UNIT 4

STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD

1. Define Dip?

The inclination of the bedding planes, with the horizontal, is called dip and is always expressed in degrees.

2. Explain true dip?

It is the maximum inclination of bedding planes with the horizontal, or in other wards it is the inclination of the direction of which water would flow, if poured on the upper surface of the bed.

3. Explain apparent dip?

- The inclination of the bedding planes, with the horizontal, in any other direction, other than the direction of the true dip, is known as the apparent dip.
- The value of apparent dip is always less than the true dip.

4. Define strike?

- It is the direction, measured on a Horizontal surface, of a line formed by the intersection of dipping bed with the horizontal plan.
- It is always expressed in terms of main direction i.e., is North, South, East or West.

5. What is meant by folds?

- The earth's crust is tilted out of the horizontal and is bent into folds. Such a fold may ranges from a microscopic crinkle to great arches and troughs even up to 100 kms across.
- A set of such arches and troughs is called a fold.

6. What is meant by Anticline and Syncline?

- When the beds are unfolded in an arch-like structure, it is called an anticline.

- When the beds are down folded in trough like structure, it is called a Syncline.
- It may be noted that in an anticline the oldest rock is in the centre, where as in a syncline the youngest rocks is in the centre.

7. Explain Causes of folding?

- The interior of the earth is getting cooler and cooler day by day, which is sure to cause some shrinkage in the earth's crust.
- This stink age is responsible for the compressive and shearing stress to be developed within the earth's crust.
- Some time these stresses are small in magnitudes but go on exerting pressure for a sufficient length of time and result in buckling or folding of the layers of the earth's crust.

8. What are the types of folds?

a) Symmetrical fold,

b) Asymmetrical fold,

c) Overturned fold,

d) Isoclinals fold,

e) Recumbent fold,

f) Plunging fold,

g) Open fold,

h) Closed fold,

i) Anticlinorium,

j) Synclinorium,

k) Dome,

l) Basin and m) Monoclinal fold.

9. Define Faults?

- Faults are fractures, along which the movement of one block with respect to other, has taken place.
- This movement may vary from a few centimeters to many kilometers depending upon the magnitude of the stresses, and the resistance offered by the rocks.

10. Explain the Causes of Faulting?

- The interior of the earth becoming cooler day by day, which is sure to cause some shrinkage in the earth's crust. This stink age is responsible for the stress to be developed within the earth's crust.
- These stresses, when greater in magnitudes exert so much pressure that the layers of the earth's crust are fold due to compressive stresses and afterwards when the stresses are released, fractures are formed.
- If the stresses still continue, the blocks move up or down along the fault plane depending upon the direction of stresses and their intensity. Such a fracture, along which a movement has taken place, is called a fault.

11. What are the classifications of faults?

Faults are classified on the basis of their apparent displacement, i.e., the direction of movement, of one block, with respect to the other along the fault plane.

12. What are the criteria for the recognition of a fault?

1) Discontinuity of strata

2) Repetition and omission of strata

3) Physiographic features

4) General.

13. What is meant by Joints?

When sufficient tensile stress in developed between two successive points, a crack is developed at right angle to the direction of the stress, such cracks are called joints.

14. What is meant by Master joints?

- The joints always occur in sets and groups. A set of joints means, joint occurring in the same dip or strike.
- A group of joints means a few sets of joints having almost the same trend. If a few sets or groups of joints appear for a considerable length in a rock, such joints are called major joints or master joints.

15. Define out crop?

- A little consideration will show that the out crop of a rock is affected by the angle of dip also.
- If a rock has a vertical dip then the outcrop will be less, than that when the same rock is dipping at some angles.

16. What are the different forms of out crops?

a) Out lier,

b) In lier,

c) Unconformity,

d) Overlap and e) Cross bedding.

17. Define over lap?

An overlap is particular type of an unconformity, in which the overlying strata extends so as to overlap the underlying strata.

18. Define cross bedding?

Sedimentary beds or layers are generally parallel to one another. But, sometimes, it has been observed that the beds lie slightly oblique to the major bedding planes.

19. What are the classifications of joints?

a) Geometrical classification

- Strike joints,
- Dip joints,
- Oblique joints

b) Genetic classification

- Tension joints,
- Shear joints

20. What are the methods of Geophysical Exploration?

Depending upon the type of energy field used, the following methods may be used.

- Seismic method,
- Electrical method,
- Gravitational method,
- Magnetic method,
- Radiometric method,
- Geothermal method.

UNIT IV
STRUCTURAL GEOLOGY AND GEOPHYSICAL METHODS

1) Write short notes on

a) **Outcrop**
b) **Bedding**
c) **Dip and Strike**

Outcrop

- An outcrop is the exposures of a solid rock on the surface of the earth.
- In certain regions alluvium or soil may be spread for thousands of square kilometers and the bed rock may not be visible anywhere.
- In other area however exposures of rocks may be easily seen forming sides of valleys or caps of the hills or even flatlands in fields.

Bedding:

- Most sedimentary rocks are deposited under conditions which favor development of distinct layers from bottom to top.
- These layers are often easily distinguished on the basis of variation in color composition and grain size. It is sedimentary rocks are the most widespread on the surface of the earth.
- Forming more than 75 percent of all the rocks exposed. This layered character called Stratification or bedding therefore of fundamental significance in the study of structural features of sedimentary rocks.

Dip and Strike:

These are two definite quantities by which the position or attitude of a body of rock, especially stratified is expressed.

DIP:

- It is defined as the maximum angle of slope of a bed or layer of rock with the horizontal. It is expressed both in terms of degree of inclination and direction of inclination.
- The amount of dip is the angle between the bedding plane and a horizontal plane.

STRIKE:

It is a geographic direction of extension of the layers of rocks and may be explained as the direction of intersection of the bedding plane with a horizontal plane

Types of Dip

Primary Dip
Secondary dip
Local Dip
Regional dip

2) Define a fold. Briefly explain the various classification of the fold?

Folds may be defined as undulations or bends developed in the rocks of the crust of the earth as a result of stresses to which these rocks have been subjected from time to time in the past history of the earth.

The process of development of bends and curvatures in rocks is defined as folding.

Classification of fold:

These structures are variously classified on the basis of:

i) Position of the axial plane.
ii) The degree of compression induced in folds
iii) Mode of occurrence
iv) Behavior of the folds with depth.

Position of axial plane

i) Symmetrical folds:
A symmetrical fold may be an anticline or syncline.

ii) Asymmetrical folds:
These folds, anticlines or synclines in which the limbs are unequal in length and dip unequally on either side are termed asymmetrical.

iii) Overturned folds:
These are actually folds with inclined axial plane in which both the limbs are dipping essentially in the same general direction.

iv) Isoclinal folds:
These are groups of folds in which the limbs are dipping essentially in the same direction and at equal angles. Consequently their axial planes are essentially parallel.

v) Recumbent folds:
These can be treated as extreme types of overturned folds in which the axial plane acquires a horizontal attitude. In such folds one limb comes to lie vertically above the other.

vi) Conjugate folds:
In certain cases a pair of folds that are apparently related to each other may have mutually inclined axial planes. The individual folds themselves may be anticlinal or synclinal or their modifications.

vii) Box fold
It may be described as a special type of folds with exceptionally flattened dip and steeply inclined limbs almost forming three sides of a rectangle.

Degree of compression

Layers of rocks may be compressed only slightly or very severely during the process of folding depending upon the intensity of forces acting on the rocks. These folds in which the thickness of the rocks is not effected during the process are termed open folds. And the other types with thickened crests or toughs and thinner limbs as closed folds.

Mode of occurrence

Following are common types of folds recognized on the basis of their mode of occurrence.

Anticlinorium

It is a system of exceptionally large sized folds running often for several hundred kilometers in a length and several kilometers in width.

Synclinorium

It is the reverse of an anticlinorium and may be defined as an extensive system of folds having a clearly down arched general folding trend. The strata may show numerous types of small scale folds of all the types.

Domes and Basins

Domes are a group of strata centrally uplifted from below in such a way that seen from the top, the strata dip away in all directions. In any cross section a dome always appears as an anticline.

Basins are the reverse of domes and may be defined as a group of strata that are centrally depressed in such a way that the involved layers dip from all the sides towards a common centre.

Position of axis

The axis of fold has already been defined as the line joining all the points of maximum curvature in folded sequence. This axis may be horizontal or inclined at any angle with the horizontal when inclined; it makes an angle with the horizontal, which is called Plunge.

Plunging fold

When the axis makes an angle with the horizontal plane.

Non plunging

When the fold axis is horizontal.

3) Describe the various characteristics in fault?

There are some salient displacements characters are shown as seen in vertical cross section of the involved region.

Fault Plane:

The surface along which the fracture occurs in faulting in a rock mass and relative displacement of blocks takes place is generally a planar discontinuity and is termed as Fault plane.

Fault Zone:

In many other cases however a small region may be fractured and displaced along numerous closely spaced and more or less parallel faults. In such cases it is customary to classify the whole tabular fault infested and effected rock zones as a fault zone.

Shear Zone:

In shear zones displacement is confined generally to zones of weak materials which are interbedded with rocks of component or strong character.

Dip and Hade

The dip of the fault plane is its inclination with the horizontal and is measured both in terms of degree of inclination and direction of inclination. The strike of the fault is the bearing or geographical direction of the line of intersection of a horizontal plane.

The Walls

In any given body of rock, a fracture will naturally result in two parts or blocks. These blocks are often referred as walls, especially when the fault plane is inclined at an angle other than vertical.

Slip and Separation

Faulting involves as is clear from definition relative displacement of blocks of the same rock which were formerly contiguous. There are two general terms to express the nature and magnitude of such a displacement.

Fault Breccias

It is the crushed angular, fragmentary material produced during faulting and found in some cases at or near the base of the up thrown block.

Mylonite

This rock also called micro breccia. It is extremely fine grained ,vary hard and coherent. Faulting is believed to be the cause of development of such rocks.

4) Explain briefly about classification of fault?

These types are distinguished on the basis of following factors:

a) The apparent movement of the disrupted blocks along the fault plane.
b) The relation of the fault attitude to the attitude of the displaced beds.
c) The direction of the slip
d) The amount of the dip of the fault.
e) The mode of occurrence

Apparent movement as basis

Three fundamental types of faults are classified on the basis of apparent movement:

Normal fault

This fault in which hanging wall has apparently moved down with respect to footwall is termed a Normal fault.

Gravity Fault

Normal faults in which the hanging wall has actually gone down relative to the foot wall are often termed as Gravity Faults.

Reversed Fault

A reversed fault is such a type of fault in which the hanging wall has been apparently mode up with respect to the footwall.

Thrust Fault

In which the hanging wall has actually been moved up relative to the footwall are described as thrust faults or simply thrusts.

Vertical fault

Faults in which the fault plane s vertical or nearly so and the resulting movement of blocks is also in a vertical direction ate termed vertical faults

Attitude of fault as basis

It enables us to distinguish three types of faults:

Strike fault
Dip Faults
Oblique Fault
Hinge fault

Slip as Basis

On the basis of direction of slip with respect to the fault plane attitude, following three types are commonly recognized

Strike Slip Fault
Wrench fault
Rift

Dip-slip faults

Those faults in which the slip occurs parallel to dip of the fault are named as dip slip faults.

Oblique-slip Faults

These may be defined as those faults in which the direction of net slip is parallel neither to the strike nor to the dip direction of the fault but is inclined to both these directions.

Dip of fault as a Basis

High Angled Faults
Low Angled Faults

5) Explain briefly about Origin and occurrence of joints?

Origin of joints

Joints are caused in different rocks due to different reasons. The joints may be caused in different rocks. These are outlined as follows:

Contraction during Formation

The plastic nature and rich in moisture in the initial stages undergo some contraction on dying up which might have resulted into irregular jointing.

Expansion and contraction

The repeated expansion and contraction is characteristic of regions with dry hot climates where day and night temperatures on the one hand and summer and winter temperatures on the other hand vary within a very wide range 50^0 to 60^0c.

Crystal Disturbances

Many joints especially those associated with folded and faulted rocks are clearly related to processes of crustal disturbances that are responsible for building of mountains and continents. These process are easily capable of exerting sustained and strong forces on rocks that virtually into slices along certain directions irrespective of the composition and strength of the rock components.

Occurrence of joints

Joints are perhaps the most common structural features of all types of rocks. It is seldom that we may find any big rock mass on the surface free from joints. There are three main categories in show joints of various types.

Igneous rocks

The three regular or systematic types of joints observed in igneous rocks are:

Sheet joints
Mural jointing
Columnar jointing

Sedimentary rocks

Joints may be of systematic and nonsystematic classes. This joint may be closely and regularly spaced sets, parallel or sub parallel to each other and bearing varying relationships with the attitude of the rocks. Since sedimentary rocks are often folded and faulted.

Metamorphic rocks

These rock types are heavily jointed in many cases but in most cases the joints are of irregular or non systematic types. These joints are often the result of local and regional stresses acting on rocks as a source of metamorphism. In many cases the metamorphic rocks may show those joints which were pre existing at the time of metamorphism of the rock with little or no modification.