# GEOLOGY

# LAB MANUAL

## B. Tech III Year - I Semester

NAME: _____

ROLL NO: _____

DEPARTMENT OF

**CIVIL ENGINEERING**

**Aurora's Technological & Research Institute**

Parvathapur, Uppal, Hyderabad-98

**CONTENTS**

**Evaluation of Laboratory Marks for III Year (Internal Exams)**

1. The internal lab examination schedules will be given by the Examination Branch.

2. During a year there will be three lab exams and each exam will be evaluated for 25 marks.

3. Average of three lab exams will be the final internal lab exam marks.

4. First laboratory exam will be conducted on First 1/3 of the total number of experiments, Second Laboratory Exam will be conducted on the Second 1/3 of experiments and the Third Laboratory Exam will be conducted on the last 1/3 of experiments.

The evaluation is as follows

I. Continuous evaluation - 15 marks
II. Internal Laboratory Exam - 10 marks

**I. Continuous Evaluation**

a) Day to day evaluation - 10 marks

Each experiment / program will be evaluated for 10 marks.
The splitting of marks is as follows

i) Attendance - 2 marks

The student should attend the lab regularly; if he/she is absent he/she will be losing 2 marks.

ii) Experiments / program and observation

The student should complete the program / experiment within the assigned time otherwise he / she will be losing 2 marks.

iii) Experiment result will carry 4 marks.

iv) Record 2 marks
Student must submit the record in the next lab session.

v) Average marks of the Half of the experiments will be considered for day to day evaluation for 10 marks separately for lab examination one and two.

b) Lab knowledge Test (Quiz) - 5 marks

- A quiz will be conducted along with the internal lab exam and schedule will be given separately.

- The quiz will be conducted for 20 minutes. The quiz contains 20 questions of type multiple choice. Each question carrying 0.25 marks.

**II. Internal laboratory examination** - 10 marks

a) Exam - 7 marks

The Splitting of marks as follows

i) Experiments / Program write up - 4 marks

ii) Result and Graphs - 3 marks

b) Viva Voce - 3 marks

- The internal lab examination duration - 2 hours
- Every student will be given programs / experiments in the internal lab exam. In case the student wishes to change the programs / experiments 1 mark will be deducted. A time slot of 45 minutes is given for write up of programs / experiments.
- The student is expected to complete the assigned program / experiment within 1 hour and the remaining 15 minutes will be utilized for viva voce examination.

5. There shall be no supplementary exams in case the student fails to attend internal lab and quiz exam as per schedule.

**Evaluation of Laboratory Marks (End exams)**

1. The external lab examination schedules will be given by the Examination Branch.

2. Duration of External lab examinations - 3 Hours

3. Exam will be evaluated for 50 Marks

   The Splitting of marks is as follows

| | | | |
|---|---|---|---|
| I. | Experiment write-up / Program with algorithm | - | 10 marks |
| II. | Experiment Setup / Program execution | - | 10 marks |
| III. | Result | - | 10 marks |
| IV. | Viva –Voce | - | 20 marks |
| | a) Written Viva | - | 10 marks |
| | b) Oral Viva | - | 10 marks |

Written Viva-Voce Exam will be consisting of 10 questions of short answer type and fill in the blanks. Each question will carry equal marks and allotted time is 15 minutes.

**LAB CODE**

1. Students should report to the labs concerned as per the timetable.
2. Students who turn up late to the labs will in no case be permitted to perform the experiment scheduled for the day.
3. After completion of the experiment, certification of the staff in-charge concerned in the observation book is necessary.
4. Students should bring a notebook of about 100 pages and should enter the readings/observations/results into the notebook while performing the experiment.
5. The record of observations along with the detailed experimental procedure of the experiment performed in the immediate previous session should be submitted and certified by the staff member in-charge.
6. Not more than three students in a group are permitted to perform the experiment on a set up.
7. The group-wise division made in the beginning should be adhered to, and no mix up of student among different groups will be permitted later.
8. The components required pertaining to the experiment should be collected from Lab- in-charge after duly filling in the requisition form.
9. When the experiment is completed, students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.
10. Any damage of the equipment or burnout of components will be viewed seriously either by putting penalty or by dismissing the total group of students from the lab for the semester/year.

11. Students should be present in the labs for the total scheduled duration.

12. Students are expected to prepare thoroughly to perform the experiment before coming to Laboratory.

13. Procedure sheets/data sheets provided to the students' groups should be maintained neatly and are to be returned after the experiment.

14. DRESS CODE:

Boys - Formal white shirt neatly tucked in, and white trousers, white / black / brown / tan shoes and belt, I-cards worn round neck

Girls - Formal white Salwar Kameez, white / black / brown / tan shoes, I-cards worn round neck

## IDENTIFICATION OF MINERAL

### DEFINITION OF MINERAL:

A Mineral may be defined as a natural inorganic homogenous, solid substance having a definite chemical composition and regular atomic structure.

To call any substance as a Mineral, The requirements to be filled are:

1. It must have been formed by natural process i.e., artificial or synthetic or manmade substance are not eligible to be called as mineral
2. It must be an inorganic substance i.e., substance of wood or any other organic materials cannot be called as mineral
3. It must be homogeneous i.e., all parts of the mineral should possess the same physical, chemical characters
4. It must be solid i.e., gaseous, liquid or semi solid substances are not minerals.
5. It must have a definite chemical composition i.e., particular kind of mineral always has the same chemical composition irrespective of its size, shape, origin, occurrence, association etc.
6. It must have a definite atomic structure i.e., chemical composition & atomic structure are specific for every mineral no two minerals can possess the same chemical composition and atomic structure.

### MODE OF FORMATION OF MINERALS:

Basically there are 3 kinds of formation of minerals in naturel. They are formed from magma or out of secondary process or under metamorphism.

### MINERALS ARE FORMED FROM MAGMA:

Most of the minerals formed directly or indirectly out of magma during different of its solidification. Important and built of rock forming minerals such as feldspar, quartz, pyroxene, amphiboles, mica & olivine some precious minerals and ore minerals like gemstones, topaz, magnetite, native beryl, apatite, muscovite, lead zinc ores and tourmaline are also formed from magmatic sources.

### SECONDARY PROCESS:

In nature some minerals are formed when secondary processes like weathering, precipitation and deposition minerals like calcite, dolomite, bauxite – limonite's, salts coal and petroleum, chlorite, phosphates, clays, agate, opal and zeolites are examples of this group.

### UNDER METAMORPHISM:

These minerals are formed under the influence of high temperature and pressure with or without the active involvement of chemically active solution.

### Example:

Minerals like Andalusite, Sillimanite, Kyanite, Staurolite, Garnets, Chlorite, Graphite, Talc, Cordierite Etc.,

**DIFFERENT METHODS OF STUDY OF MINERALS:**

Common methods of study and identification of minerals are based on

i. Their physical properties
ii. Their chemical composition
iii. Their optical properties
iv. Their x-rays analysis

**STUDY OF PHYSICAL PROPERTIES:**

Physical properties of minerals like colour, lustre, streak, clearage etc., can be studied with their observations and feeling of small mineral specimens. So these properties are dependent on chemical composition and atomic structure i.e., if atomic structure and chemical composition remain same. The resulting physical properties also should be similar. Since every mineral invariably possess its own specific chemical composition and atomic structure. Every minerals should possess its own set of physical properties.

**STUDY OF CHEMICAL COMPOSITION:**

According to definition every mineral has its own definite chemical composition which is not to be found in any other mineral therefore by chemical analysis if the composition is known it should be possible to identify the mineral.

**Example:**

If unknown mineral is found to have lead sulphide then the mineral is galena because galena always has the chemical composition of lead sulphide and no other mineral has this composition.

**STUDY OF OPTICAL PROPERTIES:**

In this method of study the minerals are ground very fine and fixed over glass slides by means of Canada balsam.

The principal which makes this method useful for study and identification of minerals is that when polarized light passes through thin section of minerals it is influenced in a characteristic way depending on the chemical composition and atomic structure of the mineral since every mineral has its own chemical composition and regular atomic structure the optical properties of every mineral are also definite and hence helpful in the identification of the mineral.

**X-RAYS ANALYSIS:**

X-rays Analysis make use of the definite atomic structure found in every mineral X-rays are similar to light waves but have a much shorter wavelength, comparable to the distance between atoms in a crystalline mineral. When a beam of X-rays falls on a crystal it is diffracted by the layers of atoms with in the crystal.

In making an X-rays Analysis of the atomic structure of the crystal, the diffracted X-rays are allowed to fall on a photographic plate, and the resulting photograph shows a series as sports or lines which form more or less symmetrical pattern form

measurement made on the photograph the arrangement of the atoms in the crystal can be deduced and also the distances between them. In short results of X-rays Analysis of minerals reveal their actual atomic structures which is definite for each mineral this enables the accurate identification of minerals.

**ADVANTAGES OF DIFFERENT METHODS OF STUDY:**

1. The unique advantages is that it makes possible the study of minerals or rocks in the filed itself.
2. It does not requires and equipment worth mentioning.
3. It does not involve the use of chemicals and it does not need additional facilities.
4. It involves no loss or wastage of material this enables the minerals to be studied, any number of times.
5. It is quickest method of identifying the minerals, because with the help of previous knowledge it requires very little time for identification. But in other methods immediate inference is not possible for obvious reasons.
6. It is the cheapest simplest and least method for identification of minerals i.e., money, energy and time are spent to the minimum extent.

**DISADVANTAGES OF DIFFERENT METHODS OF STUDY:**

1. In some cases even slight variation in chemical composition result in considerable change in color.
2. Weathering the universal phenomenon, alters many physical properties significantly and make identification difficult. Therefore only fresh minerals are easily identified in this way.
3. Further, some minerals when formed under different conditions show slight variation in physical properties.

**Study of Physical properties and identification of minerals referred under theory:**

**Rock forming Minerals:** Quartz, Feldspar, Muscovite, Biotite, Augite, Hornblende, Olivine, Garnet, Kyanite, Talc, Chlorite, Flit, Jasper, Asbestos, Calcite etc.

**Economic Minerals:** Bauxite, Magnetite, Hematite, Pyrite and Chromite.

Galena, Graphite, Pyrolusite, Magnesite

**Identification based on** the various physical properties of minerals are as follows

1. Form
2. Colour
3. Streak
4. Luster
5. Fracture
6. Clearage

7. Hardness
8. Specific Gravity (Density)
9. Degree of Transparency
10. Special Properties

**FORM:**

This is one of the first observation made when a mineral is examined in a hand specimen. The form represent the common mode of occurrence of a mineral in nature it is also called habit or structure of the mineral.

The following is the list of some common forms and the minerals which characteristically exhibit them, i.e., appearance of the particular form is indicative of a certain mineral.

| Sl.No. | Name of the Form | Description | Mineral Example |
|---|---|---|---|
| 1 | Lamellar Form | Mineral appear as thin separate layers | Different varieties of Mica |
| 2 | Tabular Form | Mineral appear as slabs of uniform thickness | Feldspar |
| 3 | Fibrous Form | Mineral appear to be made up of fine threads fibers may or may not be separable | Parallel Fibers Asbestos type Satinspar. Radiating Fibers Stibnite, Pyrite Zeolites |
| 4 | Pisolitic Form | Mineral appear to be made up of small spherical grains (pea-size) | |
| 5 | Oolitic Form | Similar to Pisolitie but grains are of still smaller size (like fish egg) | Some Limestone’s |
| 6 | Rhombic Form | Rhombic Shape | Calcite, Dolomite |
| 7 | Bladed Form | Mineral appear as cluster or as independent lath shaped (i.e., rectangular grains) | Kyanite |
| 8 | Granular Form | Mineral appear to be made | Chromite, Magnetite, |

| | | | |
|---|---|---|---|
| | | up of innumerable equidimensional grains of coarse or medium or fine size | Pyrite |
| 9 | Reni From | Kidney shaped mineral appear with number of over lapping smooth and somewhat large curved surfaces | Hematite |
| 10 | Botryoidal Form | Similar to Reni form but with smaller curved faces like bunch of grapes | Chalcedony Psilomclane hematite |
| 11 | Mammillary | Mineral appear with large mutually interfering spheroidal surface – similar to Reni form | Malachite |
| 12 | Acicular Form | Mineral appear to be made up of thin needles | Natrolitc, Actinolite |
| 13 | Columnar Form | Mineral appear as long slender prism | Tourmaline precious Topaz |
| 14 | Prismatic Form | As elongated indepent crystals | Staucdite, Beryl, Apatite, Quartz |
| 15 | Spongy Form | Porous | Pyrolusite, Bauxite |
| 16 | Crystal Form | Polyhedral, Geometrical Shapes | Garnet, some Zeolites, Quartz, Amethyst, Pyrite, Galena |
| 17 | Interpenetrating Twin Form | ---------- | Staurolitc |
| 18 | Massive Form | No definite shape for mineral | Fluorite, Pyrite Calcite, Graphite, Olivine, |

| | | | |
|---|---|---|---|
| | | | Quartz, Jasper |
| 19 | Concretionary Form | Porous and appear due to accretion of small irregularly shaped masses | Laterite |
| 20 | Nodular Form | Irregularly shaped impact bodies with curved surface | Flit, Limestone |

**COLOUR:**

It depends upon the absorption of some and the reflection of others of coloured ray of white light. Colour of an object depends upon the colour of the reflected rays when all other colour rays are observed the colour of a mineral is often its most striking property.

1. Absorbed light represents energy that has been used to move electrons from energy level to the other.
2. Factors affecting colour of a mineral type of element valence, state, type of bonding type of neighboring atoms, feature of local symmetry.

**For Example:**

Chemical composition of olivine of 2-end members

1. Fosterite: - $Mg_2sio_4$; White Colour
2. Fayalite: - $Fl_2sio_4$; Dark Bottle Green
   This is caused by eh $Fe_2$ ion observing the more of the reddish and the violet parts of the spectrum. Therefore, olivine is more or less green according to its iron content. Sometimes impurities cause colour.

**Diagnostic colours of some minerals:**

1. Galena – Dark Leady Grey
2. Hematite - Dark Leady Grey
3. Graphite – Shining Black
4. Pyrite – Black
5. Olivine – Yellow
6. Muscovite in book form – Silver White Colour
7. Muscovite in thin layers – Colorless
8. Magnesite – Spotless White
9. Opal – Milky white
10. Chromite, Magnetite – Black

**Commonly Exhibited Colour of some Minerals:**

| | |
|---|---|
| Hornblende → Dark Green | Calcite → White |
| Augite → Greenish Black | Quartz → White / Colorless |
| Orthoclase → White or Shades of Red | Asbestos → White, Green, Grey, Yellow |
| Plagioclase → Grey or White | Jasper → Red |
| Microcline → White, Pink or Green | Flint → Yellowish Brown |
| Kyanite → Blue | Limonite → Yellow or Brownish |
| Garnet → Red | Baryets → White / Pale Grey |
| Talc → White / Pale Yellow | Gypsum → Colorless or White |

**Minerals which show different colours:**

1. Quartz → Colourless, White, Green, Violet, Grey, Yellow, Pink etc.,
2. Feldspar → White, Grey, Shades of Red, Green, Dirty, White etc.,
3. Calcite → Colourless, White, Shades of Red Grey, Yellow etc.,

**STREAK:**

The colour of mineral powder is called streak of a mineral, and may be quite different from that of the mineral mass. An unglazed white porcelain plate called a streak plate is used in the lab for testing the streak of a mineral. It is conveniently obtained for observation purpose by rubbing a mineral against by harder surface.

1. It is a reliable property than colour during specific investigation of sulphides and some oxides.
2. Magnetite and chromite, though look alike (inform, colour and luster) can be distinguished from streak. Magnetite gives black streak, whereas chromite gives brown streak.

**LUSTRE:**

Lustre is the nature of shining on the surface of the mineral.

**Based on the Quality of Shining Lustre are grouped as:**

| Sl.No. | Name of the Lustre | Description of Lustre | Mineral Examples |
|---|---|---|---|
| 1 | Metallic Lustre | Metallic Lustre is the type of shinning that appears on the surface of a metal | Galena, Pyrite, Gold, Bernie |

| | | | |
|---|---|---|---|
| 2 | Submetallic Lustre | Similar to Metallic Lustre but the amount of Shining is less | Hematite, Chromite, Magnetite, Ilmenite, Psiolmelane |
| 3 | Vitreous Lustre | Shining like a Glass Sheet | Quartz, Calcite, Dolomite, Feldspar barytes etc., |
| 4 | Sub vitreous | Sub vitreous Lustre is similar to vitreous but with less shining | Pyroxenes and amphiboles |
| 5 | Pearly Lustre | Shining like a Pearl | Tale, Selenite (Gypsum) Mica Muscovite |
| 6 | Silkey Lustre | Shining like a Silk | Fibrous Minerals kike asbestos and satinspar |
| 7 | Resinous Lustre | Shining like a Resin | Opal agate chalcedony |
| 8 | Greasy Lustre | Shining like a Grease | Graphite, Serpentine |
| 9 | Adamantine Lustre | Shining like a Diamond | Garnet, Sphene, Zircon Diamond |
| 10 | Earthy or Dull Lustre | Shining like a Earth or Chalk | Magnesite, Kaolin, Chalk Bauxite |

The Lustre of mineral may be of different degrees of intensity, according to the amount of light reflected form their surfaces: Splendent, Shinning, Glistening Glimmering and Dull

**FRACTURE:**

Fracture is the randomly broken surface a mineral. It is important to note the characters of the fracture displayed in the broken or chipped surfaces. Fracture

with irregular surfaces are independent and different from smooth flat surfaces of cleavages

**Fracture is described as:**

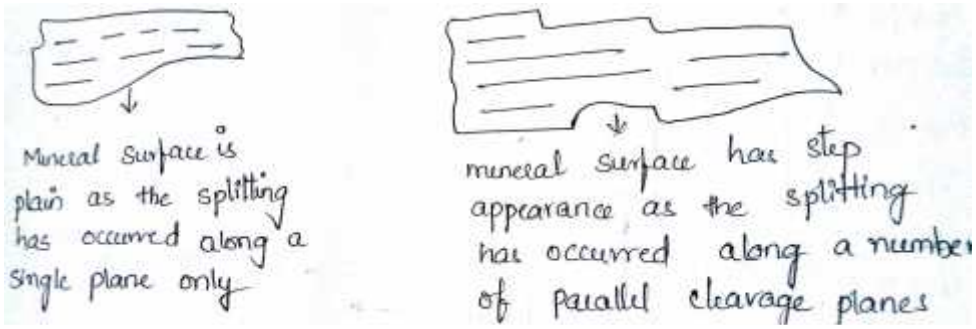
| Sl.No. | Name of the Fracture | Description of the Mineral | Mineral Examples |
|---|---|---|---|
| 1 | Even Fracture | If the broken surface of a mineral is plain an smooth, it is called Even Fracture | Magnetite, Chalk |
| 2 | Uneven Fracture | If the broken surface is rough or irregular it is called Uneven Fracture | Most of the Minerals |
| 3 | Hackly Fracture | If the broken surface is very irregular like the end of a broken stick | Asbestos, Tremolite, Kyanite |
| 4 | Conchoidal Fracture | If the broken surface is smooth and curved it is called Conchoidal Fracture | Opal, Volcanic Glass |
| 5 | Sub-Conchoidal Fracture | If the curved nature is less prominent it is called Sub-Conchoidal Fracture | Agate, Flint, Japer etc., |

Like streak it is also less useful in mineral identification because a majority of the minerals shows the same kind of Fracture.

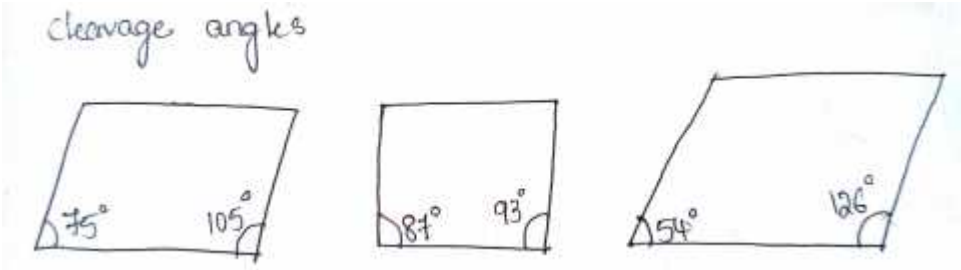
**CLEAVAGE:**

The definite direction or plane along which mineral tends to break easily is called the cleavage that mineral. Cleavage pane represents he planes of weakness in the atomic structure of a mineral. Cleavage if present occurs as innumerable parallel planes along which the mineral is equally weak. Hence all such parallel planes of weakness are referred to as a se. depending on their atomic structure. Crystalline mineral will have one set of cleavage, two sets of cleavage, three sets of

cleavage, four sets of cleavage, and six sets of cleavage. The atomic structure of a mineral is definite. The cleavage, character of the mineral will also be definite. In any mineral the occurrence of cleavage can be detected easily by fitting or turning the specimen in different directions. Depending or the atomic structure development of cleavage character may differ in different minerals or in the same mineral.




Depending on the degree of perfection cleavage may be described as perfect or eminent or Excellent, Good, Imperfect, Poor or Indistinct. This is measurable by a **Goniometer.**




**Changes Angles in a) Calcite b) Pyroxene and Amphibole:**

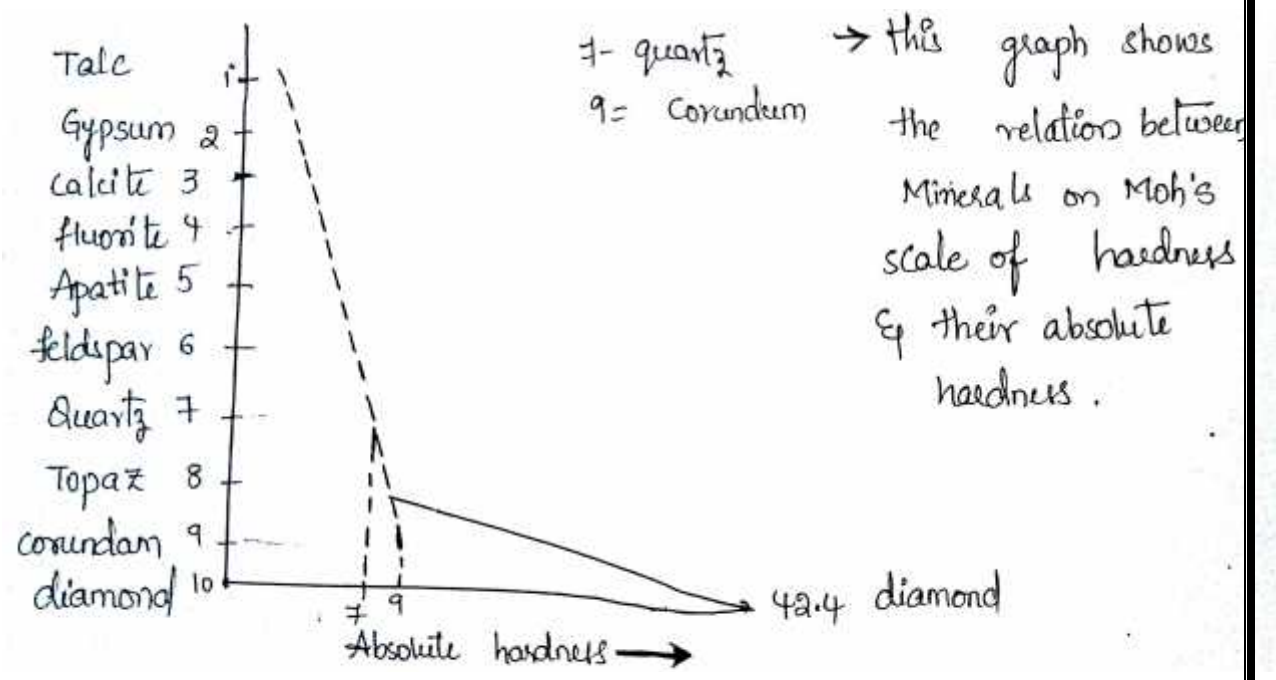
| Sl.No. | Cleavage Sets | Mineral Example |
|---|---|---|
| 1 | 1 Set | Mica, Chlorite Etc., |
| 2 | 2 Sets | Feldspar, Pyroxenes, Amphiboles |
| 3 | 3 Sets | Calcite, Dolomite Galena |
| 4 | 4 Sets | Fluorite |
| 5 | 7 Sets | Sphalerite |
| 6 | No Cleavage | Quartz, Divine, Garnet |

**HARDNESS:**

Hardness may be defined as the resistance offered by mineral to abrasion or scratching. Hardness may be tested by rubbing or scratching the specimen over a file or knife. The amount powder and the degree of noise produced is a test of the hardness of the mineral. When a softer mineral is scratched by a harder mineral, a definite scratch is observed on the softer mineral.

A standard set of 10 reference mineral is used to determine the hardness of a mineral. This is called Moh's Scale of hardness.

| | |
|---|---|
| Talc | = 1 |
| Gypsum | = 2 |
| Calcite | = 3 |
| Fluorite | = 4 |
| Apatite | = 5 |
| Feldspar | = 6 |
| Quartz | = 7 |
| Topaz | = 8 |
| Corundum | = 9 |
| Diamond | = 10 |




Hardness may be tested by means of Penknife (H=6), Window Glass (H=5) and Fingernail (H=2.5).

## SPECIFIC GRAVITY OR DENSITY:

### Measure of Minerals Density

1. Density = Mass per unit volume Grams / $cm^3$.
2. Density depends on the type of atoms composing the mineral and how densely they have packed by the crystal lattice.

### General Range of Density:

1. Density around 2.7 common for light coloured rock forming minerals such as Felds par.
2. Density around 6 common pyrite and other are forming minerals.

### Note:

Some important rock forming minerals such as pyroxenes and Amphiboles have densities around 3.3.

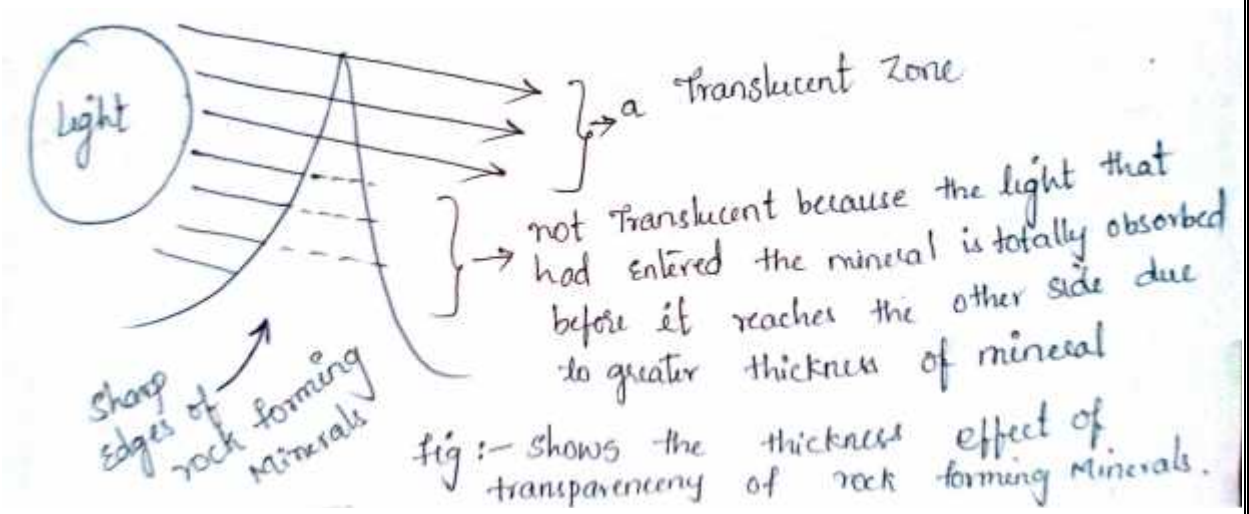
Specific Gravity is the ratio between its weight and the weight of an equal volume of water at 40°C. Based on the Specific Gravity of Minerals, the Density of Minerals may be described as High, Medium and Low.

| Sl.No. | Density | Mineral Example |
|---|---|---|
| 1 | Low Density | GYPSUM (2.3), Graphite (2-2.3) Coal (1-1.8) |
| 2 | Medium Density<br>(Sp.Gravity 2.5-3.5) | Quartz (2.7), Feldspar (2.56-3.00), Pyroxene (3.1-3.5), Amphiboles (2.9-3.47), Mica (2.7-3.1) |
| 3 | High Density<br>(Sp.Gravity 2.5-3.5) | Magnesite (5.18), Hematite (4.9-5.3), Galena (7.5), Hematite (3.5-5.5), Pyrolusite (4.8), Chromite (4.5-4.8) tin stone (8.71) |

## DEGREE OF TRANSPARENCY:

Depending upon the resistance offered by the mineral to the passage of light through them, they may be classified as transparent, translucent and opaque.

1. Transparent:-Passage of light through the mineral.
2. Translucent:-Allows the passage of light but reflects back the light by mineral.
3. Opaque:-Does not allow and does not reflect back the light.




**SPECIAL PROPERTIES:**

Some minerals exhibit peculiar characters which enable them to be identified easily. In some cases they are the consequences of the physical properties of the mineral itself. They are as follows.

1. Tale by virtue of its Soft Nature (H-1) exhibits smooth touch or soapy feel.
2. Graphite→ its low hardness (H-1 to 2) and black color marks on paper and due to their softness and black colour soil the fingers.

## IDENTIFICATION OF MINERALS

**AIM:**
Identification of the given mineral by using physical properties.

**PROCEDURE:**
The following prospectus are to be observed for the identification of the given minerals.

1. Colour :
2. Streak :
3. Lustre :
4. Form :
5. Hardness :
6. Cleavage :
7. Fracture :
8. Density / Specific Gravity :
9. Degree of Transparency :
10. Special Properties :

**CONCLUSION**
Based on the above physical prospectus the given specimen is identified as…….

11. Uses :
12. Chemical Composition :
13. Mode of Occurrence :
14. Crystal System :

II. Megascopic description and identification of rocks referred under theory:

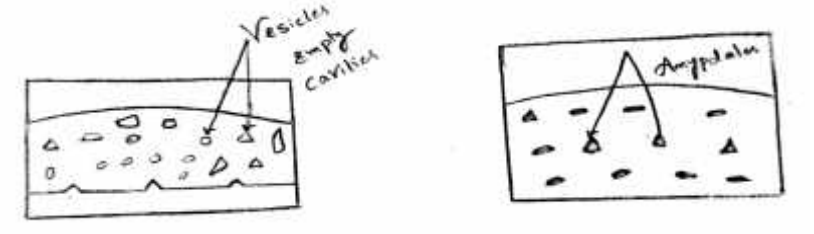
**a. MEGASCOPIC IDENTIFICATION AND DESCRIPTION OF IGNEOUS ROCKS:**

**AIM:**
Megascopic identification and description of the Igneous Rock.

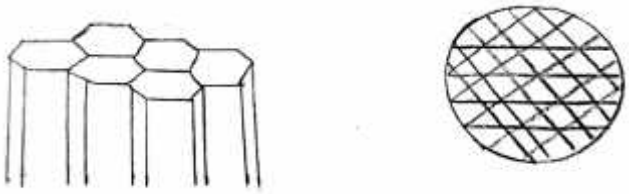
**PROCEDURE:**
The following prospectus are to be observed for the identification of the given minerals.

1. **COLOUR:** The body colours of the Igneous Rock.

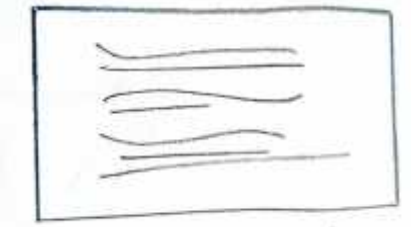
2. **STRUCTURE:** The common structures of igneous rock are.
   a. **Vesicular Structure:** The rock contains empty cavities of various sizes and shapes also called porous structure the cavities are called vesicles.
   b. **Amygdaloidal Structure:** The vesicles which are empty are filled with hydrothermal solutions such fillings are called amygdales.



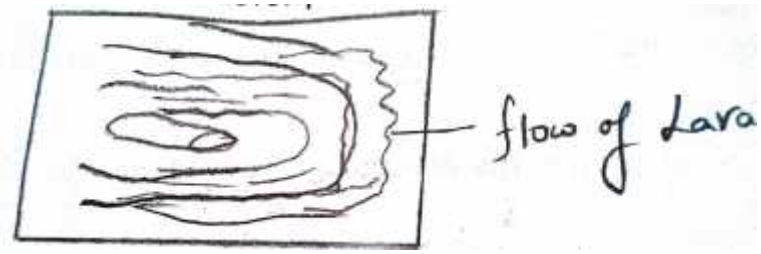

   c. **Columnar Structure:** The Igneous rock appear to be made up numerous parallel polygonal prismatic columns bundled together.



   d. **Sheet Structure:** The rock appear to be made up of a No.of Sheets.



e. **Flow Structure:** This structure refer to be linear and nearly parallel features occurring in volcanic rock which develop as a consequence of the flow of lava.




f. **Pillow Structure:** The rock appear as a pile of numerous overlapping pillows

❖ **Common Texture of Igneous Rocks:** The texture based on the degree of crystallinity.

- **Holo Crystalline:** (Holo = Complete) or completely crystalline i.e., completely made up of minerals without glory matter.
- **Holohyaline:** (Hyaline = Glassy) composed of only glass without any minerals.
- **Hemi Crystalline:** (Hemi = half) partly crystalline and partly glassy it means some part composed of minerals and rest being glass.

❖ **Textures based on Granularity:**

1. **Phaneric Texture:** If the mineral grain size in rock are big enough to be seen by the naked eye.

- If the mineral grain size is > 5 mm the texture of the rock is called Phaneric Coarse.
- If the mineral grain size is between 1 mm to 5 mm the texture of the rock is called Phaneric Medium.
- If the mineral grain size is < 1 mm the texture of the rock is called Phaneric Fine.

2. **Aphanitic Texture:** If the mineral grain sizes are too fine to be seen separately by the naked eye.

- Aphanitic Glassy → Minerals grains are of glassy material.
- Aphanitic Crystalline → Minerals grains are of mineral mater.

| Micro Crystalline | & | Crypto Crystalline |
|---|---|---|
| ↓ | | ↓ |
| Seen under Microscope | | Seen by the Polarized Light |

❖ **Textures based on the Shapes of Crystals:**

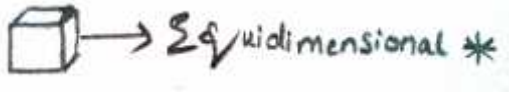
1. **Euhedral:** When the mineral is completely bounded the crystal faces.

2. **Anhedral:** When crystal faces are absent.

3. **Subhedral:** When only a part of the mineral is bounded by the crystal.

❖ **Texture Shapes of the Crystal based on growth Pattern:**

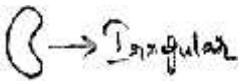
1. Equidimensional → The Minerals grows equally in all directions.




2. Platy → The growth is possible only in 2 directions.

3. Prismatic → Similar to equidimensional but elongated.


4. Irregular → No definite shape



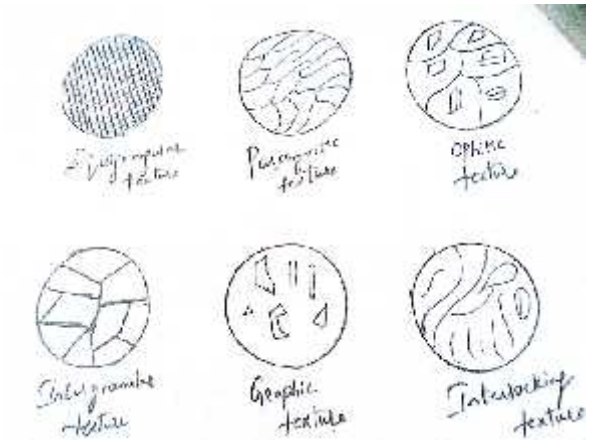

❖ **Texture Shapes of the mutual relationships of constituent minerals of rock:**

1. Equidimensional Texture → The Minerals grains present are approximately of the same size and depending on the grain size this may be described as either phaneric or aphetic.
2. Phaneric Coarse grained equiangular.
3. Phaneric Medium grained equiangular.
4. Phaneric Fine grained equiangular.
5. Aphanitic equiangular (observed under microscope).
6. In equiangular texture different sizes of the mineral grains occur in the rock surface.

❖ **Porphyritic Textures:** Mineral grains of two different sizes occur i.e., larger and smaller. Larger mineral grains is called phenocryshs & smaller mineral grains is called ground mars.

1. **Poilitic Texture:** In this the smaller mineral grains are enclosed in between larger ones.

2. **Ophitic Texture:** In this mineral grains enclose small rectangular grains in larger ones.
3. **Seriate Texture:** In this the grain size of minerals are gradually from the smallest to the largest.
4. **Enter Granular Texture:** In this rectangular shaped grains forms a networks.
5. **Graphic Texture:** This is an intergrowth texture by the two minerals that are formed simultaneously.
6. **Inter Locking Texture:** The different minerals are closely inter linked or mutually locked with one another.




3. **MINERALOGY:** It presents of No.of Minerals in the rock. The composition of group of minerals in the rock.
   - Essential Minerals: The highest composition / high percentage of the minerals.
   - Accessory Mineral: Low mineral composition in rock.

4. **CONCLUSION:**

5. **PETROGENISIS:** Which type of rock.

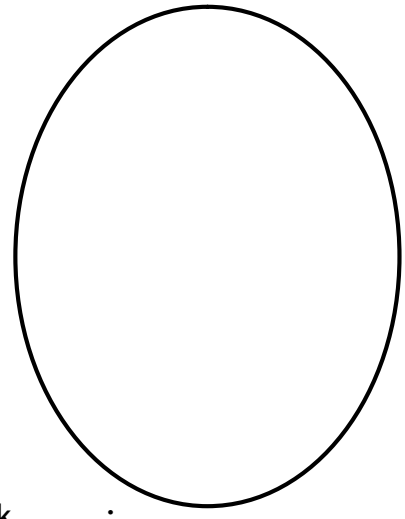
6. **E-PROPERTIES:**

**IDENTIFICATION OF IGNEOUS ROCKS**

**SPECIMEN NO:**

**AIM** : Megascopic identification and geotechnical description of the Igneous Rocks.

**PROCEDURE**



1. **COLOUR** :
2. **STRUCTURE** :

   **Texture** :

   **a.** Crystallinity :

   **b.** Granularity :

   **c.** Shape of the Crystal :

   **d.** Mutual relations of Constituent mineral of rock :

   **e.** Others :
3. **MINERALOGY** :

   **a.** Essential Minerals :

   **b.** Accessory Minerals :

   **c.** Cementing Material :
4. **CONCLUSION** : Based on the texture and mineralogy, the given rock sample is identified as _____.
5. **PETROGENISIS** :
6. **E-PROPERITES** :

## b. MEGASCOPIC IDENTIFICATION AND DESCRIPTION OF SEDIMENTARY ROCKS

**SEDIMENTARY ROCKS:**

**Sedimentary Rocks:** Sedimentary Rocks are formed due to the weathering and erosion of the pre-existing rocks. Sedimentary Rocks are classified on the basic of the character of the mineral and process which leads to its deposition. In additional, the depositional environments plays a major role in the formation of Sedimentary Rocks i.e., deposited the material by wind action or water action

**Example:** Sand Stone, Lime Stone, Dolomite, Shale, Conglomerate etc.,

**IDENTIFICATION OF SEDIMENTARY ROCKS:**

**AIM:**

Megascopic identification and description of the Sedimentary Rock.

**PROCEDURE:**

The following prospectus are to be observed for the identification of the given minerals.

1. **Texture:** Sedimentary Rocks are formed out of Sedimentary deposits in basin (LOWLYING ARE) like fragments of the rocks which are the products of weathering. So, these sediments vary in sizes like Clay, Sand, Pebbles and Boulders due to attraction and abrasion suffered during to their place of deposition. So the grains of sediments change its shape for example angular to rounded shape the loose sediments change to sedimentary rocks due to process called lith; faction. Loose mineral grains are held together by cementing materials.
   a) **Grainsize:** During formation of Sedimentary physical breakdown of rocks takes place. Based on the range of grainsize sediments are classified on to certain grades.

| Sl.No. | Grade | Range of Grainsize of Sediments |
|---|---|---|
| 1 | Boulders | > 200mm |
| 2 | Cobbles | 50-200 mm |
| 3 | Pebbles | 10-50 mm |
| 4 | Gravel | 2-10 mm |
| 5 a | Very Coarse Sand | 1-2 mm |
| b | Coarse Sand | 0.5-1 mm |
| c | Medium Sand | 0.25-0.5 mm |
| d | Fine Sane | 0.1-0.25 mm |

| | | |
|---|---|---|
| 6 | Silt | 0.01-0.1 mm |
| 7 | Clay | 0.01 mm |

b) **Shape of the Grain:**
   1. **Angular:** Very Angular, Angular, Sub-Angular
   2. **Rounded:** Very Rounded, Rounded, Sub- Rounded
      - ❖ Heavier fragments becomes and more Rounded than the small ones.
      - ❖ The softer mineral become more rounded than the border minerals.

c) **Orientation of Grains:** Based on the arrangements of grains they are Randomly Oriented, Horizontally Oriented, Vertically Oriented, Inclined Oriented or Incliendly Oriented.

d) **Packing of Grains:** Loosely Packing of Grains, Closely Packing of Grains, Densely Packing of Grains.

e) **Sorting of the Grains:** Poorly Sorted, Well Sorted and Medium Sorted.

**2. Mineralogy:**

a. **Minerals:** Types of Minerals presented in a given rock sample.
Eg: Quartz, Clay Minerals, Calcite, Feldspar etc.,

b. **Matrix:** The arrangements and attachment. Packing sorting of the goods.
Eg: Conglomerates and brelias rocks the fine grains surrounding large pebble consists of matrix. Matrix means finer materials acts as matrix between the grains of the Sedimentary Rocks.

c. **Cementation or Cementing Material:** The material which bonds the individual grains such materials is called cementing. Generally finer material acts as a binding material and depending on various finer materials kike calcareous, argillaceous, ferruginous or siliceous.

**3. Classification:** The Sedimentary Rocks are broadly classified into Detrail and Non Detrail Rocks, Residual Rocks, Chemical Deposits and Organic Deposits.

a. **Detrail Rocks:** are popularly called elastic rocks are formed of physically broken and transported rock fragments.

b. **Non-Detrail Rocks or Non Clastic Rocks:** These rocks are formed due to precipitation and evaporation etc.,

c. **Residual Rocks:** Sedimentary Rocks formed insitu due to weathering of rocks, compositionally they are made up of unaltered minerals and insoluble products of decomposition of other mineral of original rocks. Unaltered minerals may be garnets, iron oxide, tourmaline, insoluble products are clay minerals.
Eg: Laterite or combination of different sizes of the grain or sediments.

d. **Detrail Rocks:** These Rocks are formed or made up of grains and fragments coarser than gravel which had undergone transport physically due to geological agencies like wind, river and glaciers. These types of rocks also depends on the size and shape of the fragments.

e. **Chemically Formed Rocks:** During weathering of rocks some of the soluble constituents are leached and carried away in the form of solution such

dissolved matter come out as solid material subsequently either due to precipitation or evaporation. Which are physical AND chemical deposits.
Eg: Lime Stone.

f. **Organically Formed Rock:** The Sedimentary deposits which are formed with the active involvements of plants and animals if these are mainly due to plants they are called phytogenic if they mainly due to animals called zoogenic.
   1. Calcareous Type
   2. Phosphatic Type
   3. Ferrorgeneous Type
   4. Siliceous Type
   5. Carbonaceous Type

4. **Conclusion:** Based on the texture and mineralogy the given rock sample is identified as ……

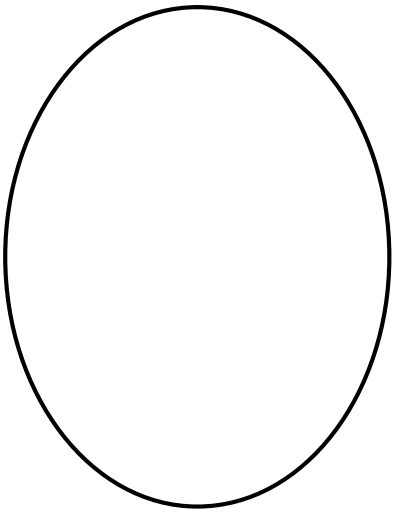
5. **Petrogenesis:** Based on the above description he origin of the rock is identified as sedimentary rock indicates the depth of formation distance travelled etc.,

6. **Engineering Properties:** Based on the type of sedimentary rocks it possess certain properties like Strength, Density, Specific Gravity, Hardness etc., which are to be used for the certain engineering purpose.

## IDENTIFICATION OF SEDIMENTARY ROCKS

**SPECIMEN NO:**

**AIM** : Megascopic identification and geotechnical description of the Sedimentary Rocks.



**PROCEDURE** :

1. **TEXTURE** :
   - **a.** Grainsize :
   - **b.** Shape of the Grains :
   - **c.** Orientation of the Grains :
   - **d.** Packing of the Grains :
   - **e.** Sorting of the Grains :
2. **MINERALOGY** :
   - **a.** Minerals :
   - **b.** Matrix :
   - **c.** Cementing Material :
3. **CLASSIFICATION:**
4. **CONCLUSION** : Based on the texture and mineralogy, the given rock sample is identified as _____.
5. **PETROGENISIS** :
6. **E-PROPERITES** :

## c. MEGASCOPIC IDENTIFICATION AND DESCRIPTION OF METAMORPHIC ROCKS:

**Metamorphic Rocks:** Metamorphic Rocks are formed through the transformation of the pre-existing rocks under increased temperature and pressure conditions. This process of transformation is known as Metamorphism.
Formation of Metamorphism rock from a pre-existing is controlled by the following parameters Temperature, Pressure, Chemically active fluid these there are known as Metamorphism agents. Generally all these three acts together and cause Metamorphism. But sometimes, any one or two of them any dominate and play together and cause Metamorphism. But sometimes any one or two of them may dominate and play on active role.

**Temperature:** Changes take place in the temp 350-380˚C.

**Pressure:** Uniform pressure increase with depth direct pressure due to tectonic forces.

**Chemicals:** Liquids which acts as carrier of chemical components, volatiles of magma and hydrothermal solutions.

### IDENTIFICATION OF METAMORPHIC ROCKS:

**AIM:**
Megascopic identification and geotechnical description of the Metamorphism Rock.

**PROCEDURE:**
The following prospectus are to be observed for the identification of the given minerals.

1. **Colour:** Body Colour

2. **Grain Size:** Depends on the Size of the Sediments

| Sl.No. | Grade | Range of Grainsize of Sediments |
|---|---|---|
| 1 | Boulders | > 200mm |
| 2 | Cobbles | 50-200 mm |
| 3 | Pebbles | 10-50 mm |
| 4 | Gravel | 2-10 mm |
| 5 a | Very Coarse Sand | 1-2 mm |
| b | Coarse Sand | 0.5-1 mm |
| c | Medium Sand | 0.25-0.5 mm |

| | | |
|---|---|---|
| d | Fine Sane | 0.1-0.25 mm |
| 6 | Silt | 0.01-0.1 mm |
| 7 | Clay | 0.01 mm |

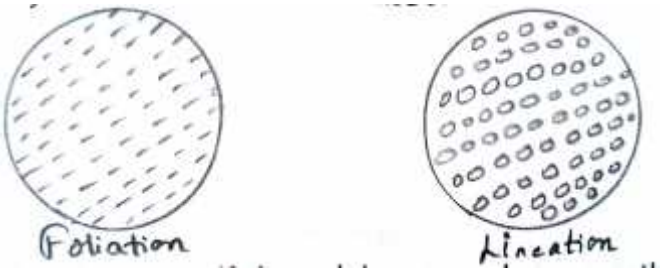
3. **Texture:** In Metamorphism rock textures are form due to recrystallization occur or both may be together.

- **Crystalloblastic and Palimpsest Texture:** The texture which have developed newly during the process Metamorphism are called crystalloblastic texture.
- **Palimpsest Texture:** The texture which bond parent rock but still retained in Metamorphic Rocks are called Palimpsest texture (refer all textures of Igneous and Sedimentary).
- **Xenoblastic and Idioblastic Texture:** The Crystalloblastic and Idioblastic Texture. In the Xenoblastic Texture, the constituent minerals of the rock have no well-developed crystal faces. If eh minerals have well developed crystal faces and forms the texture is known as idioblastics.
- **Others:** If the porphyritic texture appear as a result of Metamorphism it is called Balstoporphyritic.

4. **Structure:**

- **Gneissose Structure:** If the rock consists of equidimensional minerals along with other first segregation of minerals occurs and alternating bands are formed (i.e., equidimensional and other minerals occurs (alternating bands)) then foliation and of platy and prismatic minerals take place such a texture or arrangement of minerals is Gneissose Structure.


- **Schistose Structure:** If the rock consists of only prismatic or platy minerals. Then no segregation takes place (because of the absences of equidimensional minerals) but only foliation or lineation is called Schistose Structure.



- **Granulose Structure:** If the rock is composed permanently of equidimensional minerals then neither segregation nor foliation takes place (segregation does not occur because of the absence of platy or prismatic minerals. Foliation or alignment does not appear because of equidimensional character of minerals) such a texture is called Granulose Structure.


- **Cataclastic Structure:** If the rock contains soft rocks and hard rock is called Cataclastic Structure.

Cataclastic { Relatively Stronger, Harder and Tougher

5. **Mineralogy:** Types of Minerals present in the Metamorphism Rocks or in a given sample.

6. **Conclusion:** Based on the texture structures and mineralogy the given rock sample is identified as ……

7. **Petrogenesis:** Based on the mineral composition of the Rock the kind of Metamorphic Rock are diagnosed.

8. **Engineering Properties:** Every Rock possess particular engineering property which is used for Civil Engineers Purpose.

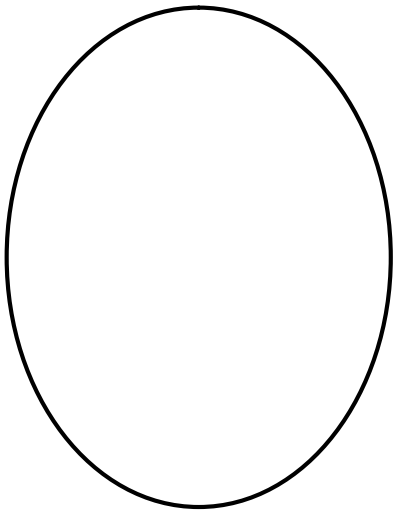
## IDENTIFICATION OF METAMORPHIC ROCKS

c. Identification of Metamorphic Rocks

**SPECIMEN NO:**

**AIM:** Megascopic Identification and geotechnical description of the Metamorphic Rocks.

**PROCEDURE:**



1. **Colour:**
2. **Grain size:**
3. **Texture:**
4. **Structure:**
5. **Mineralogy:**
6. **Conclusion:**

   Based on the texture, structure and mineralogy, the given rock sample is identified as _____.

7. **Petrogenesis:**
8. **Engineering properties:**

III. Interpretation and drawing of sections for geological maps showing tilted beds, faults, unconformities etc.

Construction of geological profiles and interpretation of geological history from geological maps.

**IV. Simple structural geology problems:**

**THICKNESS OF BEDS :**

1. A coal bed dips at an angle of 40°W. If the exposed thickness of the coal bed at its surface is 200 m, find the true thickness and vertical thickness of the bed.

2. A ground is sloping towards West at an angle of 15°. A coal bed is dipping at an angle 50° towards East. If the exposed thickness of coal bed is 300 m what are its true and vertical thicknesses?

3. A sand stone bed is dipping at 45° W. If its vertical thickness under a river bed sloping towards west at a gradient of 1 in 5 is 75 m, find the true thickness and exposed thickness.

4. If the top of the coal bed is met a depth of 100 m and bottom at a depth of 700 m, and its true thickness is 450 m find the exposed thickness when the ground is (a) horizontal (b) inclined at 20°W.

**STRIKE & DIP:**

1. A bed dips at 1 in 8 along N 30° W and 1 in 10 along N 45°
   (a) Find its True dip
   (b) Find the dip along N 60°E
   (c) Find the direction along which the Dip is 1 in 12
2. A coal bed dips at the rate of 1 in 8 along S 35° E. Find the apparent dip in a direction S 10° W.
3. A sand bed dips at the rate of 1 in 5 in a direction S 30°E. Determine the direction in which the strata dips at 1 in 10
4. A coal bed dips 50° along S 30° W. Find the direction along which the dip ids 28°
5. A sand stone bed dips at 40° along N 60°E. Determine the amount of dip along S 80° E.
6. A coal bed dips at 30° along S 50° E and 25° along N 70° E. Find the amount of true dip and the direction along which it acts.

**FAULTS:**

1. A limestone bed is found dipping 40º W and occur at two places separated by a distance of 180 m. A fault is found at the midpoint of the beds and dipping at 45°E. Find out Throw, Hade, Net slip and the type of fault.
2. A Sandstone that strikes N 45º W and dips 60º SW is broken by a strike fault that dips 35º SW. The sandstone outcrops 250m north east of the fault and 150m south west of the fault. Assuming the movement to have been directly down the dip of the fault plane, calculate the (a) net slip (b) dip slip (c) strike slip (d) throw (e) heave (f) horizontal separation in a vertical plane perpendicular to the strike of the fault. (g) Vertical separation in the same plane (h) stratigraphic throw.