K.D.K. COLLEGE OF ENGINEERING, NAGPUR.

Department of Civil Engineering

ENGINEERING GEOLOGY

LABORATORY LAB MANUAL

Civil Engineering Department

K.D.K. COLLEGE OF ENGINEERING, NAGPUR.

LIST OF EXPERIMENTS

EXPERIMENT NO. 1

Aim: To study of Physical properties of minerals and ores.

Equipment Required

Mineral Specimens, Lenses, Colored pencils etc.

Theory

Mineral

- Mineral are defined as naturally occurring, inorganic, solids substance with a definite chemicalcomposition and a structure.
- Different chemical composition results in different minerals.

Tabe-1 Mineral Physical Property chart

Physical Property	Definition	Testing Method
Cleavage	Breakage of a mineral along planes of weakness in the crystal structure	Examine the mineral for area where the mineral is broken. Look for area where the light reflects from planar surfaces. This can be easilyconfused with a crystal face and is the most difficult properties for student to master
Color	Visible light radiation reflected from a mineral.	look at the sample and determine its color white, green, black, clear etc.
Forms	Shape of a mineral	examine and describe the shape of the mineral, accicular, bladed etc.

Fractures	Breakage of a mineral, not along planes of weakness in the crystal structure	Examine the mineral for area where the mineral is broken. Describe the breakage as eitherirregular or conchoidal (has the appearance of broken glass) As classify in three types i)even ii)uneven iii)chonchoidal
Hardness	Resistance to scratching or abrasion	Use mineral of know hardness from the Mohs hardness Kits. Scratch the unknown mineralwith a know hardness to determine which isharder. Continue doing this with harder or softer minerals from the kit until the hardness is determined.
luster	Character of the light reflected by a mineral	Look at the samples to determine if the mineral is metallic in appearance or non metallic. Vitreous, like glass and earthy (like dirt, or other Powderly material)
Specific gravity	Ratio of the mass of a mineral to the mass of an equal volume of water	Generally not determined in an introductory lab.
Streak	Color of the mineral when it is powdered	Grind a small amount of a mineral into a powder on a porcelain streak plate and determine the color of the powder.
Transparent	Stages of transparency of mineral	A mineral is Transparent when the outline of an

Table -2 Moh's scale of Hardness

Hardness	Mineral
1	Talc
2	Gypsum
3	Calcite
4	Fluorite
5	Apatite
6	Orthoclase
7	Quartz
8	Topaz

9	Corundum
10	Diamond

(Table – 3) Specific Gravity of the Impotant Minerals	
Mineral	**Specific Gravity**
Graphite	2.23
Quartz	2.65
Feldspars	2.6- 2.75
Fluorite	3.18
Topaz	3.53
Corundum	4.02
Barite	4.45
Pyrite	5.02
Galena	7.5
Cinnabar	8.1

Format of writing Physical properties of Minerals:-

- Form
- Colour
- Luster
- Cleavage
- Fracture
- Streak
- Hardness
- Specific Gravity
- Diagnostic Characteristics of Minerals
- Name of Mineral

Aim :- To study Rock Specimen.

- Igneous Rock
- Sedimentary Rock
- Metamorphic Rock

Equipment Required:- Rock specimens, lenses, Colored pencils etc.

Procedure

To identify a rock three things must be considered: (1) Origin, (2) Composition (3) Texture

Rock Origin: The first step to identify a rock is to try categorizing the rock into of the three main types or group of rocks. These include igneous, sedimentary and metamorphic types. The only rocks which do not fall into one of these categories are meteorites. Igneous, sedimentary and metamorphic rock tupes are distinguished by the processes of their formation.

Rock Composition: The rock composition is determined by the identification of mineral make up the rock. By the identification, a rock is a solid mass or compound consisting of at least two minerals (although there are some exceptions when a rock may consist entirely of one mineral). The minerals comprising the rock cab be identified using common field testing method for individual minerals, particularly where the texture is sufficiently coarse grained enough to distinguish the individual minerals with the naked eye or a hand lens. Where the grain sizes of the minerals comprising the rock are too fine grained to recognize identification in many cases.

Rock Texture: The texture of a rock is defined by observing two criteria: 1) grain size, 2) grain shapes.

1) **Grain Size:** It is the average size of the mineral grains. The size scales used for sedimentary, igneous and metamorphic rock are different.

2) **Grain Shape :** It is the general shape of the mineral grain.

Rock Type	Very Fine grained	Fine Grained	Medium Grained	Coarse Grained	Very Coarse Grained
Igneous		< 1 mm	1 - 5 mm	5 - 20 mm	> 20 mm
Clastic Sedimentary	.06 - .125mm	.125 - .25 mm	.25 - .5 mm	.5 - 1 mm	1 - 2 mm
Metamorphic		<.25 mm	.25 - 1mm	1 - 2 mm	> 2 mm

EXPERIMENT NO. 2

Aim :- Megascopic Indentification of Igneous Rock Specimen.

(Table no. – 3) Recognition of Igneous Rocks

Grain size	Usual color	Other	Composition	Rock type
Coarse	Green	Dense	Approximately 90 to 95% Olivine	Dunite
Fine	Dark	Contain Quartz	Low - silica lava	Basalt
Coarse	Light	Wide range of color and grain size	Large grains of quartz, feldspar, Olivine and pyroxene	Granite
Coarse	Medium to dark	Little or no Quartz	Plagioclase and dark mineral	Diorite
Coarse	light	Wide range of color and grain size but no Quartz	Feldspar with Pyroxene, amphibole and mica	Syenite
Coarse	Medium to dark	Quartz may have Olivine	Calcium Plagioclase and dark minerals	Gabbro
Fine	Medium	Between felsites and basalt	Medium Silica Lava	Andesite
Fine	Light	Contain Quartz	High Silica Lava	Felsites

Format of writing Physical properties of Igneous Rocks:-

- Colour
- Texture
  a) Crystallinity
  b) Granularity
  c) Mutual Relation
- Mineral Composition
- Diagnostic Properties
- Name of Rock

EXPERIMENT NO. 3

Aim :- Megascopic Indentification of Sedimentary Rock Specimen.

Recognition of Sedimentary Rocks				
Hardness	**Grain Size**	**Other**	**Composition**	**Rock type**
Hard	Coarse	White to brown, Foliated	Clean Quartz	Sand stone
Hard	coarse	Quartz and Feldspar	Usually very coarse	Arkose
Hard to Soft	Mixed	Mixed rocks and sediments	Round rocks in finer sediment matrix	Conglomerate
Hard to soft	Mixed	Mixed rocks and sediments	Sharp and angular pieces of rocks in finer sediments matrix	Breccia
Soft	Fine	Fizzes with acid	Calcite	Limestone
Soft	Fine	Foliated	Clay minerals	Shale
Hard	Fine	Chalcedony	No fizzing with acid	Chert
Hard	Fine	Feel gritty on teeth	Very fine sand no clay	Silts tone

Format of writing Physical Properties of Sedimentary Rocks:-

- Colour
- Texture
- Mutual Relationship
- Mineral Composition
- Cementing Matrerial
- Name of Rock
- Result

EXPERIMENT NO. 4

Aim :- Megascopic Indentification of Metamorphic Rock Specimen.

Recognition of Metamorphic Rocks					
Grain Size	**Hardness**	**Foliation**	**Usual Color**	**Other**	**Rock Type**
Coarse	Hard	Foliated	Mixed dark and	wrinkled foliation; often has large crystal	Schist
Coarse	Hard	Foliated	Mixed	Banded	Gneiss
Fine	Soft	Foliated	Dark	"tink" when struck	Slate
Coarse	Soft	Nonfoliated	light	Calcite or dolomite by the acid test	Marble
Coarse	Hard	Nonfoliated	light	Quartz (no fizzing with acid)	Quartzite
Fine	Soft	Foliated	Dark	Shiny, Crinkly foliation	Phyllite
Coarse	Hard	Foliated	Dark	Mostly hornblende	Amphibolite
Coarse	Hard	Foliated	Mixed	Distored "metled" layer	Migmatite

Format of writing Physical Properties of Metamorphic Rocks:-

- Colour
- Texture
- Structure
- Mineral Composition
- Name of Rock

EXPERIMENT NO. 5

Aim :- To study Geological Cross Sections and study of Geological Maps with Interpritation of it.

Equipments Required: Maps book, Scale, Set Square, Papers, Pencils etc.

Two types of Map are taken ⟹

- Countour Map
- Cross section

EG-MAP NO.1 – COUNTER MAP WITH STREAM LINE

EG-MAP NO.2- MAP WITH HORIZONTAL BEDS

EG-MAP NO.3- MAP WITH INCLINE BEDS

EG-MAP NO.4- MAP WITH FOLDED STRUCTURE

EG-MAP NO.5- MAP WITH FAULT STRUCTURE

EG-MAP NO.6- MAP WITH INCLINE BEDS WITH DAM STRUCTURE

EG-MAP NO.7-WATER TABLE COUNTER MAP

METHOD OF DRAWING GEOLOGICAL SECTION

Drawing of Profile:

Mark a section line along X-Y markings on the map.
Take a strip of paper and mark the contour (dotted lines) vales on it.
Now take the strip on blank page and draw the line from X to Y.
Mark all the contour points vertically above this line as per the given scale.
Finally join all contour points by a smooth line from X to Y point. This will be profile of the map.

Horizontal and inclined Beds:

Whenever the bedding planes (continuous lines) and contour lines (dotted lines) are parallel to each other, beds are called to be horizontal. Andwhen the bedding planes are intersecting contour lines, the beds are said to be inclined.

Drawing of Strike Lines for Inclined Beds:

Select a contact (bedding plane) and, mark the intersection points made by contact and contour line of same value. Join all the intersection points on the contact with a straight line, this line would be a strike line of the value same as the contour line.
Draw the strike lines for all the contacts on the map.

Determination of Dip Direction:

Consider two adjacent strike lines drawn for a contact.
no
The dip direction will be from higher strike line value to the lower strike line value.
Mark the dip direction as an arrow from higher value strike line to lower value strike line along the section line.

Determination of Dip Gradient:

Measure the perpendicular distance between two successive strike lines drawn for the same contact. This will give the true dip amount.

Determination of dip direction thickness of bed:

Select a strike line intersecting the top and bottom of a bed.
Find the elevation difference between these two values (at intersecting points).
This difference will be the thickness of the bed.

INTERPRETATION OF ENGINEERING GEOLOGICAL MAPS

1. Topography:
It includes mountains, hills, valleys, lakes, oceans, rivers and their trends, ground slope, etc.

2. Geology of the area:
It includes rock types, dip and strike of beds, structures such as fold, faults, unconformity, igneous intrusions, thickness of beds, fault throw, etc.

3. Order of superposition:
Younger beds are always towards dip direction. Under this heading bottom beds (older beds) are written first than the younger beds.

4. Engineering projects:

- **For Tunnels:** Methods, geological hazards, grouting of weak zones and tunnel lining, groundwater problems.
- **For Route Alignment:** Consideration of dip gradient and direction, valley slope, fold and fault structures, joints, etc.
- **For Dams:** Consideration of dip gradient and direction, fold and fault structures, joints, foundation, rock type, etc.
- **For Hydrogeological Map:** Consideration of ground elevation, depth to water level, drainage system in the area.