EXPERIMENT – 01

TENSION TEST

TITLE : To Perform Tension Test on mild steel on Universal Testing machine.

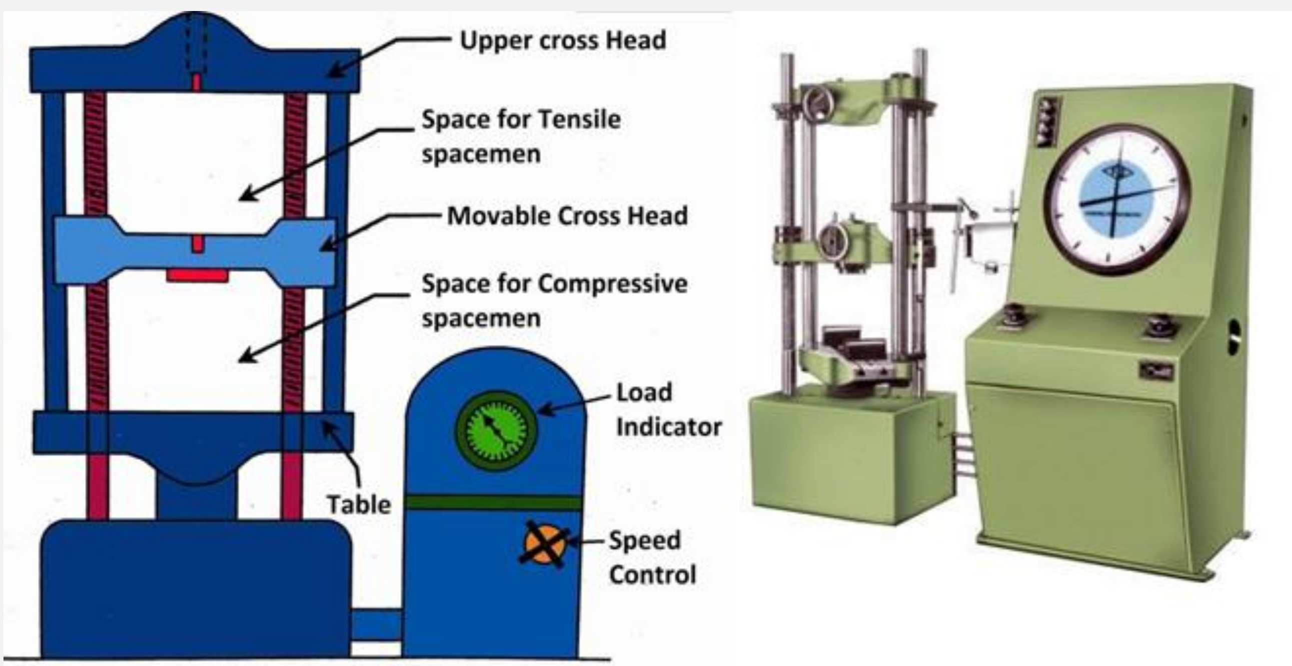
OBJECTIVE: To conduct a tensile test on a mild steel specimen and determine the following:

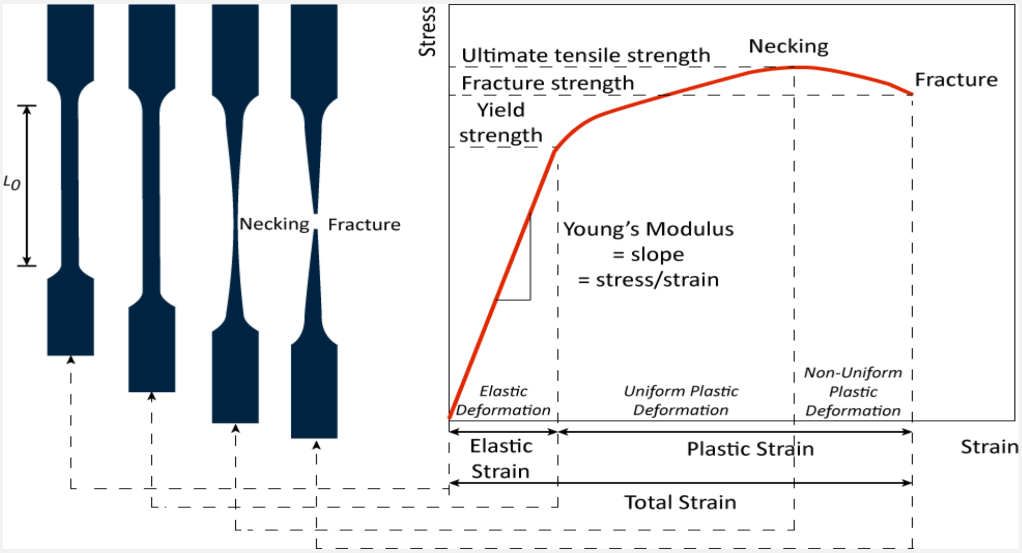
1. Limit of proportionality
2. Elastic limit
3. Yield strength
4. Ultimate strength
5. Young‟s modulus of elasticity
6. Percentage elongation
7. Percentage reduction in area.

APPARATUS:

1. Universal Testing Machine (UTM)
2. Mild steel specimens
3. Graph paper
4. Scale
5. Vernier Caliper

DIAGRAM:





THEORY:

The tensile test is most applied one, of all mechanical tests. In this test ends of test piece are fixed into grips connected to a straining device and to a load measuring device. If the applied load is small enough, the deformation of any solid body is entirely elastic. An elastically deformed solid will return to its original form as soon as load is removed. However, if the load is too large, the material can be deformed permanently. The initial part of the tension curve which is recoverable immediately after unloading is termed. As elastic and the rest of the curve which represents the manner in which solid undergoes plastic deformation is termed plastic. The stress below which the deformations essentially entirely elastic is known as the yield strength of material. In some material the onset of plastic deformation is denoted by a sudden drop in load indicating both an upper and a lower yield point. However, some materials do not exhibit a sharp yield point. During plastic deformation, at larger extensions strain hardening cannot compensate for the decrease in section and thus the load passes through a maximum and then begins to decrease. This stage the "ultimate strength"' which is defined as the ratio of the load on the specimen to original cross- sectional area, reaches a maximum value. Further loading will eventually cause 'neck' formation and rupture.

About of UTM

The tensile test is conducted on UTM. It is hydraulically operates a pump, oil in oil sump, load dial indicator and central buttons. The left has upper, middle and lower cross heads i.e; specimen grips (or jaws). Idle cross head can be moved up and down for adjustment. The pipes connecting the lift and right parts are oil pipes through which the pumped oil under pressure flows on left parts to more the cross-heads.

PROCEDURE:

1. Measure the original length and diameter of the specimen. The length may either be length of gauge section which is marked on the specimen with a preset punch or the total length of the specimen
2. Insert the specimen into grips of the test machine and attach strain-measuring device to it
3. Begin the load application and record load versus elongation data.
4. Take readings more frequently as yield point is approached.
5. Measure elongation values with the help of dividers and a ruler.
6. Continue the test till Fracture occurs.
7. By joining the two broken halves of the specimen together, measure the final length anddiameter of specimen.

OBSEVATION:

a) Initial diameter of specimen d1 =

b) Initial gauge length of specimen L1 =

c) Initial cross-section area of specimen A1 =

d) Load of yield point F_t =

e) Ultimate load after specimen breaking F =

f) Final length after specimen breaking L_2 =

g) Diameter of specimen at breaking place d2 =

h) Cross section area at breaking place A2 =

OBESERVATION TABLE:

S.No	Load (N)	Original Gauge Length	Extension (mm)	Stress (N/mm2)	Strain

CALCULATION:

$$\text{Ultimate tensile strength} = \quad \ldots\ldots\ldots\ldots \frac{N}{mm^2}$$

$$\text{Elastic Limit} = \frac{\text{Load at elastic limit}}{\text{original area of cross section}} = \quad \ldots\ldots\ldots\ldots\ldots \frac{N}{mm^2}$$

$$\text{Modulus of Elasticity (E)} = \frac{\text{Stress at proportional limit}}{\text{corresponding strain}} = \quad \ldots\ldots\ldots\ldots\ldots \frac{N}{mm^2}$$

$$\text{Yield Strength} = \frac{\text{Yield load}}{\text{original cross sectional area}} = \quad \ldots\ldots\ldots\ldots\ldots \frac{N}{mm^2}$$

$$\text{Percentage Reduction in area} = \frac{A_f - A_i}{A_i} \times 100 = \quad \ldots\ldots\ldots\ldots\ldots \%$$

$$\text{Percentage of elongation} = \frac{l_i - l_f}{l_f} \times 100 = \quad \ldots\ldots\ldots\ldots\ldots \%$$

$$\text{Limit of proportionality} = \frac{\text{Load at Limit of proportionality}}{\text{original cross sectional area}} = \quad \ldots\ldots\ldots\ldots\ldots \frac{N}{mm^2}$$

$$\text{Stress} = \sigma = \frac{\text{Yield Load}}{\text{original cross sectional area}} = \quad \ldots\ldots\ldots\ldots\ldots \frac{N}{mm^2}$$

$$\text{Strain} = \epsilon = \frac{\text{Change in Length}}{\text{Original length}} = \quad \ldots\ldots\ldots\ldots\ldots$$

PRECAUTIONS:

1. The specimen should be prepared in proper dimensions.
2. The specimen should be properly to get between the jaws.
3. Take reading carefully.
4. After breaking specimen stop to m/c.

RESULT:

1. Average Breaking Stress =
2. Ultimate Stress =
3. Average % Elongation =

VIVA-QUESTIONS

1. Which steel have you tested? What is its carbon content?
2. What general information is obtained from tensile test regarding the properties of a material?
3. Which stress have you calculated: nominal stress or true stress?
4. What kind of fracture has occurred in the tensile specimen and why?
5. Which is the most ductile metal? How much is its elongation

EXPERIMENT – 02

Compression Test

OBJECTIVE: Perform Compression test on cast iron on Universal Testing Machine

APPARATUS:

- Universal Testing Machine (UTM)
- Cast Iron specimens
- Dial Gauge
- Scale
- Vernier Caliper

DIAGRAM:

THEORY:

Several m/c and structure components such as columns and struts are subjected to compressive load in applications. These components are made of high compressive strength materials. Not all the materials are strong in compression. Several materials, which are good in tension, are poor in compression. Contrary to this, many materials poor in tension but very strong in compression. Cast iron is one such example. That is why determine of ultimate compressive strength is essential before using a material. This strength is determined by conduct of a compression test.

Compression test is just opposite in nature to tensile test. Nature of deformation and fracture is quite different from that in tensile test. Compressive load tends to squeeze the specimen. Brittle materials are generally weak in tension but strong in compression. Hence this test is normally performed on cast iron, cement concrete etc. But ductile materials like aluminum and mild steel which are strong in tension, are also tested in compression.

TEST SET-UP, SPECIFICATION OF M/C AND SPECIMEN DETAILS:

A compression test can be performed on UTM by keeping the test-piece on base block andmoving down the central grip to apply load. It can also be performed on a compression testingmachine. A compression testing machine shown in figure, it has two compression plates/heads. The upper head moveable while the lower head is stationary. One of the two heads is equippedwith a hemispherical bearing to obtain. Uniform distribution of load over the test-piece ends. Aload gauge is fitted for recording the applied load.

SPECIMEN: -

In cylindrical specimen, it is essential to keep $h/d \leq 2$ to avoid lateral instability due to bucking action. Specimen size = $h \leq 2d$.

PROCEDURE: -

- Dimension of test piece is measured at three different places along its height/lengthto determine the average cross-section area.
- Ends of the specimen should be plane for that the ends are tested on a bearing plate.

- The specimen is placed centrally between the two compression plates, such that the centreof moving head is vertically above the centre of specimen.
- Load is applied on the specimen by moving the movable head. The load and correspondingcontraction are measured at different intervals. The load interval may be as 500 kg.
- Load is applied until the specimen fails.

OBSERVATION: -

- Initial length or height of specimen h = --mm.
- Initial diameter of specimen d_o = --------- mm.

S.No.	Applied load (P) in Newton	Recorded change in length (mm)
1		

CALCULATION: -

- Original cross-section area A_o = -----
- Final cross-section area A_f = --------
- Stress = -------
- Strain = -------

For compression test, we can

- Draw stress-strain (σ-ε) curve in compression,
- Determine Young's modulus in compression,
- Determine ultimate (max.) compressive strength, and
- Determine percentage reduction in length (or height) to the specimen.

PRECAUTIONS: -

- The specimen should be prepared in proper dimensions.
- The specimen should be properly to get between the compression plates.
- Take reading carefully.
- After failed specimen stop to m/c.

RESULT: -

The compressive strength of given specimen = -------------------- N/mm^2.

EXPERIMENT – 03

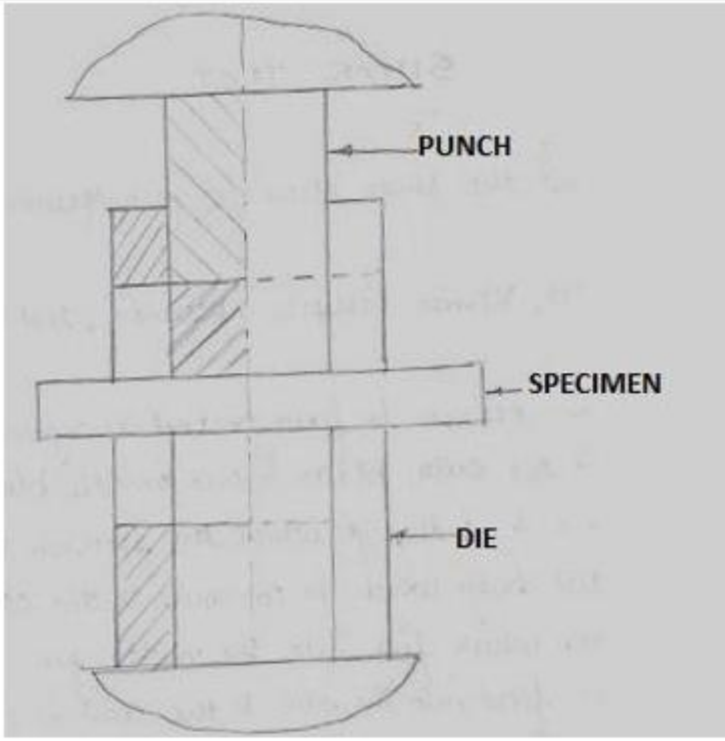
SHEAR TEST

OBJECTIVE: To Perform direct Shear Test on mild steel using Universal Testing Machine.

APPARATUS:

1. Universal Testing Machine (UTM)
2. Shear Test attachment
3. Specimen

DIAGRAM:



THEORY:

Place the shear test attachment on the lower table, this attachment consists of cutter. The specimen is inserted in shear test attachment & lift the lower table so that the zero is adjusted, then apply the load such that the specimen breaks in two or three pieces. If the specimen breaks in two pieces then it will be in single shear & if it breaks in three pieces then it will be in double shear.

PROCEDURE:

1. Insert the specimen in position and grip one end of the attachment in the upper portionand one end in the lower portion.

2. Switch on the main switch of universal testing machine machine
3. The drag indicator in contact with the main indicator.
4. Select the suitable range of loads and space the corresponding weight in the pendulumand balance it if necessary with the help of small balancing weights.
5. Operate (push) buttons for driving the motor to drive the pump.
6. Gradually move the head control level in left-hand direction till the specimen shears.
7. Down the load at which the specimen shears.
8. Stop the machine and remove the specimen

OBSERVATIONS:

Diameter of the Rod, D = ….. mm

Cross-Section Area of Rod (in double shear) = $2 * \frac{\pi}{4} * d^2$ = mm^2

Load taken by the Specimen at the time of failure, W = N

Strength of rod against Shearing = **f**x2x π/4x d^2

f = **W** / **2.π/4.d^2** N/mm

RESULT:

The Shear strength of mild steel specimen is found to be = N/mm^2

PRECAUTION:

1. The measuring range should not be changed at any stage during the test.

2. The inner diameter of the hole in the shear stress attachment should be slightly greater thanthat of the specimen.

3. Measure the diameter of the specimen accurately.

EXPERIMENT – 04

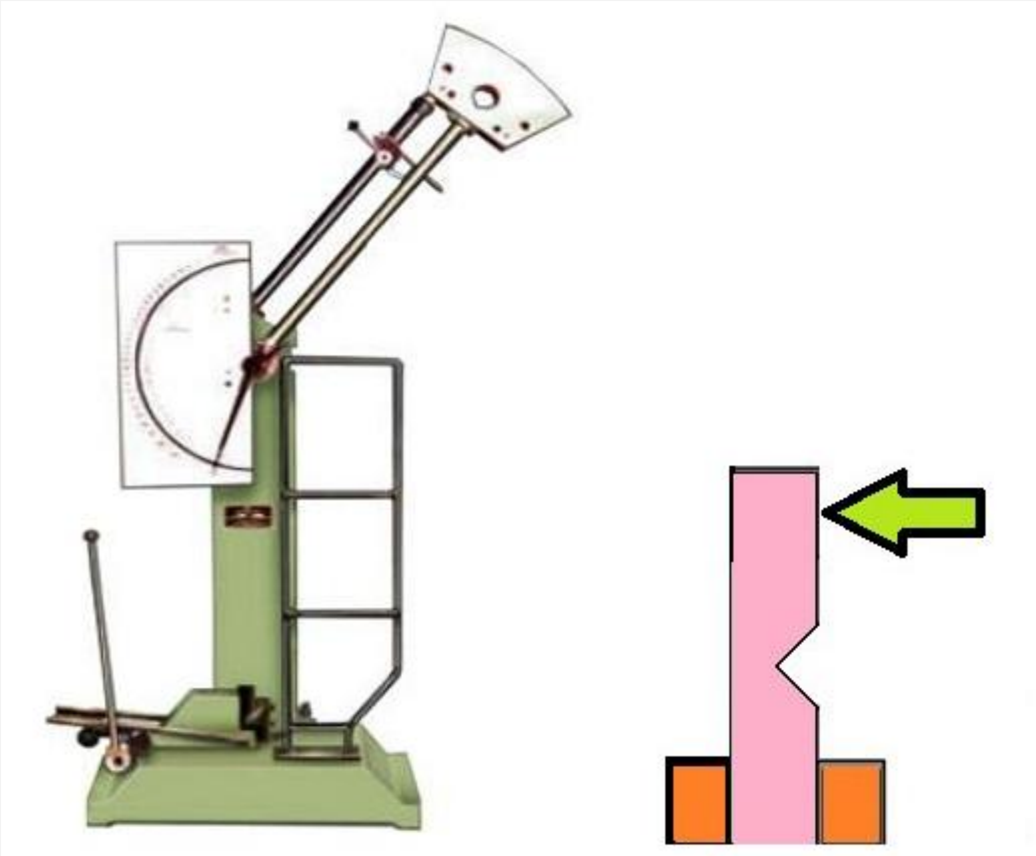
IZOD IMPACT TEST

OBJECTIVE: To Calculate Impact Value/toughness of Mild Steel using IZOD Impact Test Apparatus.

APPARATUS:

1. Impact Testing Machine
2. MS Specimen

DIAGRAM:



PROCEDURE:

1. For conducting charpy test, a proper striker is to be fitted firmly to the bottom of the hammer with the help of the clamming piece.
2. The latching take for charpy test is to be firmly fitted to the bearing housing at theside of the columns.
3. The frictional loss of the machine can be determined by free fall test, raise the hammer by hands and latch in release the hammer by operating lever the pointer will

then indicate the energy loss due to friction. From this reading confirm that the friction loss not exceeding 0.5% of the initial potential energy. Otherwise frictional loss has to be added to the final reading.

4. The specimen for izod test is firmly fitted in the specimen support with the help of clamping screw and élan key. Care should be taken that the notch on the specimen shouldface to pendulum striker.
5. After ascertaining that there is no person in the range of swinging pendulum, release them pendulum to smash the specimen.
6. Carefully operate the pendulum brake when returning after one swing to stop the oscillations.
7. Read-off position of reading pointer on dial and note indicated value.
8. Remove the broken specimen by loosening the clamping screw.
9. The notch impact strength depends largely on the shape of the specimen and the notch. the values determined with other specimens therefore may not be compared with each other.

TABLE:

S.NO	Area of cross section specimen (A)	Impact Energy (K)	I (Impact strength)

PRECAUTIONS:

1. Measure the dimensions of the specimen carefully.
2. Locate the specimen in such a way that the hammer. Strikes it at the middle.
3. Note down readings carefully.

RESULT:

The Impact strength of the given specimen is = J/m^2

VIVA QUESTIONS:

1. In what way the values of impact energy will be influenced if the impact tests are conductedon two specimens, one having smooth surface and the other having scratches on the surface
2. What is the effect of temp? On the values of rupture energy and notch impact strength?
3. What is resilience? How is it different from proof resilience and toughness?
4. What is the necessity of making a notch in impact test specimen?
5. If the sharpness of V-notch is more in one specimen than the other, what will be its effect onthe test result?

EXPERIMENT – 05

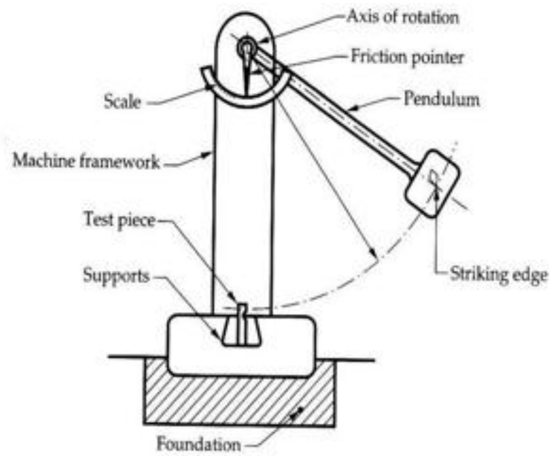
CHARPY IMPACT TEST

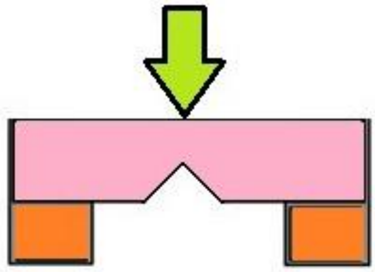
OBJECTIVE: To perform the Charpy impact test on materials. Apparatus.

APPARATUS:

1. Impact Testing Machine
2. MS Specimen

DIAGRAM:





(b) Charpy Test

THEORY:

An impact test signifies toughness of material that is ability of material to absorb energy during plastic deformation. The type of test specimen used for this test is a Square Cross-section. The specimen may have single, two or three notches.

The testing machine should have the following specifications.

- The angle 0 between top face of grips and face holding the specimenvertical=90^0 The angle of tip of hammer =$75^0 \pm 1^0$
- The angle between normal to the specimen and underside face of the hammer at striking point= $10^0 \pm 1^0$
- Speed of hammer at impact=3.99 m/sec
- Striking energy=168N-m or Joules
- Angle of drop 0of pendulum =90
- Effective weight of pendulum=21.79kg
- Minimum value of scale graduation=2 Joules.
- Permissible total friction loss of corresponding energy=0.50%
- Distance from the axis of rotation of distance between the base of specimen notch and the point of specimen hit by the hammer=22mm±0.5mm

The longitudinal axes of the test piece shall lie in the plane of swing of the center of gravity of the hammer. The notch shall be positioned so that it is in the plane of the hammer .the notch shall be positioned its plane of symmetry coincides with the top face of the grips .for setting the specimen the notch impact strength I is calculated according to the following relation.

Where I= impact strength in joules/m^2

PROCEDURE:

1. For conducting charpy test, a proper striker is to be fitted firmly to the bottom of the hammer with the help of the clamming piece.
2. The latching take for charpy test is to be firmly fitted to the bearing housing at the side of the columns.
3. The frictional loss of the machine can be determined by free fall test, raise the hammer by hands and latch in release the hammer by operating lever the pointer will then indicate the energy loss due to friction. From this reading confirm that the friction loss not exceeding 0.5% of the initial potential energy. Otherwise frictional loss has to be added to the final reading.
4. The specimen for izod test is firmly fitted in the specimen support with the help of clamping screw and élan key. Care should be taken that the notch on the specimen

shouldface to pendulum striker.

5. After ascertaining that there is no person in the range of swinging pendulum, release them pendulum to smash the specimen.
6. Carefully operate the pendulum brake when returning after one swing to stop the oscillations.
7. Read-off position of reading pointer on dial and note indicated value.
8. Remove the broken specimen by loosening the clamping screw.
9. The notch impact strength depends largely on the shape of the specimen and the notch. The values determined with other specimens therefore may not be compared with each other.

TABLE:

S.NO	Area of cross section specimen (A)	Impact Energy (K)	I (Impact strength)

PRECAUTIONS:

1. Measure the dimensions of the specimen carefully.
2. Locate the specimen (Charpy test) in such a way that the hammer. Strikes it at the middle.
3. Note down readings carefully.

RESULT: The Impact strength of material by Charpy test………

VIVA QUESTIONS:

1. What is resilience? How is it different from proof resilience and toughness?
2. The ability of the material to resist stress without failure is called?
3. The impact test is done to test____of a material?
4. In Charpy impact test, the specimen is kept as?