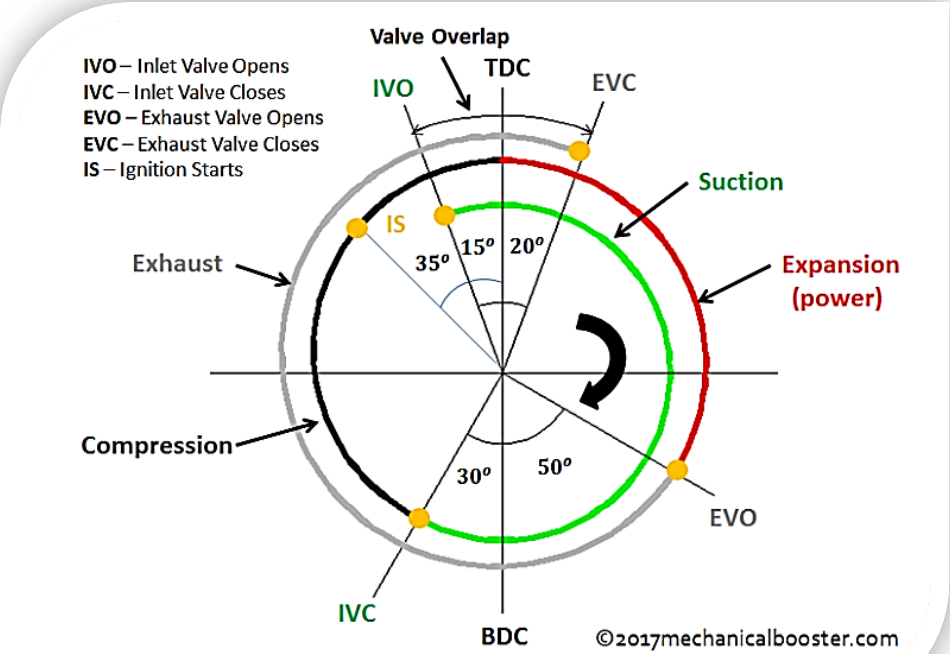


Cut Model of Diesel engine

# Valve timing diagram for 4-Stroke petrol engine

- A valve timing diagram is a graphical representation of the opening and closing of the intake and exhaust valve of the engine, The opening and closing of the valves of the engine depend upon the movement of piston from TDC to BDC.

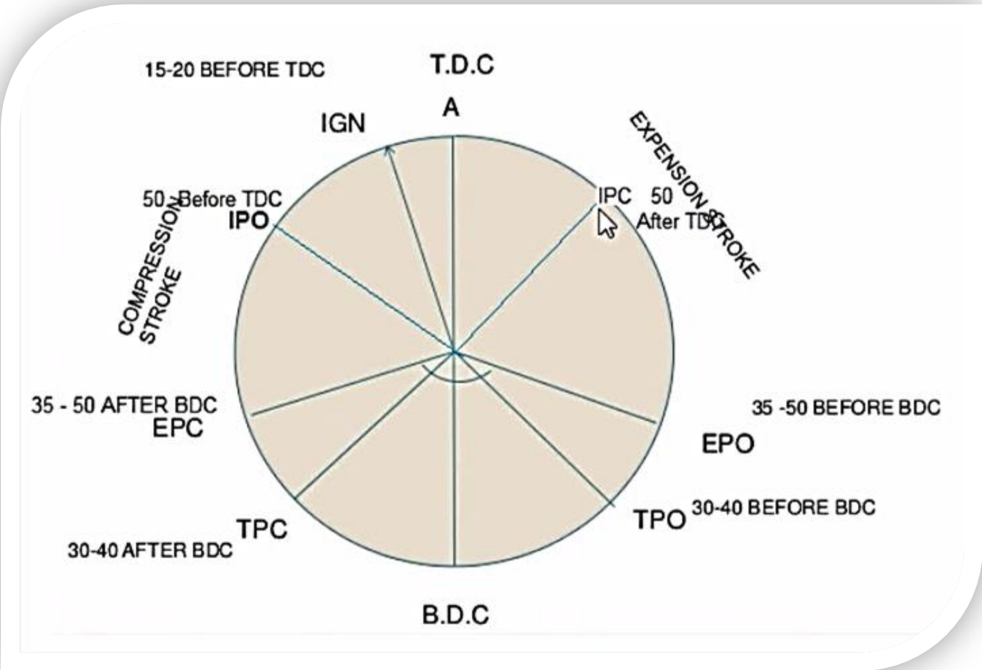


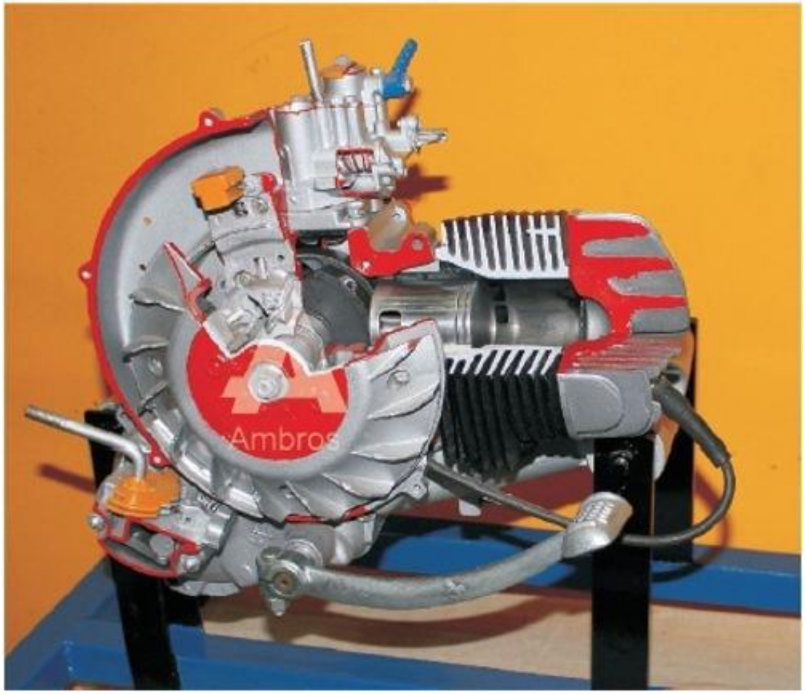

Valve Timing Diagram of 4 Stroke Petrol Engine

Cut Model of Petrol Engine

# Port timing diagram for 2-Stroke petrol engine

- A port timing diagram is a graphical representation of the opening and closing of the intake, exhaust and transfer ports of the engine, The opening and closing of the ports of the engine depend upon the movement of piston from TDC to BDC
- In two-stroke engine the cycle is completed in one revolution of the crankshaft.



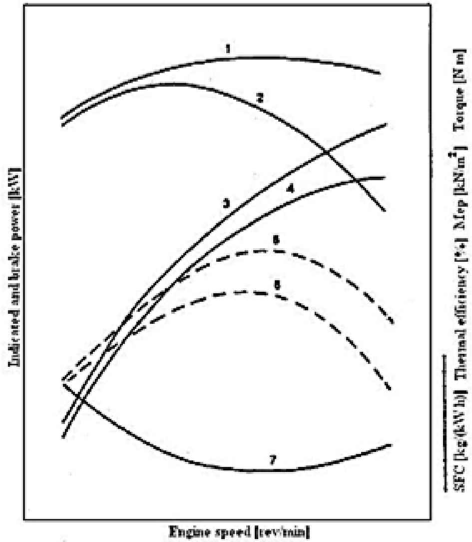




Cut Model of Petrol Engine

# Performance test on 4-stroke/2-stroke single cylinder petrol engine

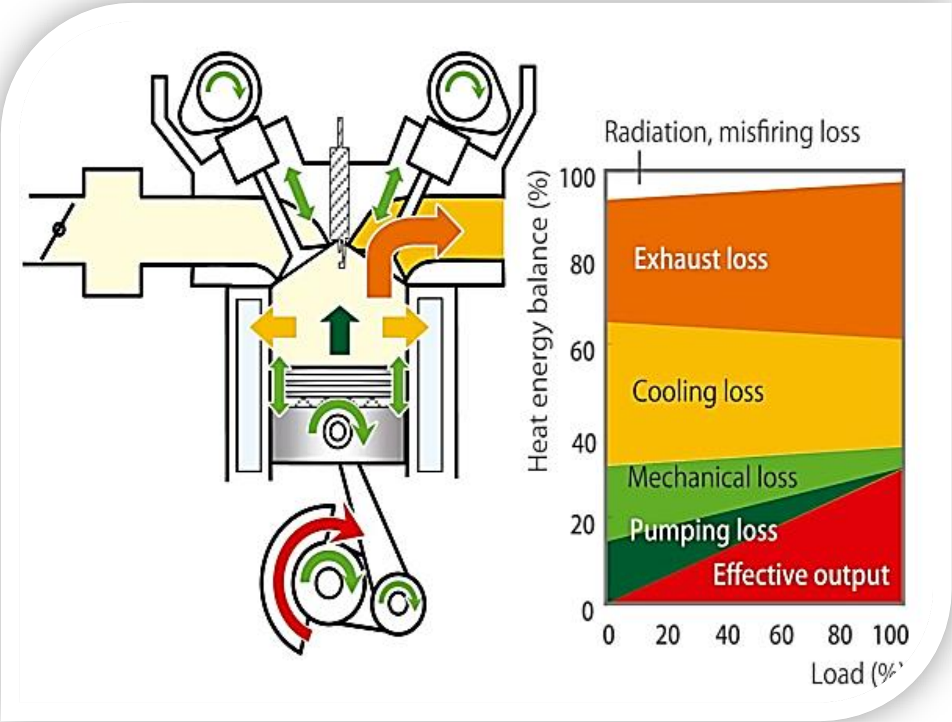
## Engine Performance Curves

1. Imep
2. Bemp and torque
3. Indicated power
4. Brake power
5. Indicated thermal efficiency
6. Brake thermal efficiency
7. Specific fuel consumption



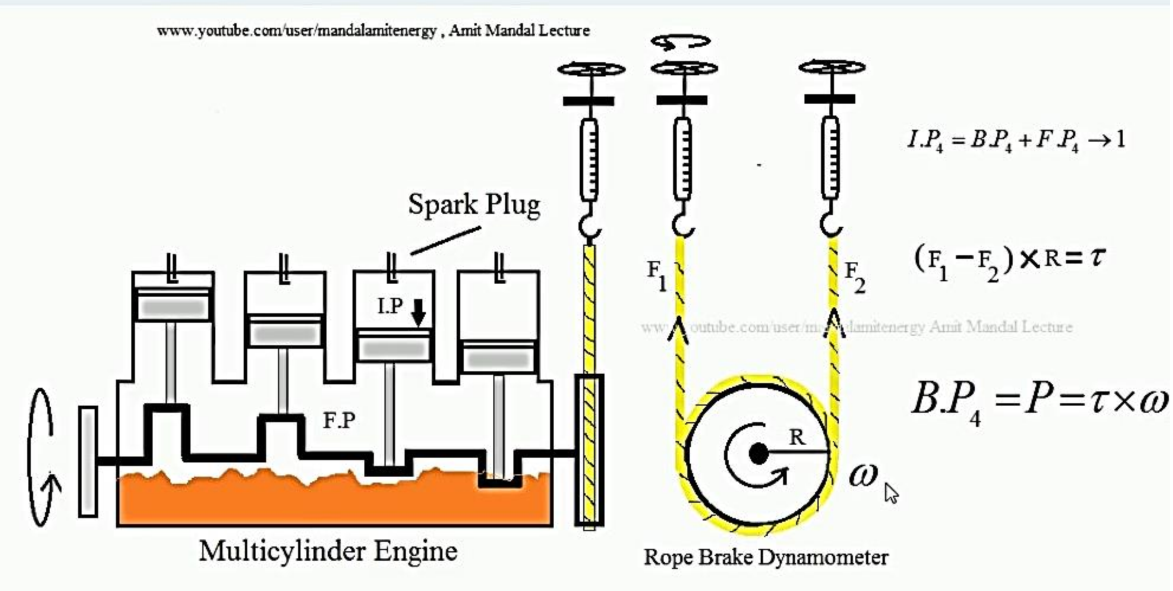

Single cylinder four stroke petrol engine test rig

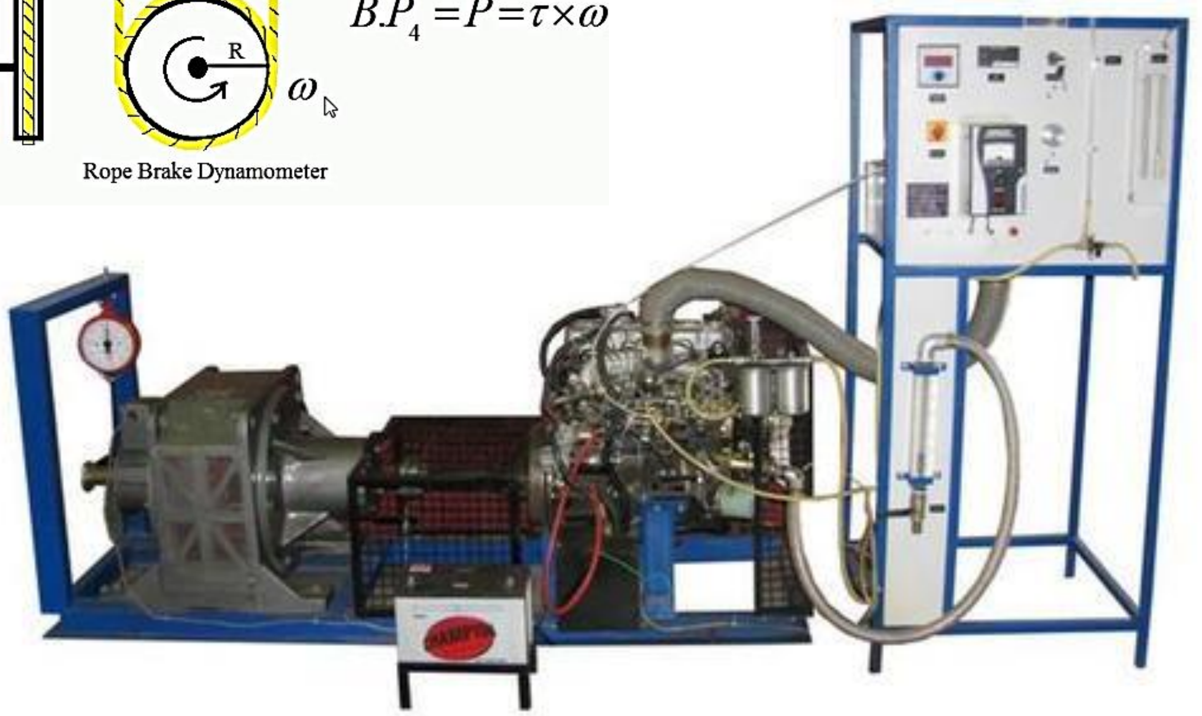
# Heat balance test on 4-Stroke single cylinder Diesel engine




Single cylinder four stroke diesel engine test rig

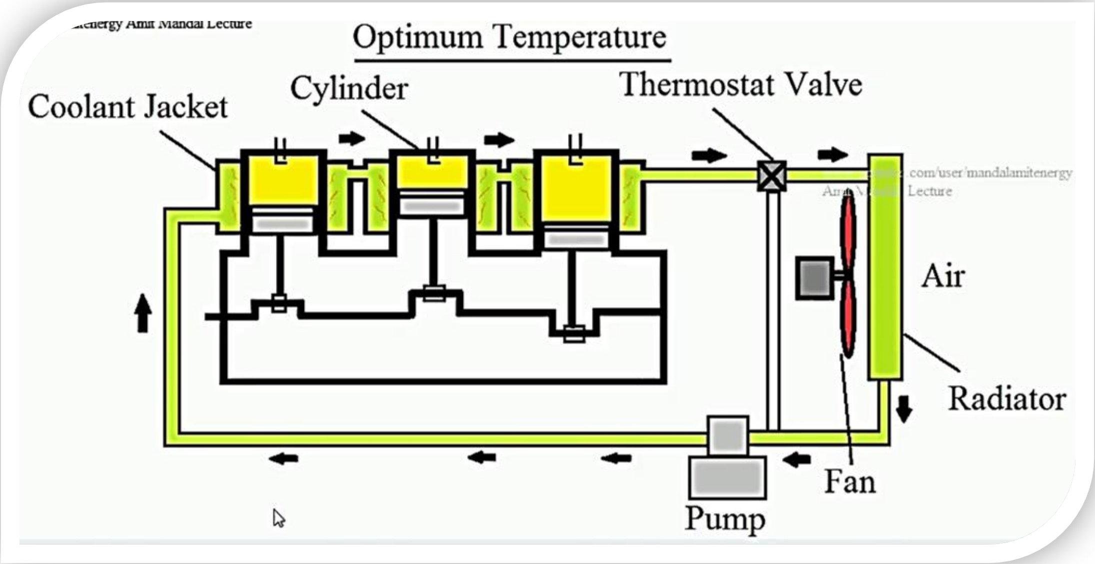
# Morse test on multi-cylinder petrol engine



Multi-cylinder four stroke diesel engine test rig

# Optimum cooling temperature test on single cylinder Diesel engine

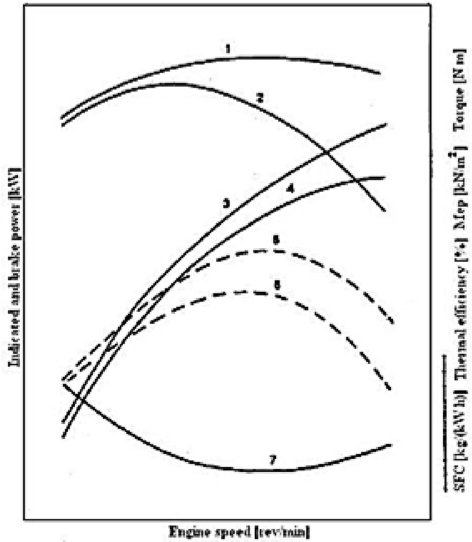



Single cylinder four stroke diesel engine test rig

# Performance test on 4-stroke single cylinder computerised Diesel engine

## Engine Performance Curves

1. Imep
2. Bemp and torque
3. Indicated power
4. Brake power
5. Indicated thermal efficiency
6. Brake thermal efficiency
7. Specific fuel consumption




Computarised single cylinder four stroke diesel engine test rig

# Permanence test on reciprocating compressor test rig

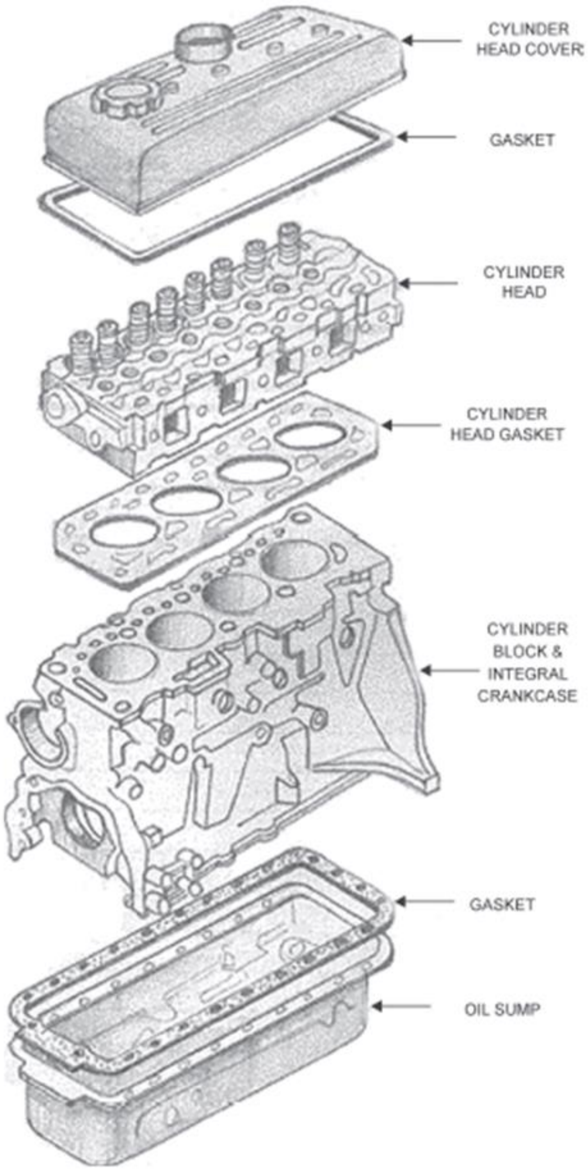
- An air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air.

This experimental set up demonstrates the students to evaluate

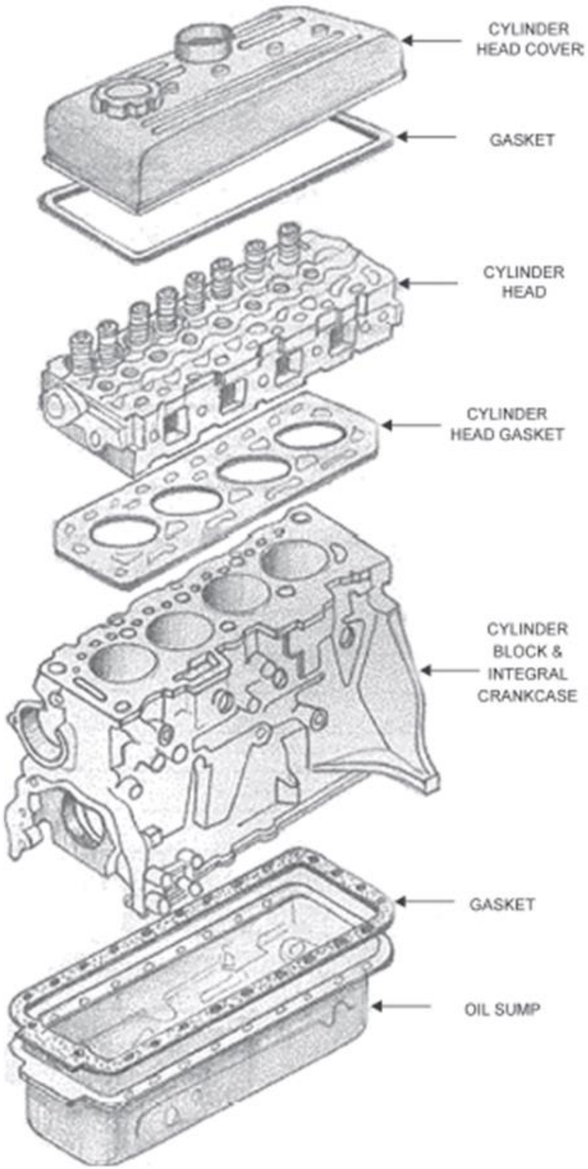
a)Volumetric efficiency
b) Isothermal efficiency

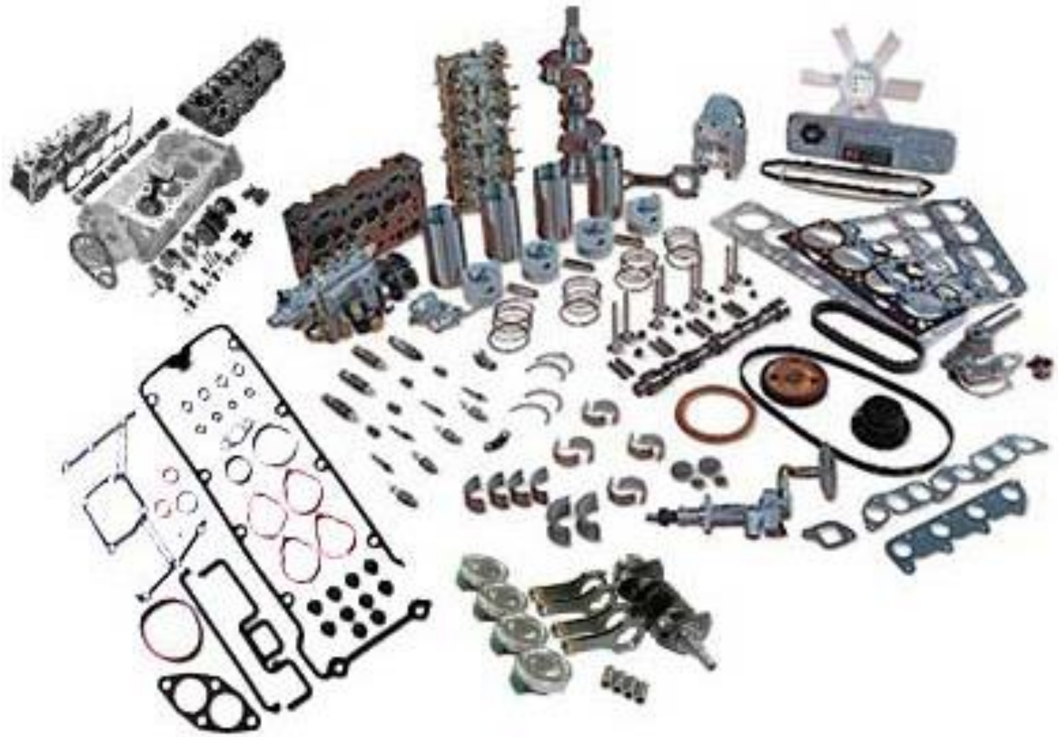
Reciprocating compressor test rig

# Dismantling, inspection and assembling of multi-cylinder petrol engine




# Dismantling, inspection and assembling of multi-cylinder Diesel engine

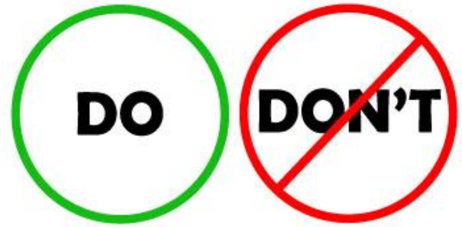


# LABORATORY SAFETY RULES

- Keep yourself and others safe.
- Wear appropriate safety equipment.
- No loose clothes and long hair around machines.
- Clean up any spills immediately.
- Wear shoes to protect the feet from falling weights.
- Don’t play with machines/tools.


- Maintain discipline and be regular to the laboratory
- Carry the observation book and record to the laboratory
- Follow proper dress code in the laboratory
- Do not use any equipment unless you are trained
- Wear safety glasses or face shields when working with hazardous materials and/or equipment
- If you have long hair or loose clothes, make sure it is tied back or confined
- Keep the work area clear of all materials except those needed for your work
- Extra books, purses, etc. should be kept away from equipment
- Students are responsible for the proper disposal of used material if any in appropriate containers




- Wear shoes to protect your feet
- Check all electrical connections and mounting bolts before each use
- Check that all rotating parts are free to turn, and that there is no mechanical obstruction before operating
- If an equipment fails while being used, report it immediately to your lab assistant or in-charge
- Never try to fix the problem yourself because you could harm yourself and others
- Exercise care when working with or near hydraulically- or pneumatically-driven equipment. Sudden or unexpected motion can inflict serious injury
- If leaving a lab unattended, turn off all ignition sources
- Clean up your work area before leaving
- Wash hands before leaving the lab and before eating

# Common Sense

Good common sense is needed for safety in a laboratory. It is expected that each student will work in a responsible manner and exercise good judgement and common sense. If at any time you are not sure how to handle a particular situation, ask your Lab in-charge or Instructor for advice. It is always better to ask questions than to risk harm to yourself or damage to the equipment. Do not touch anything with which you are not completely familiar.

# Automotive Electrical and Electronics Lab Protocol

# Objectives and outcomes

## Course Objectives

- Study and demonstrate different electrical and electronic systems in a vehicle
- Test and analyse automotive battery, starting, charging and ignition systems
- Calibrate automotive sensors for measurement
- Interface automotive sensors with ADC

## Course Outcomes

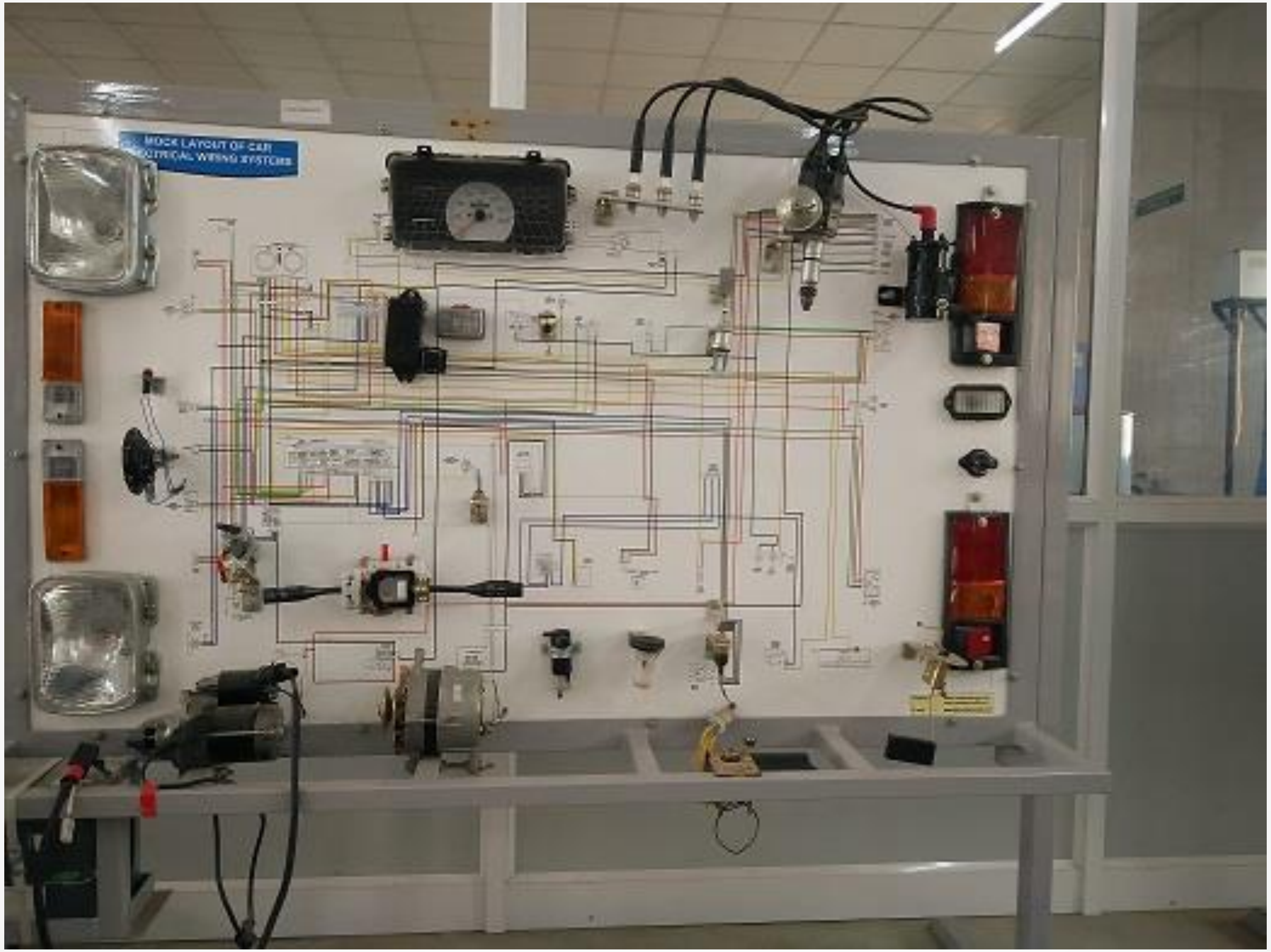
After completion of the course the student is able to

- CO-1: Demonstration different electrical and electronic systems in a vehicle
- CO-2: Test automotive battery, starting, charging and ignition systems
- CO-3: Calibrate and use automotive sensors for measurement
- CO-4: Interface automotive sensors with ADC

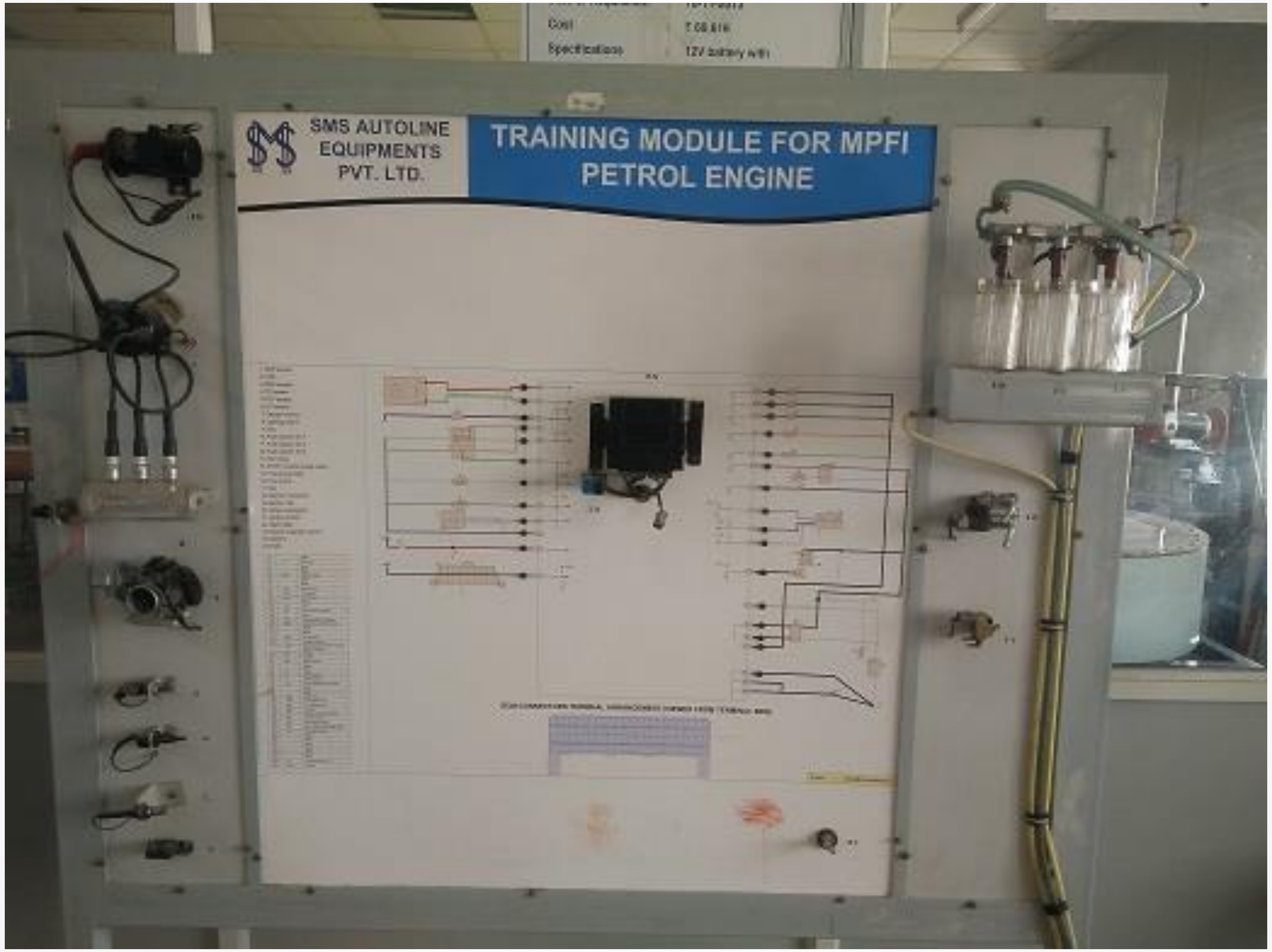
# List of experiments

1. Study and demonstration of automobile electrical wiring system
2. Study and demonstration of electronic fuel injection system
3. Battery charging and maintenance
4. Starting motor and alternator testing
5. Diagnosis of ignition system
6. Temperature measurement and interfacing RTD with ADC
7. Temperature measurement and interfacing thermistor with ADC
8. Displacement measurement and interfacing LVDT with ADC
9. Load measurement and interfacing load cell with ADC
10. Pressure measurement and interfacing with ADC
11. Testing and control of DC motor

# Study and demonstration of automobile electrical wiring system

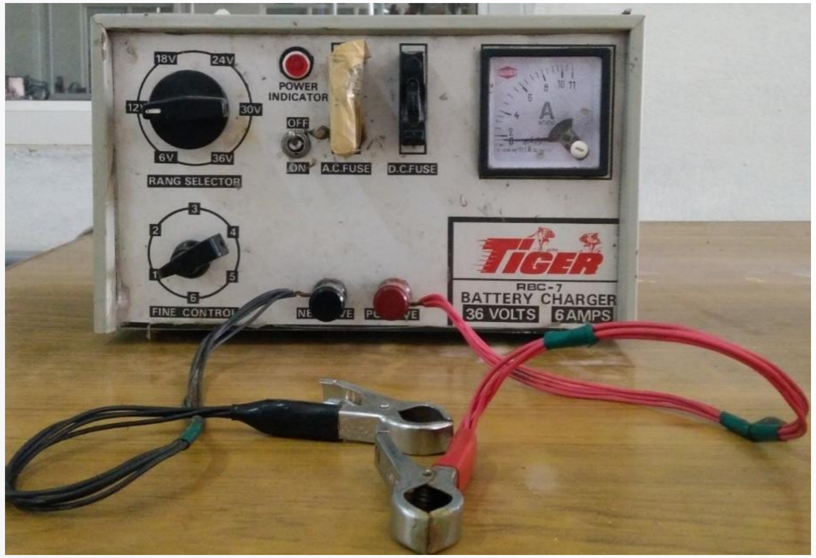


# Study and demonstration of electronic fuel injection system



# Battery charging and maintenance

- A battery charger is intended to be connected to a battery. To recharge a fuel vehicle's starter battery, where a modular charger is used and to recharge an electric vehicle (EV) battery pack
- Automotive battery tester is used to check the battery of an automobile in live conditions. It can test cranking and cold cranking conditions while being connected to the vehicle. Total life of the batter, complete analysis and health of the battery.

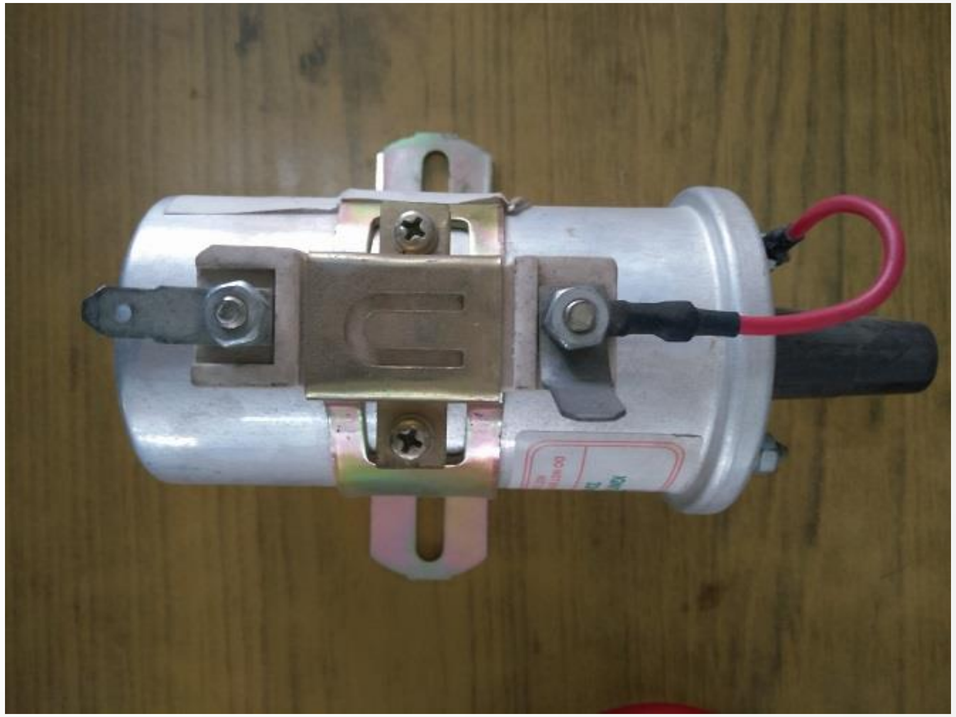



# Starting motor and alternator testing

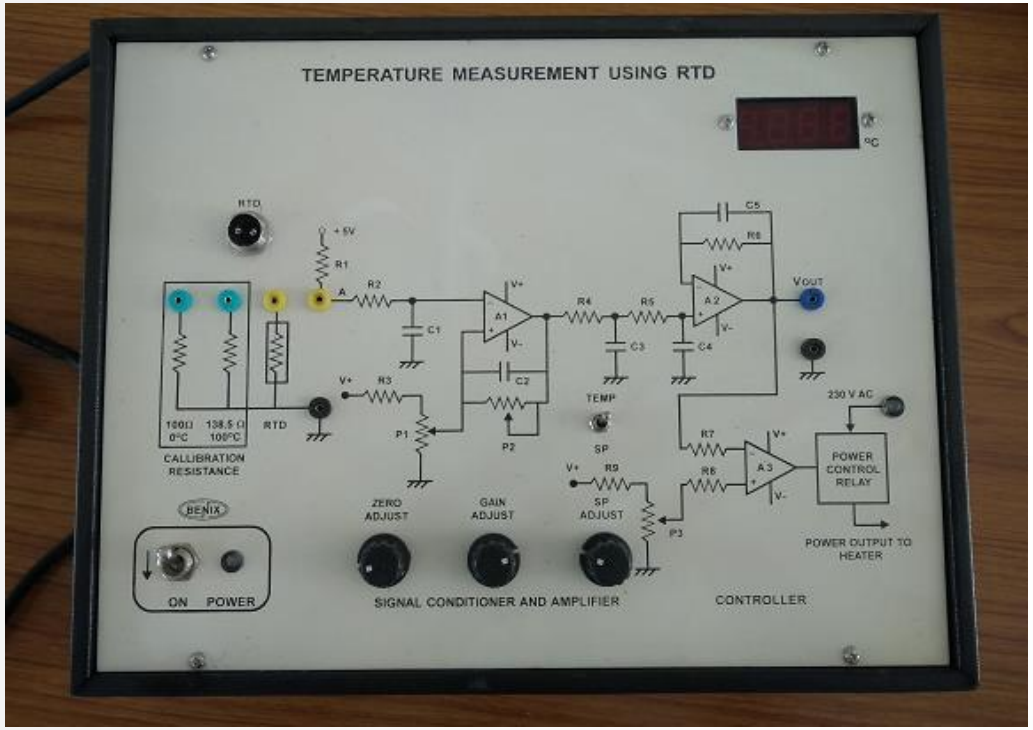
- Auto electrical test bench is a table model and has been designed to cater to the needs of auto electrician, garages, service centres, transport corporation institution and other bulk users of auto electrical equipment for complete testing of alternator, regulator and their associated parts. It has also built-in dc power supply to check light run of starter motor and alternator


# Diagnosis of ignition system

- Spark plug is a device to produce electric spark to ignite the compressed air-fuel mixture inside the cylinder. The spark plug is screwed in the top of the cylinder so that its electrodes projects in the combustion chamber.

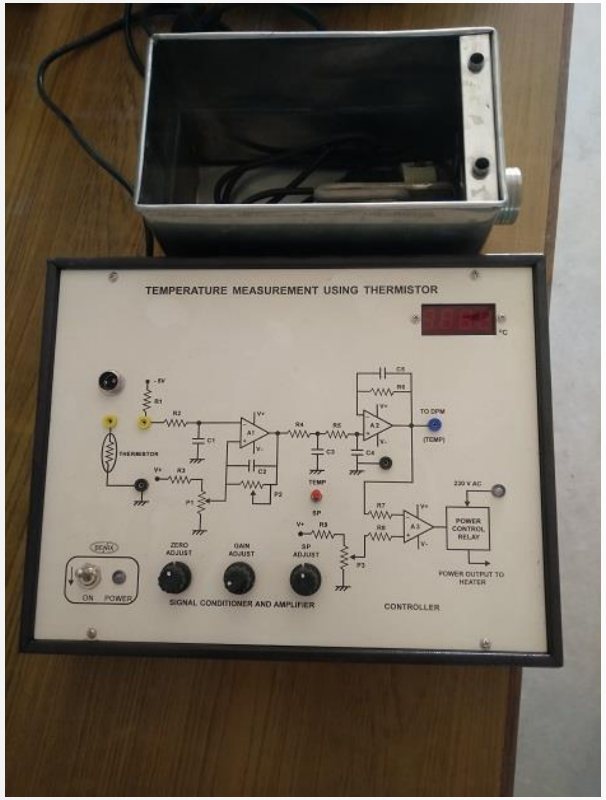



# Temperature measurement and interfacing RTD with ADC



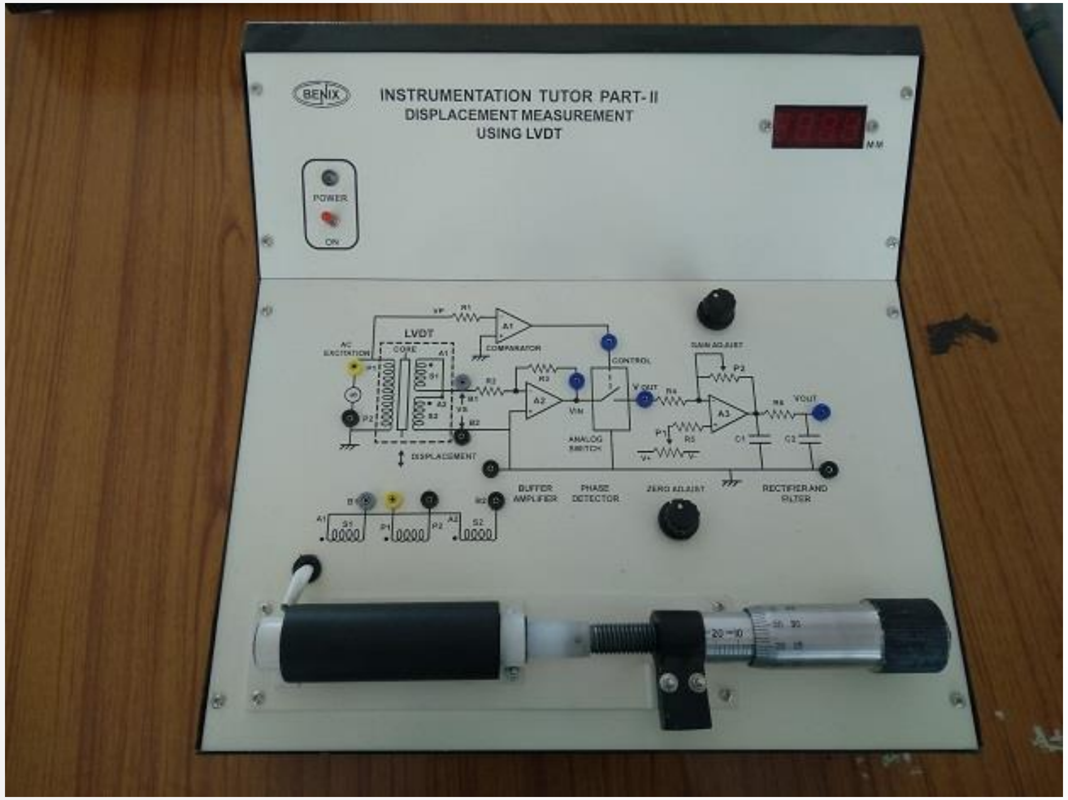

**Resistance thermometers**, also called **resistance temperature detectors** (**RTDs**), are sensors used to measure temperature. The RTD wire is a pure material, typically platinum, nickel, or copper. The material has an accurate resistance/temperature relationship which is used to provide an indication of temperature.

# Temperature measurement and interfacing thermistor with ADC




A **thermistor** is a resistance thermometer, or a resistor whose resistance is dependent on temperature. The term is a combination of “thermal” and “resistor”. It is made of metallic oxides, pressed into a bead, disk, or cylindrical shape and then encapsulated with an impermeable material such as epoxy or glass.

# Displacement measurement and interfacing LVDT with ADC

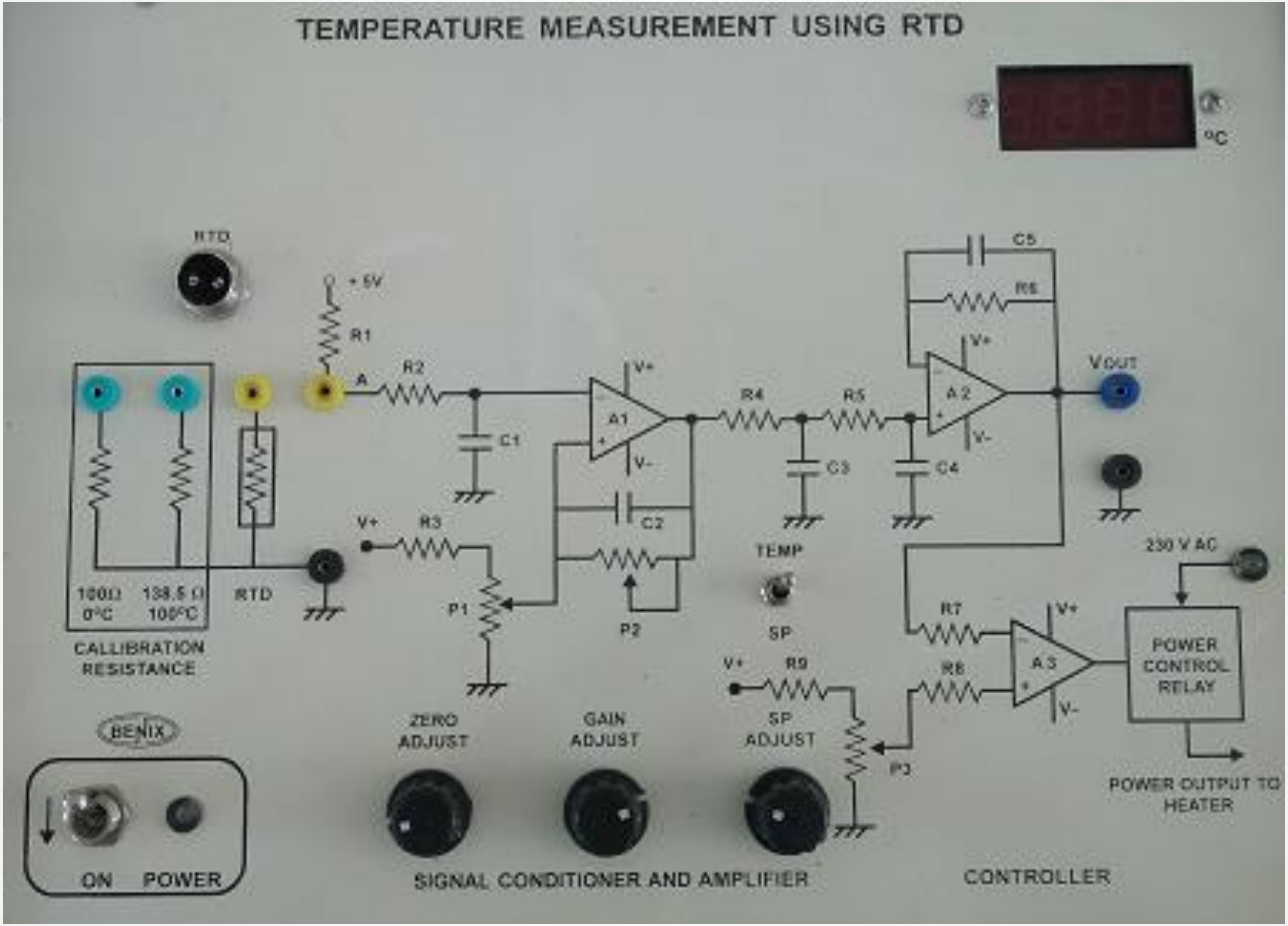



**LVDT** is an acronym for Linear Variable Differential Transformer. It is a common type of electromechanical transducer that can convert the rectilinear motion of an object to which it is coupled mechanically into a corresponding electrical signal.

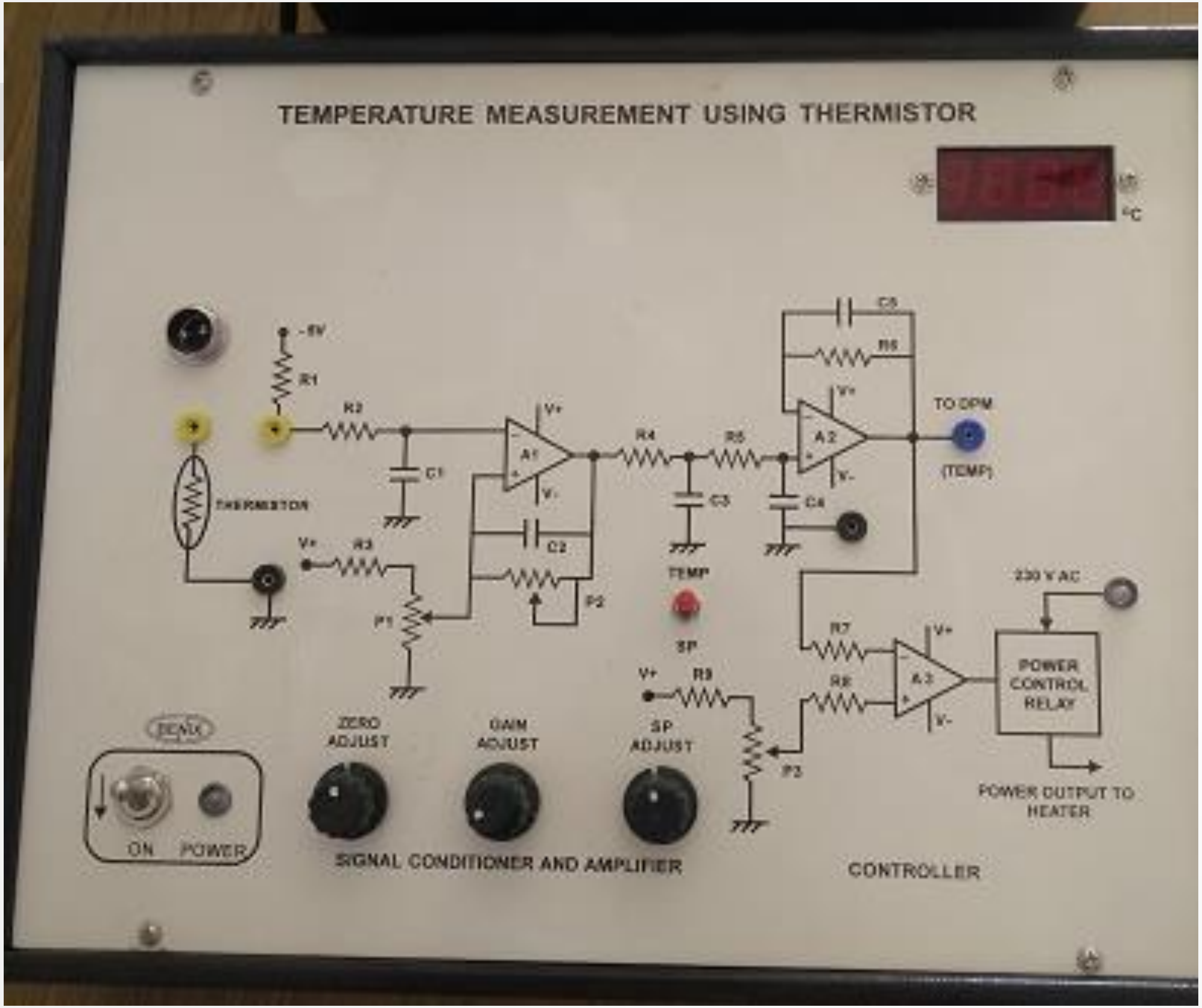
# Load measurement and interfacing load cell with ADC

- A **load cell** is a force transducer. It converts a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized. As the force applied to the **load cell** increases, the electrical signal changes proportionally.

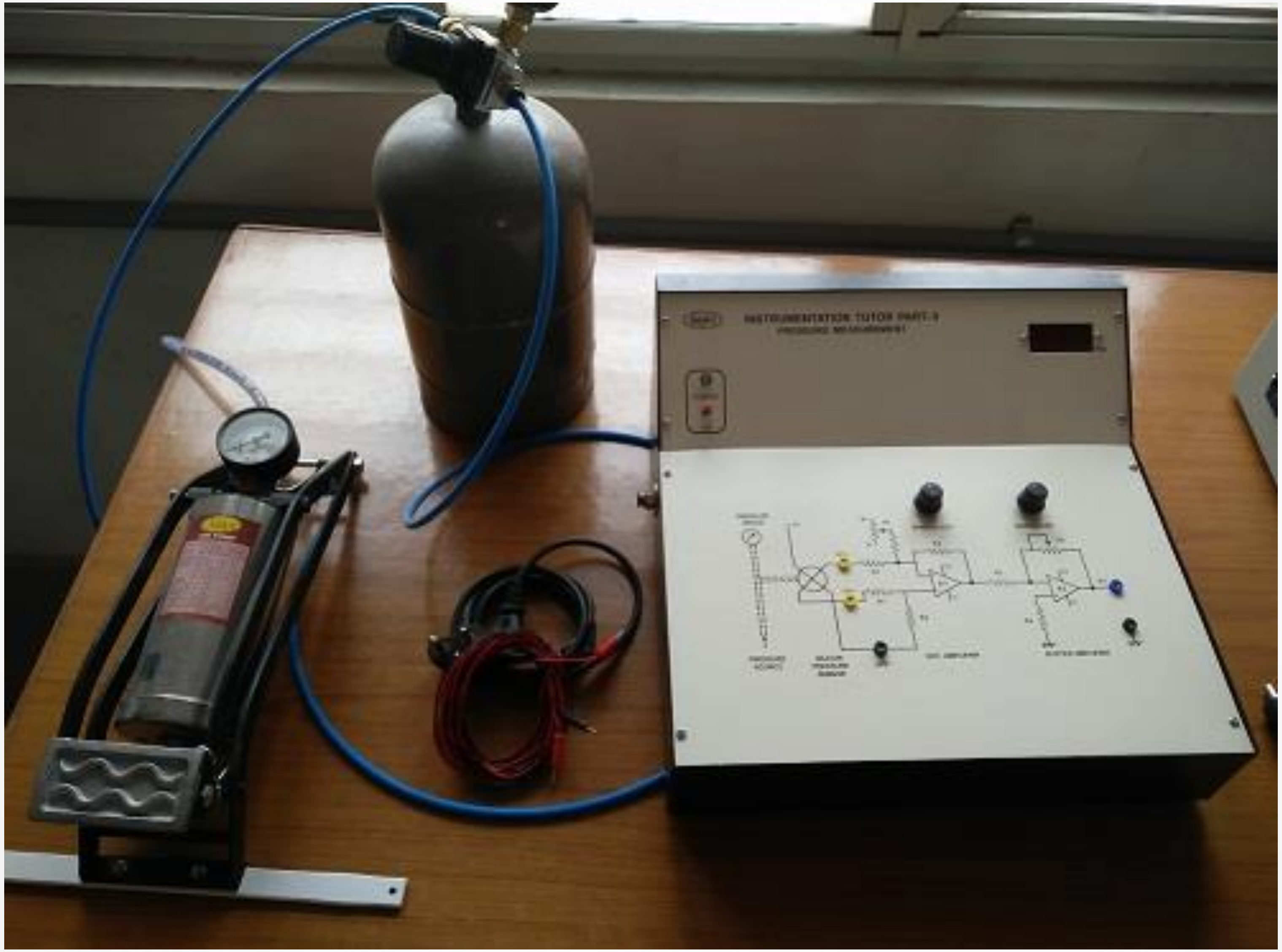
# Testing and control of DC motor



TEMPERATURE MEASUREMENT USING RTD
°C
RTD
+5V
R1
A
R2
C1
V+
V-
A1
C2
R3
P1
P2
R4
R5
C3
C4
C5
R6
A2
VOUT
TEMP
SP
230 V AC
R7
R8
R9
A3
POWER CONTROL RELAY
P3
POWER OUTPUT TO HEATER
100Ω 0°C
138.5 Ω 100°C
RTD
CALLIBRATION RESISTANCE
BENIX
ZERO ADJUST
GAIN ADJUST
SP ADJUST
ON
POWER
SIGNAL CONDITIONER AND AMPLIFIER
CONTROLLER


TEMPERATURE MEASUREMENT USING THERMISTOR
°C
THERMISTOR
TO DPM
(TEMP)
TEMP
SP
230 V AC
POWER CONTROL RELAY
POWER OUTPUT TO HEATER
ZERO ADJUST
GAIN ADJUST
SP ADJUST
ON
POWER
SIGNAL CONDITIONER AND AMPLIFIER
CONTROLLER

# Pressure measurement using pressure transducer



**VNR Vignana Jyothi Institute of Engineering & Technology**
**Department of Automobile Engineering**

# AUTOMOTIVE CHASSIS LABORATORY (19PC2AE01)

By
D.Suresh
Assistant Professor
Department of Automobile Engineering
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# Course Objectives

- To identify and study of automotive chassis systems
- To distinguish functionality of various running and control systems
- To understand the troubles and remedies chassis systems

# Course Outcomes

After completion of the course the student can

- Demonstrate the principle and functionality of various automotive systems
- Dismantle and assemble chassis systems
- Inspect and identify the faults in chassis systems

# LIST OF EXPERIMENTS

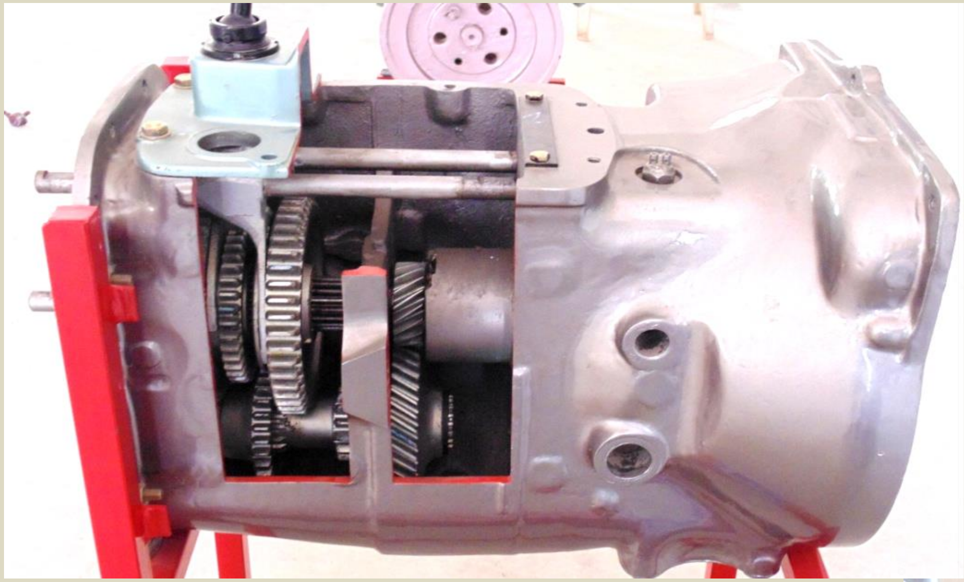
1. Dismantling, inspection and assembling of clutch
2. Dismantling, inspection and assembling of sliding mesh gear box
3. Dismantling, inspection and assembling of constant mesh gear box
4. Dismantling, inspection and assembling of synchromesh gear box
5. Dismantling, inspection and assembling of automatic gear box
6. Dismantling, inspection and assembling of transaxle
7. Dismantling, inspection and assembling of transfer case
8. Dismantling, inspection and assembling of differential unit
9. Dismantling, inspection and assembling of brake system
10. Dismantling, inspection and assembling of suspension system
11. Dismantling, inspection and assembling of steering gear box
12. Dismantling, inspection and assembling of front and rear axle

# Laboratory Equipment

HCV Clutch

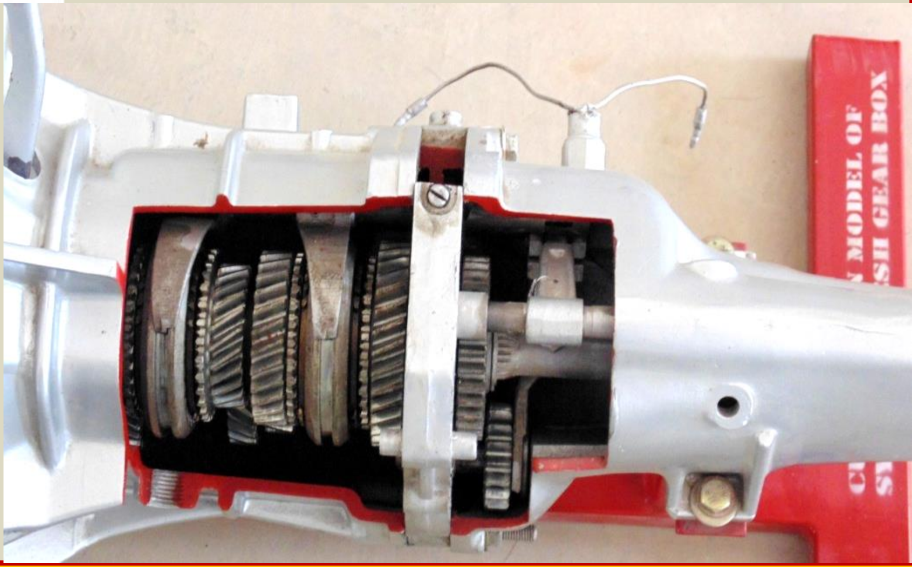
LMV Clutch

# Laboratory Equipment



**Sliding Mesh Gear box**

**Synchromesh Gear Box**



# Laboratory Equipment

**Automatic Gear box**

**Transaxle**

# Course Objectives


Hydraulic Braking System

Front axle with Suspension

# Skills Required…..

- To identify suitable tool or instrument / equipment and their functions.
- Ability to handle tools and instruments
- Ability to measure different parameters and record observations.
- To interpret test results or observations during the test
- Able to make Conclusion from the Observation.

# Laboratory Report

- Three members in a group
- Contribute / Perform proper role in the group to conduct experiment and to make observation
- Analyze the results together
- Each person of the group will write his/her own Discussion and Conclusion

# Laboratory Report

| S.No | PART NAME | QUANTITY | REMARKS |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# MEASURING PARAMETERS

- Thickness
- Diameters
- Gear ratio
- Design Terminology

# General laboratory safety

- Maintain discipline and be regular to the laboratory
- Carry the observation book and record to the laboratory
- Follow proper dress code in the laboratory
- If you have long hair or loose clothes, make sure it is tied back or confined
- Keep the work area clear of all materials except those needed for your work
- Extra books, purses, etc. should be kept away from equipment

# Course Objectives

- Check that all rotating parts are free to turn, and that there is no mechanical obstruction before operating
- If an equipment fails while being used, report it immediately to your lab assistant or in-charge
- Exercise care when working with or near hydraulically or pneumatically-driven equipment. Sudden or unexpected motion can inflict serious injury
- If leaving a lab unattended, turn off all ignition sources
- Clean up your work area before leaving
- Wash hands before leaving the lab and before eating

# LAB ASSESMENT

Semester End Examination 60 M

Continues Internal Assessment 40 M

Day to Day evaluation (10 M)

Practical Exam (10 M)

Team Project (10 M)

Record (10 M)

# Team Projects (2015-2019 batch)

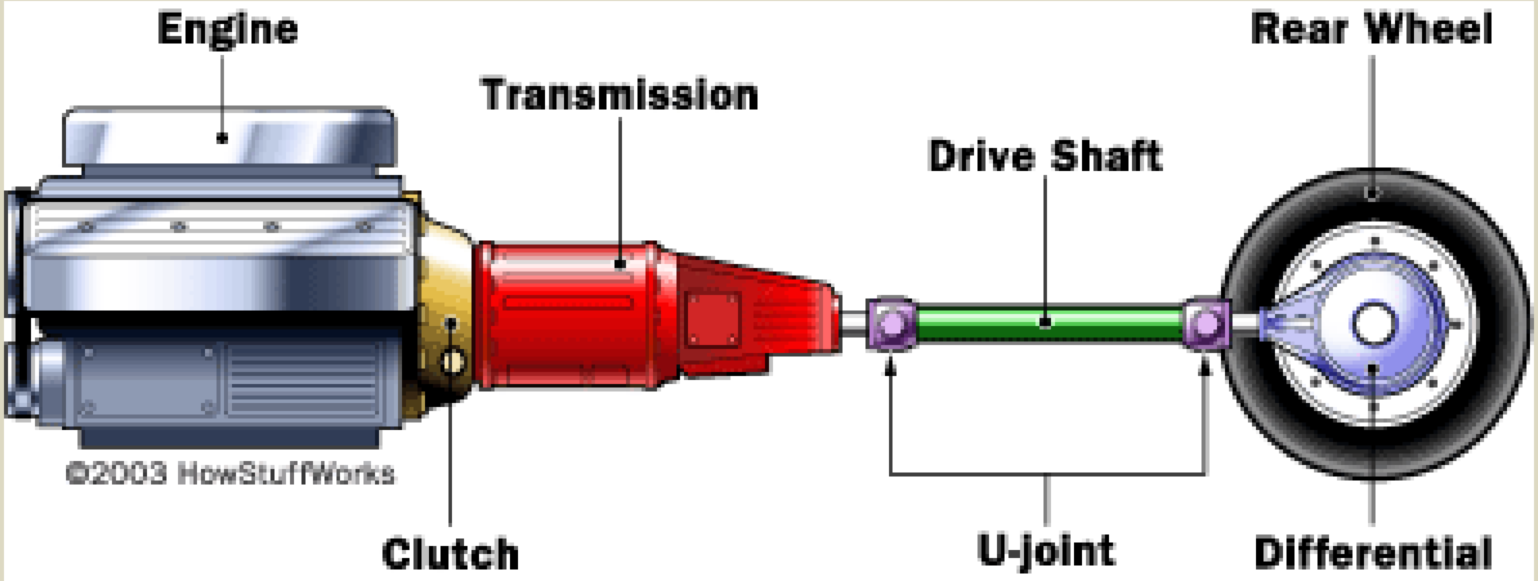
- Single plate clutch-hydraulically operated
- Multi plate clutch-mechanically operated
- Mechanically working drum brakes
- Hydraulic operated disc brake
- Double wishbone suspension system
- Telescopic shock absorber
- To prepare Rear axle assembly of Go-kart
- Motor driven constant mesh gear box

# Team Projects (2016-2020 batch)

1. Pneumatic Seater
2. Power Windows
3. Modeling of  Four Cylinder Crankshaft in CATIA V-5
4. Push Rod Suspension Actuation System Mechanism
5. CAD model of Brake Callipers
6. Electrically Power Assisted Steering
7. Analysis of Steering Knuckle
8. Modeling and Analysis of Differential
9. Effect of Variable Valve Lift on Performance of KTM 390

# Team projects (2018-2022 batch)

1. Prepare a model of chassis
2. Prepare a LMV frame
3. Make a CVT model for scooter
4. Make an Ackerman’s steering mechanism
5. Make a Davis steering mechanism
6. Prepare a claw clutch model
7. Prepare a rear suspension model
8. Prepare brake shoe working model
9. Prepare a disc brake model


Engine
Transmission
Rear Wheel
Drive Shaft
©2003 HowStuffWorks
Clutch
U-joint
Differential

# Automobile systems

Power Train

Power plant

Engine

Fuel System

Inlet System

Exhaust System

Cooling system

Drive line

Clutch

Gear box

Transfer case

Propeller shaft

Differential

Wheels

Running System

Suspension

Steering

Braking

Comfort System

HVAC

Seating

Audio/Video/

GPS

# METALLURGY AND MECHANICS OF SOLIDS LABORATORY

## AUTOMOBILE ENGINEERING DEPARTMENT

**Course Prerequisites:** Metallurgy and Material Engineering and Mechanics of Solids
Subject Code: **19PC2AE02**

**Course Coordinators**

T. Raju
Chandrashekhar B Banad

# Course Objectives

- To study the microstructure of different materials
- To understand the changes in microstructure after different heat treatments
- To analyze the various tests to be conducted on engineering materials
- To analyze the importance of tests in evaluating the corresponding mechanical properties

# Course Outcomes

- Identify different materials with microstructure
- Inspect the microstructure of a given material after heat treatments
- Evaluate the result of test and comment on the mechanical properties of materials
- Decide a material and an appropriate test suitable for given application

# METALLURGY

- Art and science of extraction metals
- Types
- Physical metallurgy
- Extraction metallurgy
- Mechanical metallurgy

# PURPOSE OF THIS LABORATORY

- To study the microstructures characteristics of various Engineering materials through metallographic.
- To verify the principles of material science described in the lectures by means of experiments.
- To Substantiate the knowledge gained from the lectures through Experiments.
- To demonstrate the use of instrumentation such as Metallurgical Microscope, Grinding Machines, Polishing Machine and materials testing equipment's.

# LIST OF EXPERIMENTS

1. **Specimen Preparation for Metalallographic Examination**

2. Preparation and study of the micro structure of pure metals like-Iron, copper and aluminum

3. Preparation and study of the micro structure of Mild steel, low carbon steels, high carbon steels

4. Study the micro structure of cast irons i.e. grey cast iron, spheroidal graphite iron, malleable cast iron ,white cast iron

5. Study the micro structure of Non Ferrous alloys- Brass, Bronze, Cast aluminum alloys

6. Study the micro structure of heat treated steels- annealing, normalizing and hardening

7. Hardenability of steels by Jomney end quench test

# LIST OF EQUIPMENTS IN THE LAB

1. Specimen cut-off machine
2. Bench grinder
3. Belt grinder
4. Emery papers
5. Disc polishing machine
6. Metallurgical microscopes
7. Image analyzer
8. Muffle furnace
9. Jominy end quench test equipment
10. Specimen hot drier

# SPECIMEN CUT-OFF MACHINE

# BENCH GRINDER

# BELT GRINDER

# EMERY PAPERS 1/0,2/0,3/0.4/0

# DISC POLISHING MACHINE

# METALLURGICAL MICROSCOPES

# IMAGE ANALYZER

# MUFFLE FURNACE

# Jominy End Quench Test Equipment

# SPECIMEN HOT DRIER

# Common Procedure

Preparation and study of the micro structure of pure metals like-Iron, copper and aluminum

Step 1: Sampling:

Select the sample rod/bar/plate which should be tested

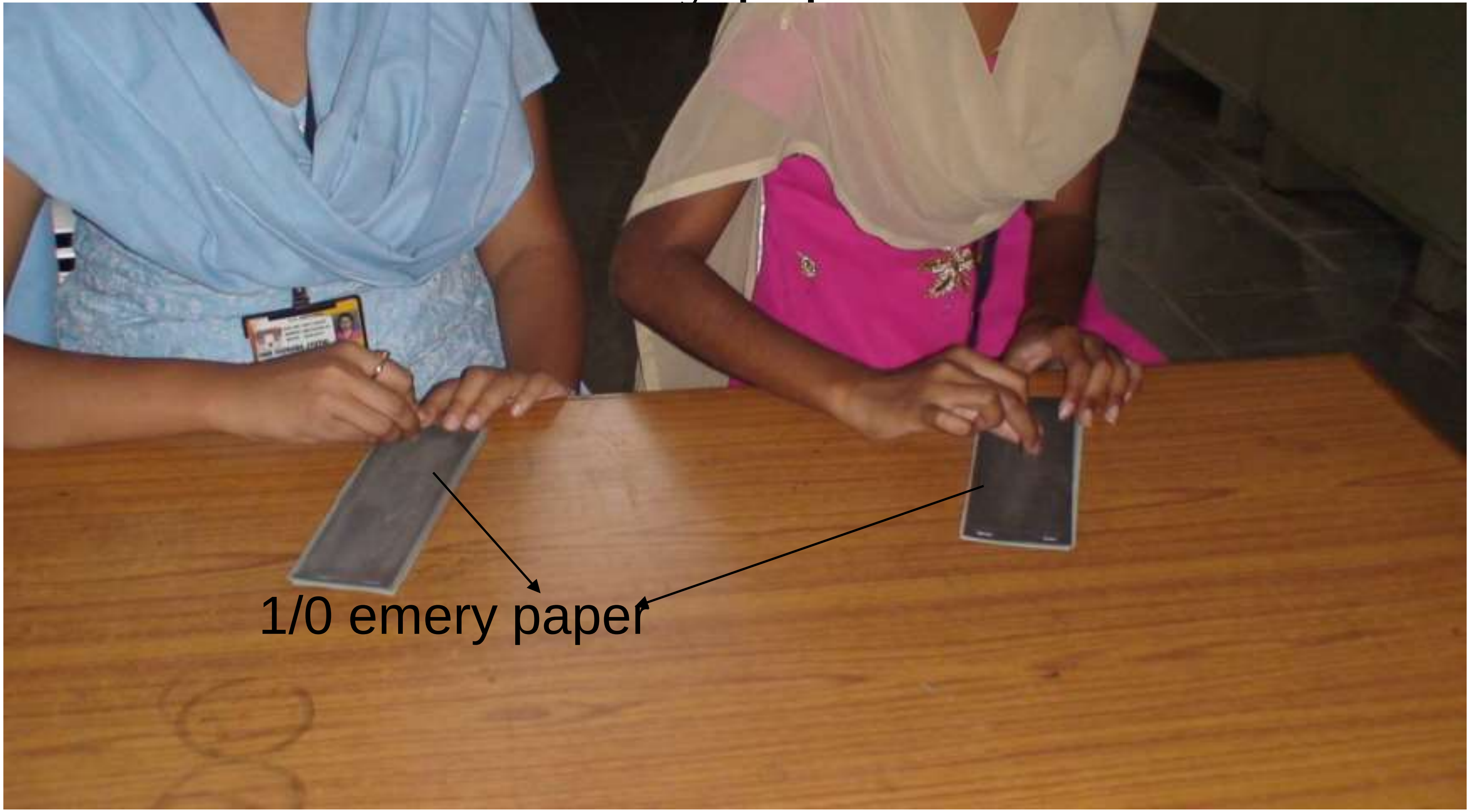
Sample bar

# Step 2: Cutting the specimen from sample bar with cut-off machine

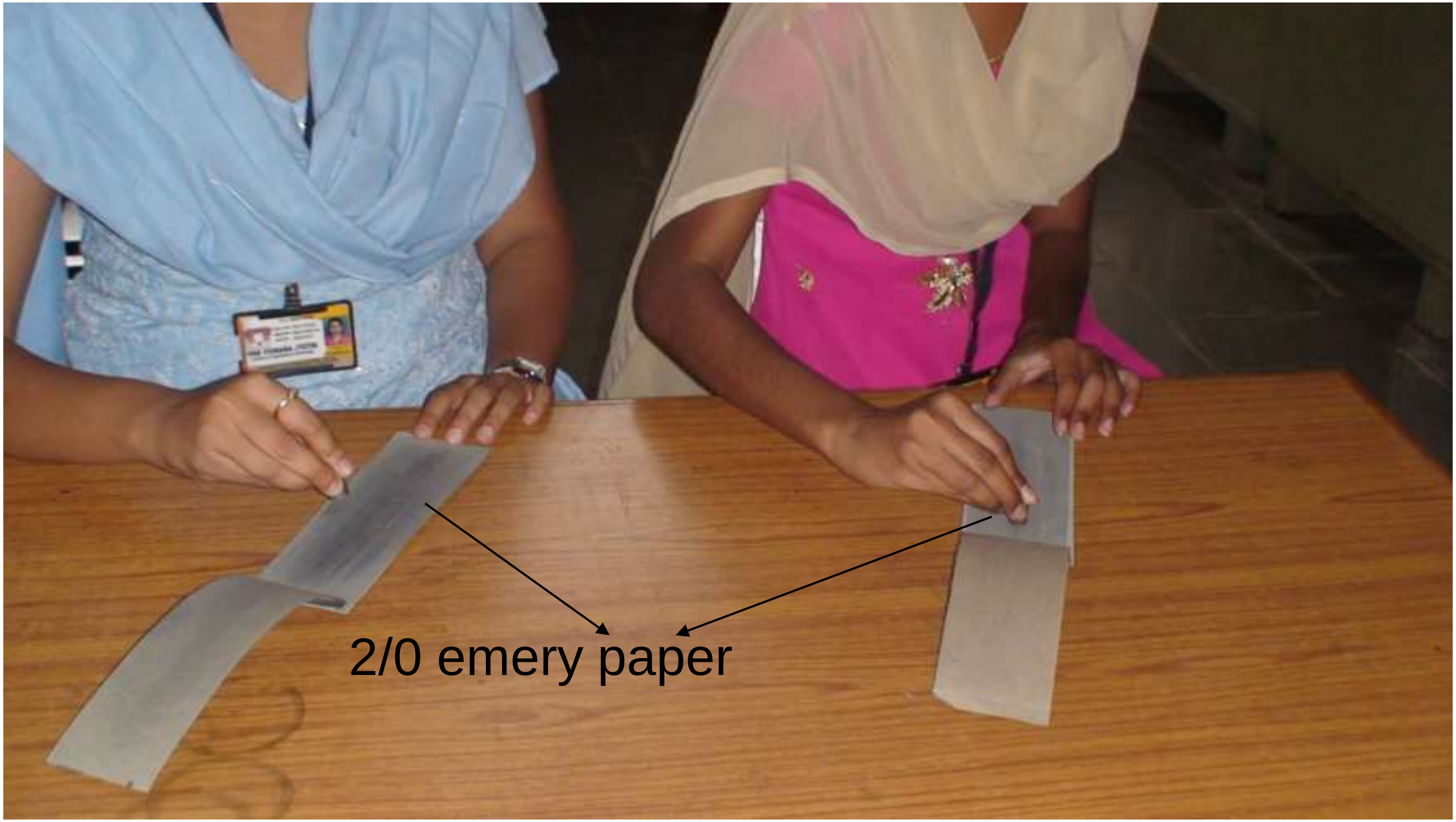
# Step3: Rough grinding with grinding machine

# Step 4: Intermediate polishing with Emery papers 1/0,2/0,3/0,4/0

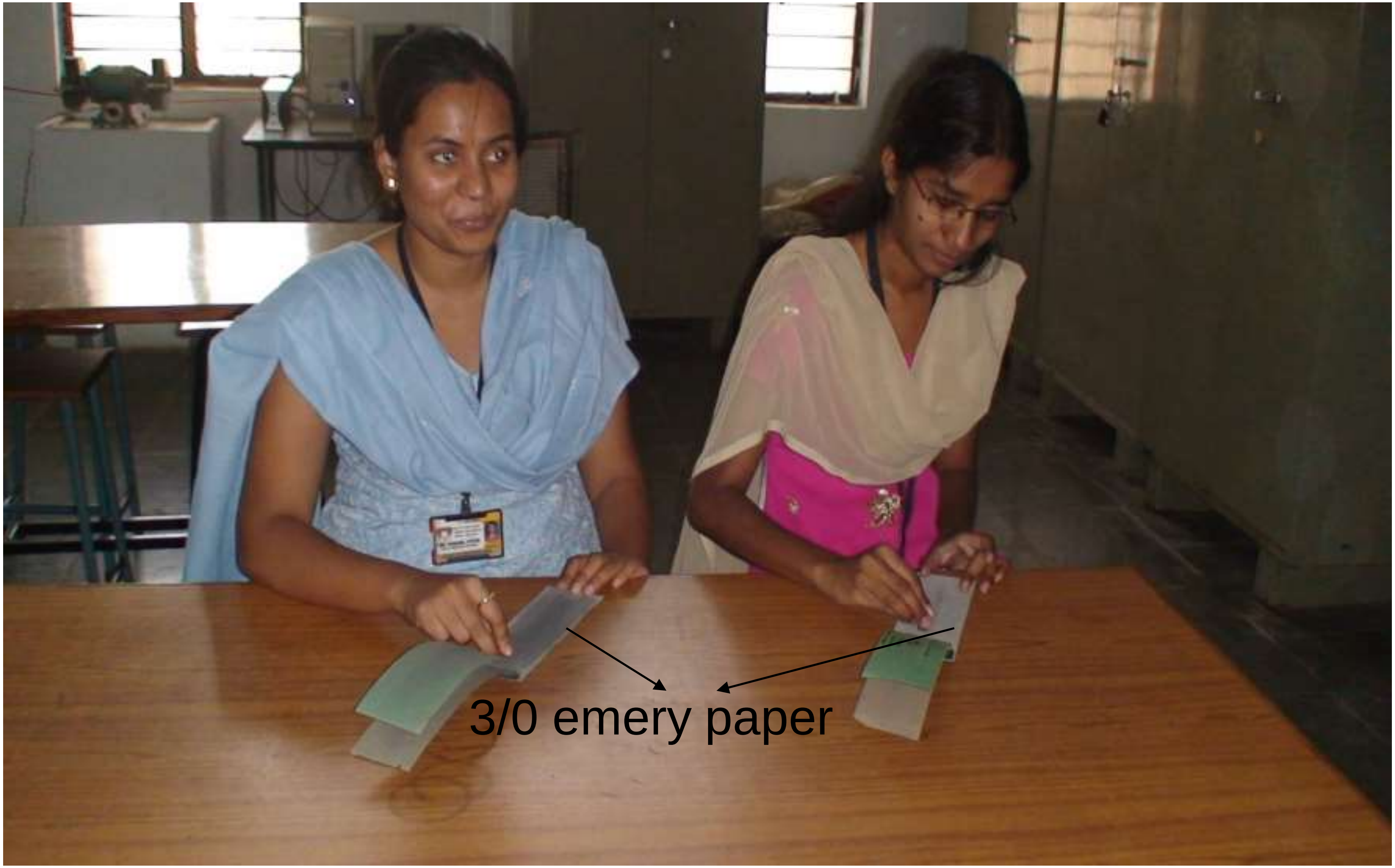
1/0 emery paper



# 2/0 emery paper



# 3/0 emery paper



# 4/0 emery paper

# Step5: Fine polishing with Disc polishing machine

# Step 6: Cleaning

Clean the specimen with distilled water, then cotton waste after disc polishing

# Step 7: Drying with Drier

- SAMPLE SHOULD BE FREE FROM SCRATCHES AND ALSO FREE  FROM DUST/DIRT

## Step8: Etching: Keep specimen in the etching reagent (Nitol sol.) (Mixture of 2%Nitric acid and 98%alcohol)

- Clean the specimen with cotton waste after etching

# Step9: Drying with Drier

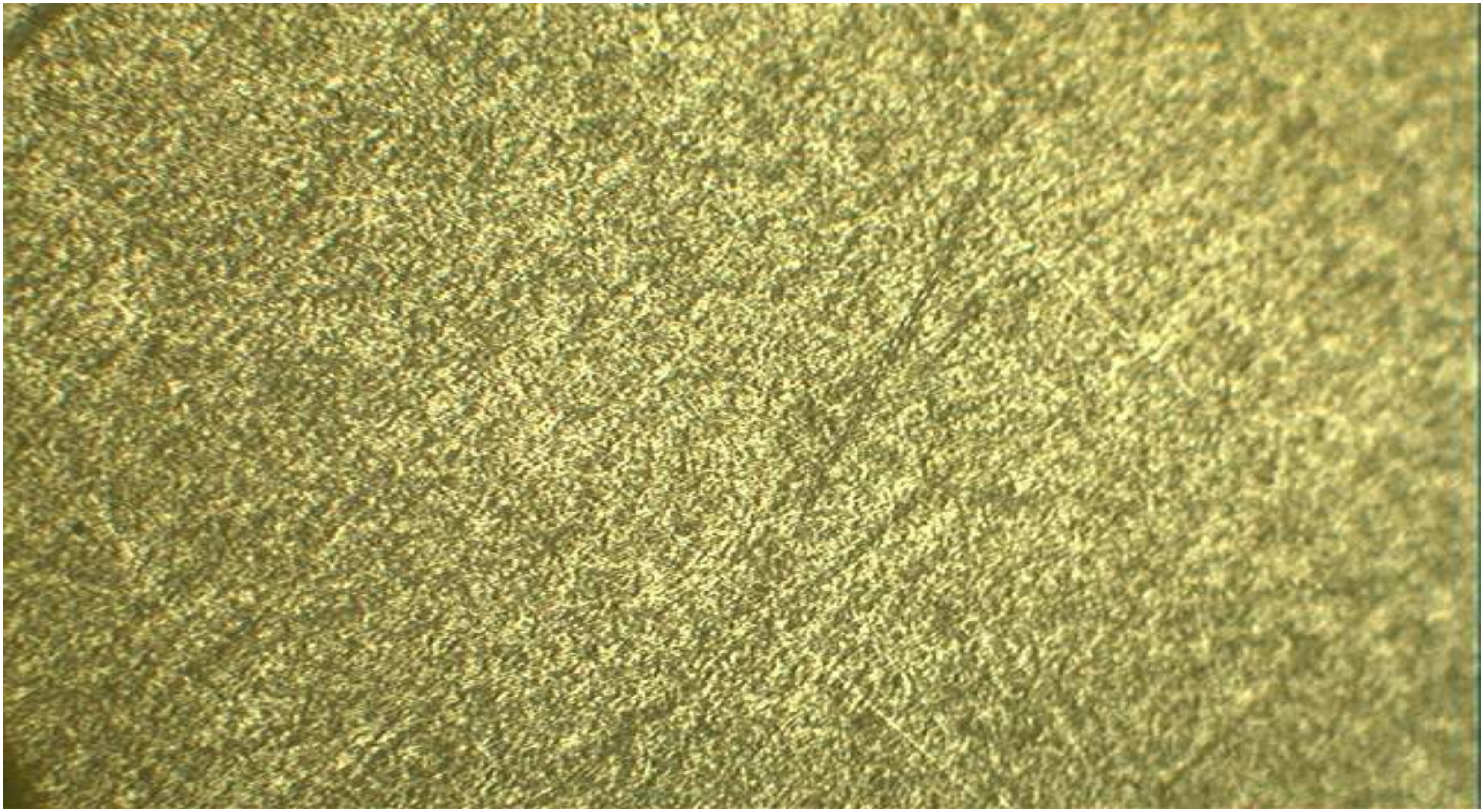
# Step 10
# Study/observe-microstructure of the specimen under the microscope

# Study/observe-the microstructure of the specimen under image analyzer

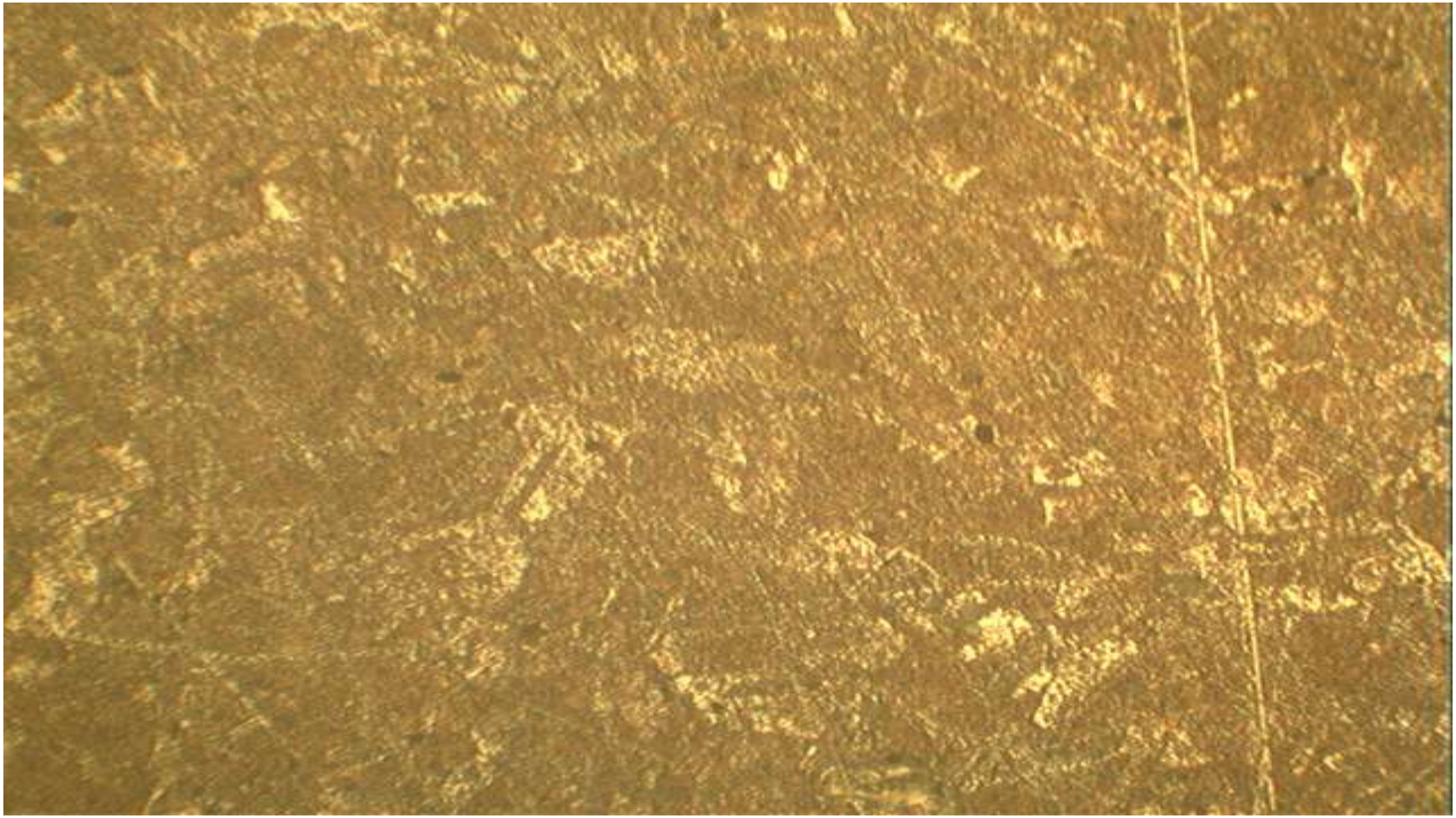
# SUBMIT THE REPORT

- Magnification
- Specimen name
- Composition
- Micro structural details
- Heat treatment if any
- Etchant
- Etching time
- Remarks

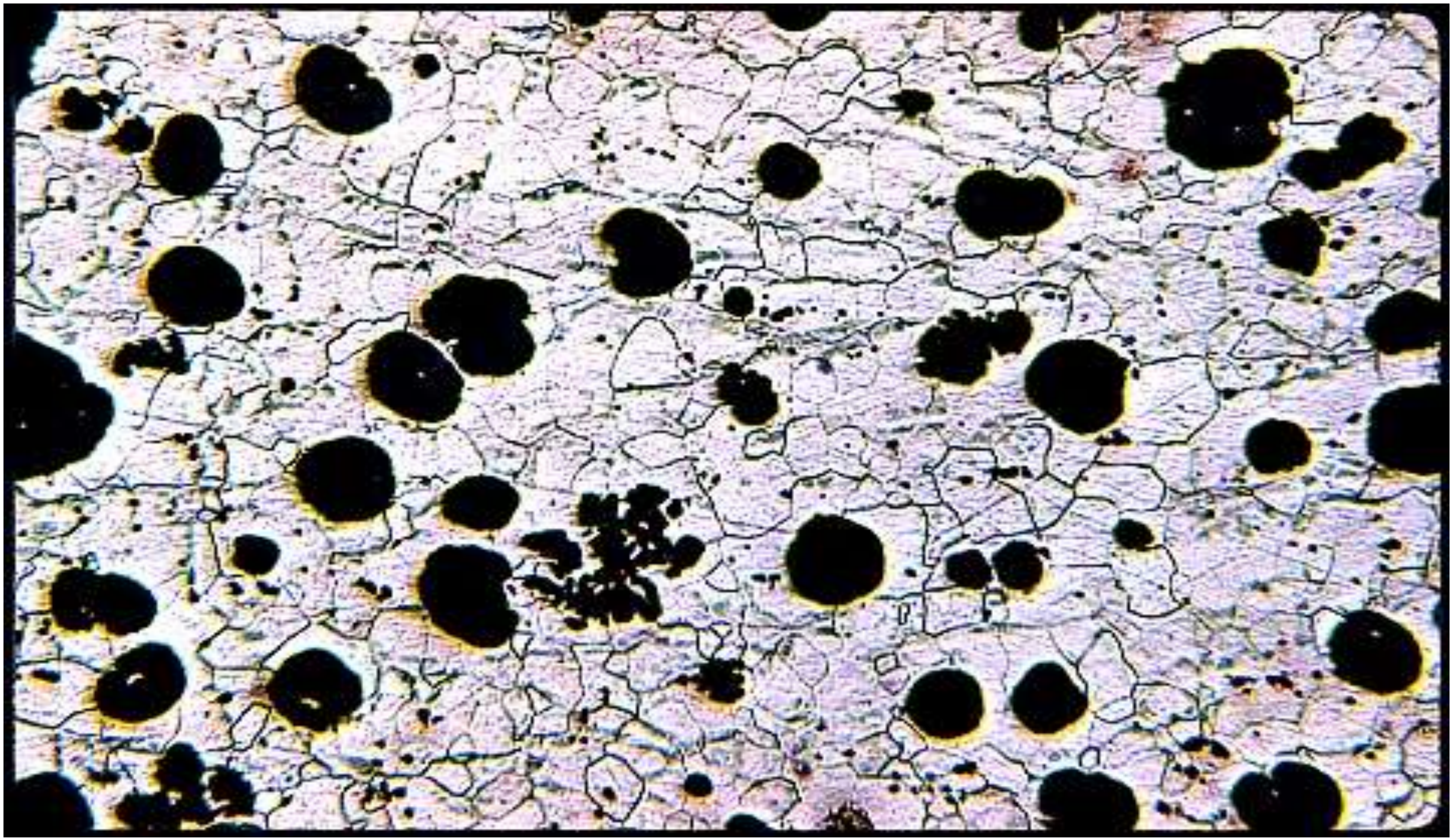
# Pure Aluminium



# Pure Copper



# Cast Iron



Thank you

# VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

## Mechanics of Solids Lab Protocol

## Department of Automobile engineering


**By**

| | |
|---|---|
| **T. Raju** | **- Assistant Professor** |
| **Aziz Athani** | **- Assistant Professor** |
| **Nagaraju A Shet** | **- Assistant Professor** |
| **M Siva Prasad** | **- Instructor** |


**Venue: D-002**
**CIVIL Engineering Department**

AUTOMOBILE ENGINEERING


MECHANICAL ENGINEERING

# MECHANICS OF SOLIDS


AERONAUTICAL ENGINEERING

CIVIL ENGINEERING

# LEARNING OVERVIEW

- Study of the subject is useful to understand various forces like

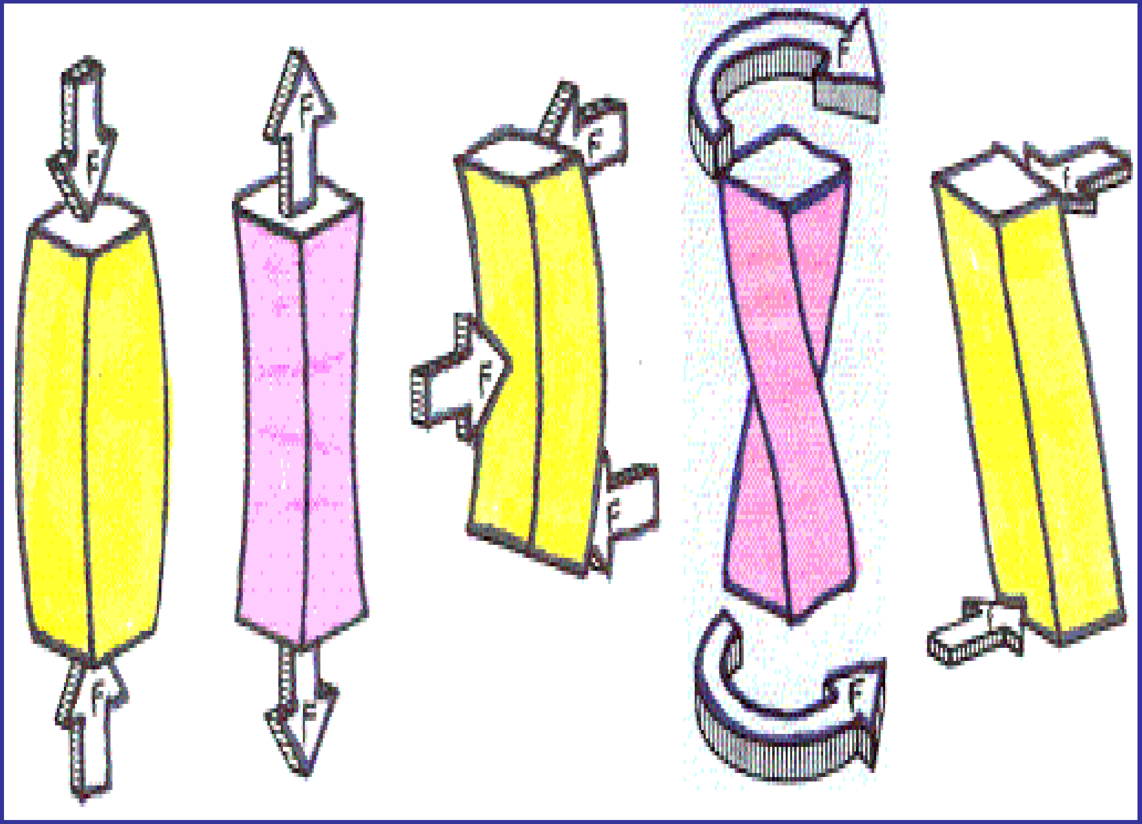
  1) compression

  2) Tension

  3) Bending

  4)Torsion and

  5) Shear



# LEARNING OVERVIEW

- It is essential for designing of various structural members and machine components subjected to various actions, so that members/components should be able to bear the maximum load without failure during the service period with knowledge of this subject.

# Laboratory Introduction

- In Strength of Materials laboratory testing of materials under tension, compression, shear and bending will be done and failure patterns will be studied.

- Mechanical properties like elasticity, plasticity, ductility, hardness, toughness and brittleness will be investigated and the strength of various materials with reference to above properties that influence the design, will be determined.

# Laboratory Introduction

- Concepts to be developed through this laboratory work:- Stress, strain, elasticity, plasticity, hardness, toughness, machinability, ductility, modulus of elasticity, modulus of rigidity, bulk modulus, strain energy, shear strength, flexural strength, torsional rigidity and stiffness.

- Principles to be understood-
  1) Hooke's law
  2) Mohr circle

# Various tests for material properties

- Tension test
- Compression test
- Shear test
- Hardness test
- Torsion test
- Bending Test
- Impact test
- Mechanical advantage
- Moment of Inertia

# Instrumentation

- Various instruments for measuring linear dimensions with various degrees of accuracy- scale , vernier calipers.

- Instrumentation for measuring displacements-dial gauges, electrical resistance strain gauges.

- Various methods of measuring forces-proving rings, hydraulic pressure gauges, pendulum dynamometer.

# Intellectual skills

- To identify different parts of Instrument/equipment and their actions.
- To interpret failure patterns of different materials under different actions.
- To compute the required properties by measuring the appropriate displacements/deformations.
- To interpret test results or observations during the test, the properties of materials like yield stress, Ultimate strength, ductility, toughness etc. and decide the suitability of the material for a particular situation.

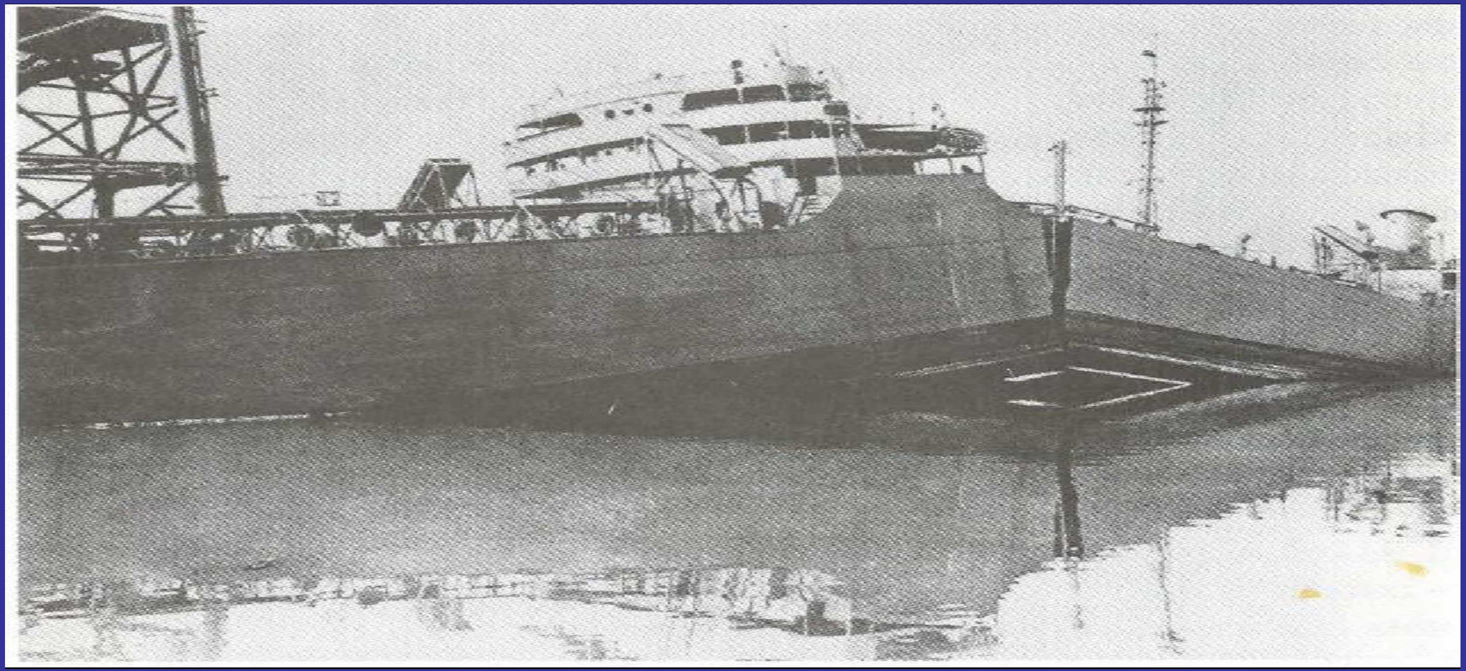
# Intellectual Skills

- Ability to draw sketches of standard specimen, arrangement for test in respective machines.
- Ability to measure different parameters and record observations.
- Ability to handle Instruments and observe behavior of different materials during various stages of test.
- Conclusion from the results.

# Objectives

- To understand the stress – strain relation of the materials in elastic and plastic stages.
- Different ways of mechanical testing will be highlighted.
- The interpretation of sensible information from the test data such that mechanical assessments are used for selecting suitable material.
- Finally , the cause of material failure will be investigated and suggest possible solutions for avoiding the failure .

# Failure in materials

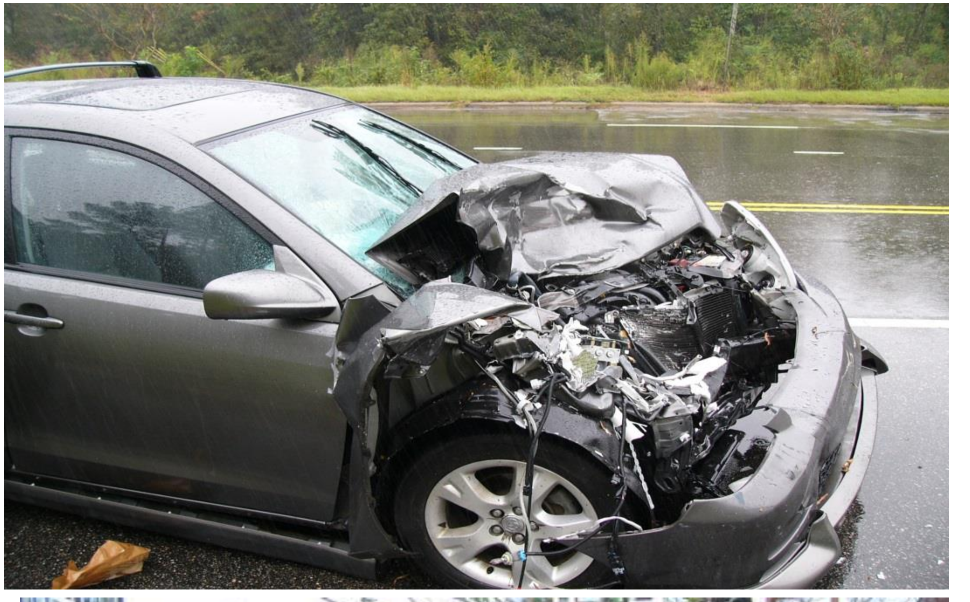


- Failure of Liberty Ships during services in World War II. Seven of the Liberty ships built during the world war II have failed completely breaking into two as a result of brittle fractures. Over 1000 of approximately 5000 merchant ships built during World War II had developed cracks of considerable size and became unserviceable.

# Failure in materials

The aircraft was used for inter-island transportation for 19years, failed due to multiple reasons

TAMASOMA JYOTHIRGAMAYA

# Material property assessments

- **Hardness** --- Micro/Macro hardness tests
- **Strength, Ductility** --- Tension tests **(elongation, area of reduction)**
- **Torsional rigidity** --- Torsion tests
- **Flexural rigidity** --- Bending test
- **Toughness (resistance** ---- Toughness tests **Impact tests/ Fracture to failure)**

# Hardness tests

- Hardness is a property which is a measure of a resistance to permanent or plastic deformation.

- Using different indenters, i.e., ball, diamond

Parameters:

Brinells hardness (BHN)
Rockwell hardness

**Rockwell** →

**Brinell** →

# Tensile test

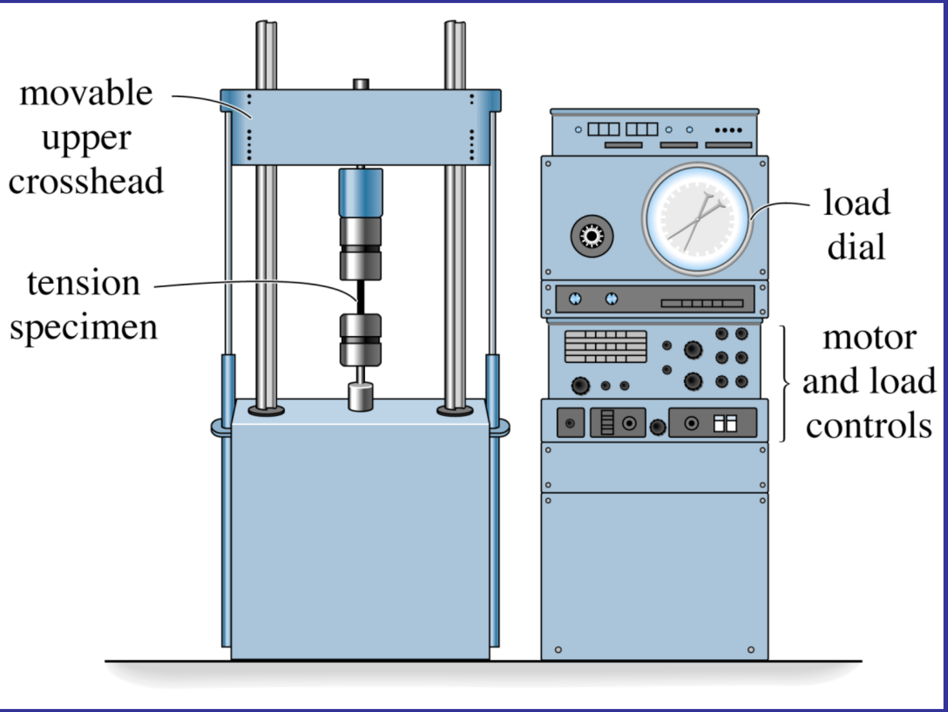
- Provides basic design information on the strength of materials.
- Provides acceptance test for the specification of the materials.

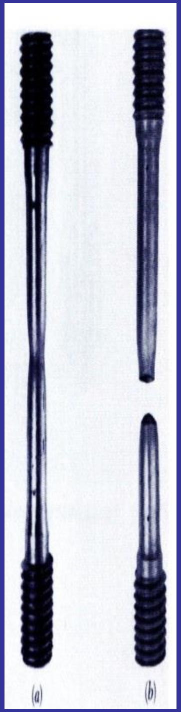
## Parameters:

- **Ultimate Tensile strength $\sigma_U$**
- **Yield stress $\sigma y$**
- **Young's Modulus of elasticity E**
- **Ductility indices:**

**%Elongation**

**% Area of reduction**



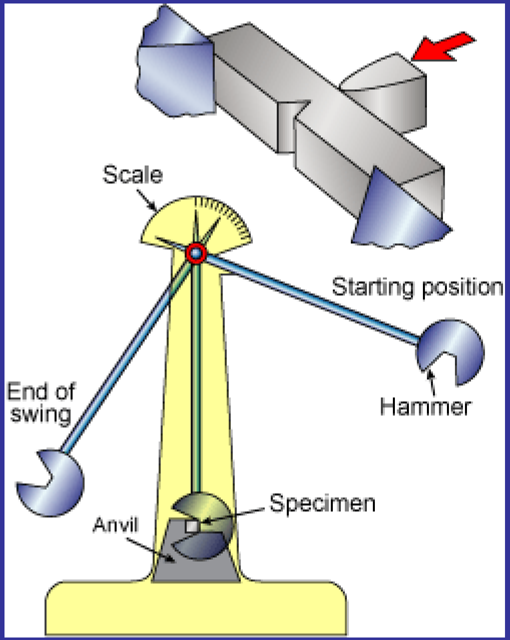



# Compression Test

- Compression tests on various brittle materials are conducted on specimens in the shape of cubes or cylinders.
- Compression test on Concrete is an important test because the strength of concrete is considered only in compression.
- In every important construction project , it should be ensured that the required strength has been obtained.
- The friction between the test platen of the machine and top surface of the specimen will apply a lateral restraint on the lateral expansion of the specimen resulting due to Poisson’s effect.
- True compressive strength is indicated only in a test on a cylinder with l/d ratio greater than 2 .
- To avoid difficulty in capping concrete cubes are tested for the determination of compressive strength of concrete.

# Impact tests

- Measure toughness of materials in terms of energy absorption.
- Specimen is broken by the impact of a hammer and the energy absorbed during fracture is measured in Joules.
- Easy and works on energy principle.
- Not a standard material parameter, should be used in conjunction with other material properties such as strength and fracture toughness for materials by Izod and Charpy methods




**Parameters:**

- Impact energy
- Toughness

# Torsion test

- Applying twisting moment to the specimen and measure the torque and angle of Twist

## Parameters:

- Shear Modulus
- Polar M.I
- Torque
- Twist
- Torsional rigidity

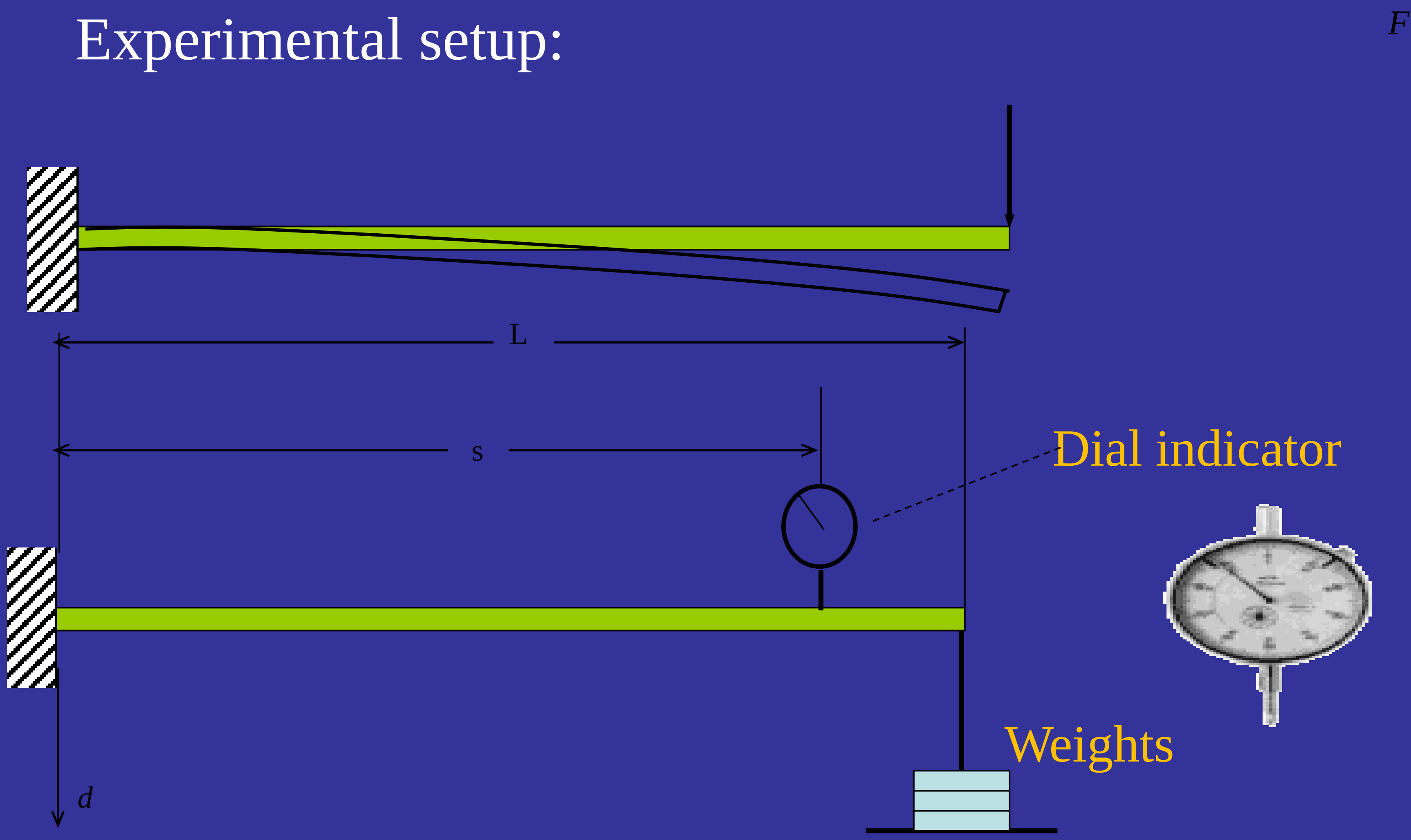
# Bending of a Cantilever Beam

**<u>The deflection of the beam at a section  depends on:</u>**

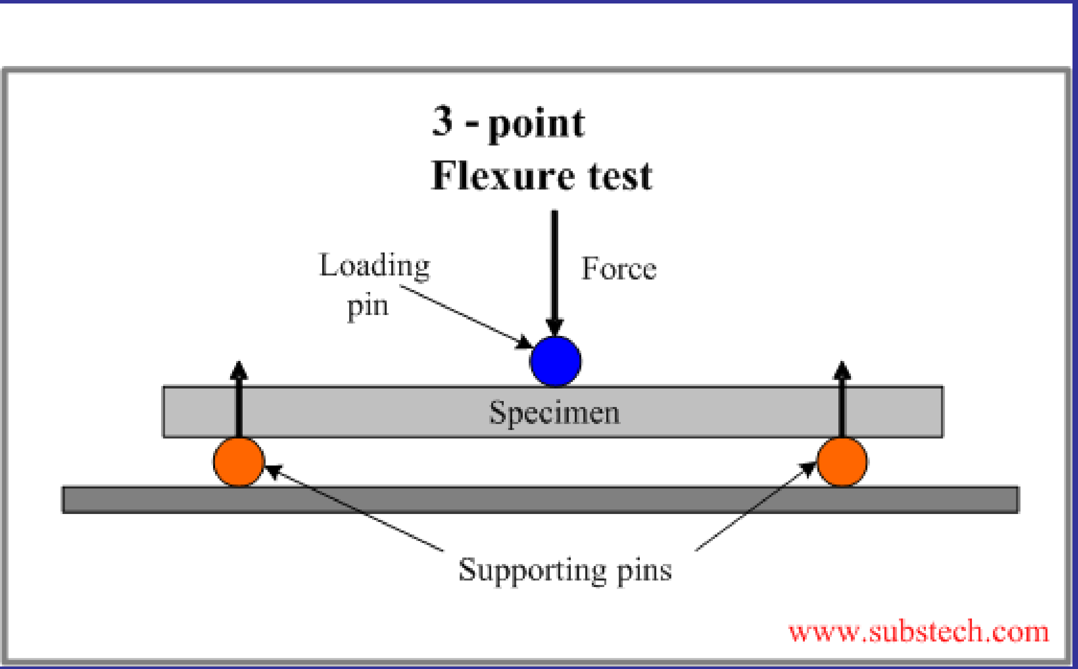
- The magnitude and position of the load
- The span of the beam.
- Material stiffness. Material of higher stiffness produces less deflection.
- The geometry of the cross section.  Higher moment of inertia results in less curvature.
- Hence on Flexural rigidity .

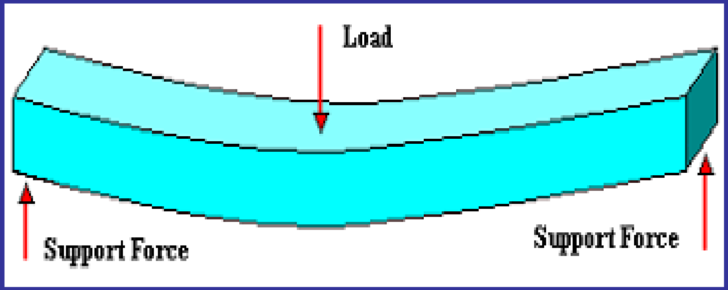
# Bending of a Cantilever Beam

Experimental setup:

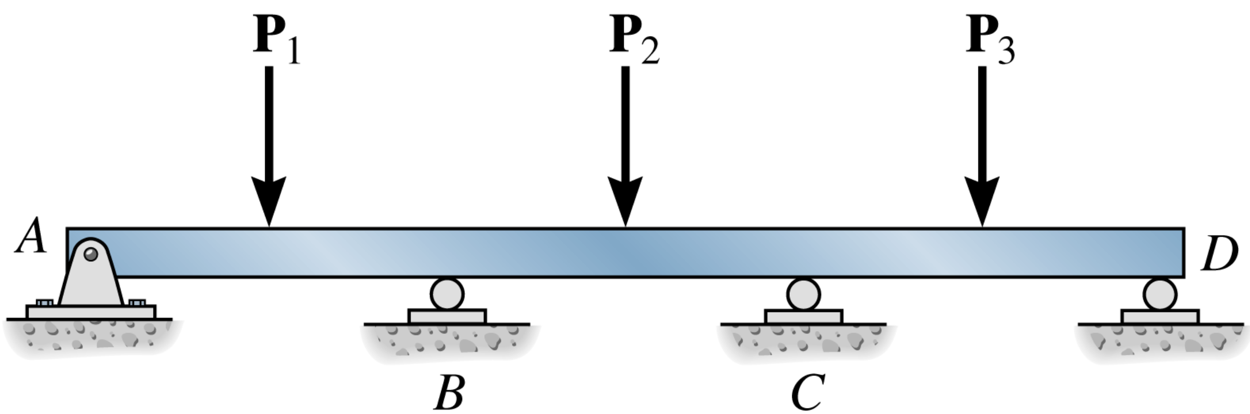


# Bending of a simply supported beam




# Bending test on continuous beam




(a)

# Spring test

- Applying Tensile/Compressive force to the specimen and measure the Deflection sustained by the Spring.

## Parameters:

- Shear Modulus
- Twisting moment
- Deflection

# List of Experiments

1. To conduct the Uniaxial Tension test and to determine the yield stress, Ultimate strength, Breaking stress, % elongation & Modulus of elasticity by Tension test on Mild Steel bar.
2. To determine the crushing strength of cocrete and bricks
3. To determine the Shear strength of M.S. in Double shear.
4. a)To determine the Brinell Hardness numbers for M.S., Aluminium ,copper and Brass.

# List of Experiments

4\. b) To determine the Rockwell Hardness nos for M.S., Aluminum , Brass.

5\. To determine the energy absorbed by the specimen of M.S., by Izod & Charpy Impact Test.

6\.To determine the Modulus of rigidity of M.S. by Torsion test.

7\. To determine the modulus of elasticity of the material of given beam by conducting bending test on cantilever beam.

8\. To determine the modulus of elasticity of the material of given beam by conducting bending test on Simply supported beam.

# List of Experiments

9.To determine  Moment of Inertia of a fly wheel

10. To determine the Mechanical advantage  of simple and compound screw jack

11. Demonstration of use of electrical resistance strain gauges.

12. To determine the Modulus of rigidity of a close coiled helical spring under Tension/Compression.

# LAB. REPORT

- 5 persons per group
- Analyze results together
- Each person of the group will write his/her own Discussion and Conclusion.

# LABORATORY SAFETY RULES

- Keep yourself and others safe.
- Wear appropriate safety equipment.
- No loose clothes and long hair around machines.
- Clean up any spills immediately.
- Wear shoes to protect the feet from falling weights.
- Don’t play with machines/tools.

# VNR lab protocol
## Manufacturing Technology Lab

# Course Objectives

- **Understand** casting techniques and sand properties
- **Understand** different welding processes and their use
- **Understand** different press working operations
- To practice various machining operations

# Course Outcomes

- **Apply** the knowledge involved in casting techniques
- **Decide** the selection of various welding techniques applicable for different materials
- **Integrate** the knowledge involved in press working operations
- Perform various machining operations

# Experiments

- **Metal Casting**
- **Welding**
- **Mechanical Press Working**
- **Processing of Plastics**

# Metal Casting

- Exercise 1: Pattern Design and making - for one casting drawing.
- Exercise 2: Sand properties testing - for strengths, and permeability
- Exercise 3: Moulding Melting and Casting

# Welding

- Exercise1: Spot Welding
- Exercise 2: TIG Welding
- Exercise 3: MIG Welding
- Exercise 4: Brazing

# Mechanical Press Working

1. Blanking and Piercing operations
2. Bending operation

# Processing of Plastics

1. Injection Moulding
2. Blow Moulding

# Experiments

- Metal Casting
- Welding
- Mechanical Press Working
- Processing of Plastics

# PURPOSE OF THIS LABORATORY

To understand the various production processes which are commonly applied to Industrial Production in which raw materials are transformed to finished products on a large scale.
Such finished products may be used for manufacturing , other more complex products such as Aircraft, Automobiles, House Hold Appliances, Power Plants etc.

# ***MANUFACTURING***

The processes and methods employed to transform tangible inputs such as raw materials, semi finished goods, subassemblies, ideas, information and knowledge into goods or services

# List Of Experiments

**I. METAL CASTING**

1. Pattern Design and Making- by Casting Drawing
2. Sand Properties Testing- for testing strength and permeability
3. Moulding , Melting & Casting

**II. WELDING**

1. ARC WELDING: LAP & BUTT JOINTS
2. SPOT WELDING
3. TIG WELDING
4. MIG WELDING
5. BRAZING

**III. MECHANICAL PRESS WORKING**

1. Bending Operation
2. Blanking & Piercing

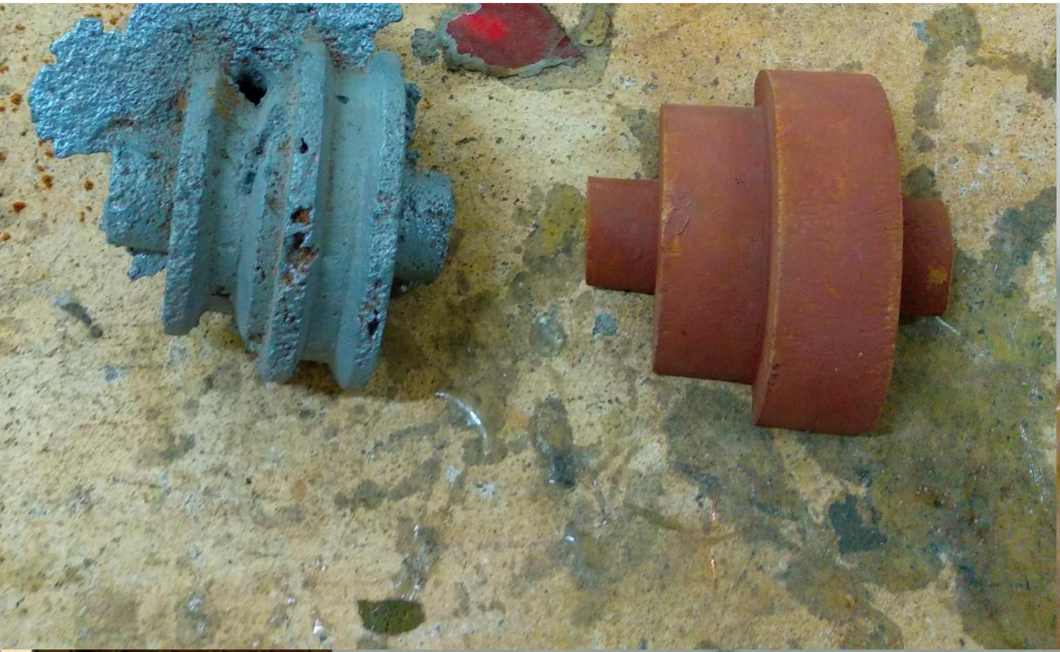
IV **PROCESSING OF PLASTICS**

1. INJECTION MOULDING
2. BLOW MOULDING

# METAL CASTING

PATTERN DESIGN AND MAKING by Wood Turning lathe

# METAL CASTING





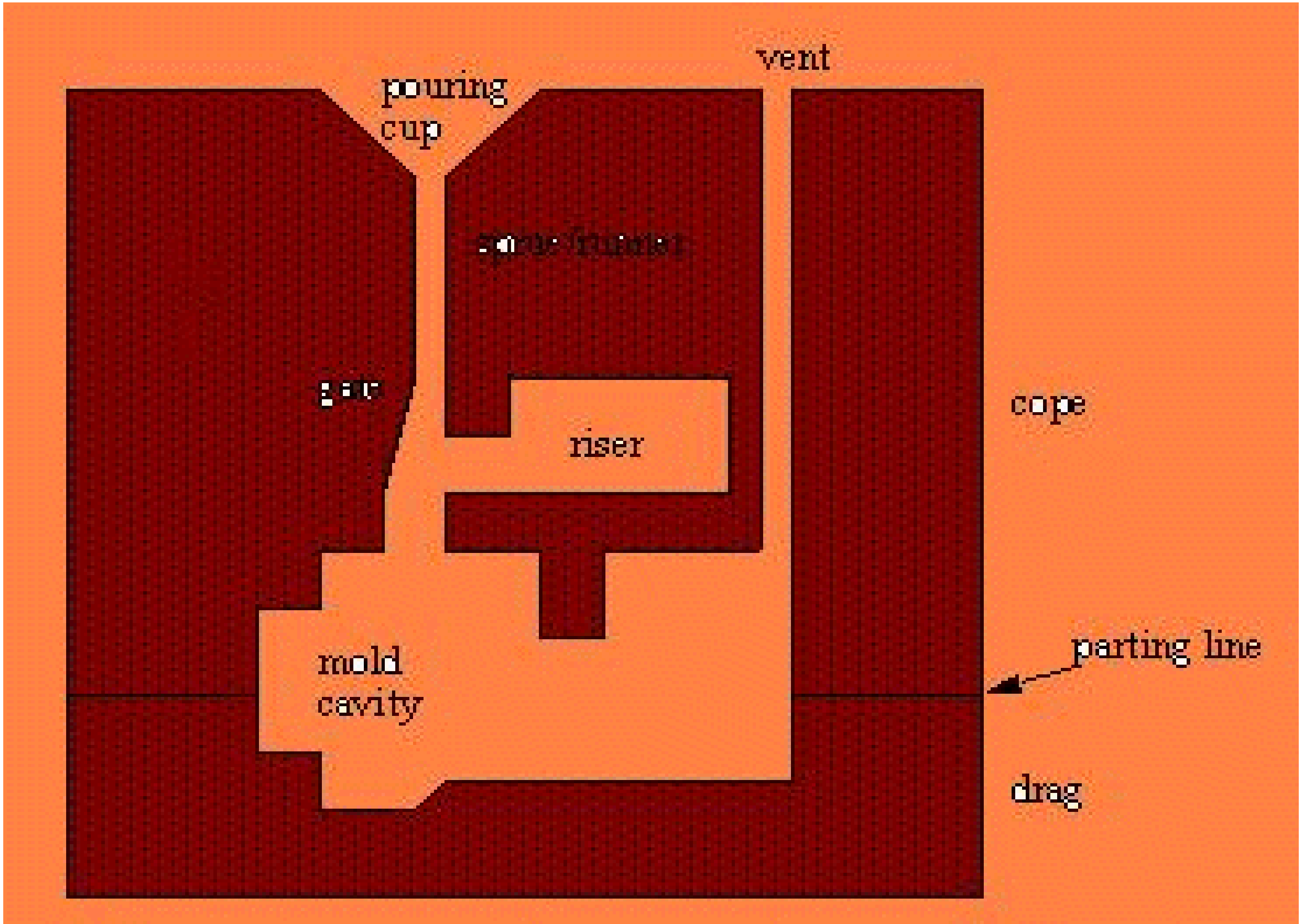
# WHAT IS A PATTERN ?

- CASTING: Casting is a manufacturing process by which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. This solidified part is known as casting which is ejected or broken out of the mold to complete the process.
- PATTERN: A pattern is a replica of the desired casting which when packed in a suitable material, produces a cavity called the mold. This cavity when filled with the molten metal, produces the desired casting after solidification.
- Commonly used patterns are

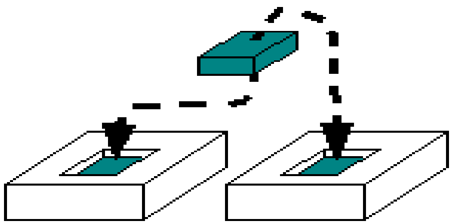
1. Single Piece Pattern
2. Split Pattern
3. Pattern with core
4. Loose Piece Pattern

Pattern materials are wood, metals & alloys, plastics, waxes.

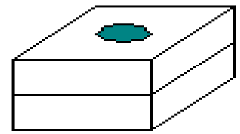
# HOW THE CASTING OF A COMPONENT IS DONE



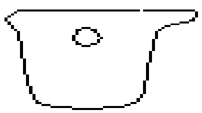
# HOW THE MOLTEN METAL FLOWS



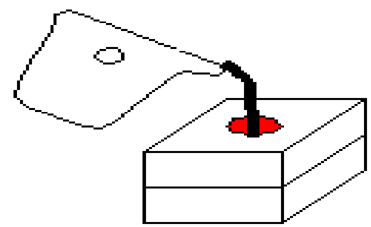
Pattern pushed into sand to make cavities A runner gate system will also be formed at this time. The same will harden



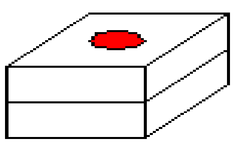
The patterns are matched with the pouring cup facing up



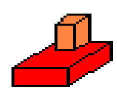
Metal is heated and prepared metallurgically. It is put into a cricible/tundish/etc for pouring



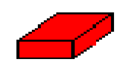
Molten metal is poured into the die



The part is allowed to sit and cool (large parts may take days)



The part is removed from the sand with the runner/gate/etc still attached



The part is finished and the surface is cleaned

# APPLICATIONS OF METAL CASTINGS

- **Transport :** Automobile, aerospace, railways and shipping
- **Heavy Equipment :** Construction, farming and mining
- **Machine Tools :** Machining, casting, plastics molding, forging, extrusion and forming
- **Plant Machinery :** Chemical, petroleum, paper, sugar, textile, steel and thermal plants
- **Defence :** Vehicles, artillery, munitions, storage and supporting equipment
- **Electrical Equipment Machines :** Motors, generators, pumps and compressors
- **Hardware :** Plumbing industry pipes, joints, valves and fittings
- **Household :** Appliances, kitchen and gardening equipment, furniture and fittings
- **Art Objects :** Sculptures, idols, furniture, lamp stands and decorative items

# SAND PROPERTIES TESTING- FOR CONDUCTING STRENGTH & PERMEABILITY
# by Universal Strength Machine & Sand rammer

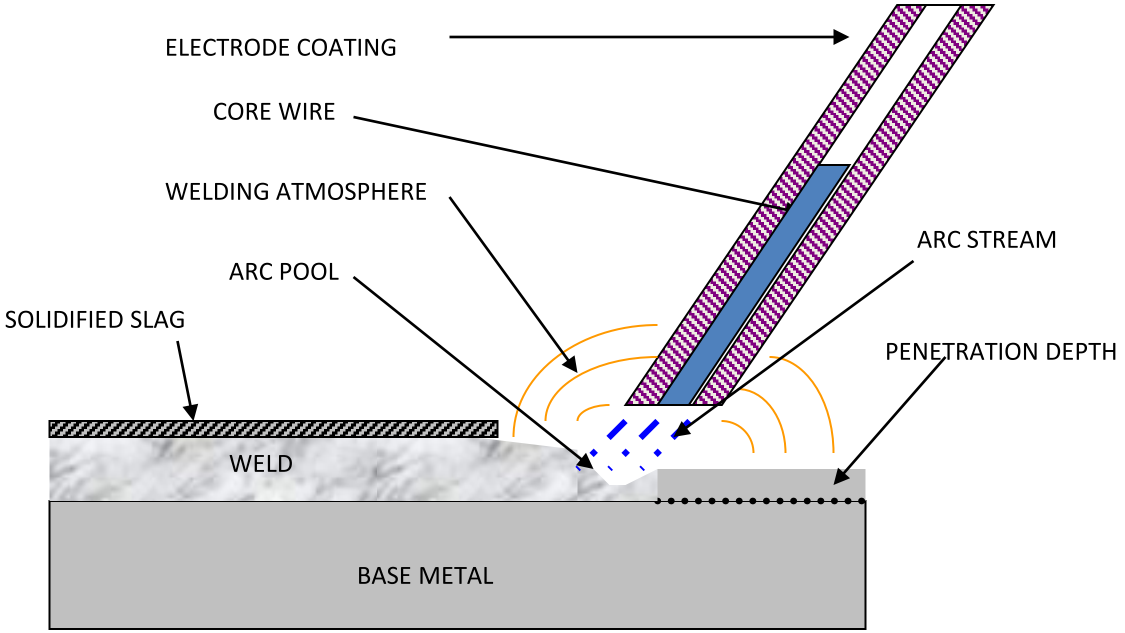

# PERMEABILITY TESTING OF SAND

- **Permeability** is the property by which we can know the ability of sand to transmit gas. The permeability is commonly tested to see if it is correct for the casting conditions

# Welding Processes

# ARC WELDING

# WORKING OF ARC WELDING



# Weld Fluxes

- Typical fluxes
  - $SiO_2$, $TiO_2$, FeO, MgO, $Al_2O_3$
  - Produces a gaseous shield to prevent contamination
  - Act as scavengers to reduce oxides
  - Add alloying elements to the weld
  - Influence shape of weld bead during solidification

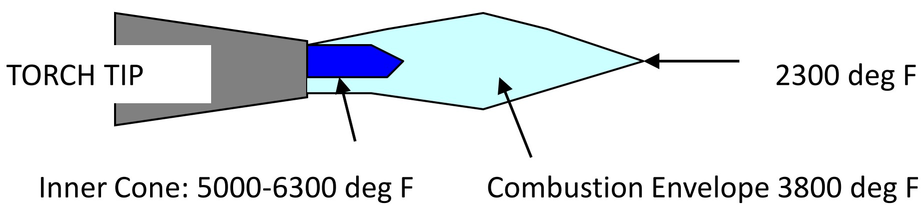
# GAS WELDING

# GAS WELDING

- Sound weld is obtained by selecting proper size of flame, filler material and method of moving torch
- The temperature generated during the process is $3300^0$c
- When the metal is fused, oxygen from the atmosphere and the torch combines with molten metal and forms oxides, results defective weld
- Fluxes are added to the welded metal to remove oxides
- Common fluxes used are made of sodium, potassium. Lithium and borax.
- Flux can be applied as paste, powder,liquid.solid coating or gas.

# Oxyacetylene Welding (gas welding)

- Flame formed by burning a mix of acetylene ($C_2H_2$) and oxygen

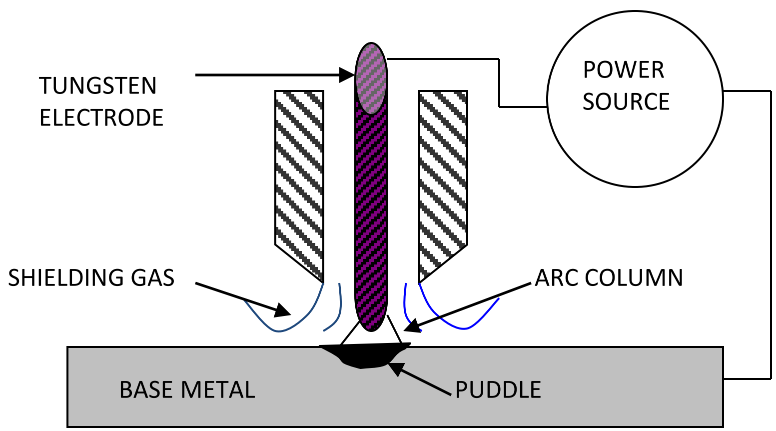


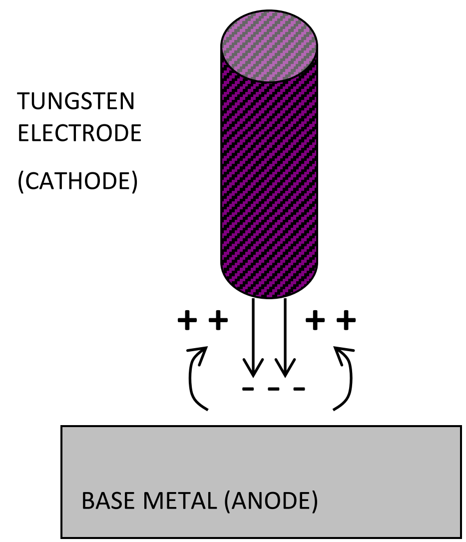

- Fusion of metal is achieved by passing the inner cone of the flame over the metal
- Oxyacetylene can also be used for cutting metals

# TIG –WELDING (tungsten inert gas)

# Tungsten Inert Gas (TIG)

- Tungsten electrode acts as a cathode
- A plasma is produced between the tungsten cathode and the base metal which heats the base metal to its melting point
- Filler metal can be added to the weld pool



# Techniques for Basic Weld Joints

## Manual Torch Movement

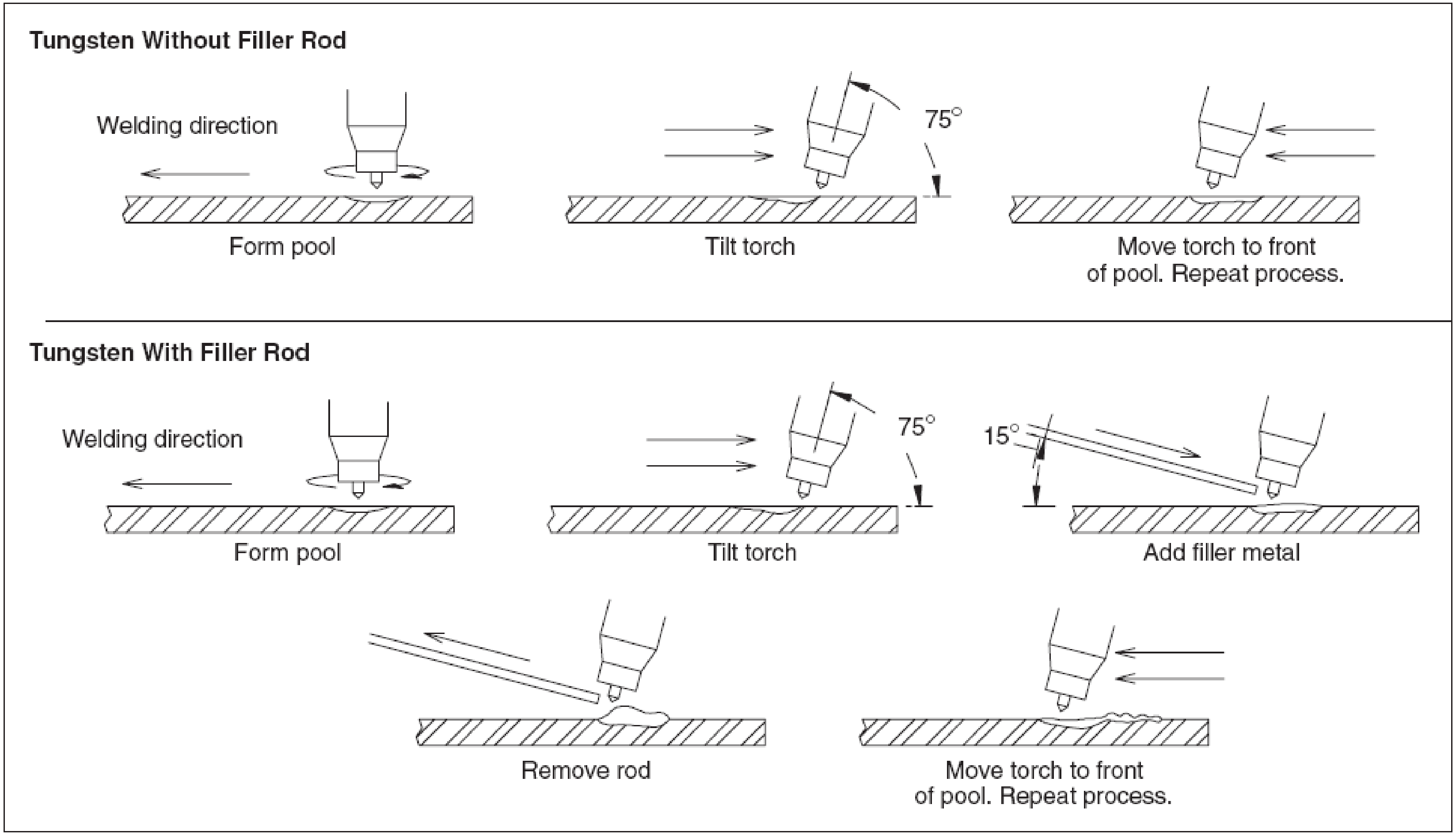
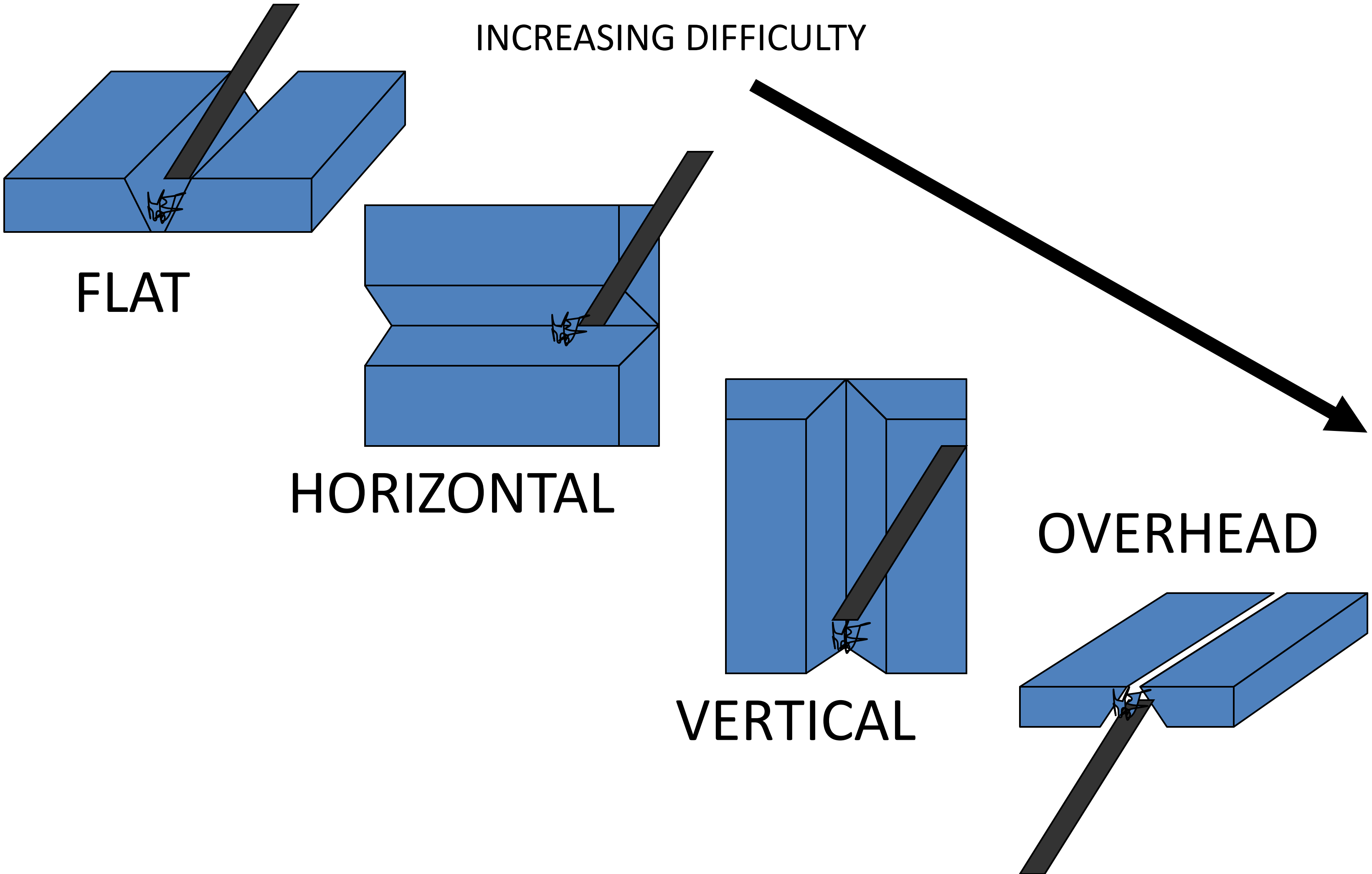



*Figure copied from "TIG Handbook"

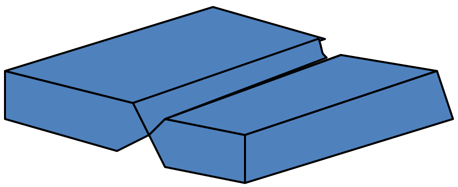
# Inert Gases

- Argon, Helium, Nitrogen, and Carbon dioxide
- Form a protective envelope around the weld area
- Used in
  - MIG
  - TIG
  - Shield Metal Arc

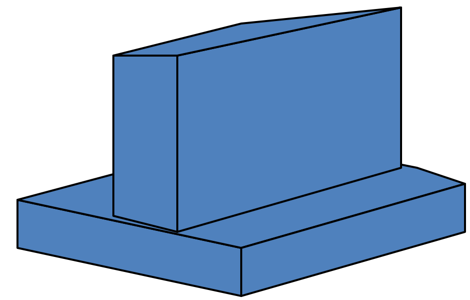
# Welding Positions



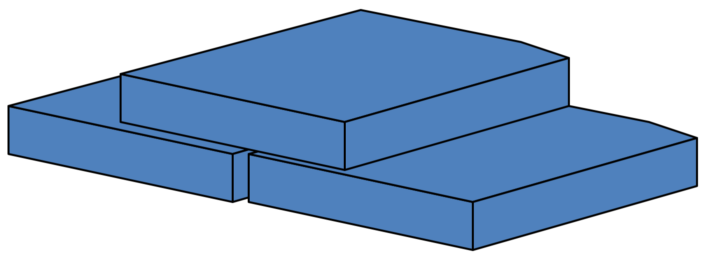
# Joint Design



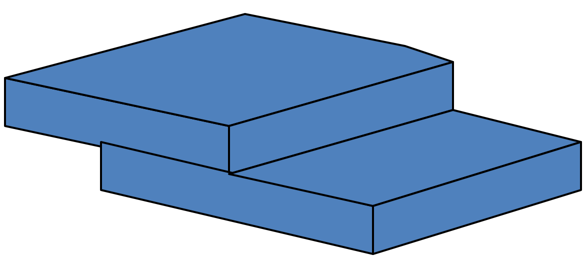
**BUTT JOINT**



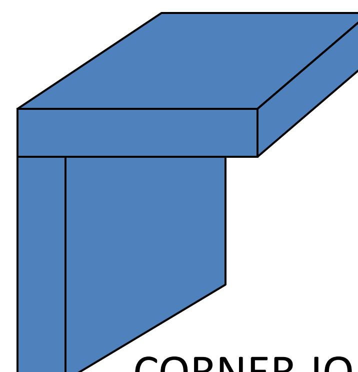
FILLET JOINT



STRAP JOINT



LAP JOINT



CORNER JOINT

# Brazing

- **Brazing**

**Brazing** is a metal-joining process whereby a filler metal is heated above melting point and distributed between two or more close-fitting parts by capillary action. The filler metal is brought slightly above its melting (liquidus) temperature while protected by a suitable atmosphere, usually a flux. It then flows over the base metal (known as wetting) and is then cooled to join the workpieces together

# SPOT WELDING

# SPOT WELDING

- **Spot welding** (**RSW**) is a process in which contacting metal surfaces are joined by the heat obtained from resistance to electric current flow.
- Work-pieces are held together under pressure exerted by electrodes. Typically the sheets are in the 0.5 to 3 mm (0.020 to 0.12 in) thickness range. The process uses two shaped copper alloy electrodes to concentrate welding current into a small "spot" and to simultaneously clamp the sheets together.
- Forcing a large current through the spot will melt the metal and form the weld. The attractive feature of spot welding is a lot of energy can be delivered to the spot in a very short time (approximately ten milliseconds). That permits the welding to occur without excessive heating to the rest of the sheet

# Fly Press


# Fly Press

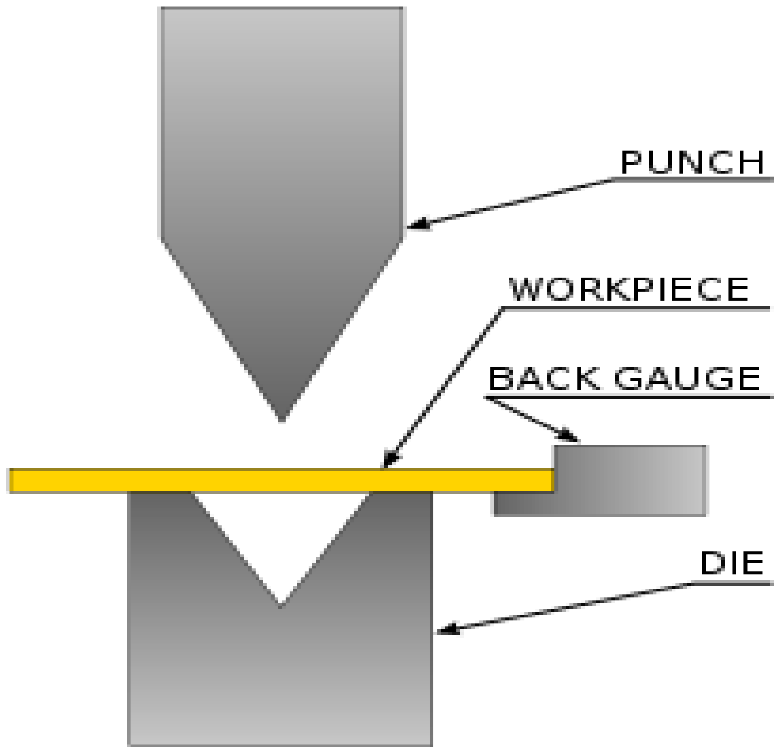
# BENDING OPERATION

# Hydraulic Press

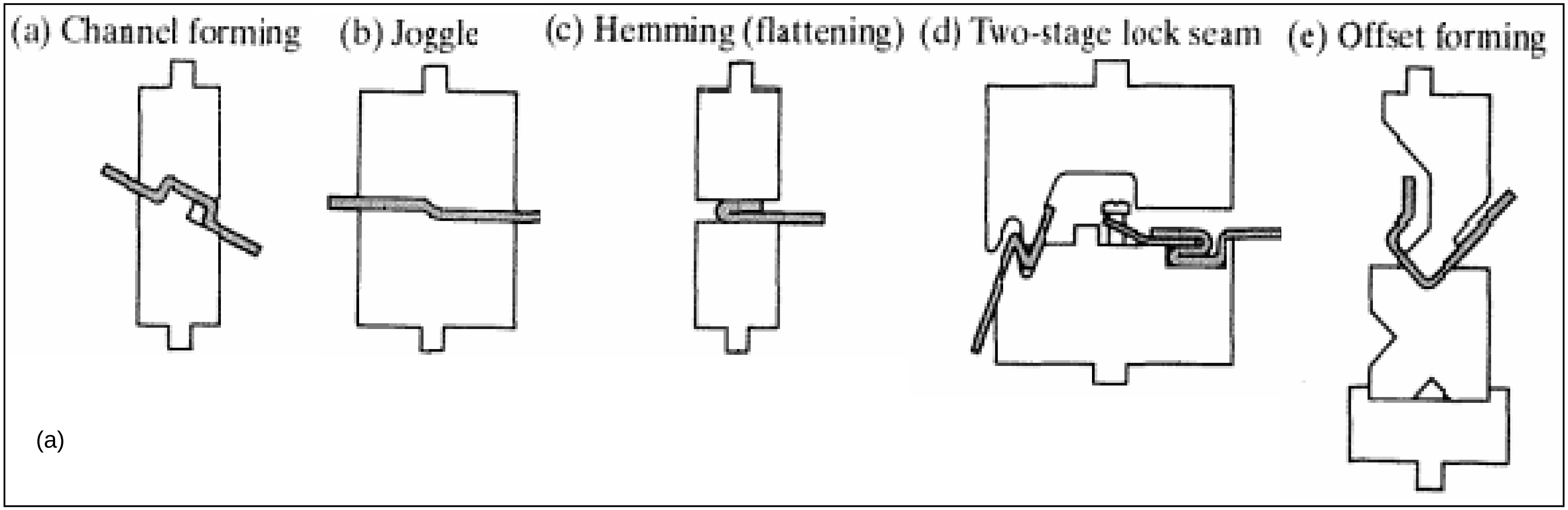
# BENDING OPERATION

- **Bending** is a manufacturing process that produces a V-shape, U-shape, or channel shape along a straight axis in ductile materials, most commonly sheet metal. Commonly used equipment include box and pan brakes, brake presses, and other specialized machine presses. Typical products that are made like this are boxes such as electrical enclosures and rectangular ductwork.

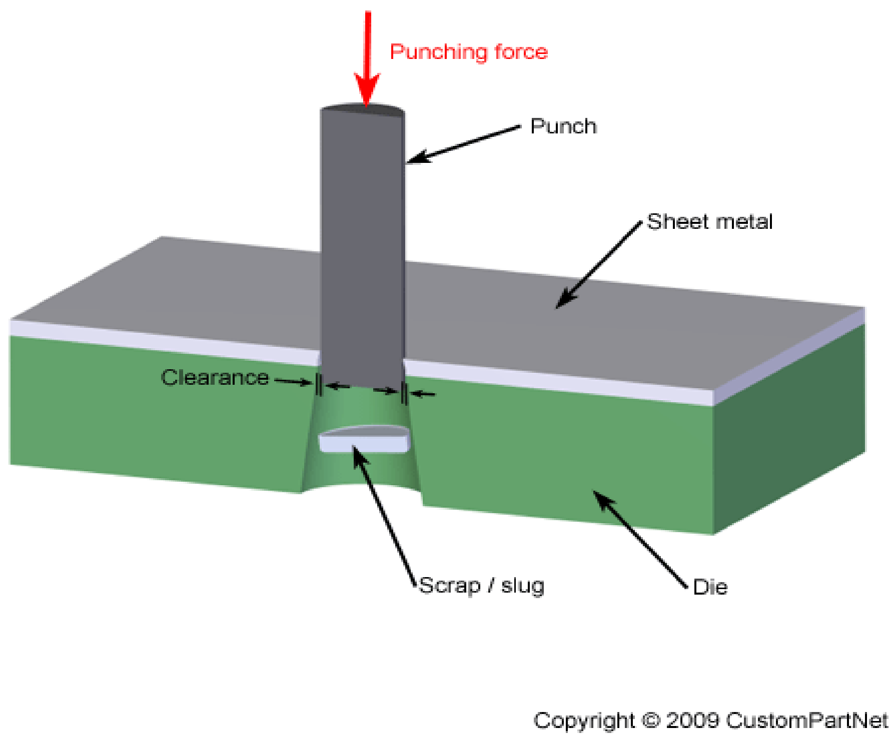
# BENDING OPERATION



**Typical bending operations and shapes**



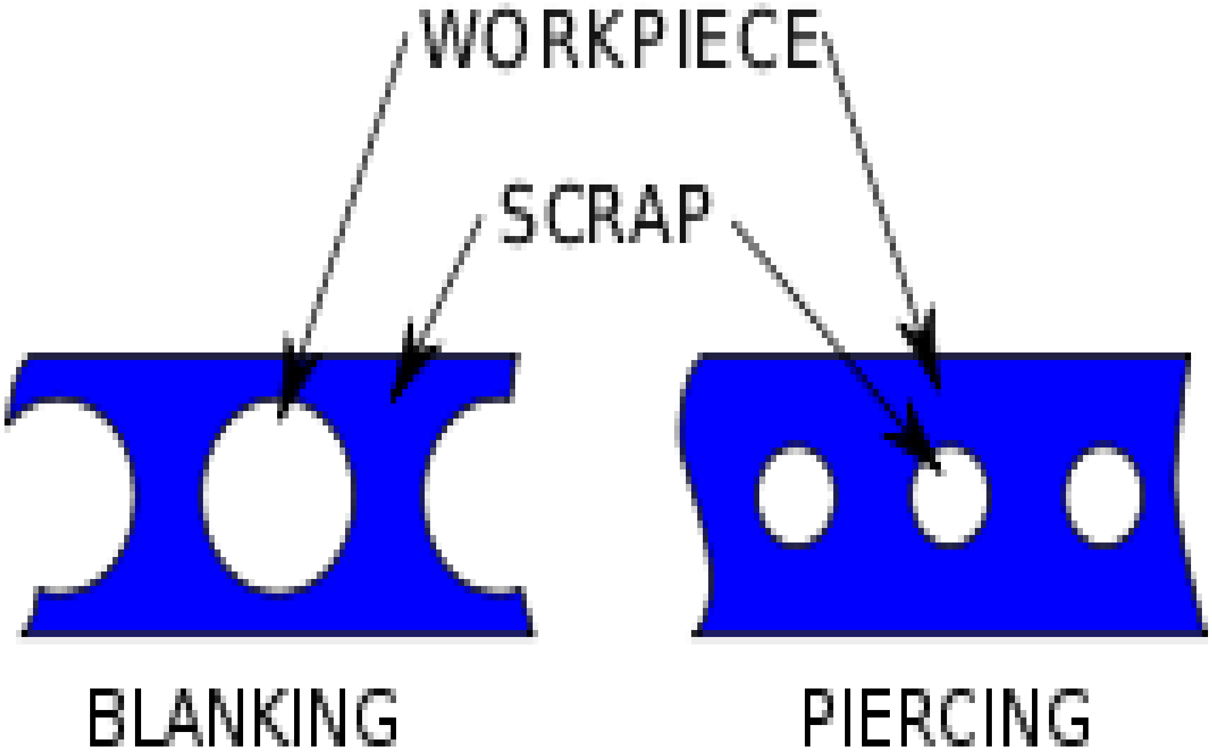

# PUNCHING OPERATION



# PUNCHING

- **Punching** is a metal forming process that uses a punch press to force a tool, called a **punch**, through the workpiece to create a hole via shearing.
- The punch often passes through the work into a die. A scrap slug from the hole is deposited into the die in the process.

# BLANKING AND PIERCING

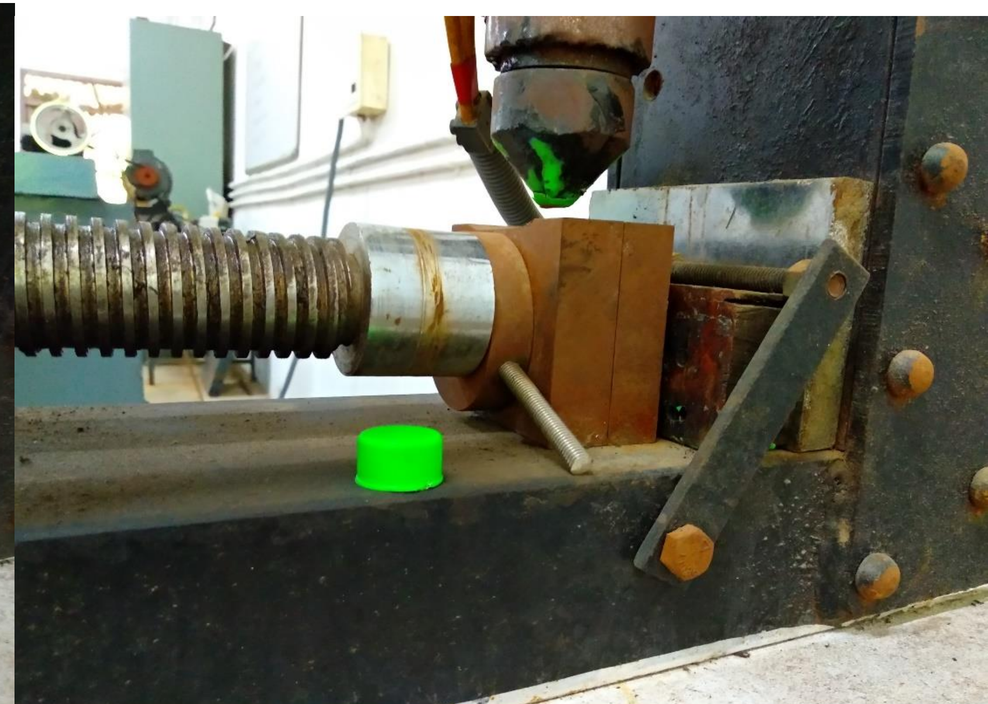


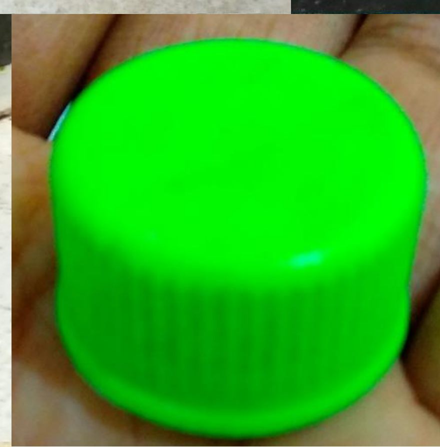
# BLANKING

- **Blanking** and **piercing** are shearing processes in which a punch and die are used to modify webs. The tooling and processes are the same between the two, only the terminology is different: in blanking the punched out piece is used and called a *blank*; in piercing the punched out piece is scrap.

# PLASTICS PROCESSING-INJECTION MOULDING


# Injection Moulding



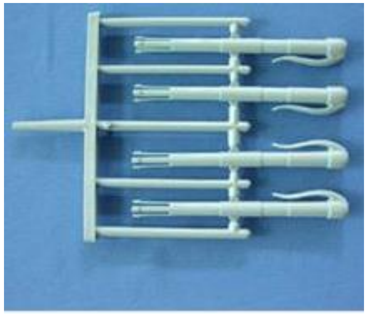

**Plastics Processing: Injection Molding**

- Probably the most common, most important, most economical process

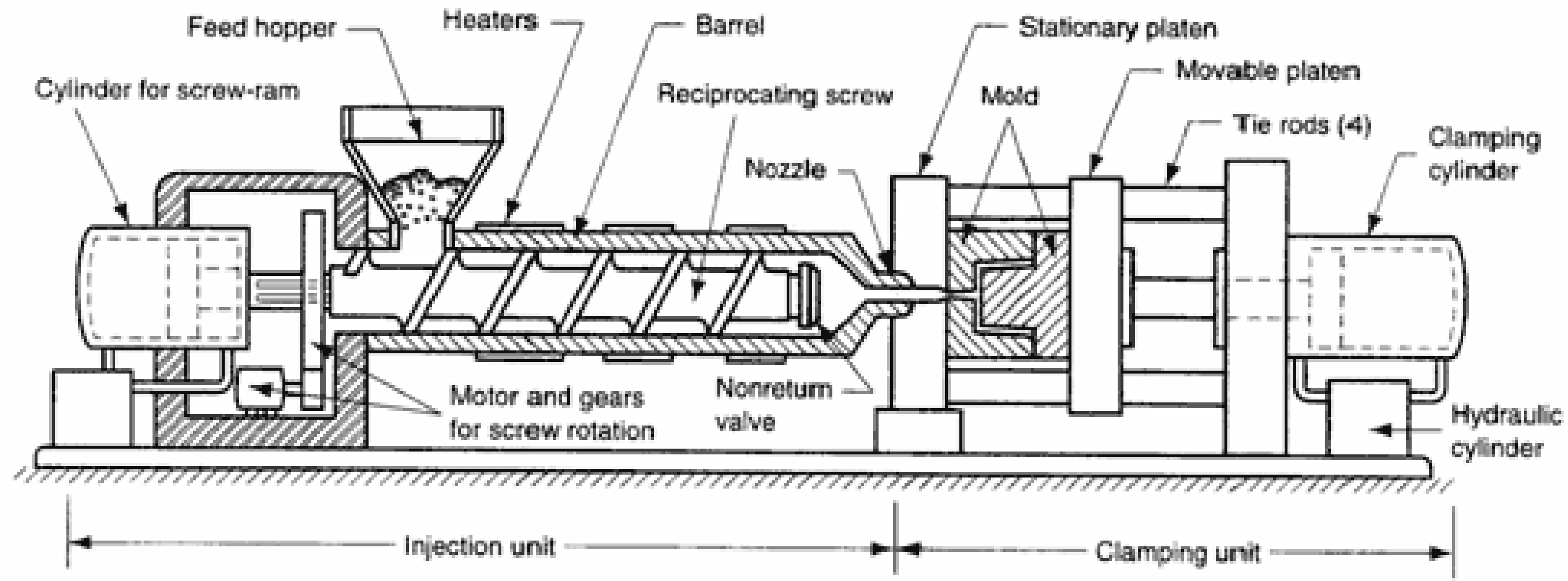
Mobile Phone

Wireless Phone

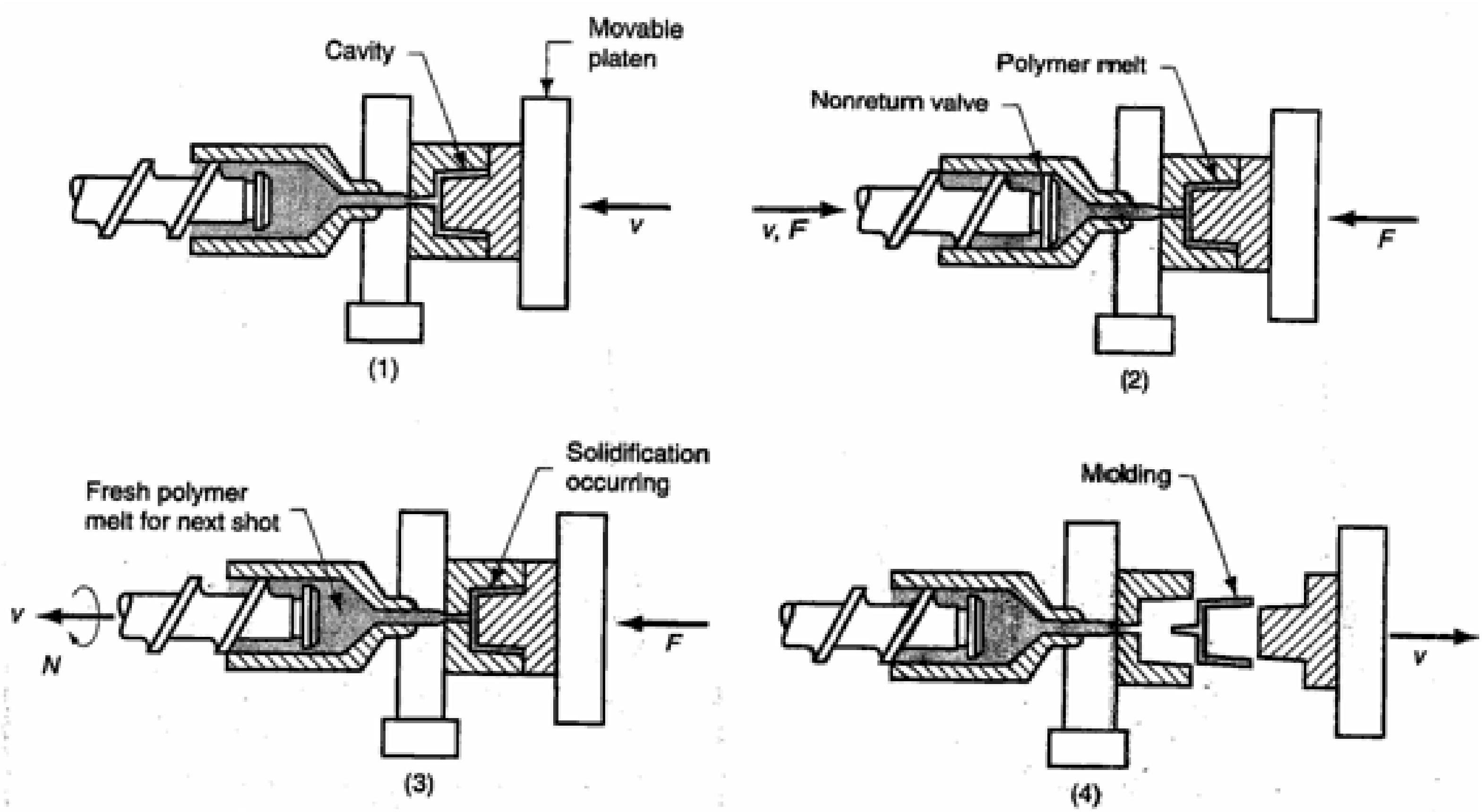
Plug



Rubber Pen



## Plastics Processing: Injection Molding




Cycle of operation for injection molding

# Blow Moulding


# Blow Moulding

# List Of Experiments

I. METAL CASTING :

1. Pattern Design and Making- by Casting Drawing
2. Sand Properties Testing- for testing strength and permeability
3. Moulding , Melting & Casting

II. WELDING:

1. ARC WELDING: LAP & BUTT JOINTS
2. SPOT WELDING
3. TIG WELDING
4. MIG WELDING
5. BRAZING

III. MECHANICAL PRESS WORKING

1. Bending Operation
2. Blanking & Piercing

IV PROCESSING OF PLASTICS

1. INJECTION MOULDING
2. BLOW MOULDING

Thank you!

VNR Vignana Jyothi Institute of Engineering and Technology, Hyderabad – 500 090

# Department of Automobile Engineering

## LAB PROTOCOL

## Vehicle Maintenance & Testing Laboratory

### IV B.Tech I Semester, Automobile Engineering

**Faculty**

**Dr. Shaik Amjad**
Professor

**Mr. Venkata Ramarao**
Assistant Professor

## ***Course Objectives***

Hands on training in in automotive shops with safety procedures

Vehicle inspection and identification of faults

Diagnosis using suitable test equipments and use of service manuals

Adjust / repair / replacement of parts

# *Course Outcomes*

After completion of the course the student is able to

Inspect vehicle and identify sub-systems

Perform fault diagnosis of engine

Perform fault diagnosis of vehicle

Execute maintenance and repair/replacement operations

# Purpose of VMT Laboratory

- All vehicles are subject to wear and tear and unless maintained at regular intervals.
- This wear and tear will eventually result in unsafe vehicles and vehicle breakdowns.
- Regular planned maintenance is a critical step in preventing this.
- Effective vehicle maintenance practices result in a vehicle that is safe and fit for.

# *List of experiments*

Vehicle inspection

Engine compression test

Engine manifold vacuum test

Automotive battery test

Multi car scanning

Petrol vehicle exhaust analysis

Diesel Smoke Measurement

Wheel balancing of wheel and tyre assembly

Wheel alignment test

Headlight alignment test

Ignition timing test

# *Vehicle inspection*

Vehicle overall inspection is carried out to find the faults

**27 POINT VEHICLE INSPECTION**

**Company Name Here**
Address Line 1
Suiet # 1234
City, State, Zip Code
Phone : 1-800-800-1234
E-mail : email@website.com

**Vehicle Informa tion**

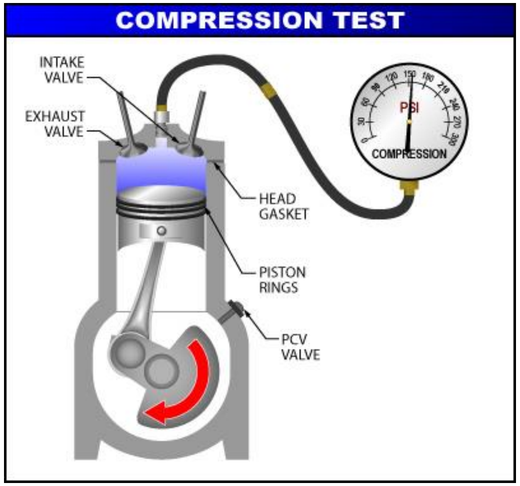
Make: .............. Modd: .............. Year: ..............
Tag #: .............. Odometer: .............. Paint Code ..............
Trim: .............. Body Type .............. Prod. Date: ..............
V.I.N.: ..............
Ins. Co.: .............. Ph: ..............
Adjuster: .............. Claim #: ..............

| ITEMS | INSPECTED | NEED ATTENTION | NEED URGENT ATTENTION | ESTIMATED COST | NOTES |
|---|---|---|---|---|---|
| 1.Tire Wear / Condition Front | ☐ | ☐ | ☐ | | |
| 2.Tire Wear / Condition Rear | ☐ | ☐ | ☐ | | |
| 3.Drive Shaft Joint Boots | ☐ | ☐ | ☐ | | |
| 4.Condition of McPherson Struts | ☐ | ☐ | ☐ | | |
| 5.Condition of Rear Shock Absorbers | ☐ | ☐ | ☐ | | |
| 6.Condition of Front Brakes | ☐ | ☐ | ☐ | | |
| 7.Condition of Rear Brakes | ☐ | ☐ | ☐ | | |
| 8.Brake, Hydraulic System (fluid, visual check) | ☐ | ☐ | ☐ | | |
| 9.Emergency Brake Adjustment | ☐ | ☐ | ☐ | | |
| 10.Clutch Adjustment | ☐ | ☐ | ☐ | | |
| 11.Clutch Hydraulic System | ☐ | ☐ | ☐ | | |
| 12.Condition of Muffler / Exh. Pipes | ☐ | ☐ | ☐ | | |
| 13.Engine and Transmission Oil | ☐ | ☐ | ☐ | | |
| 14.Condition of Drive Belts | ☐ | ☐ | ☐ | | |
| 15.Drive Belts Adjustment | ☐ | ☐ | ☐ | | |
| 16.Condition of Radiator / Coolant | ☐ | ☐ | ☐ | | |
| 17.Condition of Radiator Hoses | ☐ | ☐ | ☐ | | |
| 18.Condition of Heater Hoses | ☐ | ☐ | ☐ | | |
| 19.Condition of Battery / Cables | ☐ | ☐ | ☐ | | |
| 20.Condition of Spark Plug / Wires | ☐ | ☐ | ☐ | | |
| 21.Condition of Air / Fuel Filters | ☐ | ☐ | ☐ | | |
| 22.Condition of Wiper Blades | ☐ | ☐ | ☐ | | |
| 23.Head Light Operation | ☐ | ☐ | ☐ | | |
| 24.Stop, Tail, Turn Signal Lights | ☐ | ☐ | ☐ | | |
| 25.Heater / AC Operation | ☐ | ☐ | ☐ | | |
| 26.Restraint System | ☐ | ☐ | ☐ | | |
| 27.Other | ☐ | ☐ | ☐ | | |

NOTES:

# Engine compression test

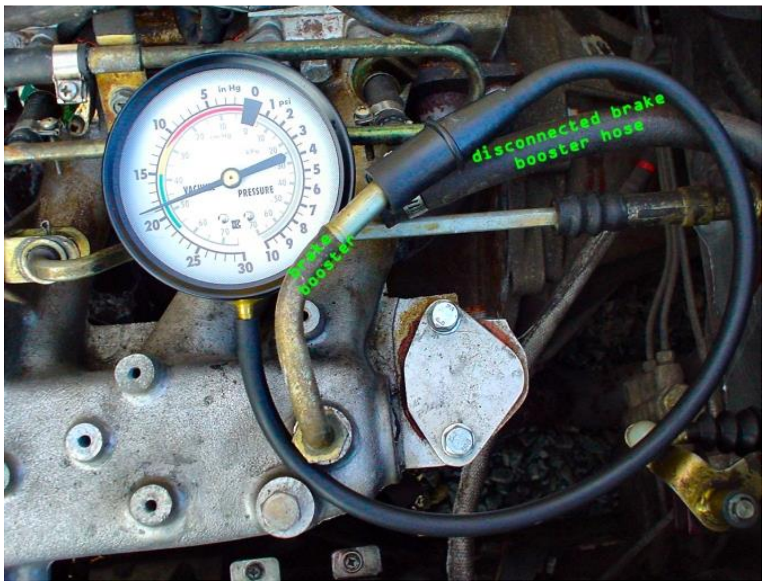
Engine compression test is carried out to determine the condition of the engine valves and piston rings

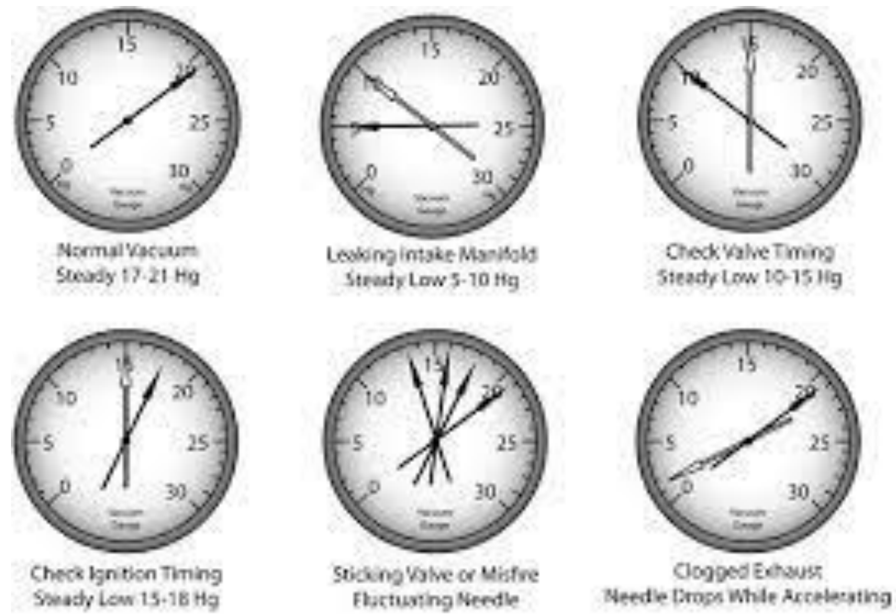



| Direct Compression Test Record Card | | | | | |
|---|---|---|---|---|---|
| | Cylinder Number 1 | Cylinder Number 2 | Cylinder Number 3 | Cylinder Number 4 | Remarks |
| Dry Test Compression | | | | | |
| Wet Test Compression | | | | | |
| Difference in Readings | | | | | |
| Date of Tests | | | | | |
| Mileage | | | | | |

# Engine manifold vacuum test

Monitoring the engine's deepest breaths can tell a lot about its health Engine manifold vacuum test is carried out to gain insight into the symptoms of vacuum leaks, incorrect timing, low compression, sticking valves and more.

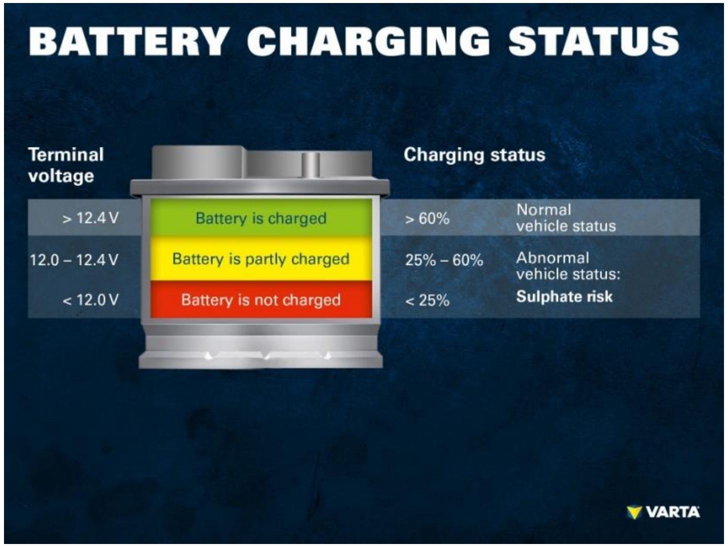


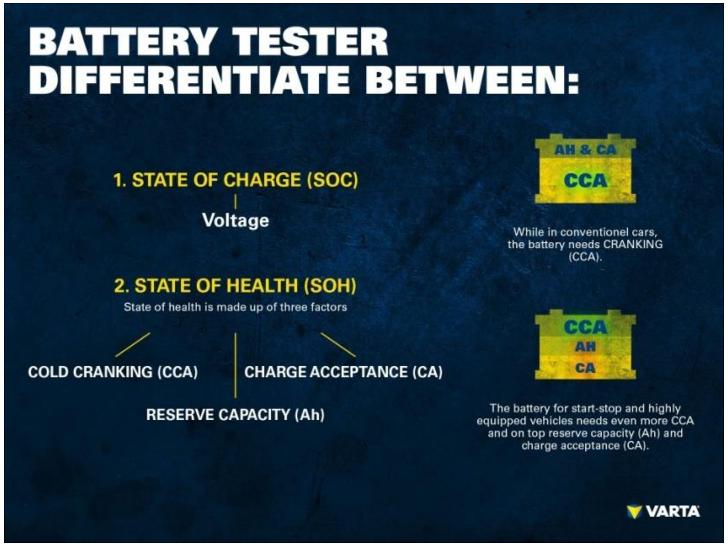




If the engine is operating under light or no load and low or closed throttle, there is high manifold vacuum.
If the engine is operating under heavy load at wide throttle openings (such as accelerating from a stop or pulling the car up a hill) then engine speed is limited by the load and minimal vacuum will be created.

# *Automotive battery test*

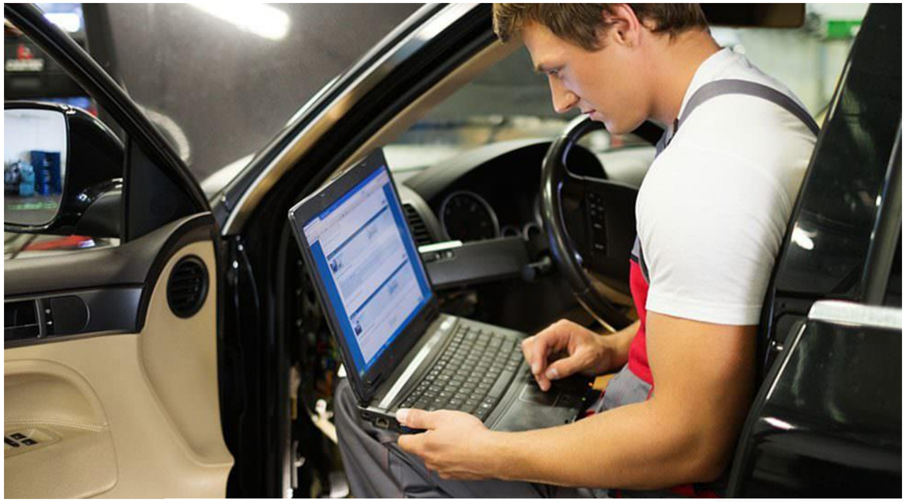
Battery test can be performed in a vehicle to test the  charge

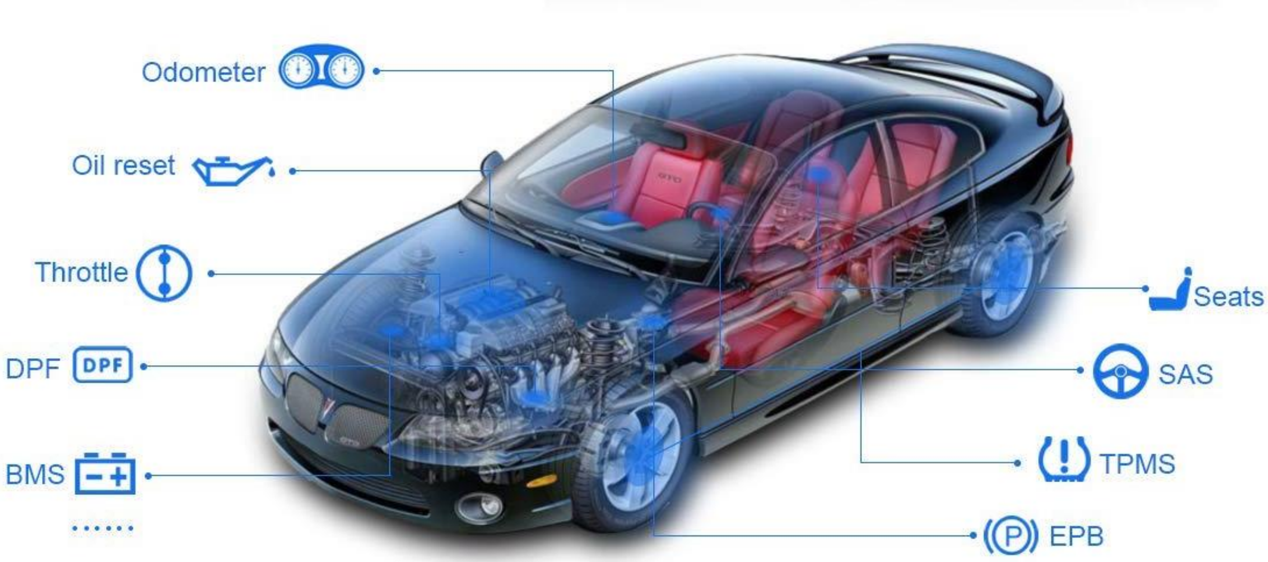


# *Multi car scanning*

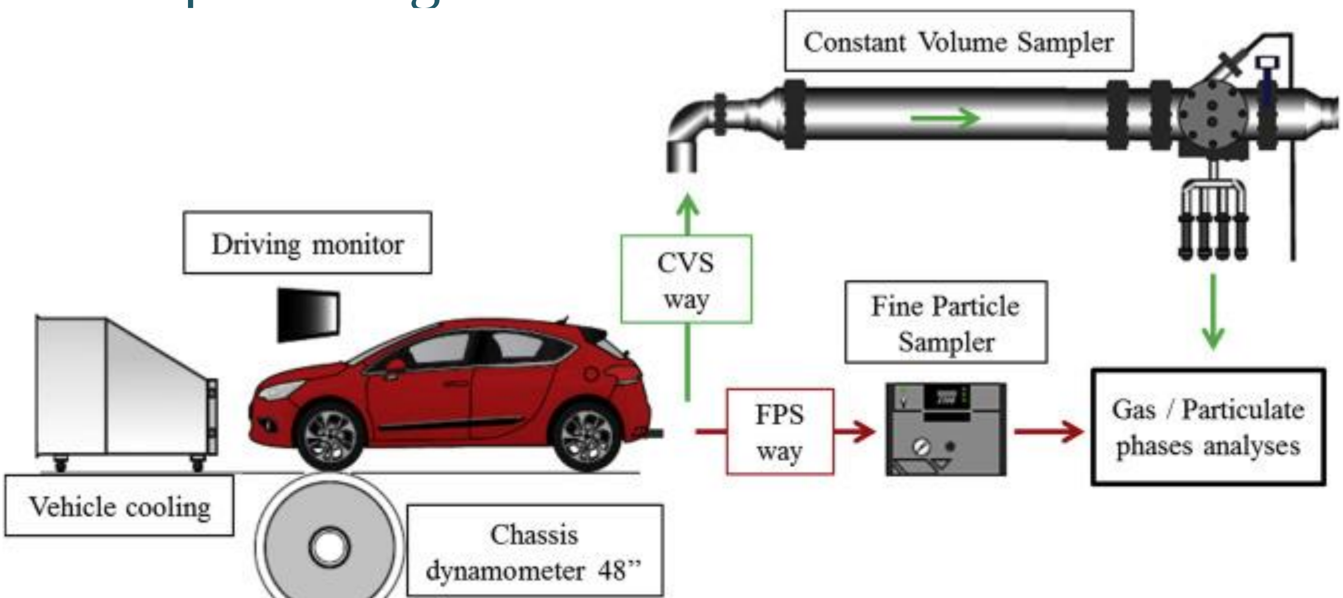
Car scanning is carried out to find error memory, and to display actual values.



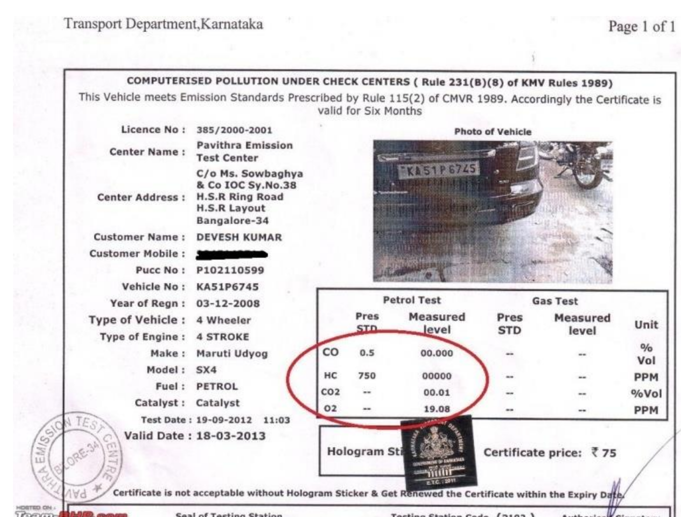



# *Petrol vehicle exhaust analysis*

Exhaust analysis is carried out to measure and analyze the emissions of a petrol engine/vehicle.







Transport Department,Karnataka

Page 1 of 1

**COMPUTERISED POLLUTION UNDER CHECK CENTERS ( Rule 231(B)(8) of KMV Rules 1989)**

This Vehicle meets Emission Standards Prescribed by Rule 115(2) of CMVR 1989. Accordingly the Certificate is valid for Six Months

| | |
|---|---|
| Licence No : | 385/2000-2001 |
| Center Name : | Pavithra Emission Test Center |
| Center Address : | C/o Ms. Sowbaghya & Co IOC Sy.No.38 H.S.R Ring Road H.S.R Layout Bangalore-34 |
| Customer Name : | DEVESH KUMAR |
| Customer Mobile : | [redacted] |
| Pucc No : | P102110599 |
| Vehicle No : | KA51P6745 |
| Year of Regn : | 03-12-2008 |
| Type of Vehicle : | 4 Wheeler |
| Type of Engine : | 4 STROKE |
| Make : | Maruti Udyog |
| Model : | SX4 |
| Fuel : | PETROL |
| Catalyst : | Catalyst |
| Test Date : | 19-09-2012 11:03 |
| Valid Date : | 18-03-2013 |

Photo of Vehicle

| | Petrol Test | | Gas Test | | |
|---|---|---|---|---|---|
| | Pres STD | Measured level | Pres STD | Measured level | Unit |
| CO | 0.5 | 00.000 | -- | -- | % Vol |
| HC | 750 | 00000 | -- | -- | PPM |
| CO2 | -- | 00.01 | -- | -- | %Vol |
| O2 | -- | 19.08 | -- | -- | PPM |

Hologram Sti

Certificate price: ₹ 75

PAVITHRA EMISSION TEST CENTRE B'LORE-34

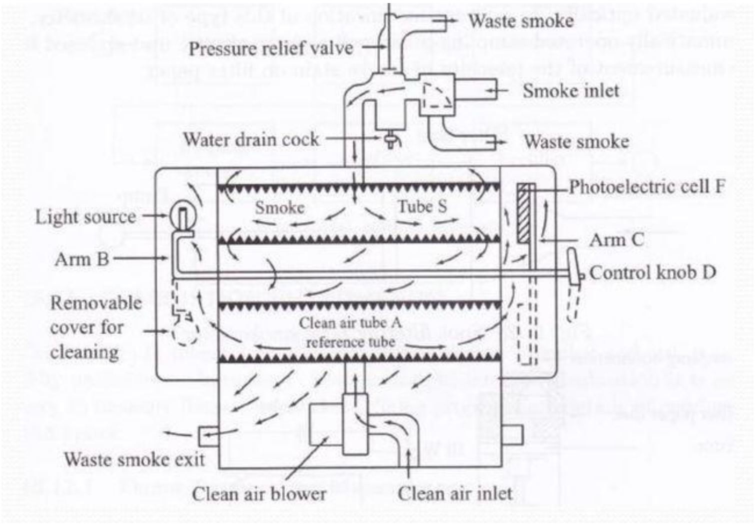
Certificate is not acceptable without Hologram Sticker & Get Renewed the Certificate within the Expiry Date.

Seal of Testing Station | Testing Station Code (P102 ) | Authorised Signatory

HOSTED ON : Team-BHP.com

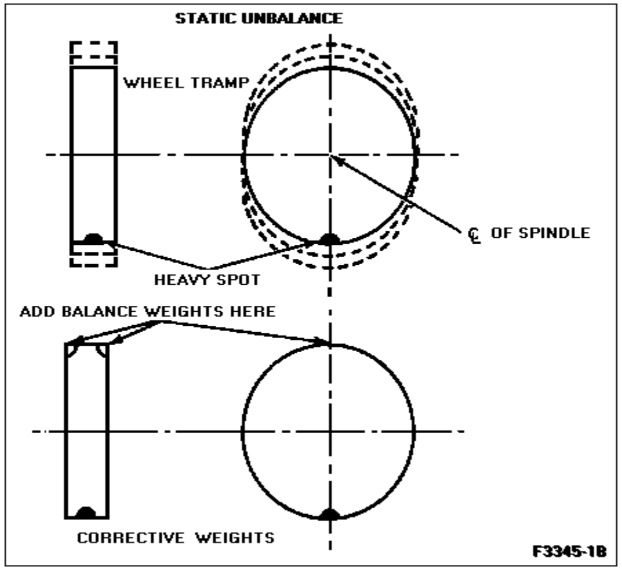
## *Diesel smoke measurement*

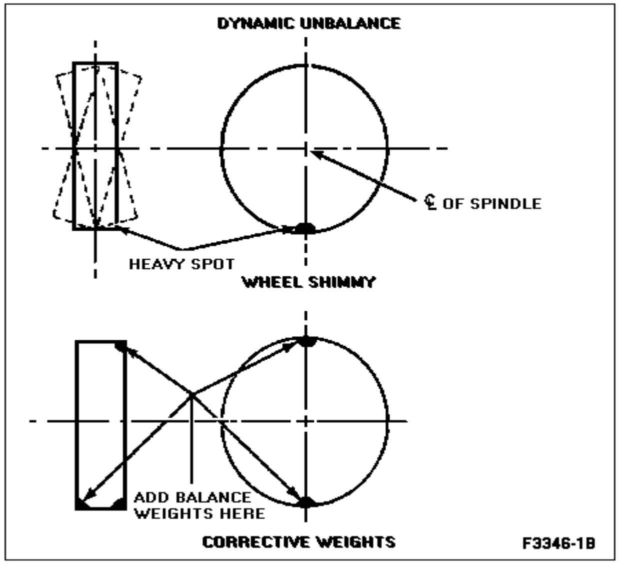
To measure the smoke emitting from a diesel engine/vehicle




# *Wheel balancing of wheel and tyre assembly*

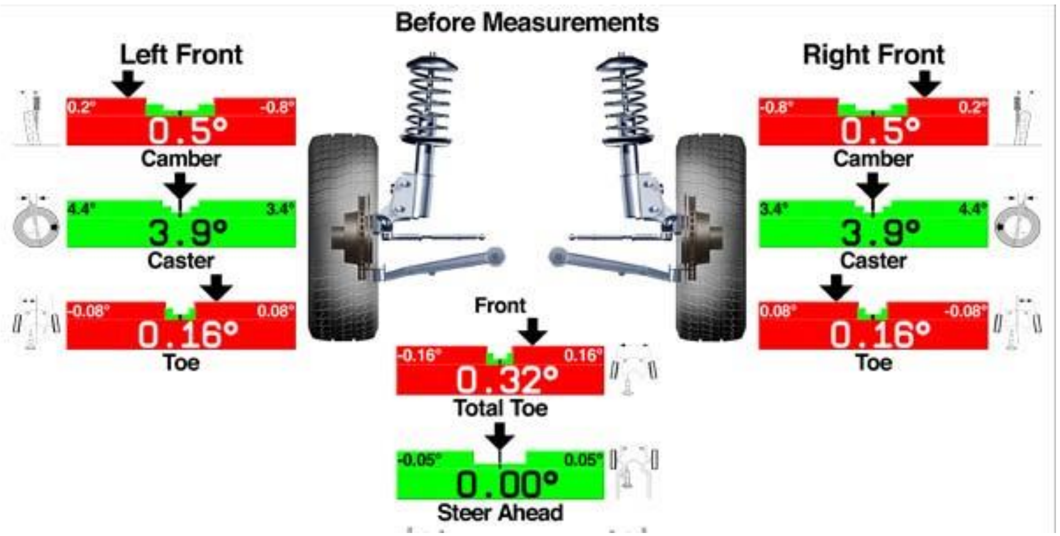
conduct the wheel balancing test on the given wheel and tyre assembly.

# *Wheel alignment test*

Wheel alignment test is carried out to find the castor angle, total toe and camber for a given vehicle.



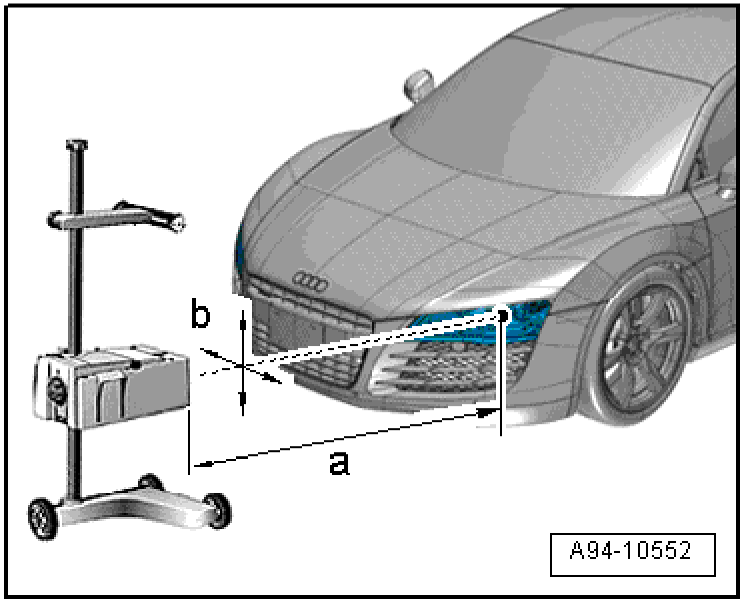
# *Applications*

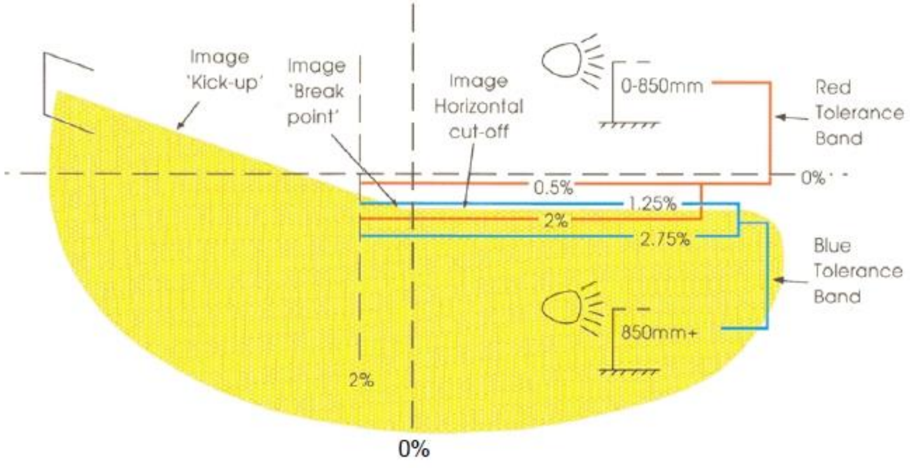
Car drifts to one side due to the misalignment of the wheel angle, to rectify this wheel alignment test should be performed

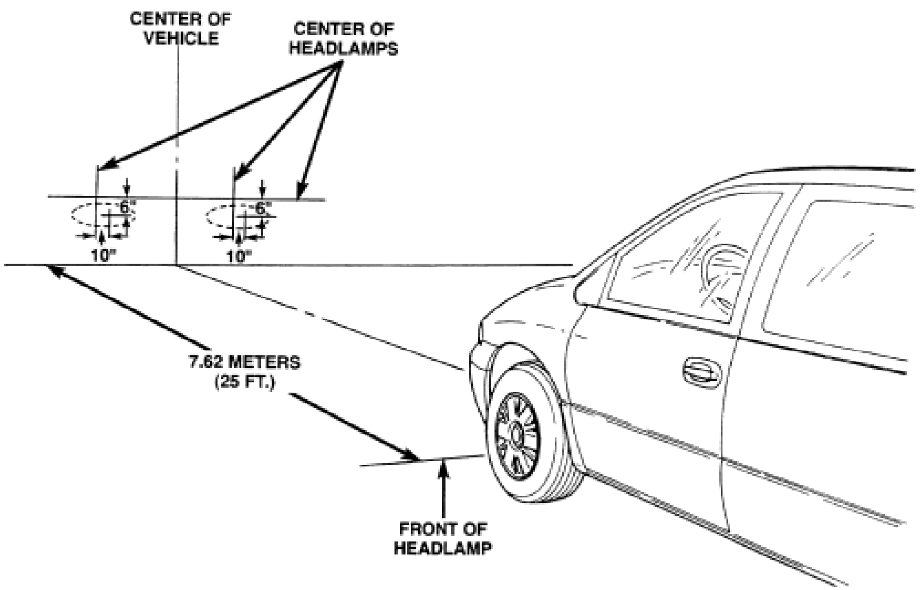

Tire tread wear causes the distribution of weight around the tire to change. This leads to an imbalance that causes the vehicle to shake or vibrate. Wheel balancing test can be performed to balance the imbalance weight.

# Headlight alignment test

Headlight alignment test is carried out to adjust the headlight

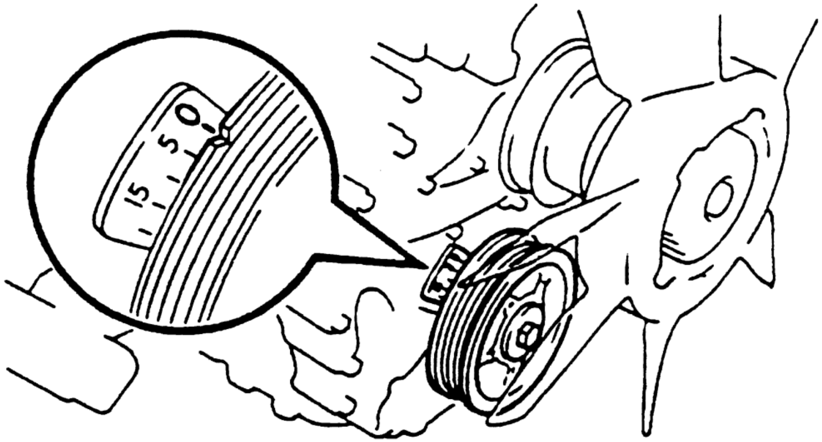


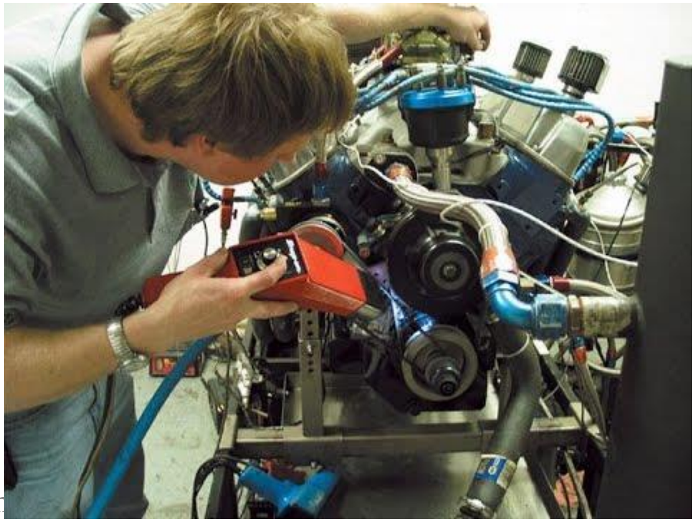



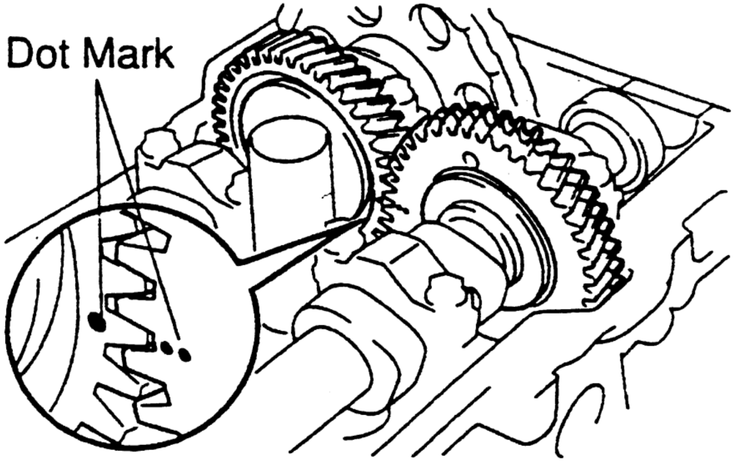



# *Ignition timing test*

Ignition timing test is carried out to check the correct position of the  ignition timing







## Cycle -I

**Vehicle Inspection**

**Engine compression test**

**Engine Manifold Vacuum test**

**Automotive battery test**

**Wheel balancing of wheel and tyre assembly**

## Cycle -II

**Petrol Vehicle exhaust analysis**

**Diesel Smoke Measurement**

**Wheel alignment test**

**Headlight alignment test**

**Ignition timing test**

**Multi car scanning**

# LABORATORY SAFETY RULES

- Keep yourself and others safe.
- Wear appropriate safety equipment.
- No loose clothes and long hair around machines.
- Clean up any spills immediately.
- Wear shoes to protect the feet from falling weights.
- Don’t play with machines/tools.


- Maintain discipline and be regular to the laboratory
- Carry the observation book and record to the laboratory
- Follow proper dress code in the laboratory
- Do not use any equipment unless you are trained
- Wear safety glasses or face shields when working with hazardous materials and/or equipment
- If you have long hair or loose clothes, make sure it is tied back or confined
- Keep the work area clear of all materials except those needed for your work
- Extra books, purses, etc. should be kept away from equipment
- Students are responsible for the proper disposal of used material if any in appropriate containers


- Wear shoes to protect your feet
- Check all electrical connections and mounting bolts before each use
- Check that all rotating parts are free to turn, and that there is no mechanical obstruction before operating
- If an equipment fails while being used, report it immediately to your lab assistant or in-charge
- Never try to fix the problem yourself because you could harm yourself and others
- Exercise care when working with or near hydraulically- or pneumatically-driven equipment. Sudden or unexpected motion can inflict serious injury
- If leaving a lab unattended, turn off all ignition sources
- Clean up your work area before leaving
- Wash hands before leaving the lab and before eating

# Common Sense

Good common sense is needed for safety in a laboratory. It is expected that each student will work in a responsible manner and exercise good judgement and common sense. If at any time you are not sure how to handle a particular situation, ask your Lab in-charge or Instructor for advice. It is always better to ask questions than to risk harm to yourself or damage to the equipment. Do not touch anything with which you are not completely familiar.


THANK YOU

# VNR Vignana Jyothi Institute of Engineering & Technology
# Department of Automobile Engineering

## ELEMENTS OF AUTOMOBILE ENGINEERRING LABORATORY
## (22D5AE101)

By
D.Suresh
Assistant Professor
Department of Automobile Engineering
VNR VJIET
suresh_d@vnrvjiet.in
91+9676541968

# Course Objectives

- To measure geometric properties like length, diameter, and angle
- To determine parameters like frequency, moment of Inertia and mechanical advantage
- To practice tools used in garage and powertrain working
- To understand automotive electrical symbols, colour codes and battery parameters

# Course Outcomes

After completion of the course the student can

- Measure geometric properties like length, diameter and angle
- Evaluate the parameters like frequency, moment of Inertia and mechanical advantage
- Choose various tools used in garage and know about powertrain
- Identify the symbols, colour codes and measurement of battery parameters

# LIST OF EXPERIMENTS

1. Measurement of length and diameter by vernier calipers and micrometer
2. Measurement of angle by using Sine bar
3. Determination of time-period and natural frequency of simple pendulum.
4. Determination of time-period and natural frequency of compound pendulum.
5. The experimental determination of the moment of inertia of flywheel
6. Grouping of batteries for measurement of voltage and current using multimeter.
7. The experimental determination of mechanical advantage of screw jack
8. Identification and use of automotive garage tools
9. Dismantling and assembling of petrol engine
10. Dismantling and assembling of diesel engine
11. Study and demonstration of transmission system and its components
12. Study and demonstration of automotive wiring colour codes and electrical symbols

# Laboratory Equipment

Vernier Calipers


Micrometer

# Laboratory Equipment

Sine bar

Compound Pendulum

# Laboratory Equipment


Flywheel

Screw jack

# Course Objectives

Petrol Engine

Diesel Engine

# Skills Required…..

- To identify suitable tool or instrument / equipment and their functions.
- Ability to handle tools and instruments
- Ability to measure different parameters and record observations.
- Able to make Conclusion from the Observation.

# Laboratory Report

- Three members in a group
- Contribute / Perform proper role in the group to conduct experiment and to make observation
- Analyze the results together
- Each person of the group will write his/her own Discussion and Conclusion

# General laboratory safety

- Maintain discipline and be regular to the laboratory
- Carry the observation book and record to the laboratory
- Follow proper dress code in the laboratory
- If you have long hair or loose clothes, make sure it is tied back or confined
- Keep the work area clear of all materials except those needed for your work
- Extra books, purses, etc. should be kept away from equipment

# General laboratory safety

- Check that all rotating parts are free to turn, and that there is no mechanical obstruction before operating
- If an equipment fails while being used, report it immediately to your lab assistant or in-charge
- Exercise care when working with or near hydraulically or pneumatically-driven equipment. Sudden or unexpected motion can inflict serious injury
- If leaving a lab unattended, turn off all ignition sources
- Clean up your work area before leaving
- Wash hands before leaving the lab and before eating

# LAB ASSESMENT

Continues Internal Assessment 50 M

Day to Day evaluation (10 M)

Practical Exam (10 M)

Course Project (10 M)

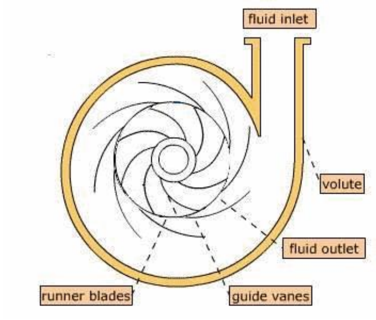
Record (10 M)

Viva Voice (10 M)

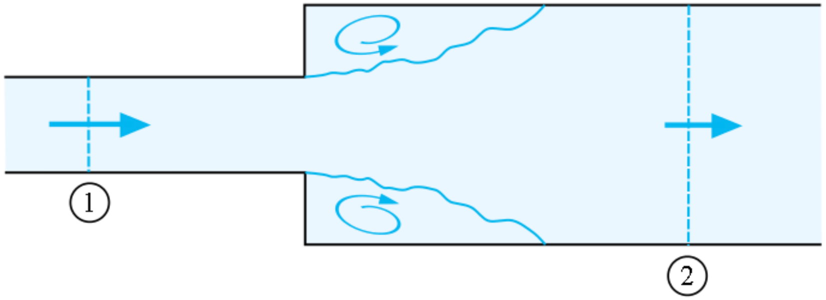
# THANK YOU


WELCOME
TO
FLUID MECHANICS
&
HYDRAULIC MACHINERY
LABORATORY

# VNR PROTOCOL FOR LABORATORIES




# FLUID MECHANICS
# &
# HYDRAULIC MACHINERY





Prepared by
R.Ramu

# LEARNING OBJECTIVES

To introduce the student the fundamental theories and the industrial applications of fluid mechanics and hydraulic machines

# WHAT WILL WE STUDY IN THIS LABORATORY

# PURPOSE OF THIS LABORATORY

To give practical understanding of the theoretical concepts taught in the class, by conducting the experiments as a part of B.Tech. Course as per the JNTU Curriculum for the following Engineering Branches

- Mechanical Engineering
- Automobile Engineering
- Civil Engineering
- Electrical & Electronics Engineering

- The purpose of this laboratory is to reinforce and enhance your understanding of the fundamentals of Fluid mechanics and Hydraulic machines.
- The experiments here are designed to demonstrate the applications of the basic fluid mechanics principles and to provide a more intuitive and physical understanding of the theory

# The List of Experiments

1. Verification of Bernoulli's Principle
2. Calibration of Venturi Meter
3. Calibration of V-Notch
4. Determination of Friction factor for a given Pipe Line
5. Determination of loss of head in different fittings in a pipeline
6. Impact of jets on Vanes

# The List of Experiments

7. Performance Test on Pelton Turbine
8. Performance Test on Francis Turbine
9. Performance Test on Kaplan Turbine
10. Performance Test on Single Stage Centrifugal Pump
11. Performance Test on Multi Stage Centrifugal Pump
12. Performance Test on Reciprocating Pump

# Lab Introduction Module

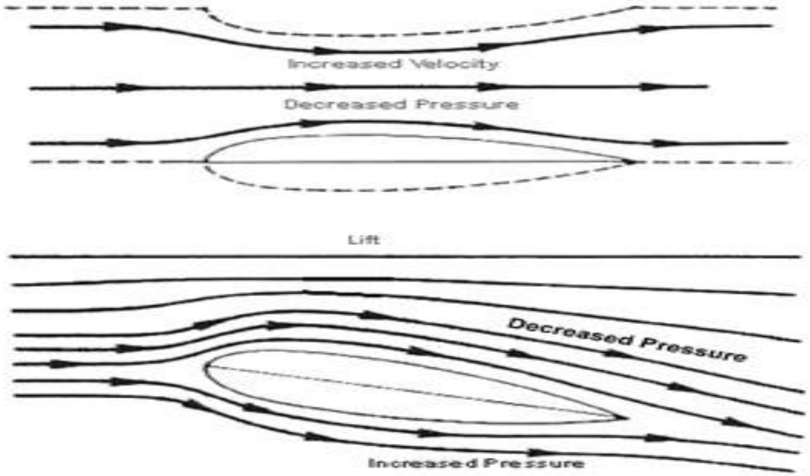
1. Fluid Flow Experiments
2. Hydro Power consuming Devices

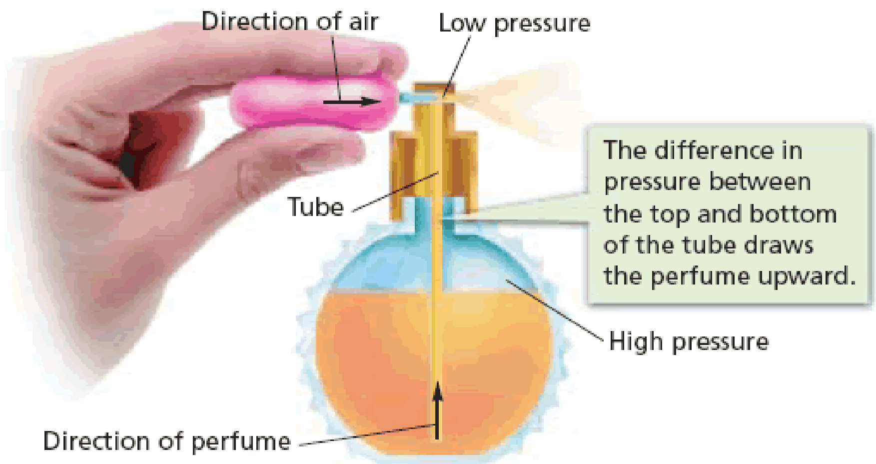
   -Hydraulic Turbines
3. Hydro Power Producing Devices

   -Hydraulic Pumps

# Cycle - I
# Fluid Flow Experiments

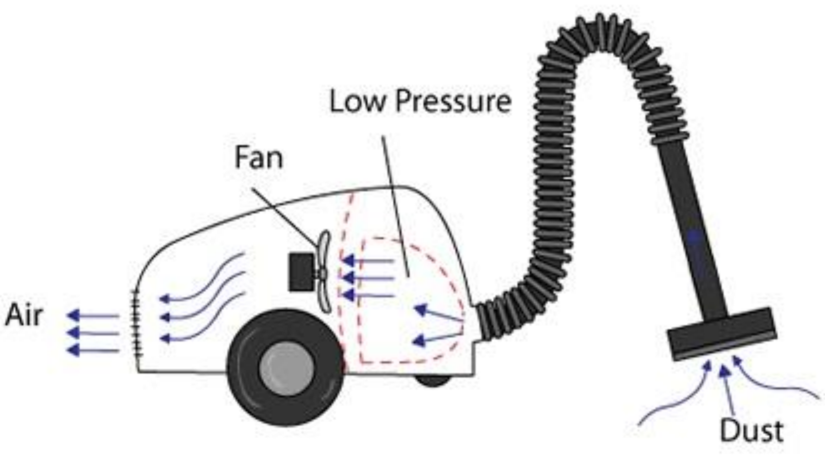
# Bernoulli's Principle

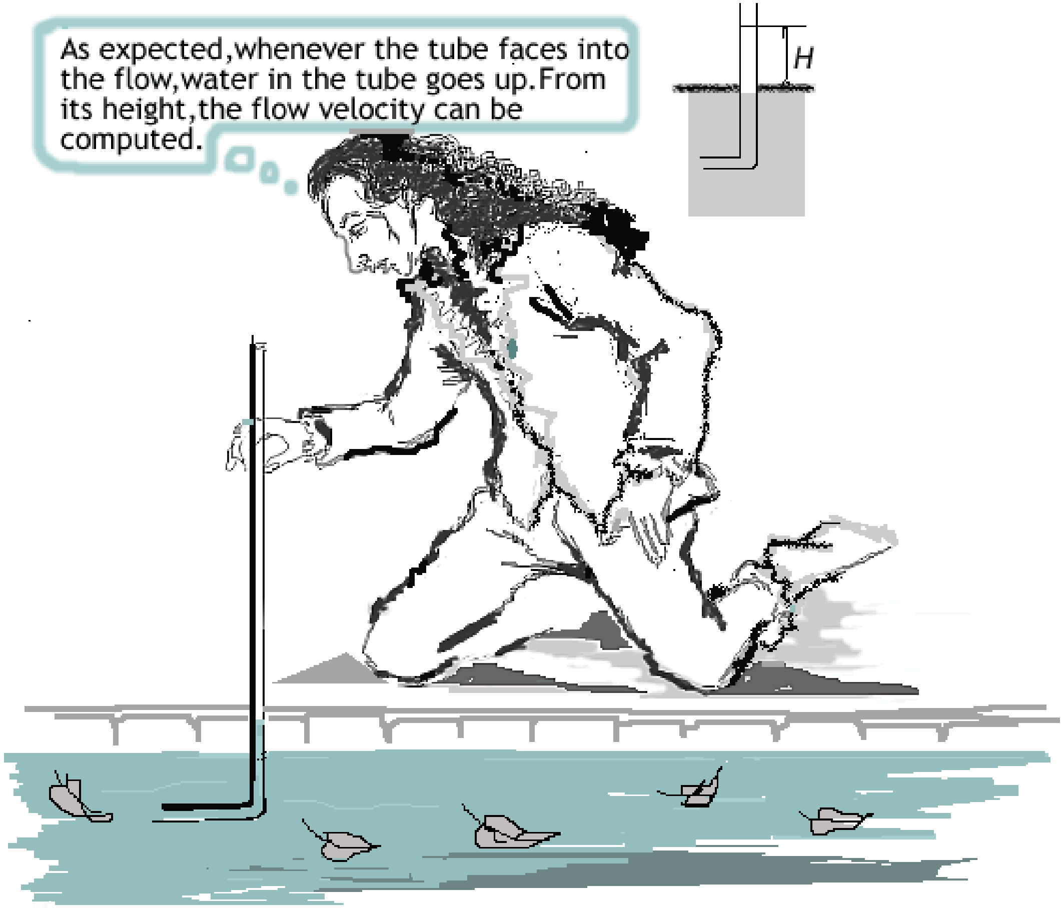


A **vacuum cleaner** is a device that uses an air pump (a centrifugal fan in all but some of the very oldest models), to create a partial vacuum to suck up dust and dirt, usually from floors, and from other surfaces such as upholstery and draperies.
Applications: homes as well as in industry.

**vacuum cleaner**

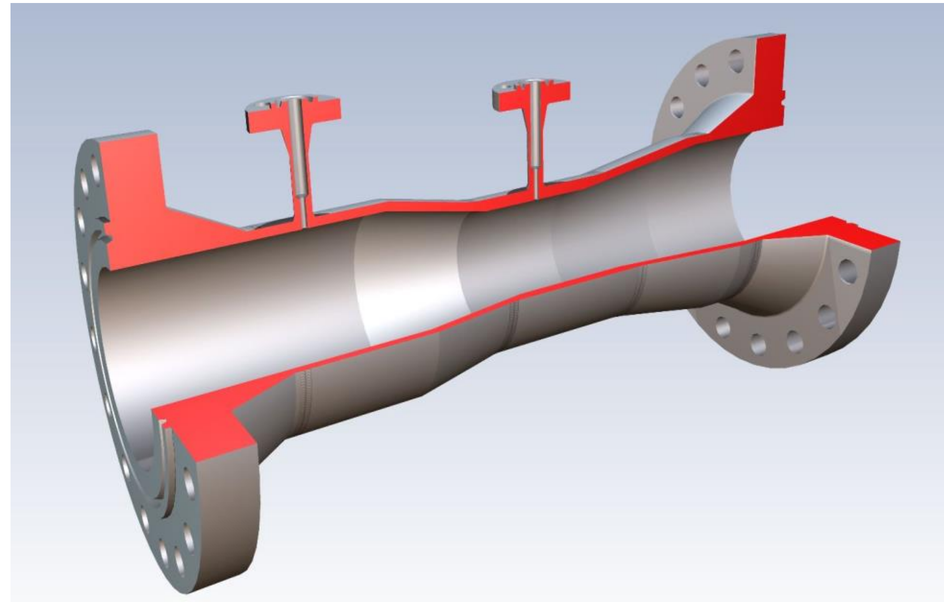



**Pitot Tube**

# Venturi-Meter

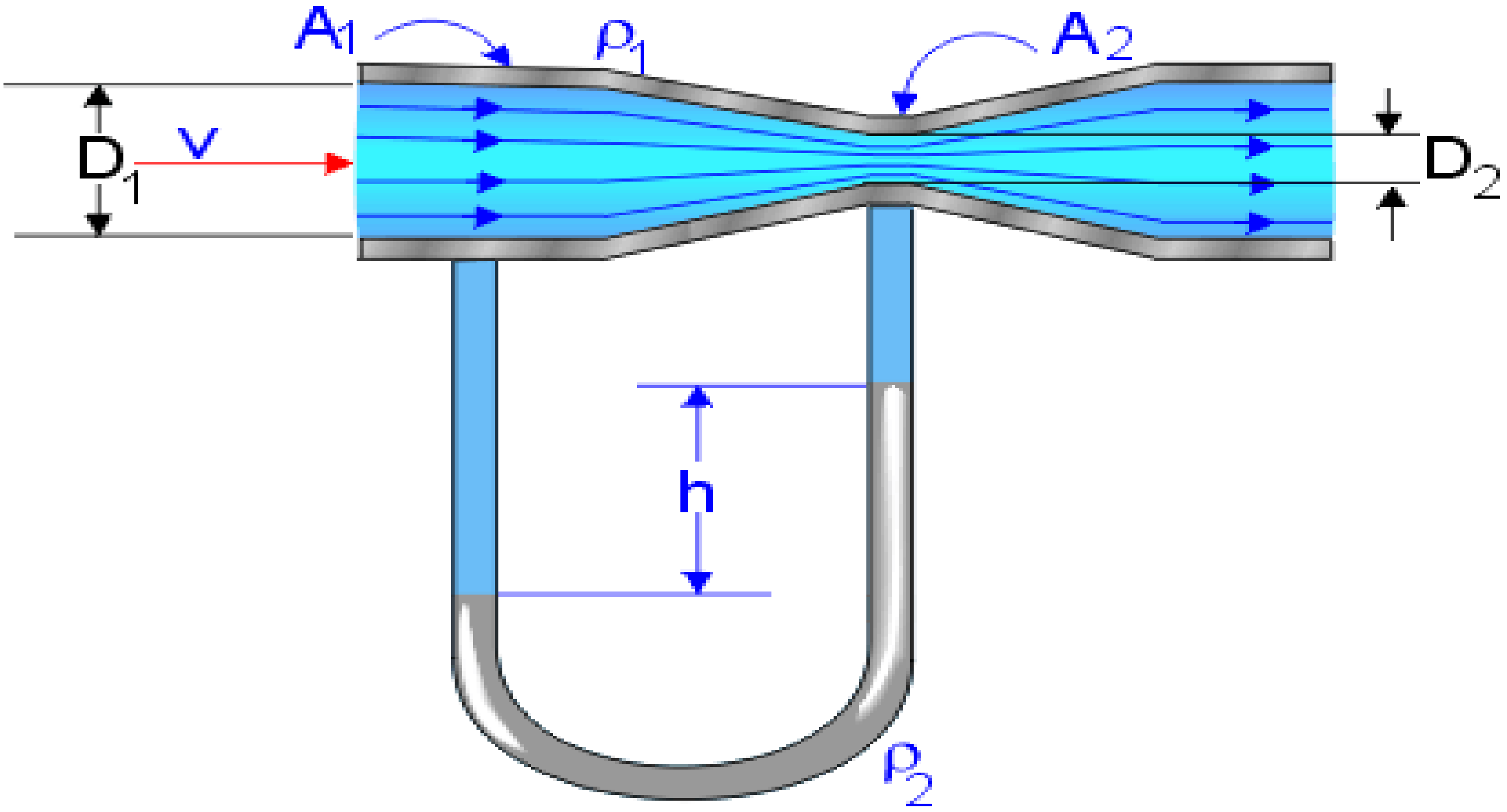
Venturi Meter is a device which is used to measure the discharge in the pipe flow



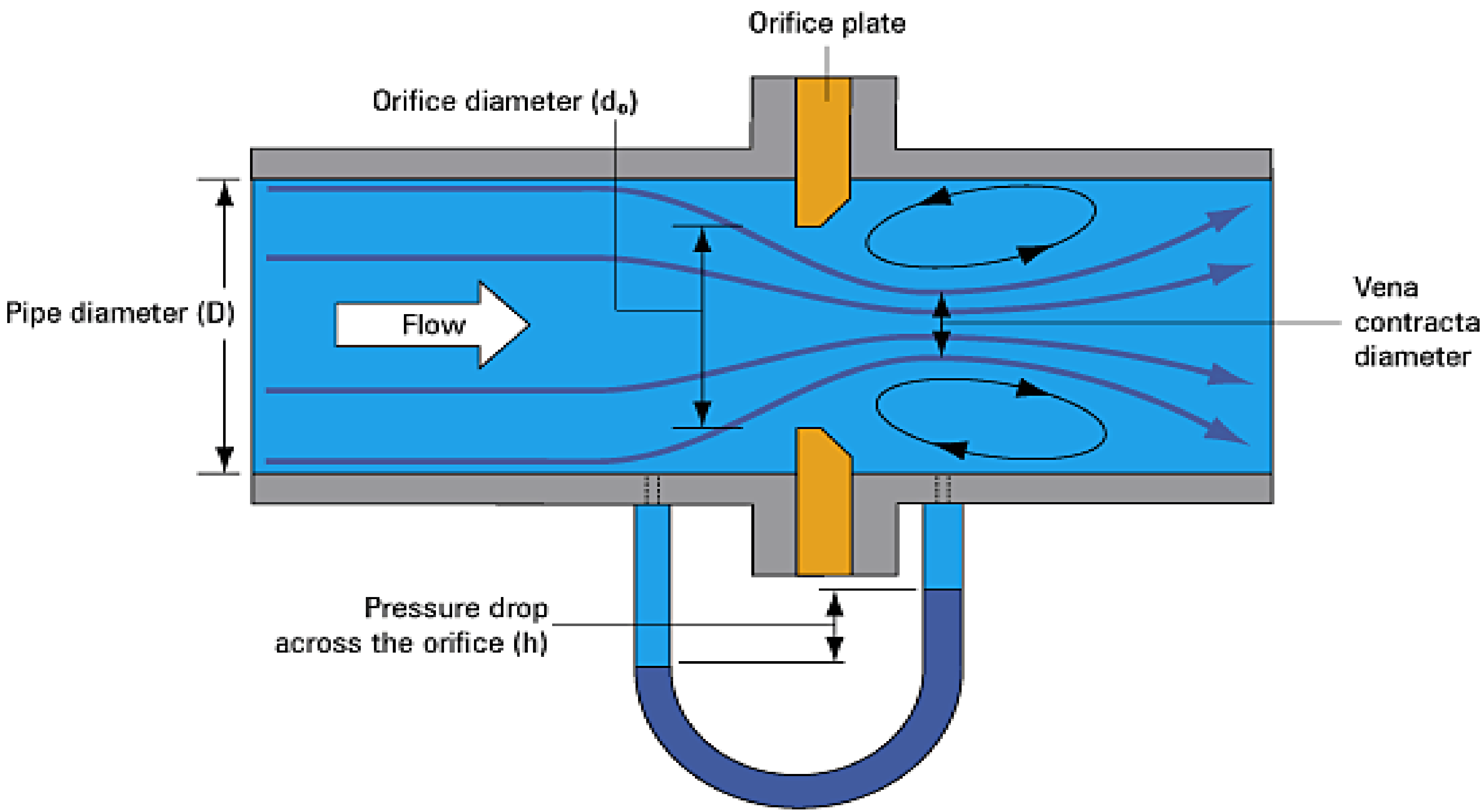
**Applications:**

- The Flow of Chemicals in Pipelines
- Flow in Carburetors
- Measurement Of Blood In Vessels
- Uses of venturi-Meter in industry

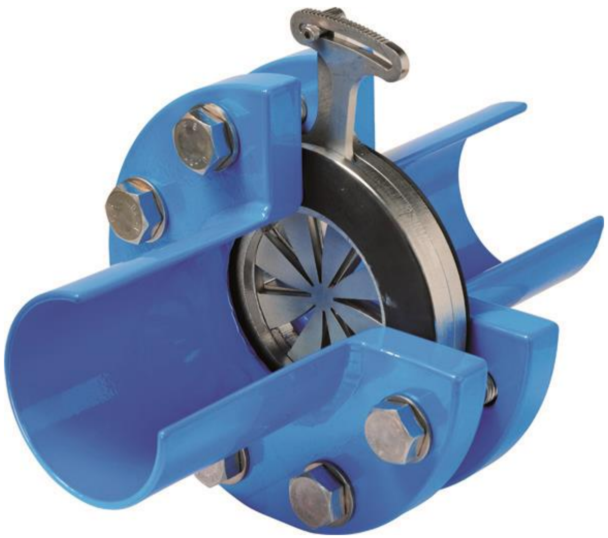
# Venturi-Meter



# Orifice-Meter



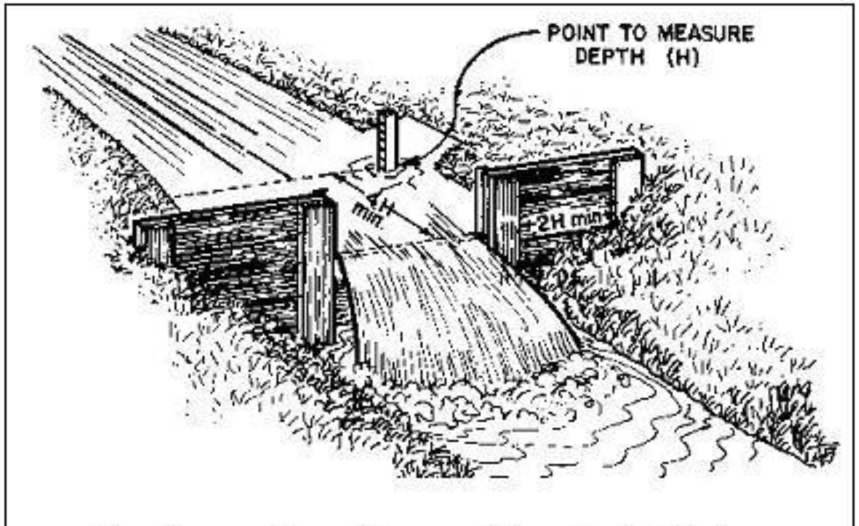
An Orifice-Meter is essentially a thin circular plate with a sharp edged concentric circular hole in it. It can used to meter lube oil, cooling water systems, and compressed air flow.



Orifice Meter is a device which is used to measure the discharge in the pipe flow

# V Notch

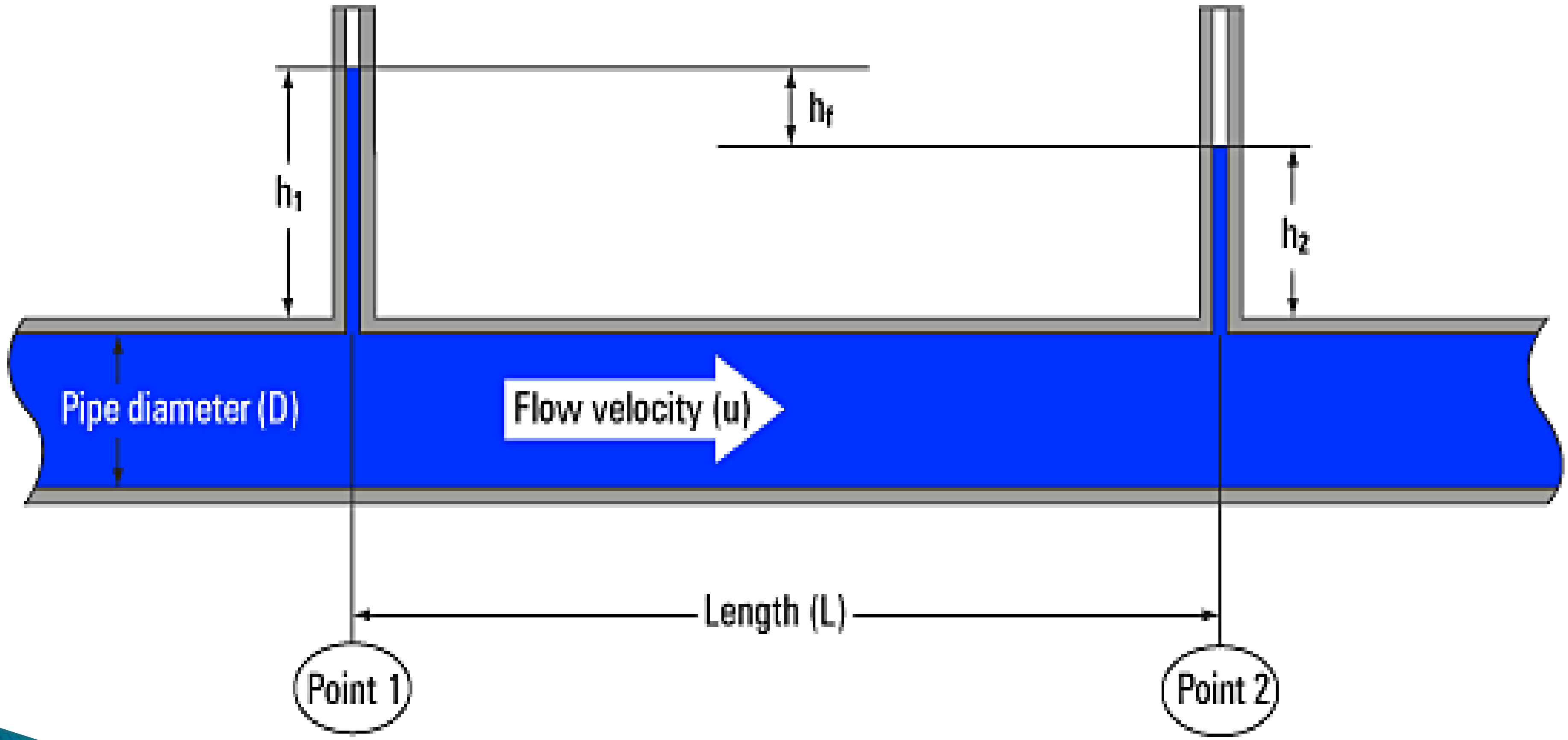
The V-notch weir is a triangular channel section, used to measure small discharge values.



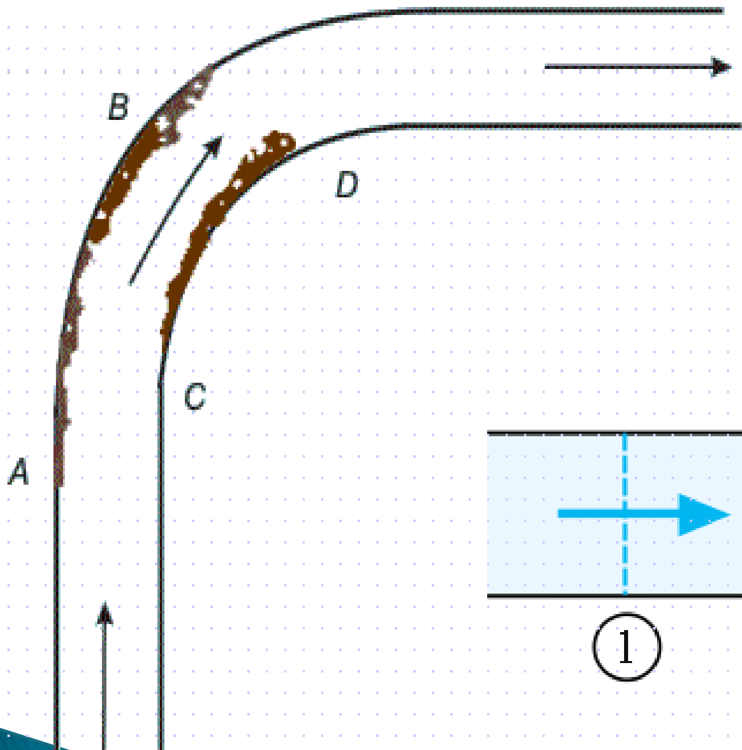
Rectangular, Sharp-Crested Weir

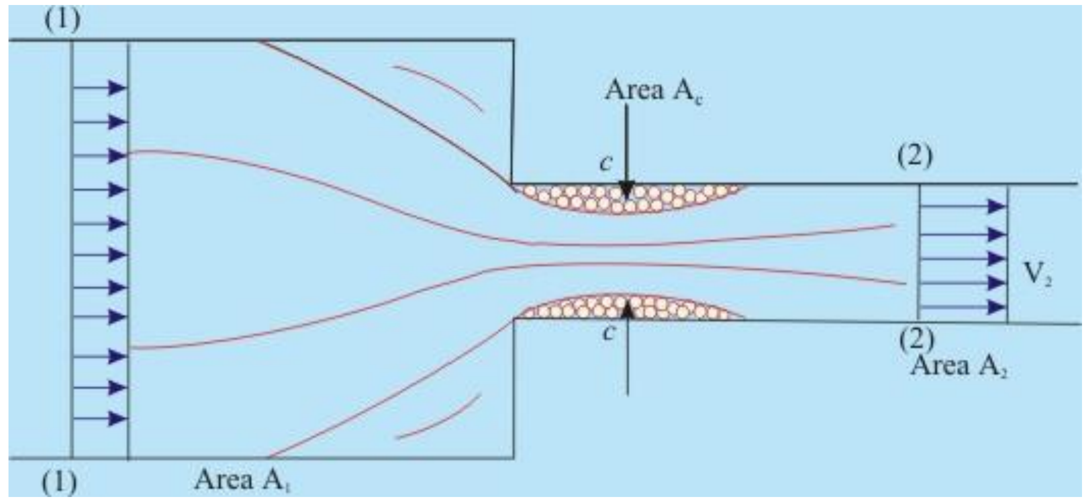

V-notch, Sutro and Rectangular plate weirs
Trapezoidal and Sharp Crested weirs also included with the S6-20.

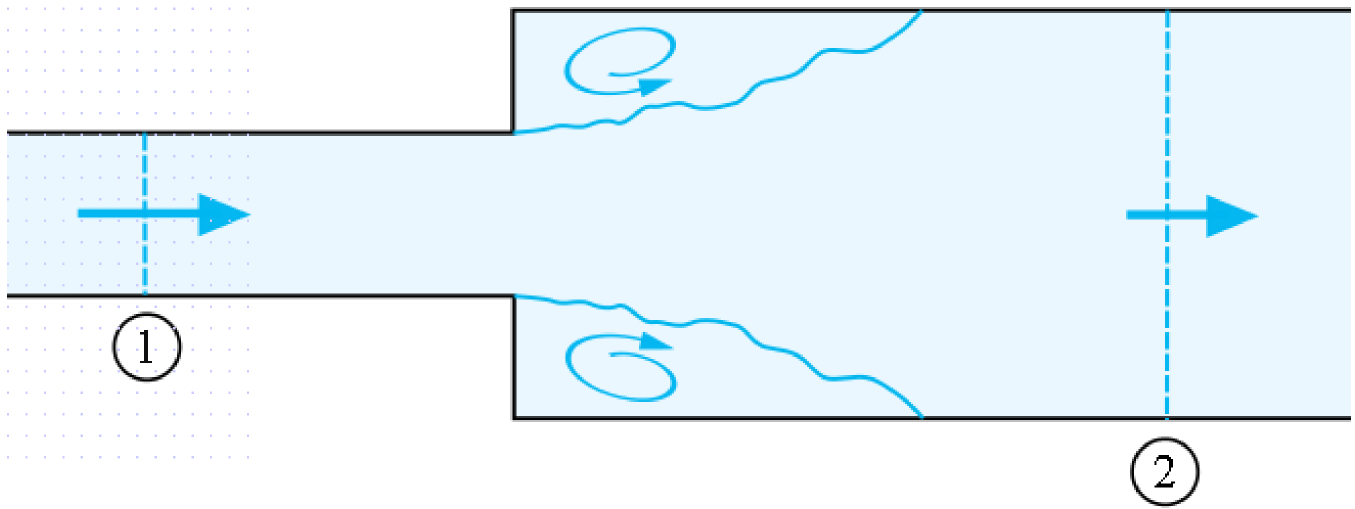
# Pipe Friction

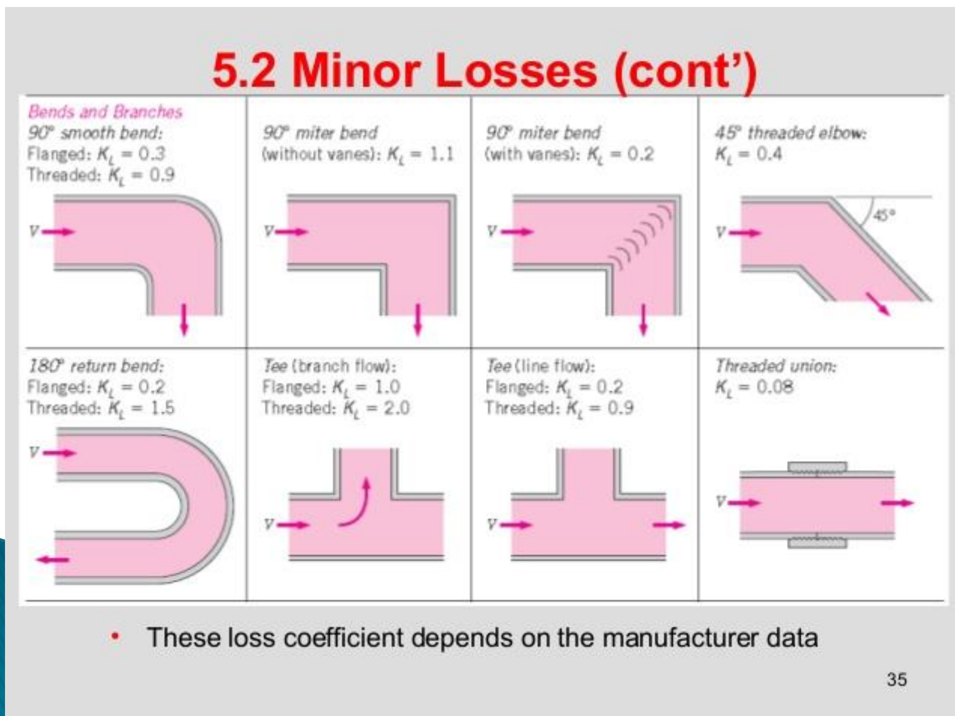


# Pipe Fittings



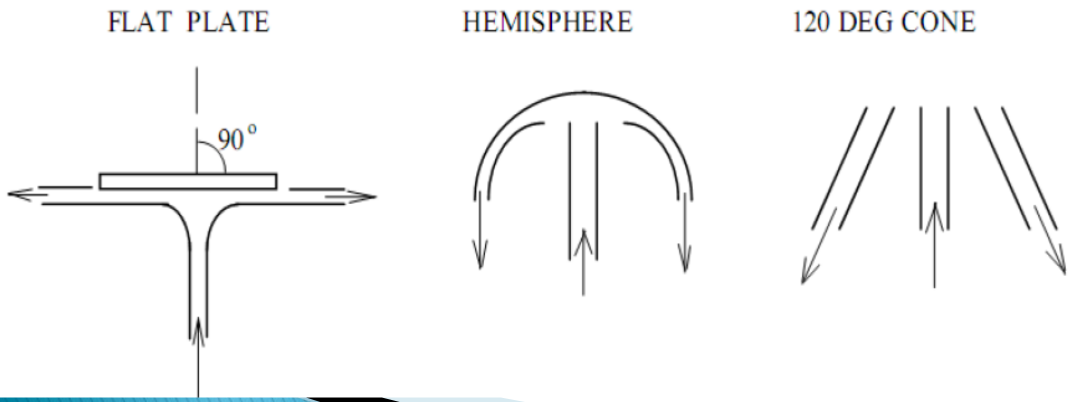




5.2 Minor Losses (cont')
Bends and Branches
90° smooth bend:
Flanged: $K_L = 0.3$
Threaded: $K_L = 0.9$
90° miter bend
(without vanes): $K_L = 1.1$
90° miter bend
(with vanes): $K_L = 0.2$
45° threaded elbow:
$K_L = 0.4$
45°
180° return bend:
Flanged: $K_L = 0.2$
Threaded: $K_L = 1.5$
Tee (branch flow):
Flanged: $K_L = 1.0$
Threaded: $K_L = 2.0$
Tee (line flow):
Flanged: $K_L = 0.2$
Threaded: $K_L = 0.9$
Threaded union:
$K_L = 0.08$
V
• These loss coefficient depends on the manufacturer data
35

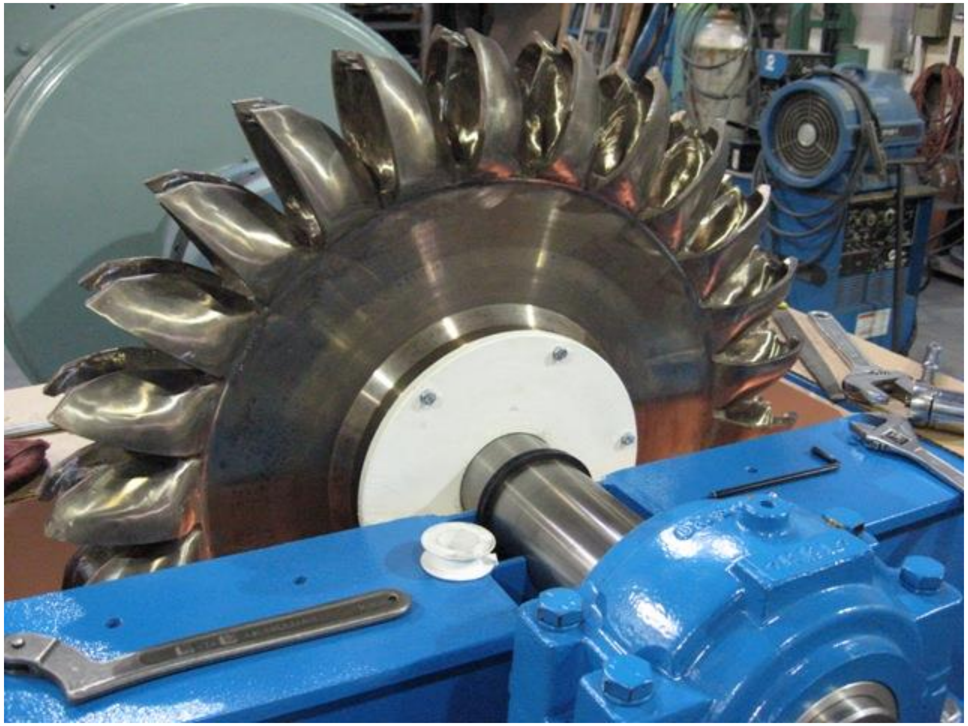
# Impact of Jet

- In each case it is assumed that there is no splashing or rebound of the water from the surface

- Jet propulsion means propulsion or movement of the bodies such as ships, rockets, aircrafts , Hydraulic Machines, etc with the help of jet.




# $2^{nd}$ Cycle
# Hydraulic Machines



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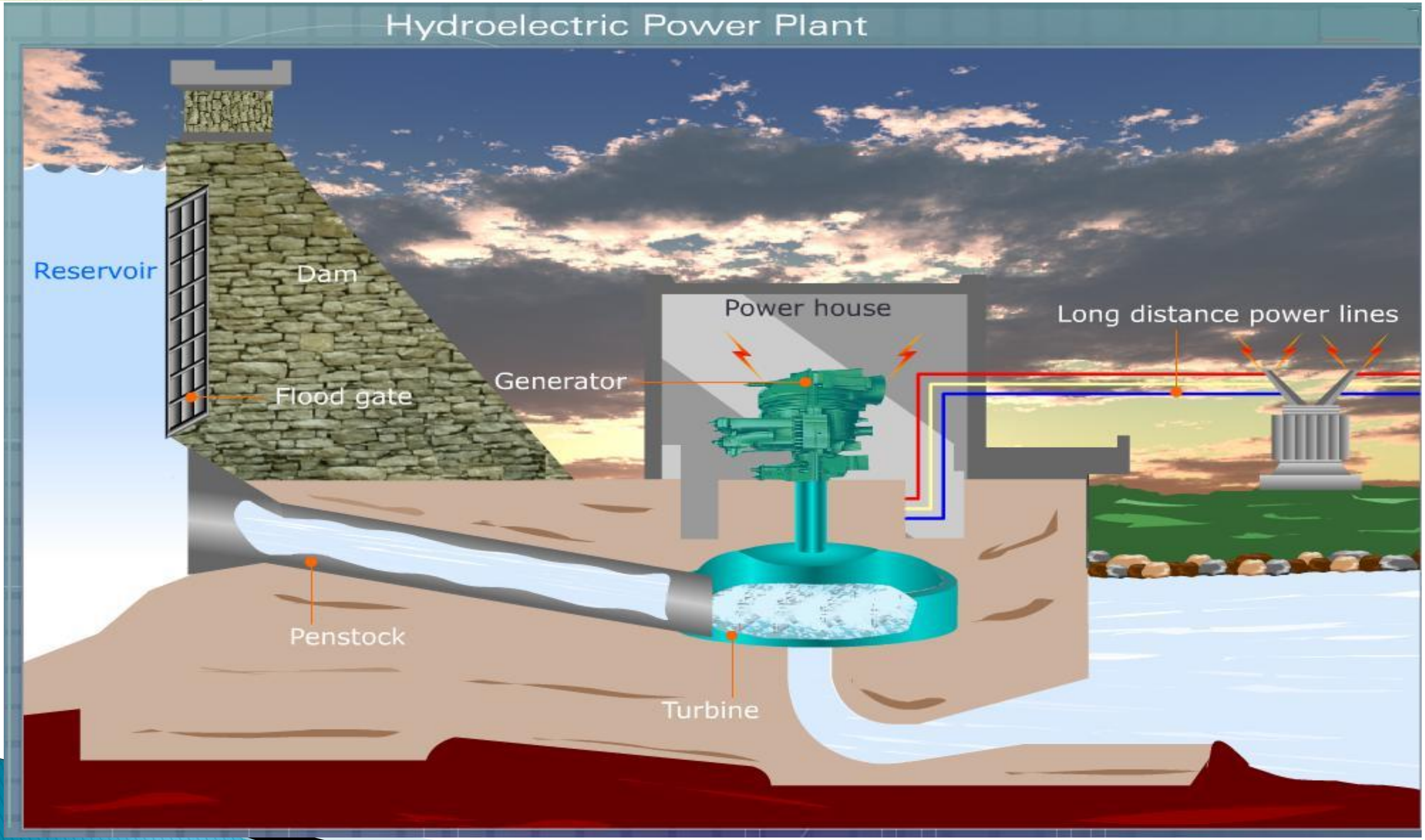
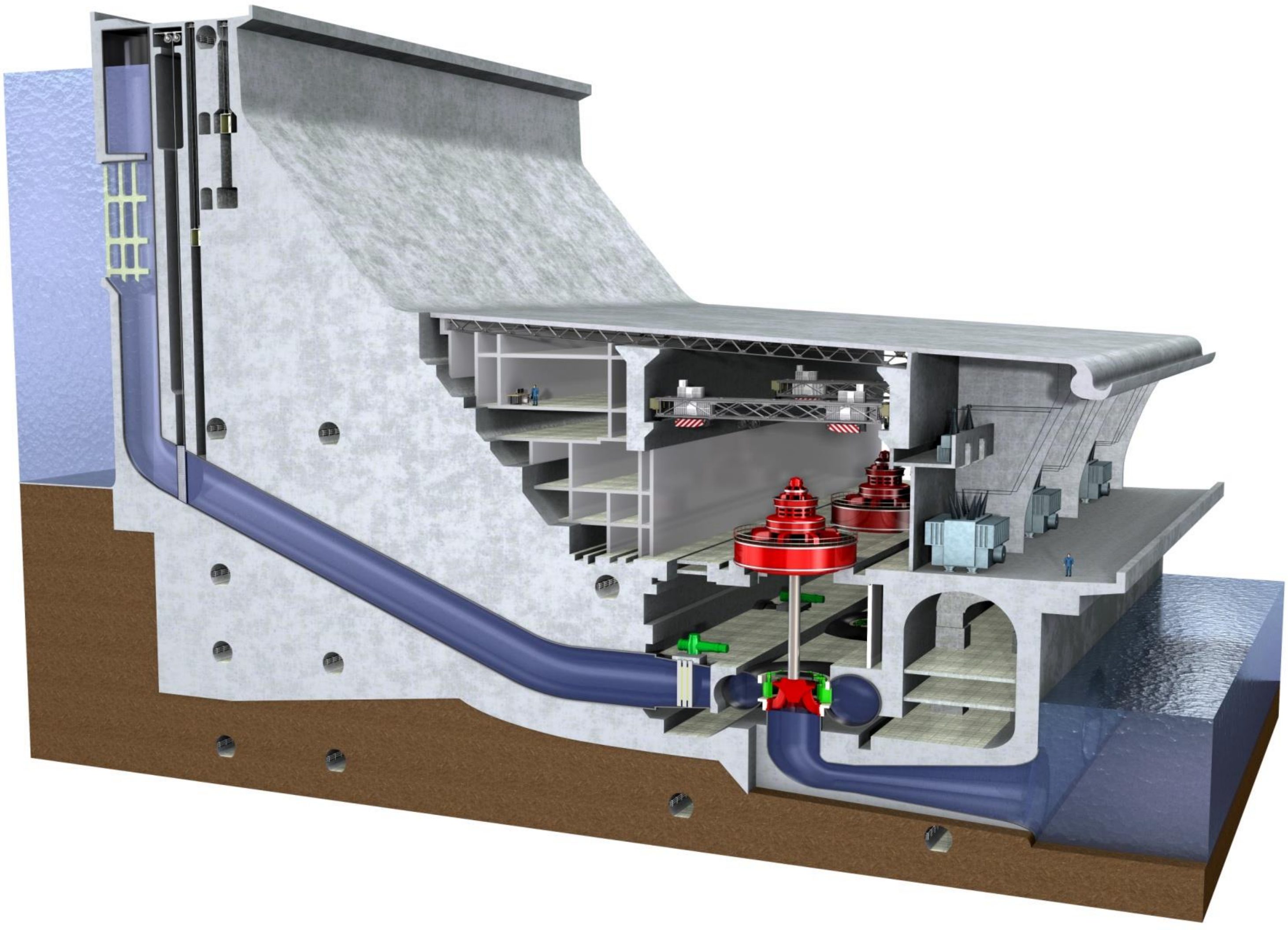
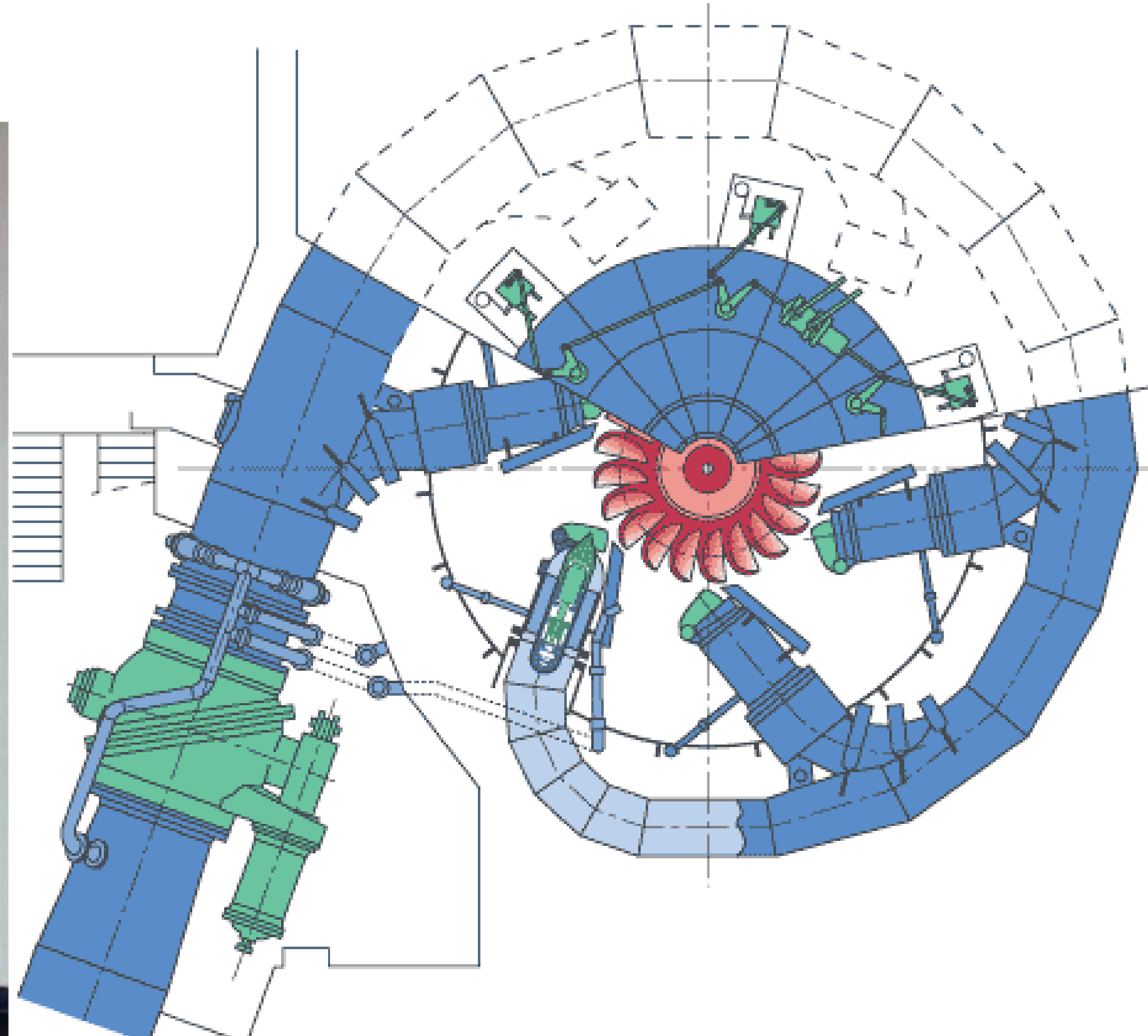
# Hydraulic Electric power Plant



# Hydraulic Electric power Plant



# Pelton Turbine



VNR Protocol-FMHM LAB/MED

TANASOMA JYOTIRGAMAYA

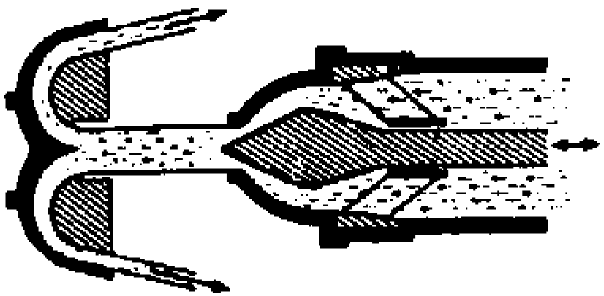
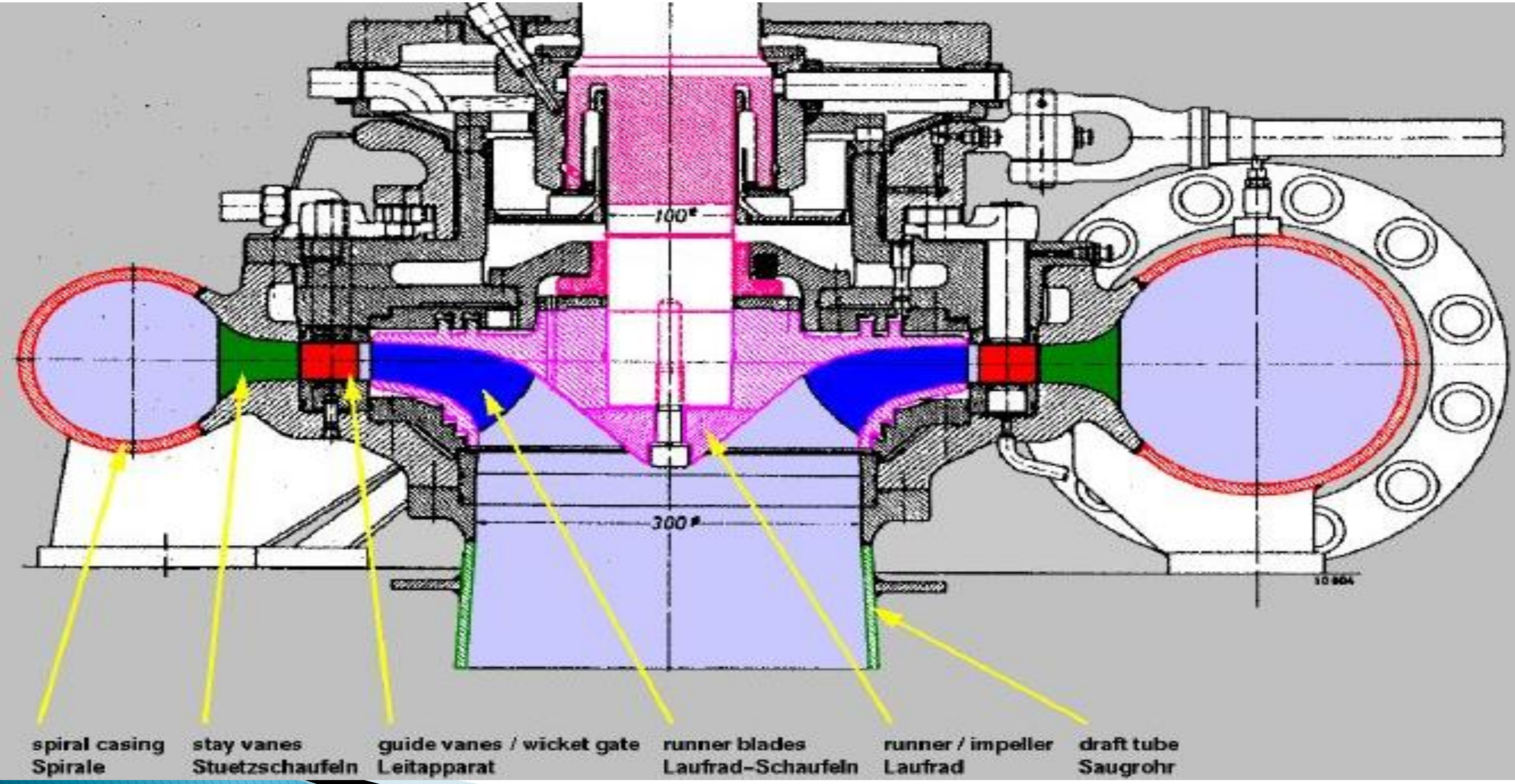


Fig. 9: Jet Impinging on Bucket


# Francis Turbine

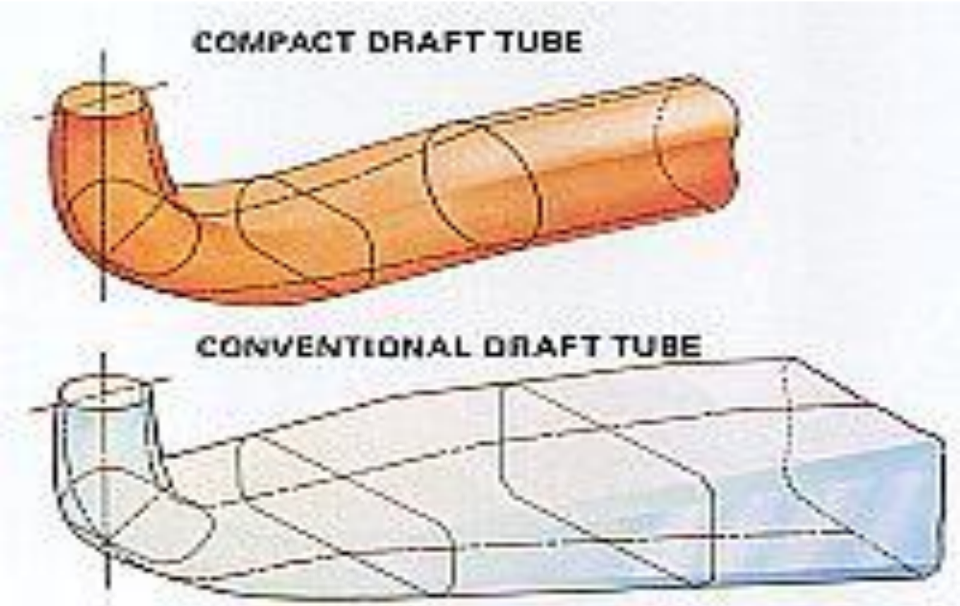


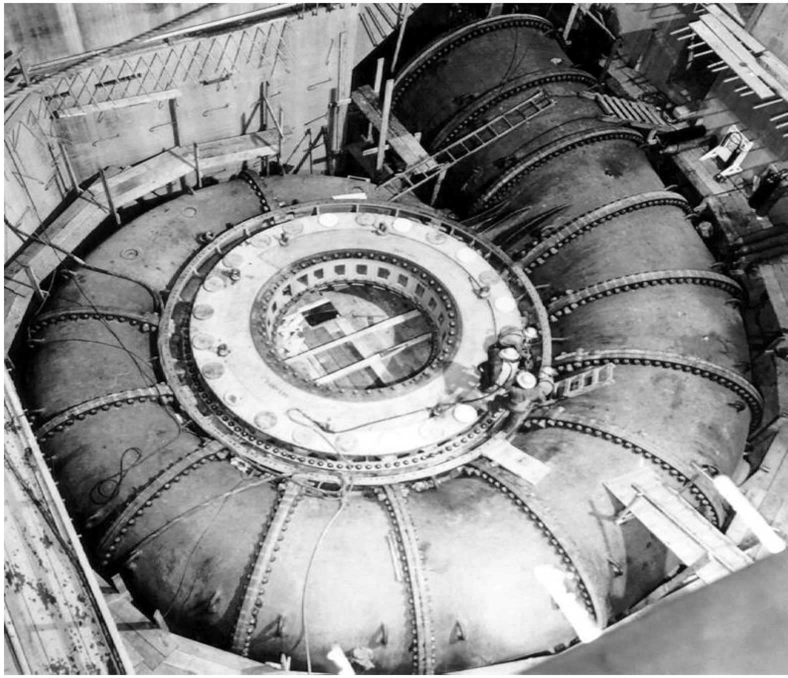
# Francis Turbine

Runner for 51.4MW turbine with 41.5m head

Runner for 325MW turbine with 116.2m head

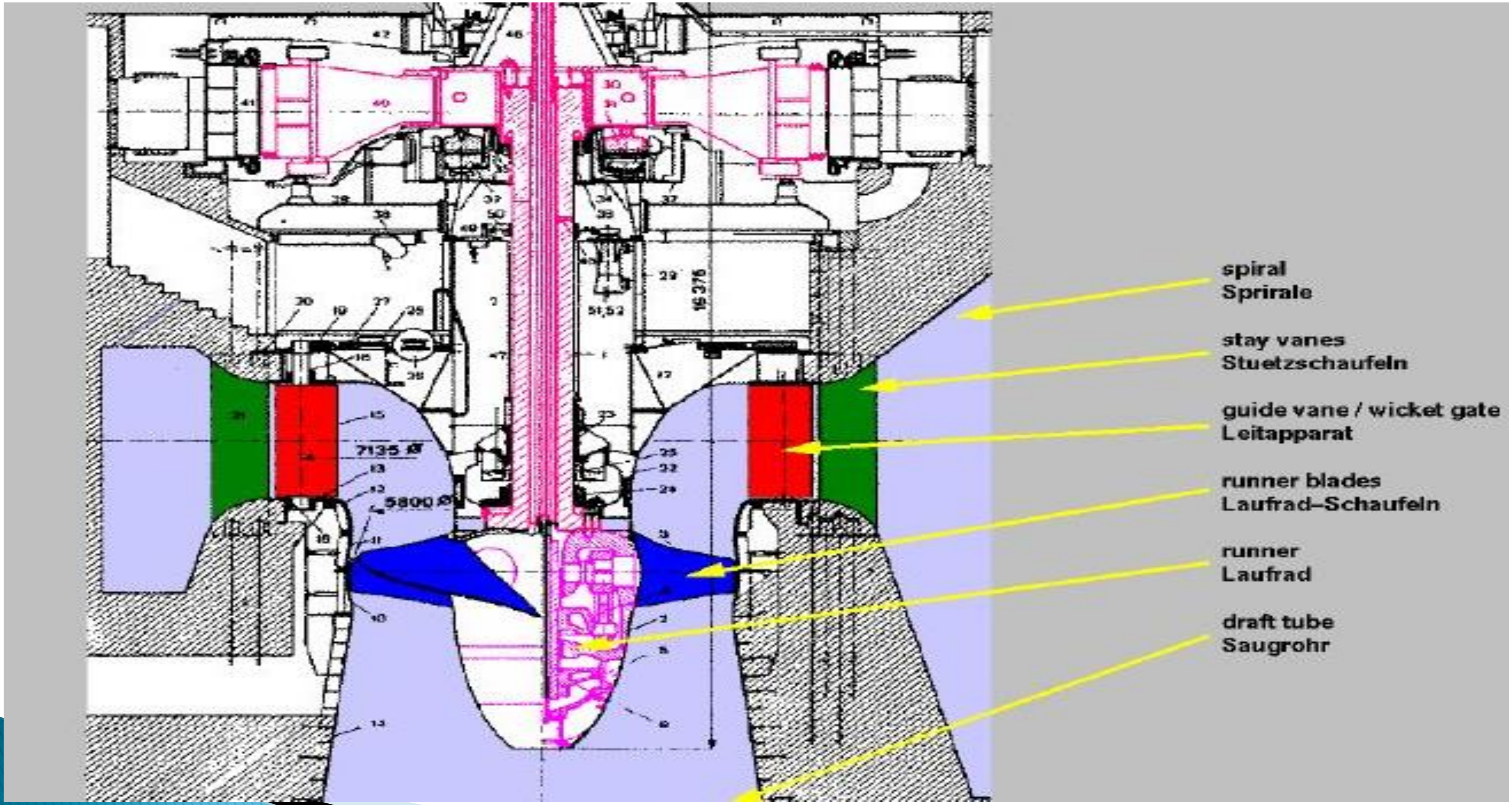
Runner for 266MW turbine with 411m head



VNR Protocol-FMHM LAB/MED

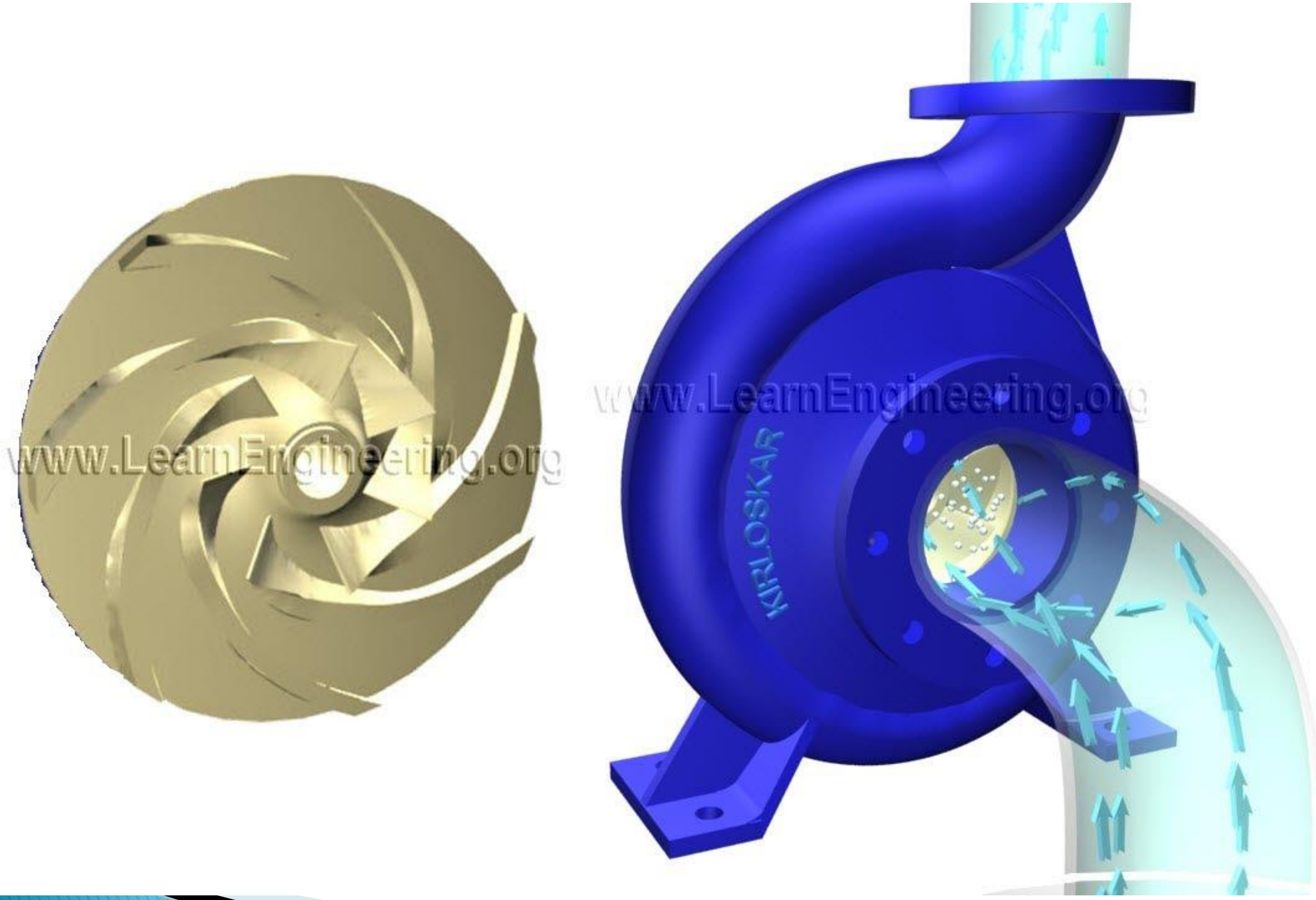
# KAPLAN TURBINE



# Centrifugal Pumps

VNR Protocol-FMHM LAB/MED

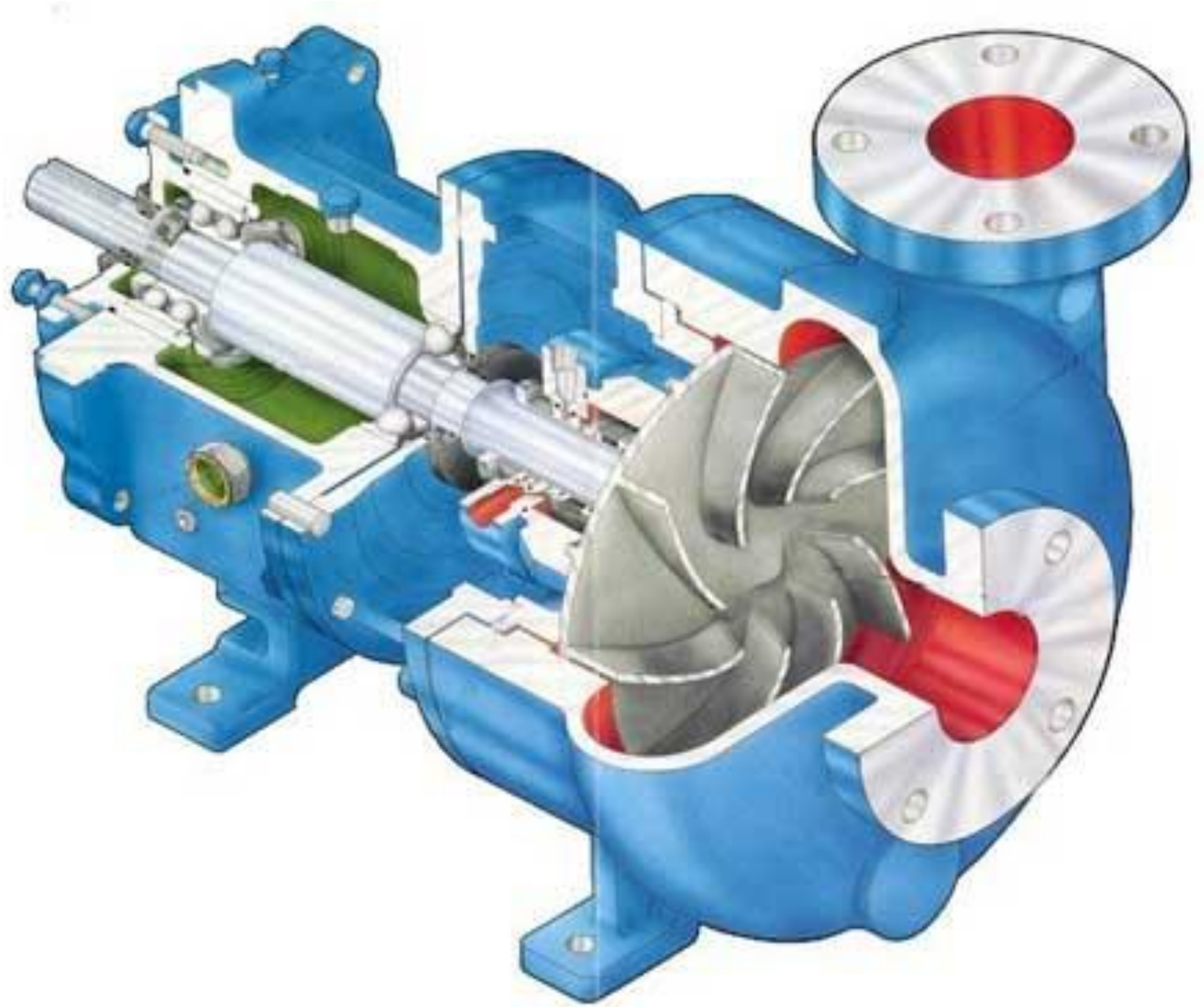
# Centrifugal Pumps



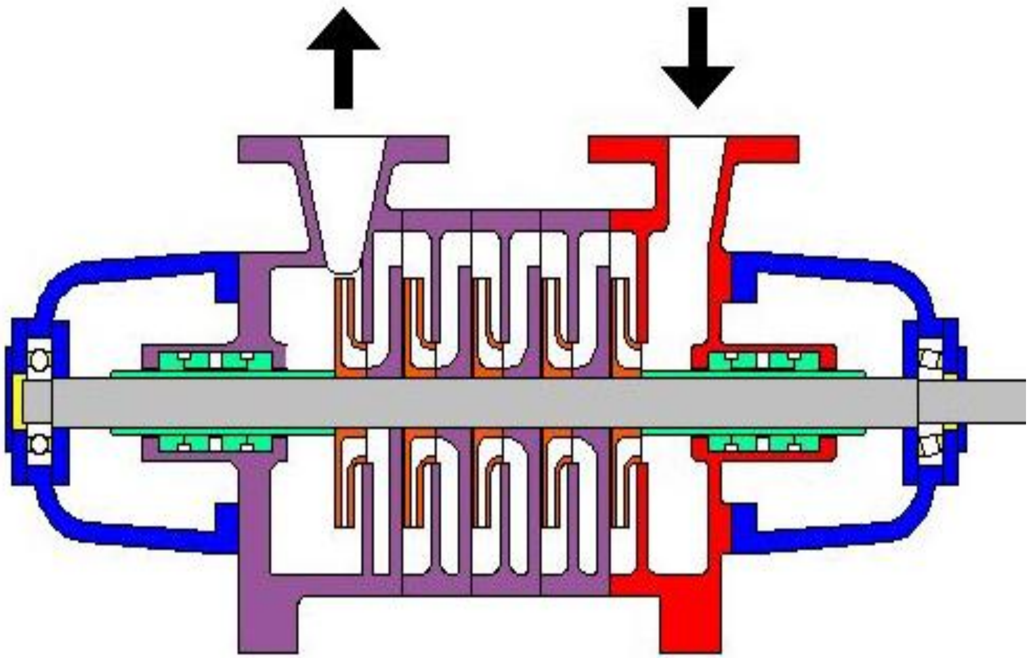
# Centrifugal Pumps

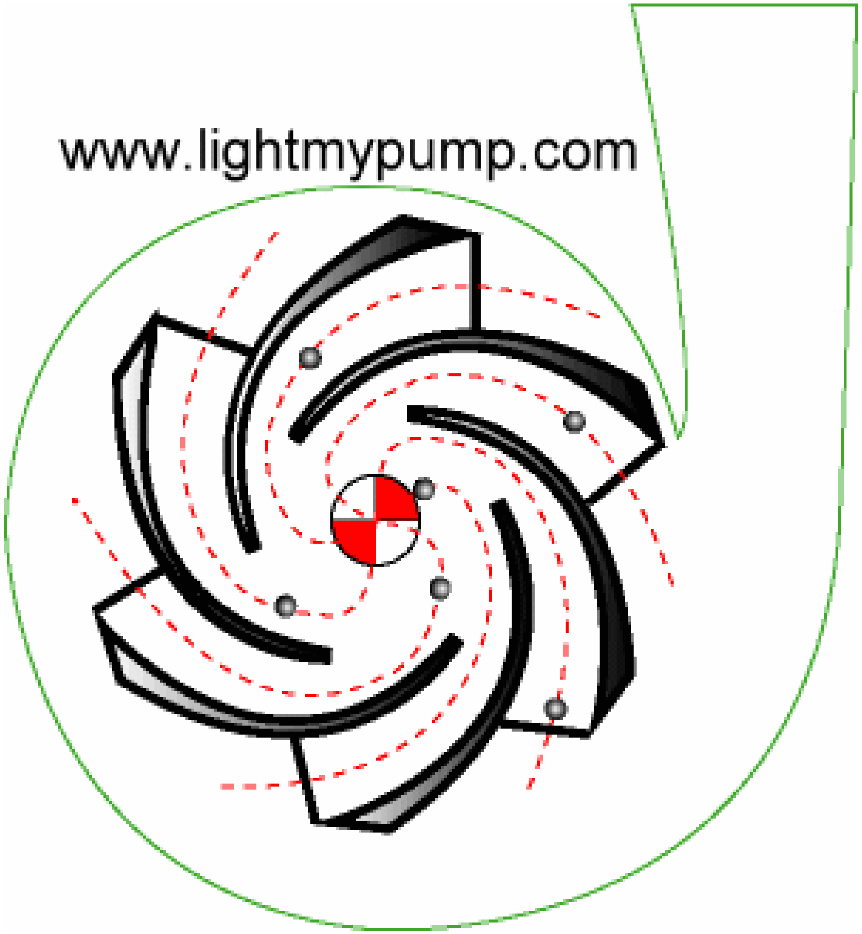
# Centrifugal Pumps

# Centrifugal Pumps

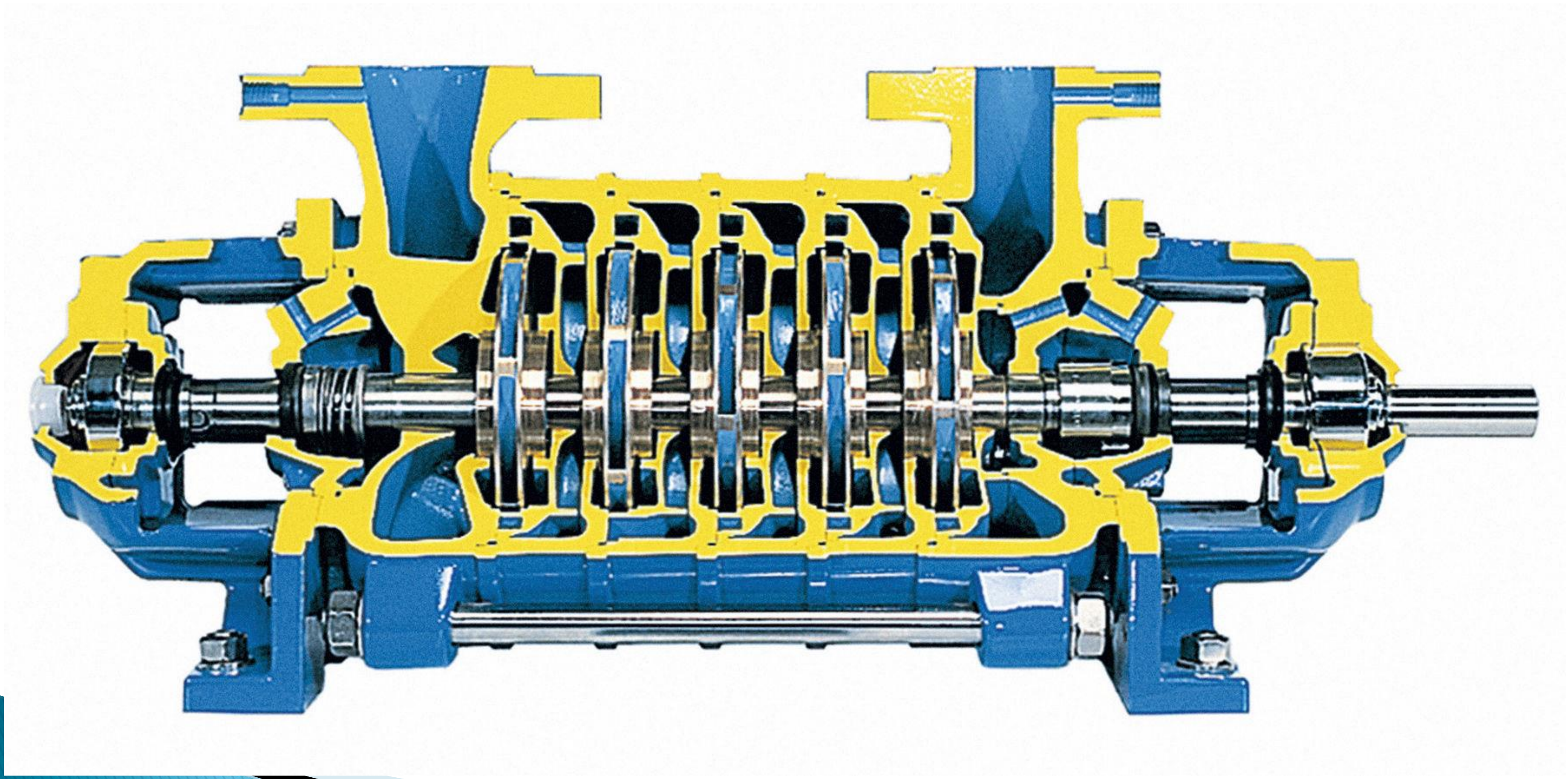


# Multi stage Centrifugal Pumps

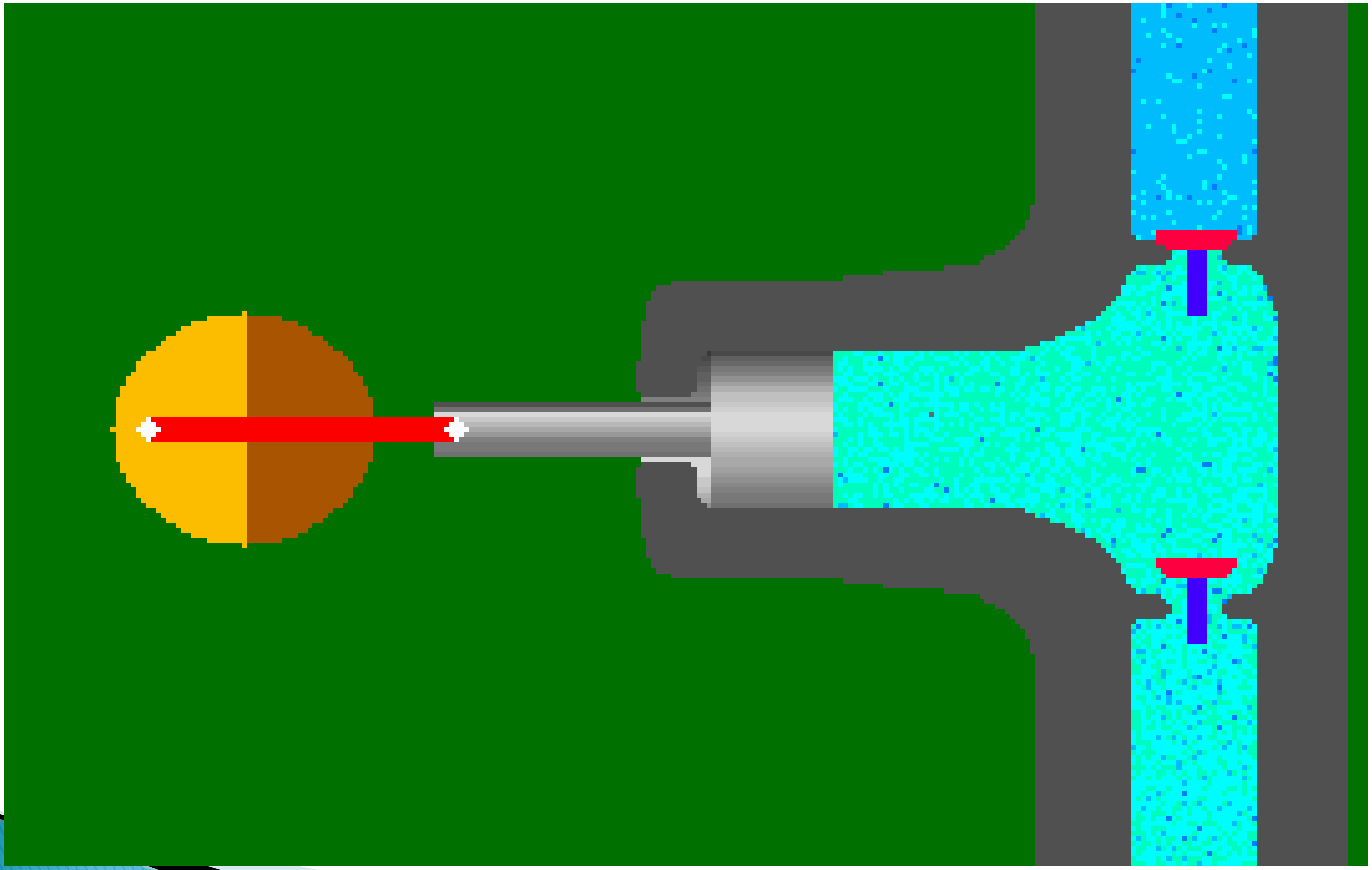




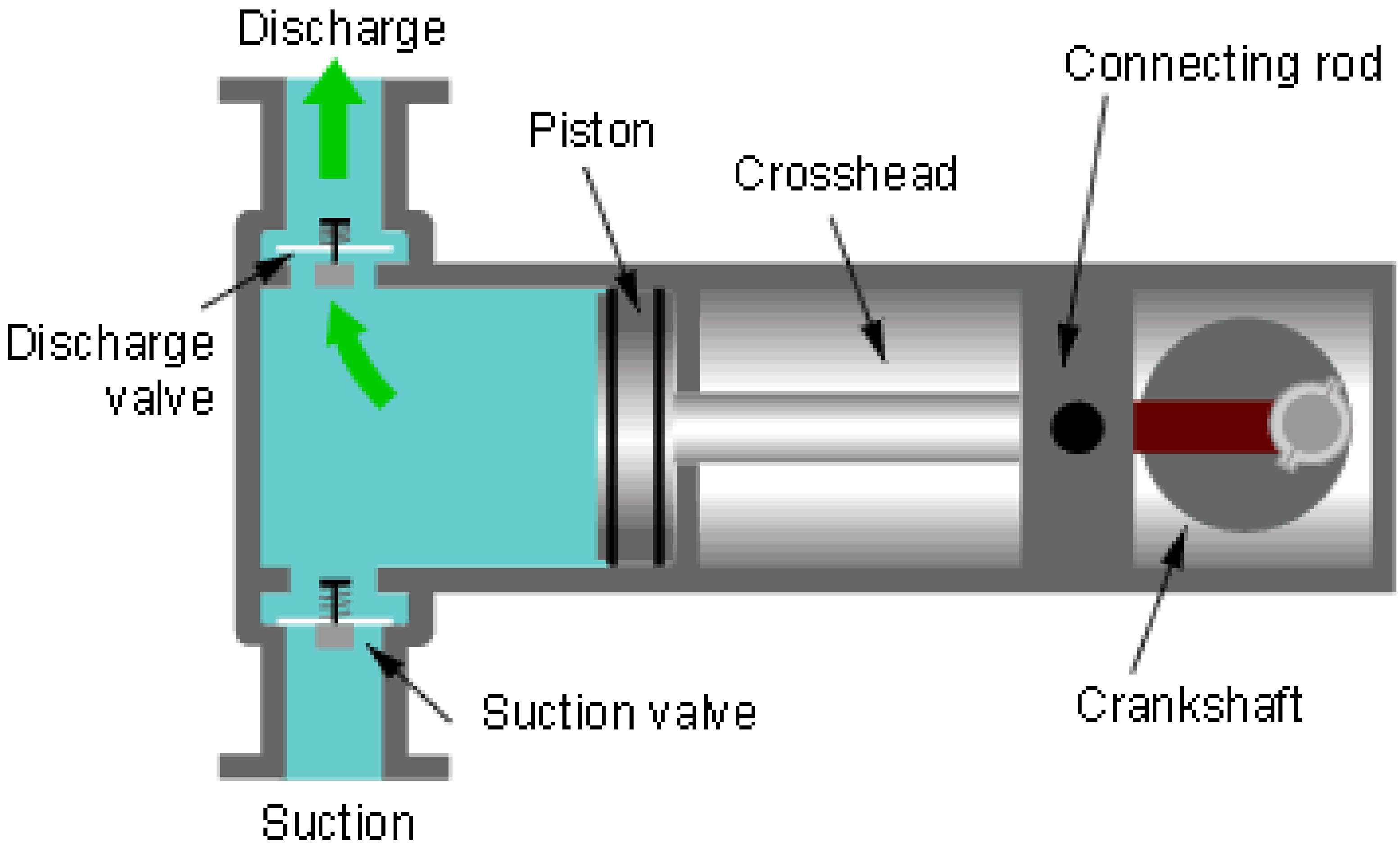
# Multi stage Centrifugal Pumps



# Reciprocating Pump



# Centrifugal Pumps



# Thank Q
# &
# ????

# Automotive Simulation Lab Protocol

# Objectives and outcomes

**COURSE OBJECTIVES:**

- **To introduce the basics of MATLAB & Simulink**
- **To model and simulate vehicle subsystems**
- **To model and simulate various powertrain systems**

**COURSE OUTCOMES: After completion of the course, the student should be able to**

**CO-1: Understand the fundamentals of MATLAB & Simulink**

**CO-2: Perform modelling and simulation of vehicle subsystems**

**CO-3: Perform modelling and simulation of various powertrain systems**

# LIST OF EXPERIMENTS

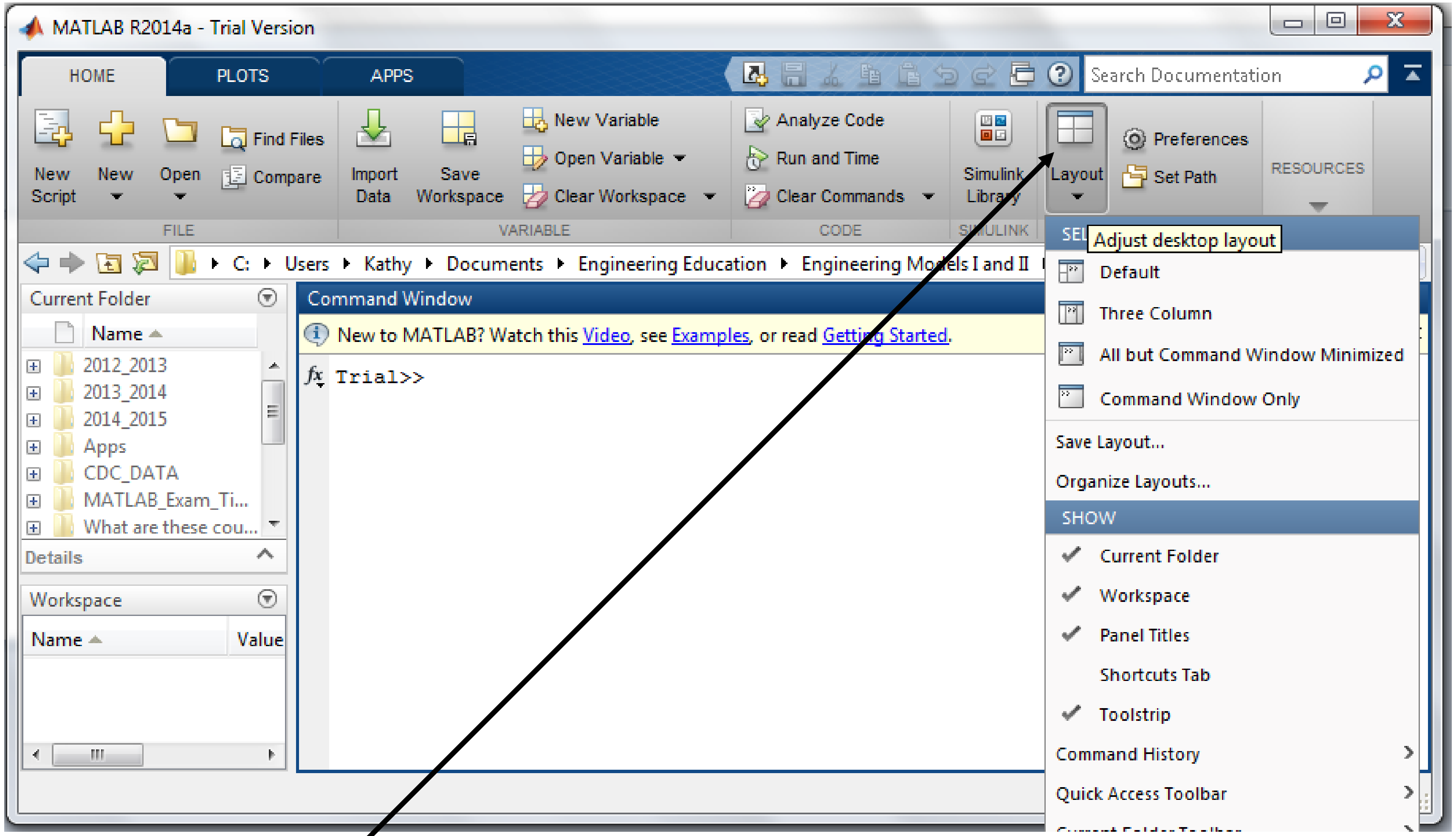
1. Create variables and perform calculations using built-in functions
2. Create vectors, matrices and perform calculations on arrays
3. Data visualization using plot functions
4. Visualization of signal values and data exchange between Simulink and MATLAB
5. Modelling and simulation of cruise control model
6. Modelling and simulation of a quarter car model
7. Simulation of IC engine dynamometer model
8. Modelling and simulation of IC engine powered vehicle
9. Modelling and simulation of a DC motor
10. Simulation of battery pack model
11. Modelling and simulation of an electric vehicle
12. Simulation of hybrid electric vehicle model

# What is MATLAB®?

MATLAB® /Simulink® is a powerful software tool for:

- Performing mathematical computations and signal processing
- Analyzing and visualizing data (excellent graphics tools)
- Modeling physical systems and phenomena
- Testing engineering designs

# MATLAB Desktop

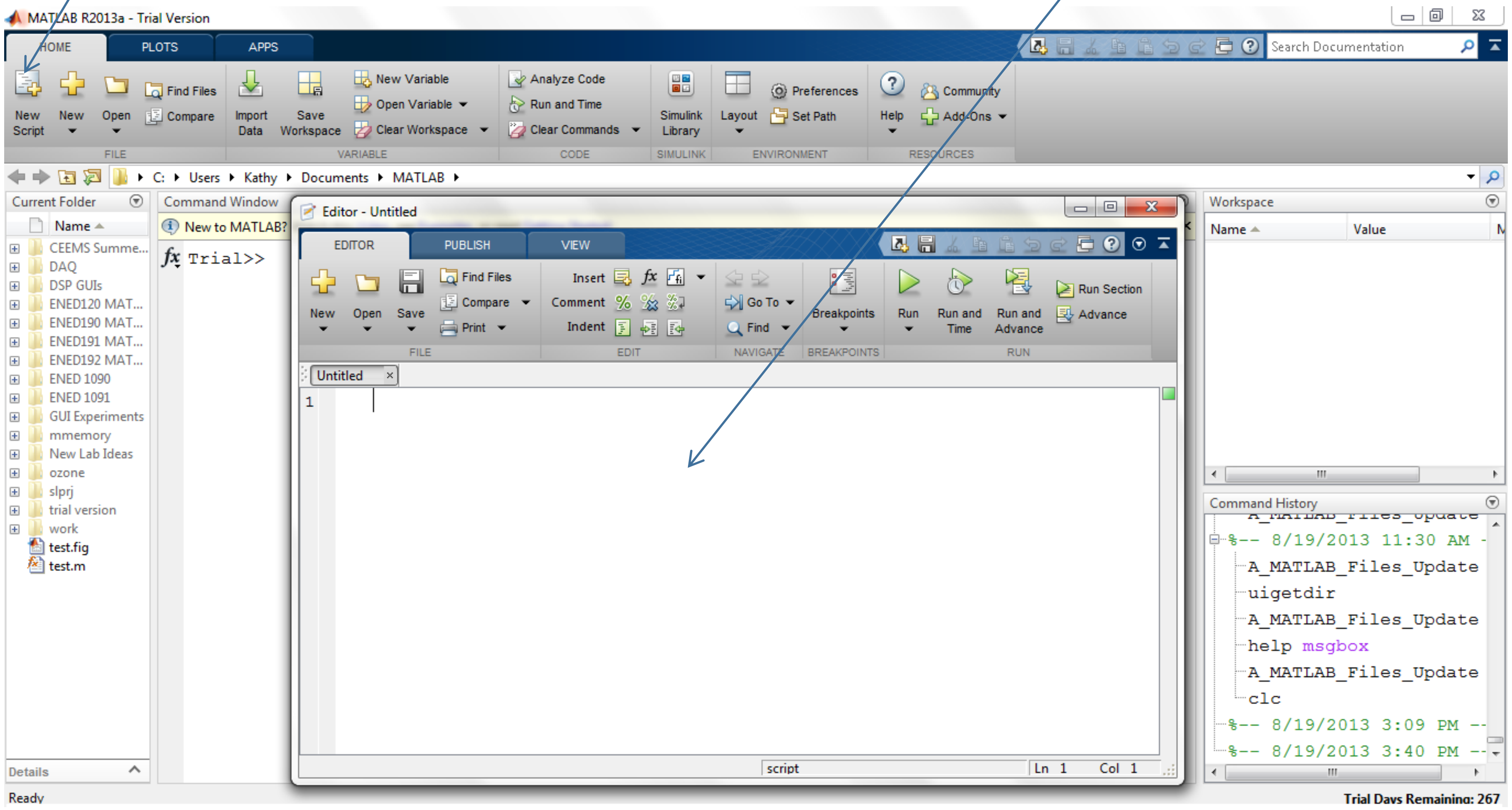


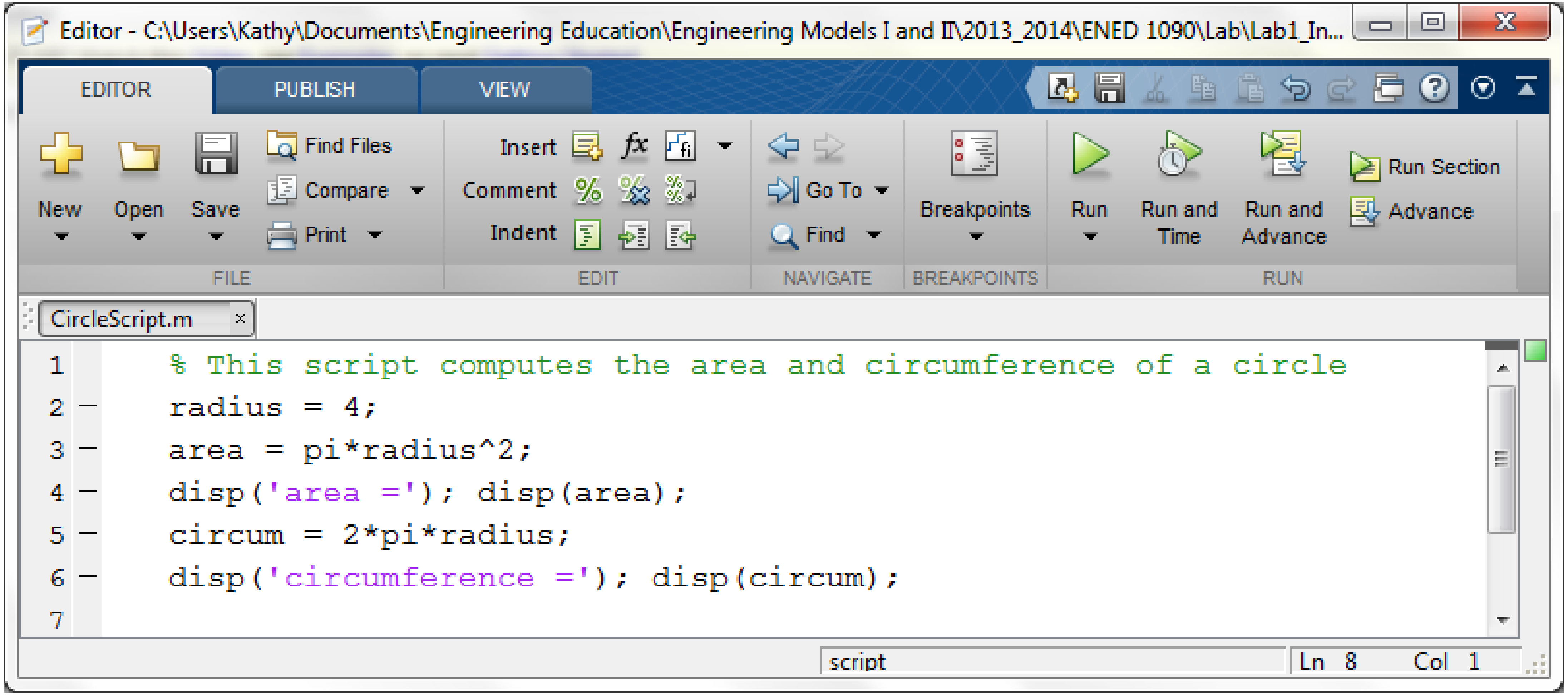

You can select what is on your desktop by Clicking on Layout. Go down to Command History and select docked.

# Script Files

Click on New Script

Creates Blank Script File

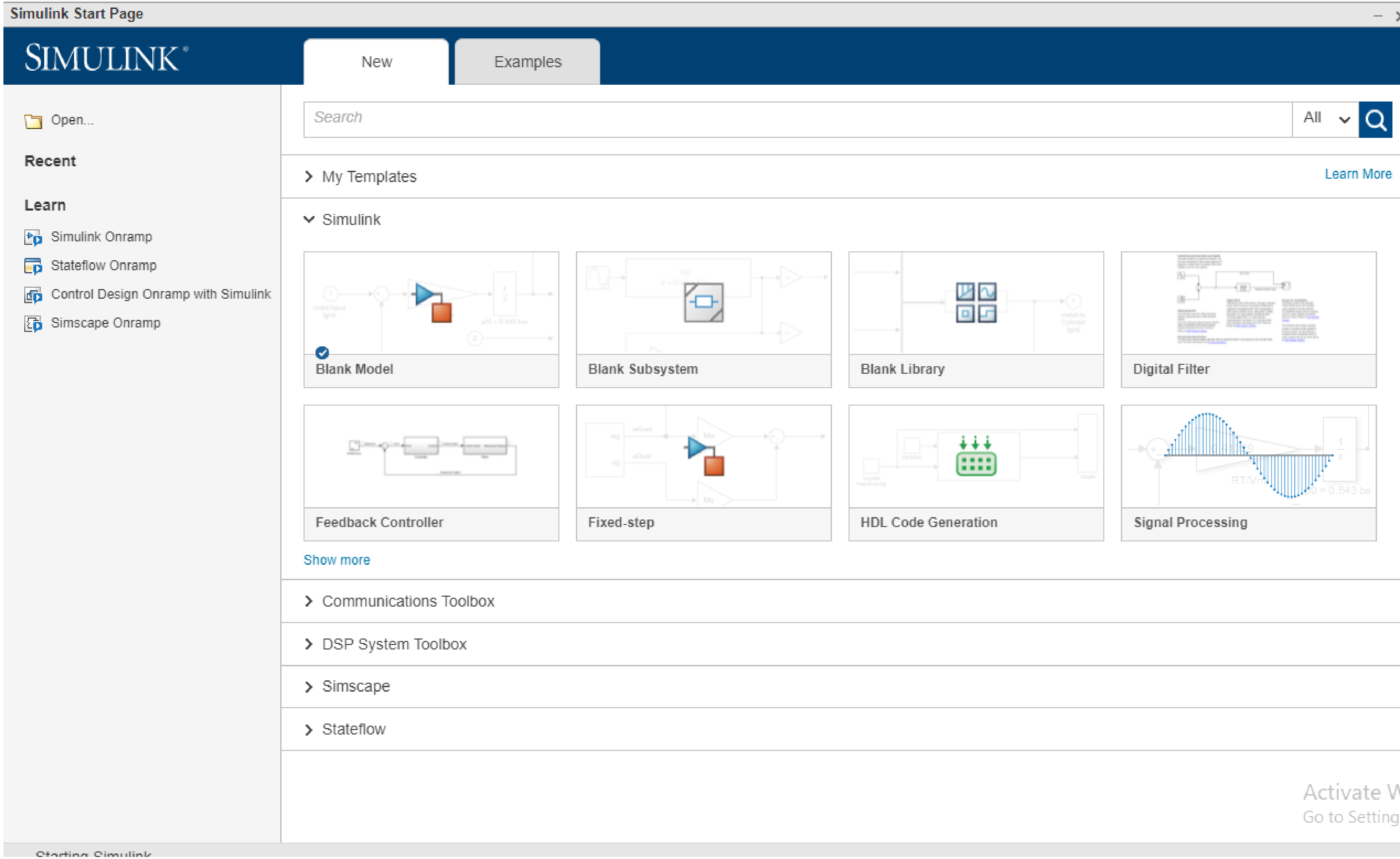





Save the file as CircleScript in your newly created folder.

Note: Any line that starts with a % is a comment and turns green – it doesn't execute.

# Simulink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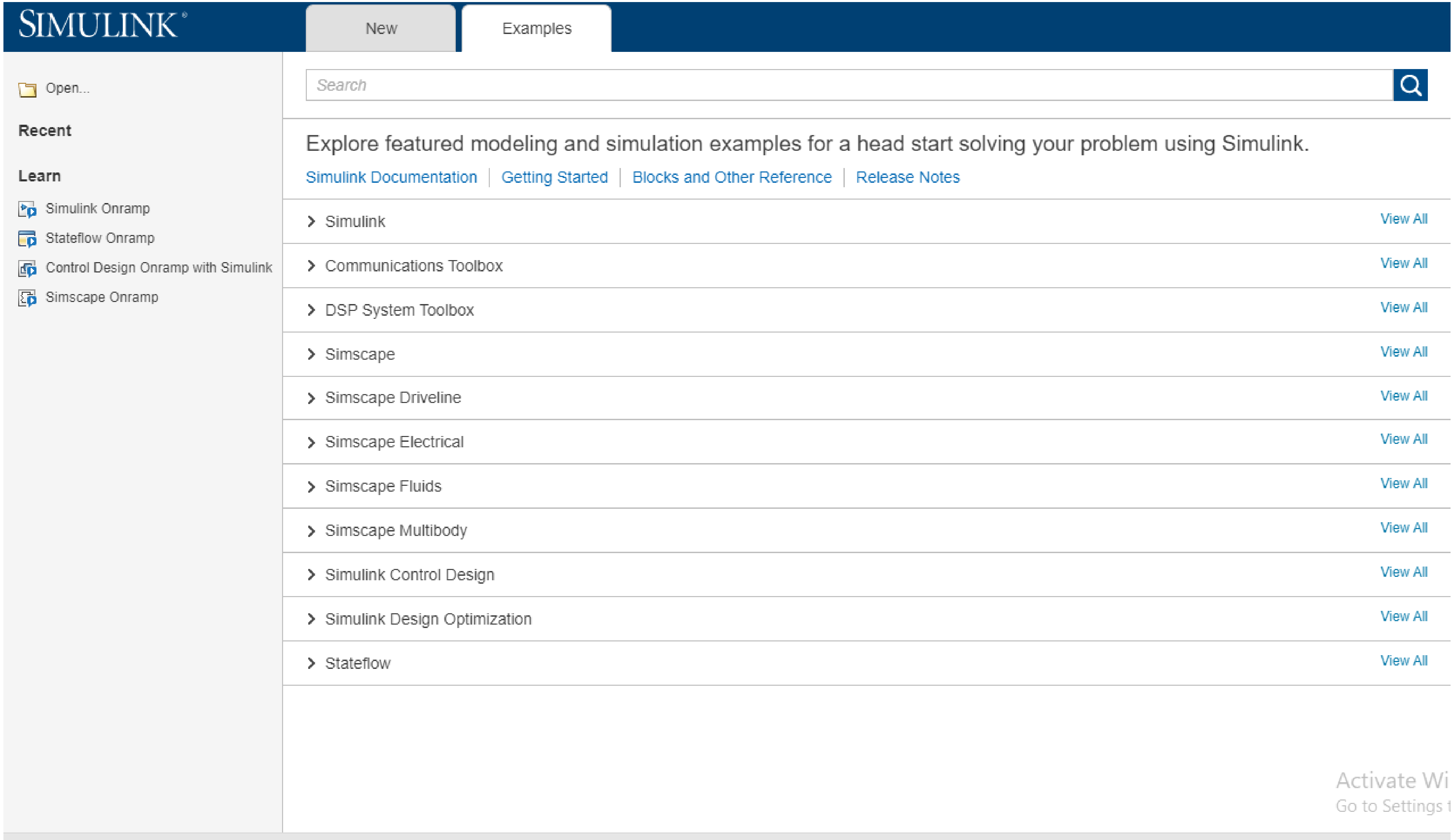
DSP System Toolbox
Simscape
Stateflow
Starting Simulink

# Examples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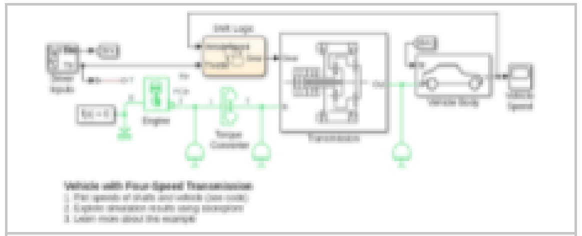
Simscape Electrical View All
Simscape Fluids View All
Simscape Multibody View All
Simulink Control Design View All
Simulink Design Optimization View All
Stateflow View All
Activate Wi
Go to Settings t

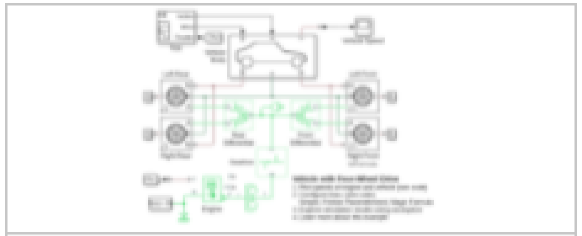
# Examples

Simscape Driveline

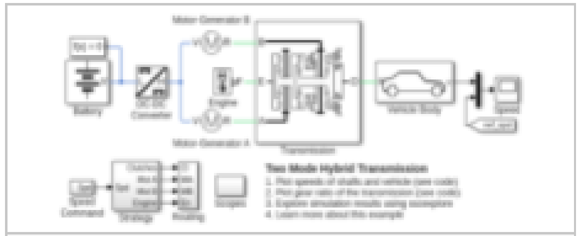
View All



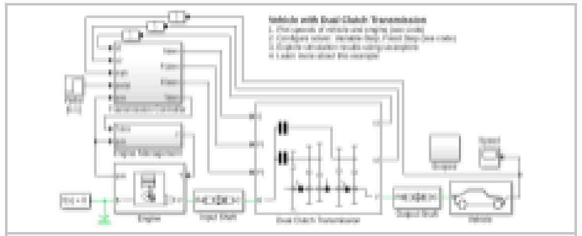
Vehicle with Four-Speed Transmis...



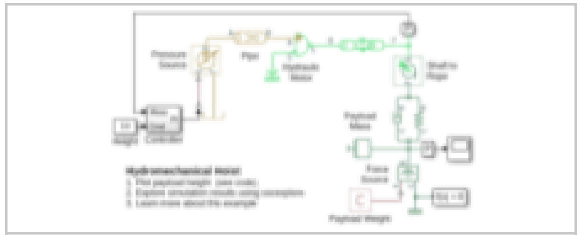
Vehicle with Four-Wheel Drive



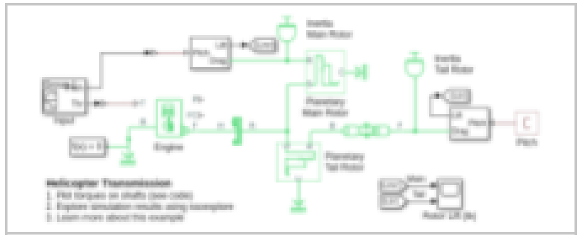
Two Mode Hybrid Transmission



Vehicle with Dual Clutch Transmis...

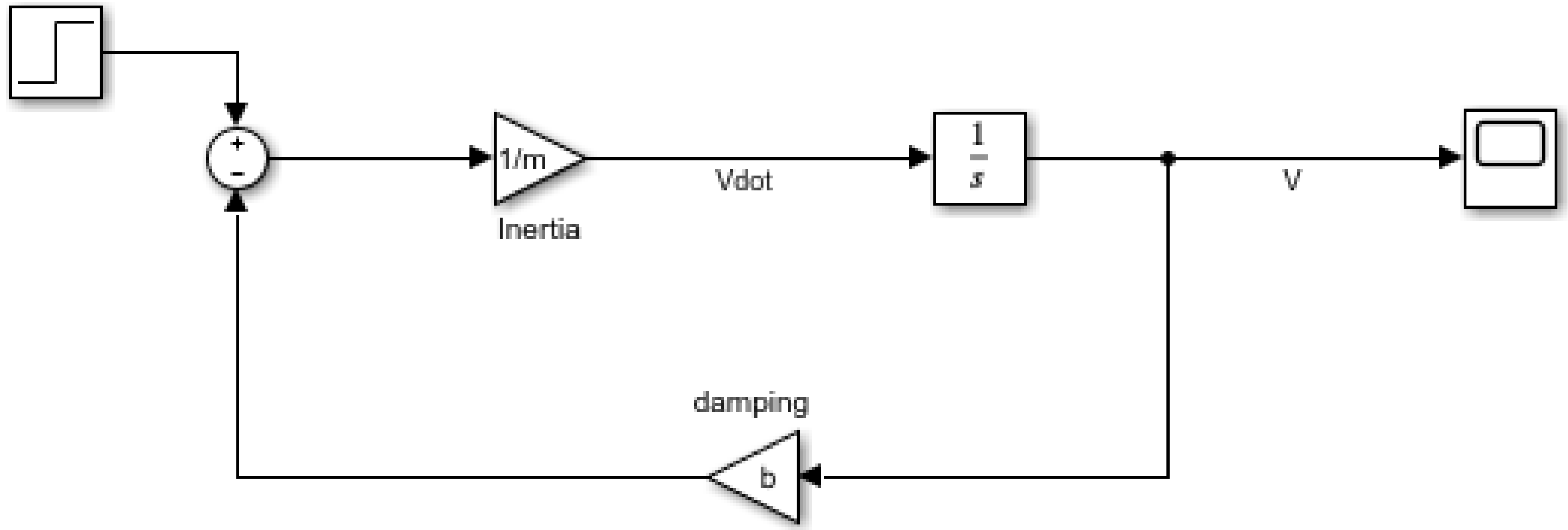


Hydromechanical Hoist

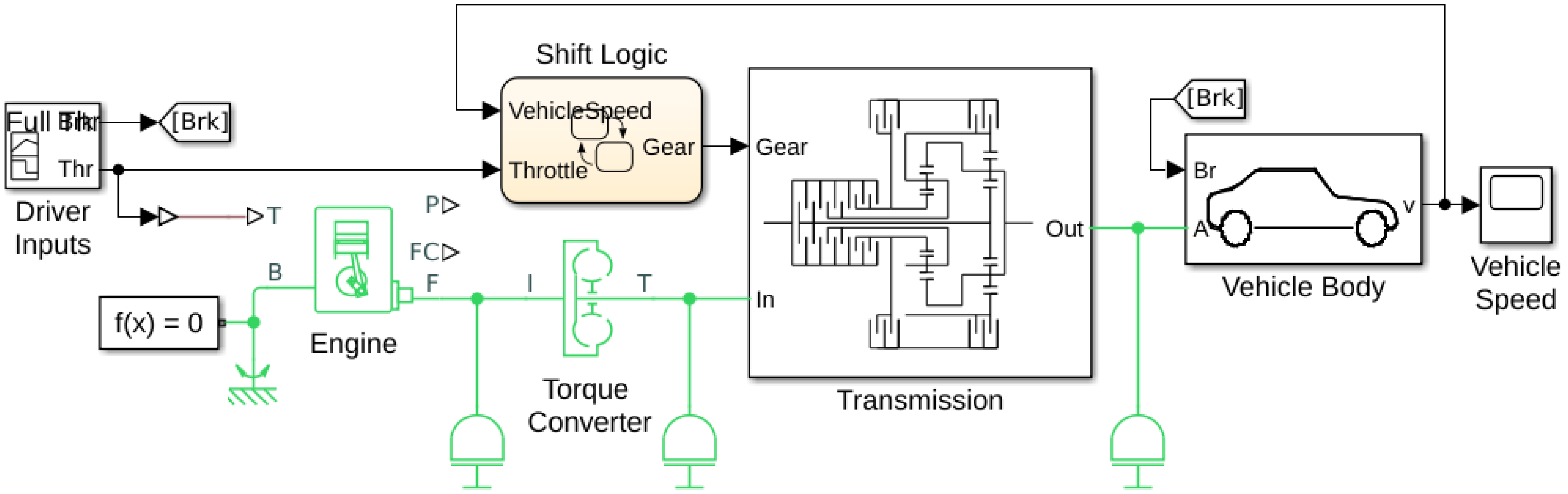


Helicopter Transmission

# Simulink model



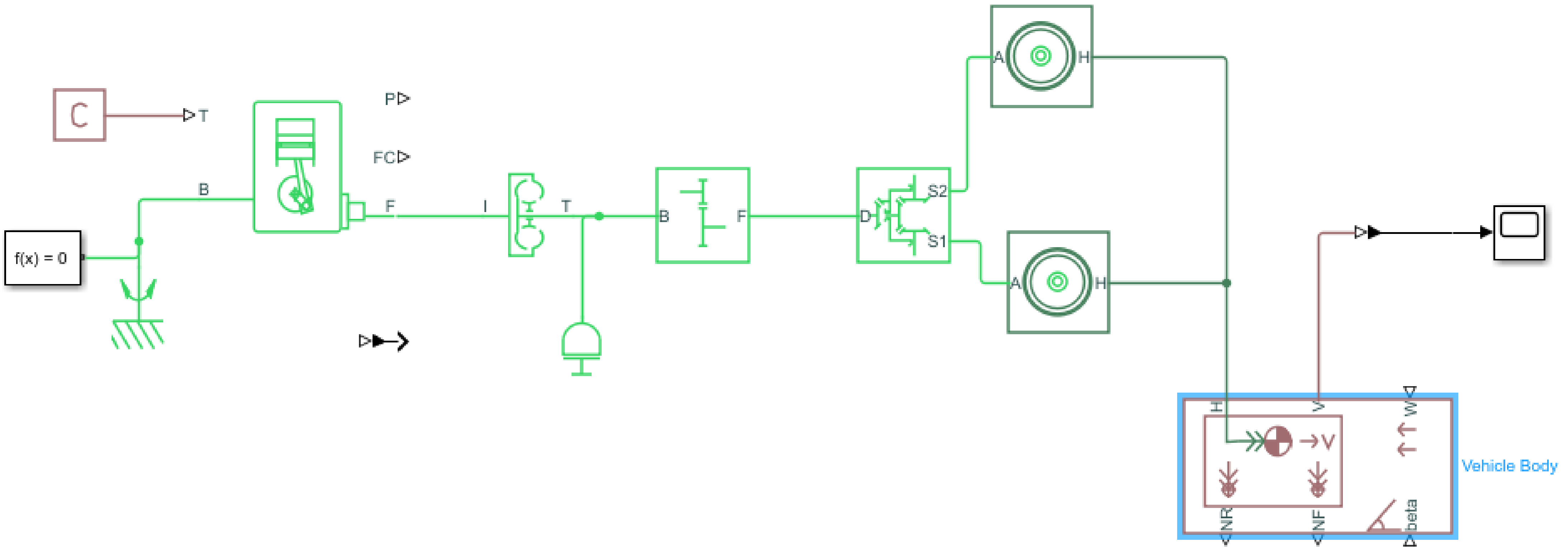
# Four speed transmission



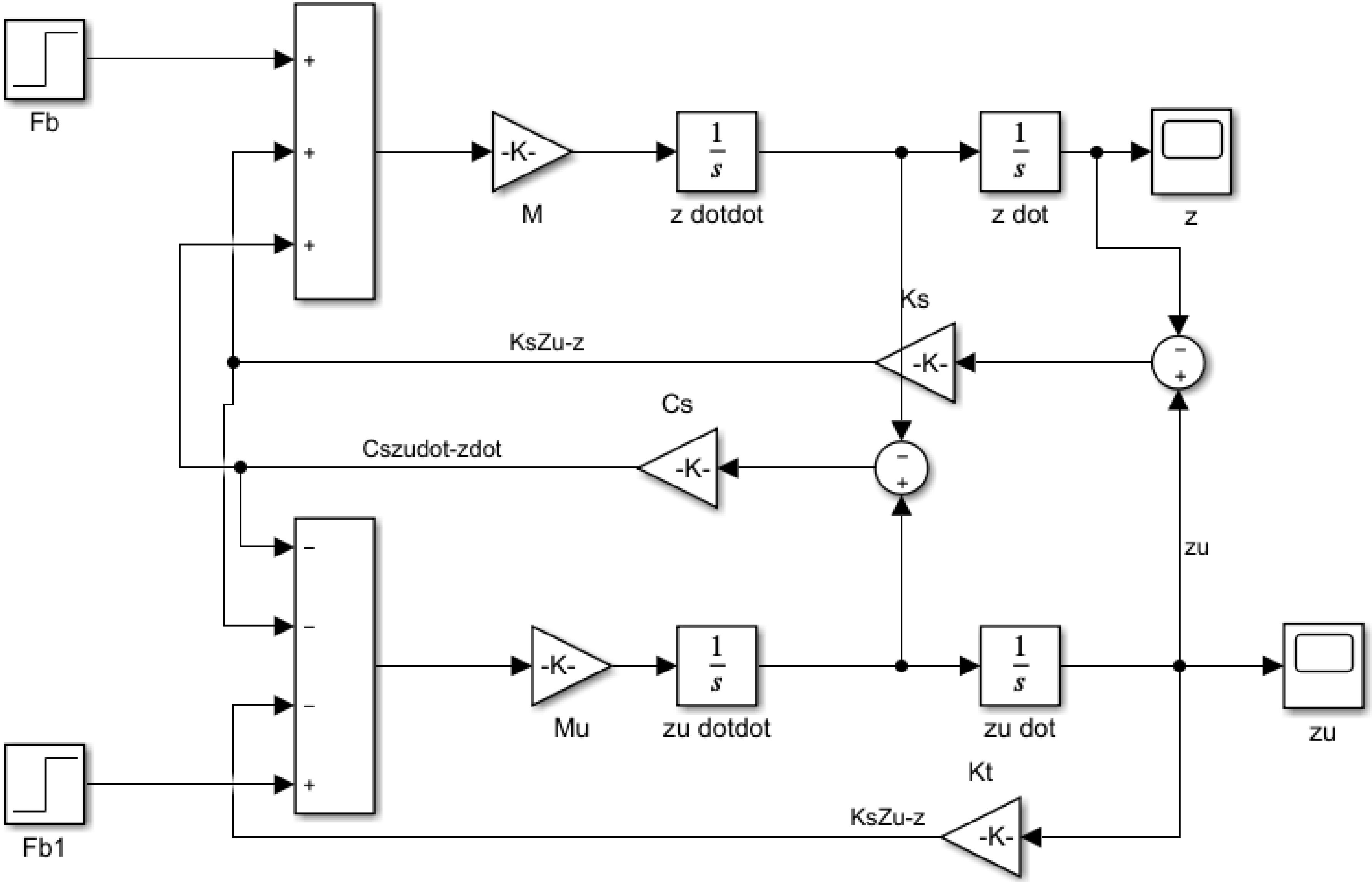

**Vehicle with Four-Speed Transmission**

1. Plot speeds of shafts and vehicle (see code)
2. Explore simulation results using sscexplore
3. Learn more about this example

# IC engine model



# Quarter car model



# Thank You