

LAB MANUAL, MECHANICAL ENGINEERING LAB I

(MECHANICAL ENGINEERING - 3RD SEM)



PREPARED

BY

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EXPERIMENT NO. 01

AIM OF THE EXPERIMENT:-

Determination of Young's Modulus using Searl's Apparatus.

APPARATUS REQUIRED:-

SL NO.	NAME OF THE APPARATUS	SPECIFICATION	QUANTITY
01	Searl's apparatus		01
02	Verniercaliper	L.C =0.02mm	01
03	Steel rule	l.c =0.5mm	01
04	Copper wire	D =0.001mm	L =
05	Balancing weight	1Kg	10
06	Weight pan		01
07	Plier		01

THEORY:-

STRESS:-

It is defined as the ratio between the load and cross-sectional area of the given specimen.

Mathematically,

$$\text{Stress} = \text{load/area}, \sigma = (P/A)$$

Unit of stress is N/M^2 or KN/M^2

STRAIN:-

It is defined as the ratio between the change in the length to its original length of the given specimen.

Mathematically,

$$\text{Strain} = \text{change in length/original length}$$

$$e = \delta l/l, \text{ It has nount.}$$

YOUNGS MODULUS:-

It is defined as the ratio between stress to strain.

Mathematically,

$$\text{Young's modulus} = \text{stress/strain} = E = \sigma/e$$

Its unit is KN/M^2 or N/M^2 .

Technical Specification:

Diameter of copper wire (d)= m^2

Cross-sectional area of the specimen (A)=($\pi/4$) $\times D^2 = \dots\dots\dots\text{M}^2$

Original Length of copper wire(L)= m

PROCEDURE:-

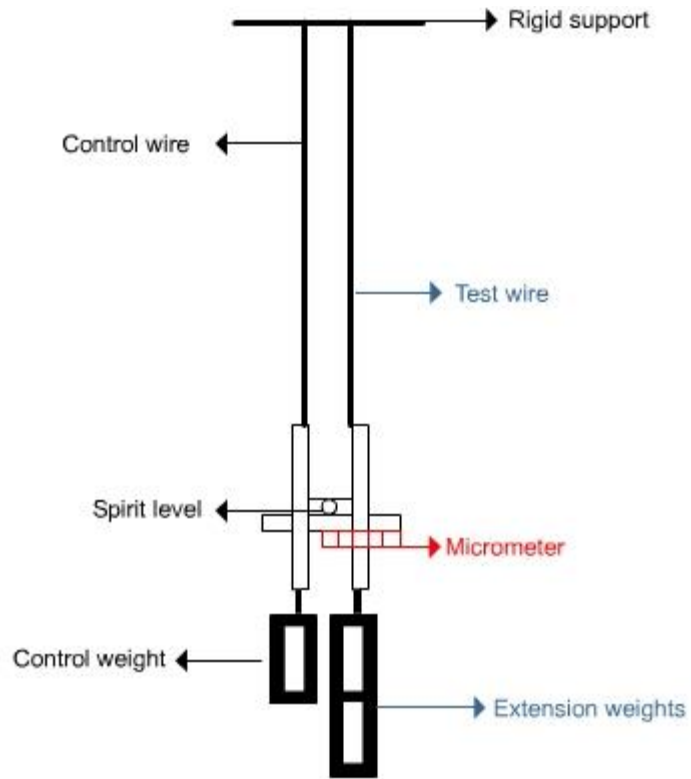
- Take two copper wires.
- Hang the searls apparatus by the two copper wires of which one wire is fixed wire and another is testing wire.
- Now measure the diameter and length of the wire.
- Then set the weight pan in the testing side.
- Then give some load in the load pan. The wire will elongate.
- Now write down the load applied and the change in length in the observation table.
- Then gradually increase the loads and take at least five readings.

OBSERVATION & CALCULATION TABLE:-

SL.NO	LOAD APPLIED(P) Kg	STRESS (P/A)	CHANGE IN LENGTH(ΔL) m	STRAIN ($\Delta L/L$)	YOOUNG'S MODULUS(σ/e)
1					
2					
3					
4					
5					

CONCLUSION:-

From the above experiment we have successfully determine the young's modulus by using the searls apparatus.



SEARL'S APPARATUS

EXPERIMENT NO:-02

AIM OF THE EXPERIMENT:-

Determination of torsional rigidity of the shaft by using torsion testing machine.

APPARATUS REQUIRED:-

SL.NO	NAME OF THE APPARATUS	SPECIFICATION	QUANTITY
01	Torsion testing machine		01
02	Mild steel specimen	D=..... L=.....	01
03	Steel rule	Least count=0.5mm	01
04	Vernier calliper	Least count=0.02mm	01

THEORY:-

- A torsion test is a quite instrumental in determining the value of modulus of rigidity (ratio of shear stress to shear strain) of a metallic specimen.
- The modulus of rigidity can be found out through observations, made during the experiment by using the torsion equation.
- Torque is defined as the product of twisting force to the distance between the point of application of the force and the axis of the shaft.
- The torsion equation is- $T/J=C\theta/L$.

So, $C=TL/J\theta$

Where,

T =Torque applied.

J =Polar moment of inertia.= $\frac{\pi}{32}D^4$

D = Diameter of specimen.

C =Modulus of rigidity.

θ =Angle of twist.

L=Gauge length of the specimen in m.

PROCEDURE:-

- Select the driving dogs to suit the size of the specimen and clamp it in the machine by adjusting the length of the specimen by means of a sliding spindle.
- Measure the diameter of the specimen at about three places and take the average values.
- Choose the appropriate range by capacity change lever.
- Set the maximum load pointer to zero.
- Set the protractor to zero for convenience.
- Carry out straining by rotating the hand lever in either direction.
- Load the machine in suitable increments, observing and recording strain gauge.

OBSERVATION TABLE:-

SL.NO	TORQUE APPLIED in (Kg-m)	ANGLE (θ) in degree	T _{mean} (kgm)	θ _{mean} (degree)
1				
2				
3				
4				

CALCULATION:-

Polar moment of inertia (J) = $(\pi/32) \times D^4 \text{ mm}^4$

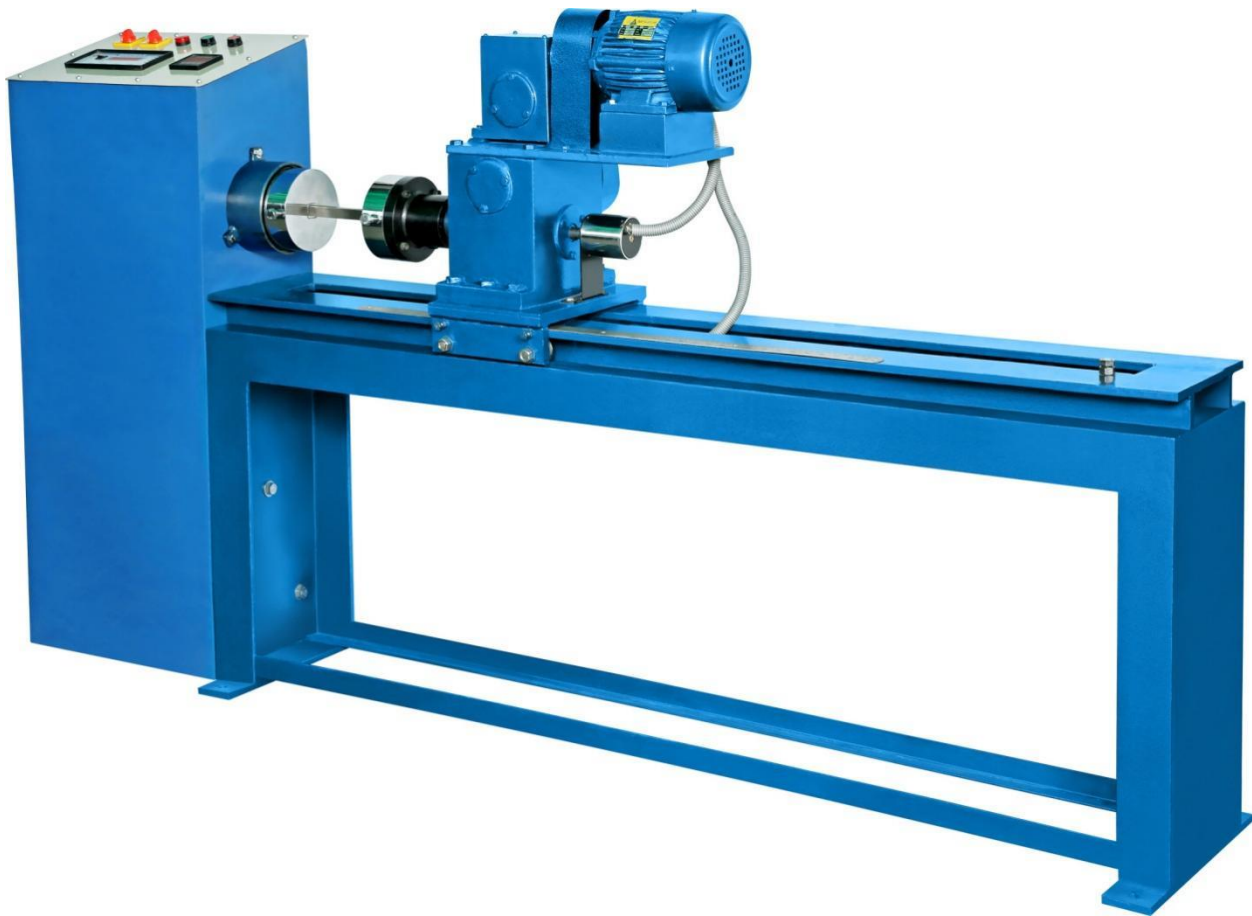
$\theta_{\text{mean}} = \dots\dots\dots = \dots\dots\dots \times (\pi/180) = \dots\dots\dots \text{rad}$

T_{mean} = $\dots\dots\dots = \dots\dots\dots \times 9.81 = \dots\dots\dots \text{N-m}$

Modulus of rigidity(C) = $TL/J\theta = \dots\dots\dots \text{N/m}^2$

CONCLUSION:-

From the above experiment we have successfully determine the modulus of rigidity of mild steel specimen by using torsion testing machine.



TORSION TESTING MACHINE

EXPERIMENT NO:-03

AIM OF THE EXPERIMENT:-

Determination of Salient points(Young's Modulus, Yield Point, Fracture point) from stress-strain curve using Universal Testing Machine(UTM).

APPARATUS REQUIRED:-

SL.NO	NAME OF THE APPARATUS	SPECIFICATION	QUANTITY
01	Universal testing machine	200KN	01
02	Mild steel specimen	L=..... D=.....	01
03	Vernier calliper	Least count=0.02mm	01
04	Steel rule	L=300mm	01

THEORY:-

- The result obtained by the tensile test are widely used in design of material for structures and others purposes.
- In this test the specimen pulled out at a constant rate by gradually increasing the axial load till the rupture takes place.
- The tensile test for a ductile material is generally carried out with the help of UTM.
- The machine has two units ,one is control unit and another is release valve.
- Control unit is used for controlling the load applied and release valve is used for releasing the hydraulic pressure.
- The tensile test of a material is generally performed to determine –
 - Proportional limit
 - Elastic limit
 - Yield point
 - Ultimate point
 - Fracture point or breaking point

PROPORTIONAL LIMIT:-

We see from the above diagram that from point 'o' to 'A' is a straight line which represents that the stress is proportional to strain. Beyond point 'A',The curve is slightly deviated from the straight line. It is then obeys the hook's law hold up to 'A' and is known as proportional limit.

ELASTIC LIMIT:-

It may be noted that even if the load is increased beyond point 'A' up to point 'B' the material will regain its shape and size after the release of load up to point B is known as elastic limit.

YIELD POINT:-

If the material is stretched beyond point 'B' the elastic stress will be reached i.e. on the removal of the load, the material will not be able to recover its original shape and size. The point 'C' and 'D' are called upper yield and lower yield point respectively. The stress corresponding to yield point is known as yield stress.

ULTIMATE POINT:-

After the lower Yield point, the specimen regains some strength and higher value of stress are required for higher strain. The stress goes on increasing till point 'E' is reached. At 'E' the stress which attains its maximum value is known as ultimate tensile stress.

BREAKING POINT:-

After the specimen has reached to the ultimate stress the neck is formed which decreases the cross sectional area of the specimen. The stress is therefore reduced until the specimen breaks itself at point 'F'. The stress corresponding to point 'F' is known as breaking stress.

MATHEMATICAL FORMULA USED:-

Stress = load / cross sectional area

$$\sigma = P/A$$

Its unit is N/M^2

Strain = change in length / original length

$$e = \Delta l / l$$

It is unit less.

Young's modulus (E) = stress / strain = σ / e

Its unit is N/M^2

OBSERVATION TABLE:-

Sl no.	Load applied(P)	Change in length(Δl)	stress(P/A)	strain($\Delta l/l$)	Young's modulus(σ/e)

CALCULATION:-

Area of specimen= $(\pi/4) \times d^2$

=.....

Stress= P/A =.....

Strain= $\Delta l/l$ =.....

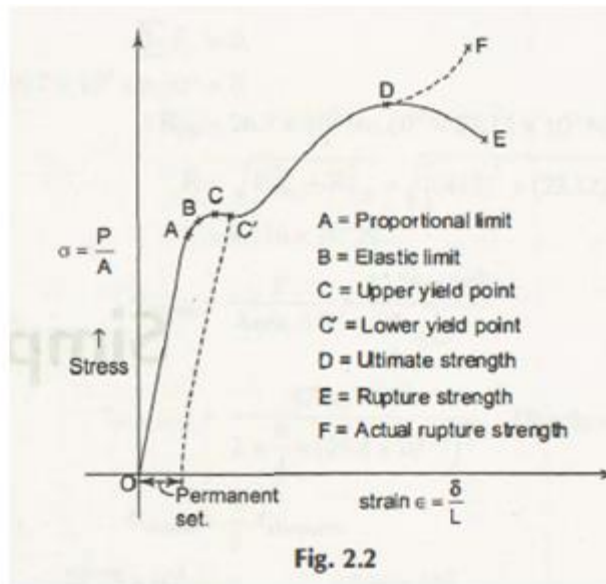
Young's modulus= $\text{stress}/\text{strain}$ =.....

CONCLUSION:-

From the above experiment we have successfully determine the young's modulus of mild steel specimen by using universal testing machine.



UNIVERSAL TESTING MACHINE(UTM).



Conditions for $\epsilon = \frac{\delta}{L}$ to be constant.

STRESS STRAIN CURVE FOR MILD STEEL

EXPERIMENT:-04

AIM OF THE EXPERIMENT:-

Determination of hardness number by Rockwell OrVickers hardness testing machine.

APPARATUS REQUIRED:-

Sl.no	Name of the apparatus	Specification	Quantity
01	Rockwell hardness testing machine	150Kgf	01
02	High speed steel	HRC/HRB	02
03	Indentors	Diamond tip	01

THEORY:-

- The hardness of a material is resistance to penetration under a localized pressure or resistance to abrasion.
- Hardness test provide an accurate, rapid and economy way of determining the resistance of material to deformation.
- There are generally three types of hardness measurement depending upon the manner in which the test is conducted.
 - Scratch hardness measurement.
 - Rebound hardness measurement.
 - Indentation hardness measurement.

PROCEDURE:-

- Insert indenter on to the machine.
- Make the specimen surface clean by removing the dust ,dirt,oil and grease etc.
- Select 150kgf load.
- Make contact between the surface and the ball by rotating the jack, adjusting wheel till the needle touch the red mark.
- Pull the load release lever and wait for minimum 30sec. The load will automatically apply gradually.
- Note the hardness reading.
- Repeats the entire operation three times.

OBSERVATION:-

Sl.no	Hardness no.	Mean hardness(HRC)	Mean hardness(HRB)

CONCLUSION:-

From the above experiment we have successfully determine the hardness by Rockwell/Vickers hardness testing machine.



ROCKWELL HARDNESS TESTING MACHINE.

EXPERIMENT NO:-05

AIM OF THE EXPERIMENT:-

Determination of toughness of material by using impact testing machine.(charpy/izod).

APPARATUS REQUIRED:-

Sl.no	Name of the apparatus	Specification	Quantity
01	Impact testing machine		01
02	A mild steel specimen	(75x10x10)mm For izod	01
03	A mild steel specimen	(55x10x10)mm For charpy	01

THEORY:-

- An impact test signifies toughness of material that is ability of material to absorb energy during plastic deformation.
- This important factor is determined by impact test .Toughness takes into account both the strength and ductility of the material.
- Several engineering materials have to withstand impact or suddenly applied load while in service.
- Strengths are generally lower as compared to strengths achieved under slowly applied load.
- Of all types of impact test ,the notched bar tests are more extensively used .Therefore the impact test measure the energy necessary to fracture a standard notch bar by applying an impact load.
- The test measures the notch toughness of material under shock loading.

PROCEDURE:-

- Select the test mode i.e.izod or charpy ,depending up on the test to be conducted and fix the pendulum holding pipe at the respective angle.i.e for izod at 84degree and for charpy at 140 degree and secure it tight with the bolts provided.

- The striker for izod and charpy test are different and depending up on the test to be conducted fix the correct striker on the pendulum hammer end.
- Fix the specimen on the anvil in the position corresponding to the test mode i.e.izod or charpy.
- Bring the pointer on the dial to its proper position i.e 16kgm for izod and 30kgm for charpy.
- Release the pendulum by operating the lever for the pendulum to strikes the specimen fitted on the anvil.
- Note the readings indicated by the pointer on the dial, which is the izod or charpy value as the case may be.
- The diagrams of izod and charpy strikers and their positioning on the anvil is enclosed for easy identification and fitment.

OBSERVATION:-

- Energy absorbed by izod test=.....Nm
- Energy absorbed by charpy test=.....Nm

CONCLUSION:-

From the above experiment we determine the toughness of material by using impact testing machine.



CHARPY IMPACT TESTING MACHINE



Izod Impact testing Machine

EXPERIMENT:-05

AIM OF THE EXPERIMENT :-

Determination of flash point and fire point.

APPARATUS REQUIRED:-

SL.NO	NAME OF THE APPARATUS	SPECIFICATION	QUANTITY
01	Flash point and fire point apparatus		01
02	Fuel	Petrol/Kerosene/Diesel	0.5lit
03	Ignition source	Cotton	
04	Thermometer	Degree Celsius	01

THEORY:-

Flash Point:-

The flash point of any fuel is the lowest temperature at which it can vaporize to form an ignitable mixture in air. At flash point the vapor may easily burn if the source of ignition is removed. The flash is not to be confused with auto ignition temp. Which does not require an ignition source.

Fire Point:-

The fire point of a fuel is the temp. at which it will continue to burn for at least 5 sec. After ignition by an open flame, fire point can be assumed to be about 10° C higher than the flash point.



FLASH POINT AND FIRE POINT APPARATUS

PROCEDURE:-

- We take the flash point and fire point apparatus.
- Then, its electric wire plug is connected to the electric circuit board.
- Then, we choose a fuel for testing.
- Then, take a thermometer for taking temp. Of the fuel.
- Fuel is inserted in to the apparatus.
- Set the thermometer and switch on the apparatus for heating.
- Then, the fuel is heating and also you can raise the temp. By a temp Adjustment switches on the apparatus.
- And set the ignition source on the fuel of the apparatus. If it will catch the fire frequently or slightly that is called flash point.
- Then, adjust the ignition source of the fuel. Then, if that ignition source catches the fire continuously that is fire point.

TABULATION:-

Types of fuel	Flash point	Fire point
Petrol		
Diesel		
Kerosene		

CONCLUSION:-

From the above experiment we determine the flash point and the fire point of the fuel.