UNIT 11

TOPOGRAPHICAL MAPS

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11.1 INTRODUCTION

You have read the basic concepts of maps, types and importance of maps, map scales and projections, and various data sources in the previous blocks of this course. In this unit, you will study about the topographical maps. As a learner, you must know the techniques of map interpretation to make an effective map and also its proper utilization. Map interpretation involves a synthesis in which new ideas and facts are built from a set of interrelated details. Undoubtedly, topographical maps are proved to be an important source of the map data. It provides accurate and authentic information with regard to various natural and cultural features of surface of the earth.

In Section 11.2, an overview of the topographical maps is discussed. You will learn the development of topographical maps in India and the different series of
You might have heard the name ‘toposheet’ which is also sometimes referred to as a topographical map. A topographical map is an accurate and detailed graphic representation of various physical and cultural features of the earth’s surface. It represents three dimensional features of landscape either into flat or two-dimensional features. These maps are often produced at large scale. Topographical map generally contains coordinates grid and graticules which are helpful in determining relative and absolute positions of mapped features. A topographic map characteristically represents the features including,

- **relief**: hills, valleys, slopes, depressions, coastlines and gullies;
- **hydrographic**: lakes, ponds, water tanks, rivers, streams, swamps or mudplats;
- **vegetation**: forest, wooded and cleared areas, orchards and plantations; and
- **cultural**: roads, railways, airports, buildings, rural and urban settlements, names of places and geographic features, administrative boundaries, state and international borders, etc.

The relief explained by contour lines are prominent features in any topographical map. The topographical map is different from the planimetric map in which features like roads, buildings, etc. are shown but no contour lines are visible. Whereas, the topographic maps have contours to represent the relief features along with roads, buildings, highways, rivers and so on.

You may know that various countries have established scientific organizations/institutions/national mapping agencies which produce a topographic map series for their whole country needs at varying scales. One such example is Survey of India (SOI), which publishes topographical maps for Indian territories. Other prominent organizations including United States Geological Survey for United States of America, Royal Survey for United Kingdom, Centre...
for Topographic Information of Natural Resources Canada for Canada, Geoscience Australia for Australia, etc. publishes topographical maps on various scales for their country’s requirements. If you like to find various series of topographical maps, go through the following web links: http://www.surveyofindia.gov.in/, http://store.usgs.gov, https://www.ordnancesurvey.co.uk/ http://maps.nrcan.gc.ca.

A topographical map is generally bounded by the lines of latitude and longitude. Latitudes (North or South), and longitudes (West or East), are marked on the map. These are measured in degrees (°). The latitude (the north-south angular distance), is measured from the equator whereas the longitude (the east-west angular distance) is measured from the prime meridian. The latitude of equator is 0°, and 90°N at the North pole, and 90°S at the South pole. The latitude can be expressed as 28° 38' 41'' N, 33° 51' 54'' S, etc., in the format of degree, minute and seconds. Longitude position is designated as 0° to 180°east, to designate the locations of earth’s eastern hemisphere, or 0° to 180° west, for designating the locations of earth’s western hemisphere. Hence, it is understood that the longitude ranges from 180° W to 180° E of the prime meridian and are converging towards the poles. The longitude can be shown as 77° 13' 01'' E, 119° 25' 4'' W etc.

Topographical map is generally represented by the ratio scale for example 1:25,000 or fractional scale i.e. 1/25,000. It explains that one unit of the map represents 25,000 same units on the earth’s surface. The units may be expressed in various metric units like Inch, Centimetre, and Foot, etc. In this case for example, one inch on the topographical map represents 25,000 inches on the actual ground surface. The common and popular topographical map scales are 1:10,000, 1:25,000, 1:50,000; 1:63,360; 1:100,000; 1:125,000 and 1:250,000. Small scale maps (1:250,000), show lesser details but cover larger area whereas large scale maps (1:10,000), represent greater details as it covers smaller area. A topographical map is printed with verbal scales and/or graphic bar scales. Verbal scales are approximate scales, for example, one inch is equal to one mile. While, bar scales show miles, feet, kilometres, and meters etc. You have studied and learnt in detail about the map scales in Unit 3 of Block 1. We hope that you have now understood the important characteristics and usages of a topographical map in general.

You know now that topographical map represents the earth’s surface features which existed during the period of survey. Scale explains the details of features of the map. Topomap uses a variety of symbols, generalization, topography and colour to portray different physical and cultural features of the area. You will understand the details of map reading and interpretation procedures of toposheet in the following sections.

***SAQ 1***

a) What is topographical map?

b) Name any of two prominent organisations that produces topographical maps on various scales.
11.3 DEVELOPMENT OF TOPOGRAPHICAL MAPS IN INDIA

Albrecht Penck, the German Geographer, was first person to propose a map of the entire globe on 1:1,000,000 scale popularly known as the International Map of the World (IMW), at the Fifth International Geographical Congress (IGC), held in Berne in 1891. He suggested that “the map must be having a common set of conventional signs so that it will help to create a new cartographic image of the whole globe for resolving complexity of the existing cartographic archive”. It was mentioned as "one common map for one common humanity". After several discussions, the official mapping agencies of Italy, France, Britain and Germany had started surveying for the preparation of official map series of foreign territories at the million scale. Under the project of IMW, the Survey of India had also commenced a survey to generate new map series on ‘India and Adjacent Countries’ at 1:1 million scale in 1904.

Actually, the Survey of India was established long back in 1767. Several British surveyors had worked to map the parts of India on various scales of 1 inch to 1 mile, 1 inch to 2 miles, and 1 inch to 4 miles, etc. Since then, it began to produce various topographical map series under different scales for the nation’s requirement from time to time. There were initially two main series of maps namely ‘The International Map of the World Series’ (IMW Series), and ‘India and Adjacent Countries Series’ (IAC Series). Recently, the SOI has introduced another map series called ‘Open Series Maps’ according to the guidelines of National Map Policy, 2005. Survey of India is the only organization which is responsible for publishing and selling of topographical maps of Indian territories. You will now study all the three series of topographical maps.

11.3.1 International Map of the World (IMW) Series

This series is used for international map on 1:1,000,000 or 1:1 million scale. Each sheet consists of 4° of latitude and 6° of longitude. The geographical position of the sheet is defined by two letters and a number. The first letter is N or S depending on whether the sheet is north or south of the equator. Next letter after the N or S indicates latitude of sheet alphabetically with the capital letters in succession of each 4°. Numbering starts from 180° longitude and goes from west to east, the number changes after every 6° longitude. Longitudes are numbered from 1 to 60 where 1 indicates 180°–174° West and the number 60 represents 174°–180° East. Latitudes are assigned by letters as NA (0°– 4° North) to NV (84°– 88° North) or SA (0° - 4° South) to SV (84°- 88° South). The letter Z is used to designate polar regions.

Beyond 60° latitude, the longitudinal span has increased to 12°, and from 76° latitude, it doubles again to 24°. The IMW series maps are confined only upto 1:250,000 scale. The layout of the sheets is shown in Fig. 11.1. Survey of India was published on 1:1,000,000 scale for covering 4° of latitudes and 6° of longitudes under IMW series. At present, any map of the world is not producing under IMW series.
You have understood about IMW series maps. Let us now study India and Adjacent Countries (IAC) series maps. IAC series map numbers cover the entire region of India and also adjacent lands of Afghanistan, Tibet, and China which is presented in Fig.11.2. In this series, each map is bounded by 4° latitude and 4° longitude on 1:1,000,000 scale. There are 136 sheets covering India and adjacent countries with the assigned index numbers 1, 2, 3, ......136.

Subsequently, SOI discontinued preparing maps for the adjacent lands of other countries from the year 1937 onwards. However, the layout plan and numbering system of the abandoned IAC series is continued in preparing topographical maps of India. Maps covering only India are a total of 50 index sheets that is numbered from 39 to 88. These 4 x 4 degree sheets are drawn at the scale of 1:1,000,000 (1 inch to 16 miles). These toposheets are called as 1M or 1 Million sheets. Where the sheets are falling in the Sea are not numbered. Some sheets are named after prominent places for example Delhi (Sheet No. 53). These IAC series maps were published in two categories namely Political and Layered editions. Political edition was published with administrative boundaries in colour, and Layered edition has graduated layers of colours to show altitudes.

Further, each 4°× 4° square or 1M sheet is sub-divided into 16 equal parts of 1° x 1°. Each part has been assigned with an alphabet serially as A, B, C, D, E, F, G, H, I, J, K, L, M, N, O and P. Each grid is called by the sheet number followed by an alphabet for example 53B. The sheets drawn on 1:250,000 scale (1 inch to 4 miles), are called as degree sheets or quarter-inch sheets.
You may refer to Fig. 11.3, which explains about the Indian topographic numbering system adopted by SOI for making toposheets on different scales.

Again, each 1° x 1° map (degree sheet), is subdivided into two ways. In the first order, each sheet is divided into 4 equal parts of 30' x 30' and are named as NW, NE, SW and SE for example 53M/SE. These maps are drawn at the scale of 1:100,000 (1 inch to 2 miles) and are known as half-degree sheets or half-inch or quadrant maps. In the second order, each degree sheet is further sub-divided into 16 equal parts of 15' x 15'. These sheets are designated by numbers 1, 2, 3, ........16 and are named as 53B/1, 53 B/2, 53 B/3, and so on. The scale of these maps is 1: 50,000 (1 inch to 1 mile), and are known as one inch sheets.

The 1:50,000 scale sheet (one inch sheet) is again sub-divided into two ways. In the first order, each sheet is divided into 6 equal parts of 5' x 7' 30" and designated as numbers 1, 2, 3, 4, 5 and 6. The scale of these sheets is 1:25,000. In the second order, each one inch sheet is further sub-divided into 4 equal parts. Each part has the grid extent of 7' 30" latitude and 7' 30" longitude. These sheets are numbered as 53 O/14/NW, 53 O/14/NE, 53 O/14/SW, and 53 O/14/SE. The scale of these sheets is 1:25,000.
You will further understand by studying the following table of Indian topographic map numbering system which has been adopted by SOI to identify a particular sheet of an area.

<table>
<thead>
<tr>
<th>Toposheet</th>
<th>Scale</th>
<th>Extent</th>
<th>Contour Interval (Meters)</th>
<th>Example with numbering</th>
</tr>
</thead>
<tbody>
<tr>
<td>1M</td>
<td>1:1,000,000</td>
<td>4° x 4°</td>
<td>Varies depending on terrain</td>
<td>65</td>
</tr>
<tr>
<td>Degree</td>
<td>1:250,000</td>
<td>1° x 1°</td>
<td>100</td>
<td>65 O</td>
</tr>
<tr>
<td>Half Degree</td>
<td>1:100,000</td>
<td>30’ x 30”</td>
<td>50</td>
<td>65 O/NE</td>
</tr>
<tr>
<td>Quadrant</td>
<td>1:50,000</td>
<td>15’ x 15”</td>
<td>20</td>
<td>65 O/1</td>
</tr>
<tr>
<td>Quadrant Sheet Special</td>
<td>1:25,000</td>
<td>5’ x 7’ 30”</td>
<td>10</td>
<td>65 O/1”4</td>
</tr>
<tr>
<td>1:25,000 Sheet</td>
<td>1:25,000</td>
<td>7’30” x 7’ 30”</td>
<td>10</td>
<td>65 O/1/NE</td>
</tr>
</tbody>
</table>

Now you will get an idea after going through the example given below.

**Example 1**: Find the adjacent sheets of 53 F/7 on 1:50,000 scale?

**Solution**: Let us learn how to solve the above problem.

**Step 1**: The given number is 53 F/7. The numeric number 53 shows the grid (longitude: vertical line and latitude: horizontal line), as under:
Step 2: Divide the grid - 53 into 16 equal parts and assign each box with an alphabet in the following manner. We need to have 53 F. This you can find from the box which is highlighted.

<table>
<thead>
<tr>
<th>A</th>
<th>E</th>
<th>I</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>F</td>
<td>J</td>
<td>N</td>
</tr>
<tr>
<td>C</td>
<td>G</td>
<td>K</td>
<td>O</td>
</tr>
<tr>
<td>D</td>
<td>H</td>
<td>L</td>
<td>P</td>
</tr>
</tbody>
</table>

Step 3: Further divide the grid - 53 F into 16 cells and assign numbers from 1 to 16. Now, shaded cell shows as 53 F/7.

<table>
<thead>
<tr>
<th>1</th>
<th>5</th>
<th>9</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>6</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>12</td>
<td>16</td>
</tr>
</tbody>
</table>

Step 4: You now know the adjacent numbers of 53 F/7.
Therefore, the adjacent sheets of 53 F/7 are 53 F/2, 53 F/3, 53 F/4, 53 F/6, 53 F/8, 53 F/10, 53 F/11, and 53 F/12.

### 11.3.3 Open Series Maps

Survey of India has now introduced the new map numbering system in place of the previous numbering system of India and Adjacent Countries (IAC) series according to the National Map Policy of 2005. There are two map series suggested namely **Defense Series Maps (DSMs)** and **Open Series Maps (OSMs)**. Maps of these two series are topographical maps. DSMs are prepared by using Everest/WGS-84 Datum and Polyconic/UTM Projection on various scales to cater mainly for defense and national security requirements.

On the other hand, OSMs are printed in UTM Projection on WGS-84 datum. These maps are available for general public without showing any civil and military Vulnerable Areas and Vulnerable Points (VA's/VP's). OSMs of scales larger than 1:1 million either in analogue or digital format can be purchased from SOI or through an agreement for specific end use. License agreement is necessary for purchasing of digital maps.

Numbering system adopted for OSM is based on International Map of the World. The layout of sheets covering the entire country is presented in Fig. 11.4. Details of various categories of OSM are presented in Table 11.1. Map numbering system is as follows:

- The area is covered by 32 UTM Zones with a dimension of 6°x 4°.
- These numbered toposheets are drawn on 1:1,000,000 scale called as million sheets.
- Each million sheet is divided into 24 degree sheets on 1:250,000 scale and are designated by letters A, B, C, D, E, . . . . . . X.
- Each 1 degree sheet is further divided into 16 sheets on 1:50,000 scale and are designated by numbers 1, 2, 3, 4, . . . . . . 16. These are called 15' x 15' sheets.
- Here, each 15' x 15' sheet is divided into two series. The first series is quadrant sheets of 7° 30" x 7° 30" and second series is large scale maps or LS sheets.
- The quadrant sheets are drawn on 1: 25,000 scale and are referred to as NW, NE, SW, and SE sheets.
- Secondly, each 15' x 15' sheet contains 25 sheets with a dimension of 3' x 3' on 1:10,000 scale and are designated by alphabets A, B, C, . . . . Y.
- And, each 3' x 3' sheet is again subdivided into 25 sheets of 36' x 36' on 1:2,000 scale and are assigned by numbers 1,2,3, . . . . . . .25.
Fig. 11.4: Numbering system of Open Series Maps (OSM).
(Source: Adopted from Survey of India, Govt. of India, New Delhi)
Table 11.1: Details of various categories of the OSM toposheets.

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Latitude/Longitude</td>
</tr>
<tr>
<td></td>
<td>Name of State/District/ Administrative index</td>
</tr>
<tr>
<td></td>
<td>Toposheet Number/Year of Survey/Edition No./Index to toposheets</td>
</tr>
<tr>
<td></td>
<td>Magnetic variation from true North direction</td>
</tr>
<tr>
<td></td>
<td>Map reference</td>
</tr>
<tr>
<td></td>
<td>Bar scale/Representative Factor</td>
</tr>
<tr>
<td>Administrative boundaries</td>
<td>Names: Administrative/Locality or tribal</td>
</tr>
<tr>
<td></td>
<td>Boundary: International to village, Forest, Boundary Pillars: All boundary pillars, village tri-junctions</td>
</tr>
<tr>
<td>Communication and Transmission lines</td>
<td>All Roads</td>
</tr>
<tr>
<td></td>
<td>All Tracks, pass, footpath</td>
</tr>
<tr>
<td></td>
<td>Railways: All gauges with stations, tunnels</td>
</tr>
<tr>
<td></td>
<td>Light railways or tramway, All embankments, Road/ Rail/tank Transmission lines</td>
</tr>
<tr>
<td>Hydrological details</td>
<td>All streams/canals</td>
</tr>
<tr>
<td></td>
<td>All earthwork dams</td>
</tr>
<tr>
<td></td>
<td>All rivers with details, banks, islands</td>
</tr>
<tr>
<td></td>
<td>All wells/tube wells/springs</td>
</tr>
<tr>
<td></td>
<td>All tanks (excluding overhead tanks), lightship, buoys, anchorages</td>
</tr>
<tr>
<td>Settlement/Cultural details</td>
<td>Village inhabited, deserted and forts</td>
</tr>
<tr>
<td></td>
<td>Huts, tower, antiquities</td>
</tr>
<tr>
<td></td>
<td>Religious places, tombs/grave</td>
</tr>
<tr>
<td></td>
<td>All post/telegraphic/police stations hut</td>
</tr>
<tr>
<td></td>
<td>All bungalows</td>
</tr>
<tr>
<td>Relief</td>
<td>Contours with sub-features</td>
</tr>
<tr>
<td></td>
<td>All sand features</td>
</tr>
<tr>
<td></td>
<td>Ice forms (all features)</td>
</tr>
<tr>
<td></td>
<td>Spot height, approximate height</td>
</tr>
<tr>
<td></td>
<td>Bench marks (Geodetic tertiary, canal)</td>
</tr>
<tr>
<td>Vegetation</td>
<td>All trees, Vine on trellis, grass, scrub</td>
</tr>
<tr>
<td>Forest</td>
<td>Reserved/protected</td>
</tr>
</tbody>
</table>

(Source: Survey of India, Govt. of India, New Delhi)
SAQ 2

a) Match the following:

i) Degree sheet  a) 1:250,000

ii) Half-degree sheet  b) 1:1,000,000

iii) Quadrant sheet  c) 1:50,000

b) Identify adjacent F44K10 sheets of OSM?

11.4 STUDY OF TOPOGRAPHICAL MAPS

Till now, you have understood about the numbering system of topographical maps that is published by SOI. Now, let us study a toposheet. To read and interpret any topographical map, you need to know some procedures including study of marginal information and identification of the physical and cultural features. There are several conventional signs and symbols and standard colours and letters developed for understanding the information of toposheet as each and every details of the area cannot be represented on the map. You can find the conventional signs and symbols on the toposheet itself for identifying various features of the area. Fig 11.5 represents the conventional signs and symbols of a toposheet. You must be aware of these signs and symbols and marginal information, etc., before you start reading a topographical map.

(Source: Adopted from Survey of India, Govt. of India, New Delhi)

Fig. 11.5: Conventional signs and symbols of SOI toposheet.
Let us now study the marginal information of SOI toposheet. Refer to Fig. 11.6, which shows the marginal information of a toposheet. The information related to the given area of toposheet is provided by map maker on the margin of topographical map. Fig. 11.6 shows the marginal information of a published toposheet of SOI and the details of information are given in Table 11.2. The numeric numbers on map are explained with their corresponding information of the toposheet. You must also remember that the toposheet always show direction of the north as indicated towards the top.

Fig.11.6: Marginal information of a toposheet.
(Source: Survey of India, Govt. of India, New Delhi)
### Table 11.2: Description of marginal information of the toposheet.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Information</th>
<th>General Description</th>
<th>On Toposheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sheet Name</td>
<td>Upper center margin and either the right or left side of the lower margin</td>
<td>BIHAR BHAGALPUR, MUNGER AND SAHARSA DISTRICTS</td>
</tr>
<tr>
<td>2</td>
<td>Sheet number</td>
<td>Upper right margin: Numerical numbers, and alphabet</td>
<td>NO. 72 K/15</td>
</tr>
<tr>
<td>3</td>
<td>Adjoining sheets</td>
<td>Bottom left: This box has been divided into nine parts. Each box having a number. The center box is outlined in black line and it contains a number which is the same as the map's sheet number. This is the index to adjoining sheets.</td>
<td>Index to sheets</td>
</tr>
<tr>
<td>4</td>
<td>Scale</td>
<td>Center of bottom: The scale representing that one unit of measurement on the map is equal to fifty thousand of the same units on the actual ground. The graphic scale is used to convert map distance to ground distance and vice-versa. On the map which explains you that 1 cm distance of the map covers an area of 500 m on the actual ground.</td>
<td>1: 50, 000 On bar scale: left margin 500 m to 1 cm and right margin 2 cm to 1 km.</td>
</tr>
<tr>
<td>5</td>
<td>Contour interval</td>
<td>Center of the bottom and beneath the bar scale: It gives you the vertical distance between contour lines and the unit of measurement in feet or metres.</td>
<td>Contour interval 20 metres</td>
</tr>
<tr>
<td>6</td>
<td>Colour tinting</td>
<td>Center of the bottom and beneath the contour interval: It explains different colors representing various features of the map.</td>
<td>Water features are shown in blue where they generally contain water. Cultivated areas are coloured in yellow. The boundaries of areas of Reserved or</td>
</tr>
</tbody>
</table>
Now you have understood about the marginal information of toposheet. Based on the above information and observation, you will now be able to study the marginal information of different toposheets. You can also try to download the topographical maps from Survey of India website (www.surveyofindia.org). Survey of India is a designated Government agency that publishes and sells topographical maps of India on different scales to cater the needs of users like academicians, researchers, etc.

**SAQ 3**

What is marginal information of a toposheet?
11.5 REPRESENTATION OF RELIEF BY CONTours

In this section, you will learn different techniques that are used to represent relief on topographical maps. Relief depicts the elevation of the land above sea level on a flat surface. Various techniques such as hachures, form lines, layer colouring, hill shading, contours and spot heights/benchmarks/ triangulation stations are employed to show relief on maps.

Hachures are fine small broken lines drawn along the direction of maximum slope. It is a kind of flow line symbol which was first proposed by Lehman, an Austrian Army officer, in the year 1799, for the depiction of terrain. Steep slopes have thick hachures and are very close to each other and a little wider when the slope is gentle. The blank portion shows flat areas. These are present visual impression of relief but they do not provide actual height of the areas.

Form lines are broken lines drawn in between contour lines. These are approximations based on observations of surveyors without direct measurements of the region. For example, mountainous topography, where some areas are very difficult in order to conduct actual survey.

Spot height, bench mark and triangulation stations are marked on the toposheet which indicates the real height of any point on the ground. Spot heights are shown to indicate exact height of the ground surface above mean sea level. On the toposheet, it is shown as a dot symbol accompanied by numeric numbers indicating the height in meters or feet. The height of the prominent points/objects like buildings, pillars, bridges or rocks are determined with greater accuracy and are represented as bench marks. On the toposheet, the letters BM followed by numeric numbers show the actual elevation of the point and not that of the ground. Triangulation stations are different from spot heights that shows the height which actually exist on the ground in the form of a triangulation pillar. On the toposheet, it is depicted as triangle symbol followed by number. More precisely located and more accurate in elevation, the trigonometric points are marked by a plate fixed permanently on the ground.

Contouring is the standard and best method of representing relief on topographical maps. Contours are isarithm which connect points of same elevation. It is a technique of line symbol first used by Cruquins, a Dutch man in 1730. Contours can be defined as imagery lines that connect points of equal elevations on the surface of ground above or below a reference surface, such as mean sea level. Contours cannot merge or cross each other on a map, except on vertical surfaces such as cliffs, caves or walls. On the toposheet, the height of the contour is generally printed on the contour line. The index contour i.e., every fifth or tenth contour line is drawn as thick line than the rest with the labelled information which enables us to know the heights more easily (e.g., 100, 200, etc.). The vertical distance between contour lines is known as contour interval. The specific values of contour interval depend on the map scale, the degree of relief and the purpose of map.

Based on the contour pattern, one can easily understand the shape of land
surface. The spacing of contours is significant which explains the steepness of the land surface. The contour lines are closed together; they represent a steep slope, whereas gentle slope indicates that contour lines are far away from each other. Let us know some of the surface features and how they are represented by contour patterns. You will understand these surface features by studying the following diagrams.

Gentle slope: contour lines wide apart; and Steep slope: contour lines close to each other.

Convex slope: close contours (steep), at lower than top of the hill and Concave slope: close contours at top than the lower part of the hill.
Conical hill: concentric circles of contour lines on top of the hill.

Plateau: elevated land covering with large area at the top shown with few contours surrounded by number of contours.

Cliff: contours merge into one and the other on the face of the cliff.
Waterfall: contours closely connect one and other or merge at a particular point when crossing a stream.

Rapids: contours are relatively distant at particular places of hill.
Escarpment: a sudden drop of slopes in ground level or steep hill sides. Very closely spaced contours or sometimes shown with a cliff symbol.

Ridge: a chain of hills.

Saddle: low elevation points on ridges.
Pass: a passage through a mountain range showing low elevations.

Col: the lowest point of a ridge between two mountain peaks.

Spur: a chain of small ridges connected to a ridge or hill.
Vally and Spur: 'V' points uphill (valley) and points downhill (Spur).

Gorge: contours parallel and very close to each other.

River Gap: 'U' shaped gap.
Valley: Represents ‘V’ shape

Lake: the closer points on its center represents deeper water

Valley: Represents ‘U’ shape

River Meandering
What are contour lines?

11.6 IDENTIFICATION OF PHYSICAL AND CULTURAL FEATURES

You have studied about the marginal information of toposheet and relief features which are represented by contour lines on topographical maps. As we know that the topographical map represents physical and cultural features of small areas on a large scale. As a cartographer and map interpreter, you must be familiar with conventional signs and symbols, marginal information, relief features, etc., to identify, locate and describe the immense amount of information given on the topographical map. Let us now study how to identify various physical and cultural features from the toposheet. You must refer to Fig.11.5 for understanding various signs and symbols which are conventionally assigned for identification of physical and cultural features given on a toposheet.

11.6.1 Physical Features

You could find several natural features like mountains, hills, plains, streams, vegetative cover, etc., in your surrounding landscape. These features are generally referred to as physical features. The first step for identification of physical features is to prepare the layout for broad features such as mountains, plateaus, plains and valleys, etc. Then, note the major rivers, streams and nallahas, etc. and study carefully into the details of broad features such as ridges, peaks, spurs, escarpment, cirques, knolls, cols, flood plains, valleys, rivulets, glaciers and moraine deposits, etc. Finally record the natural
vegetation of the toposheet. Broad categories of physical features are explained below.

**Relief Features**

You have already studied some of the relief features represented by contours on topomap from the previous Sec. 11.5. Other features including dunes, rock outcrops, stony waste and sheet rock, etc., can be identified by the conventional signs and letter symbols. Based on the pattern and spacing of contour lines, you will be able to identify the relief features. On the toposheet, the contour lines are either completely missing or only a few are present, thus, it indicates flat or plain area. Whereas, a large number of contours or elevation points are marked on the topomap, then it could be mountainous or hilly terrain.

**Drainage**

Even if you do not have a proper geological and elevation records, but a good knowledge of drainage system of a region, will help in understanding the rock structure and lithology of that area. It is necessary to study different drainage patterns while map reading. Drainage of an area can be studied based on its pattern and density. Drainage pattern is simply the way of arrangement of streams or drainage channels on the landscape. There are several types of drainage patterns which can be identified. Some of the most frequently observed patterns are explained here.

- **Dendritic pattern**: It is a branching tree-like drainage pattern. This pattern is developed in the areas of homogeneous rocks, for example, Igneous rocks. These areas are generally characterised by lack of structural control like folding or faulting.

- **Trellis pattern**: Streams flow parallel to each other and the tributaries join almost at right angles. The longer streams will always have the preference to flow in one particular orientation. The drainage pattern so developed will be rectangular in shape. This pattern is predominantly developed in the folded regions with alternating bands of hard and soft rocks.

- **Rectangular pattern**: It reflects the areas where joints or fault system is the main controlling factor. In this pattern, streams meet at right angles with each other.

- **Radial pattern**: Drainage channels tend to flow away from the central point of a conical hill or dome or volcano.

- **Centripetal pattern**: Streams are converging into a central depression that indicates the development of a structural basin.

We can also estimate the **drainage density** by careful reading of drainage channels present on topomap. The drainage density can be defined as the ratio of the total length of channels to the area of that basin. It is simply a measure of the closeness of the spacing of channels. Higher drainage densities can be expected where the slopes are steep, commonly found in the
hilly or mountainous terrain. Further interested in knowing more details of the drainage system, you may refer any good book of Physical Geography.

The drainage network is shown on the topographical map with the line symbols. Other drainage features including perennial channels, non-perennial channels, canals, meanders, cutoff and chute, etc., can be identified with the help of line symbols and associated patterns. Islands, gully erosion, rapids and waterfalls, etc., are represented by conventional symbols. The given explanations of drainage may help the cartographer to interpret a topographical map.

Vegetation

Forest including reserve and protected categories, scrub lands, orchards and groves, horticulture, silviculture, and plantations comprise of mango, cashew, teak, causirina, pine and bamboo, etc., come under vegetation category. These features can be identified with the help of letter and conventional symbols given on the topographical map.

11.6.2 Cultural Features

The identification of human-made features can be done with the help of the marginal information, conventional symbols and abbreviations which are published by Survey of India on the topographical map. You must remember that each toposheet may contain some special features of that particular surveyed area and vice-versa. The map reader should focus on the information provided by the map maker while studying it. The important cultural features commonly found in the plains and plateau regions of India are explained below:

Settlements

Settlements for example rural or urban and other buildings, and structures including monument, factory, chimney, post-office, temple, church, mosque, tomb, pagoda, idgah, fort, burial grounds, etc. can be identified with the help of conventional symbols. Settlement patterns like compact, scattered, linear, or circular, must be interpreted while studying a topographical map.

Transport and Communication

Record the means of transport and communications like railways i.e., narrow, meter gauge, broad gauge; roads: metalled, unmetalled, cart track, packtrack; ports, harbours, power lines and telephone lines, etc. Transport and communication lines are shown by line symbols with varying widths.

Landuse

You can identify landuse pattern such as forest, wood, cultivated lands, waste lands and irrigation system, etc.

Other cultural features such as waterway, ferry, airport, bridges, embankment and bunds, etc., are marked with letter symbols. You may also note the administrative boundaries, forest boundaries, institutions, post offices, hospitals and temples, etc., and other features, if any, not mentioned in the list.

You will further learn how to identify and interpret various physical and cultural
features from the toposheet by doing the exercises given in the Laboratory course of BGGCL-134 of B.Sc. Geography programme.

**SAQ 5**

List out any three physical and cultural features of a topographical map?

**11.7 SUMMARY**

In this unit, you have studied so far:

- The topographical map represents various relief features, hydrological features, vegetation and other cultural features.
- Survey of India (SOI) is the only organisation publishing topographical maps of India on various scales.
- Survey of India numbering system must be understood for identification of any topographic map of India. There are three map series namely IMW series, IAC series and OSMs published by SOI. Open series maps are introduced for the purpose of general public according to National Map Policy of 2005.
- Noting the marginal information is of utmost importance for those who are reading and interpreting the toposheet.
- Representation of relief is possible through hachures, form lines, layer colouring, hill shading, contours, spot heights/benchmarks/triangulation stations.
- You have also studied the identification of various physical and cultural features from the SOI toposheet.

**11.8 TERMINAL QUESTIONS**

1. Explain the importance of topomap and its characteristics.
2. Explain about India and Adjacent Countries Series and Open Series Maps with examples.
3. Describe any three prominent methods used for representing relief.
4. Draw any three relief features using contour method.
5. How do you identify the physical and cultural features from SOI toposheet? Explain.

**11.9 ANSWERS**

**Self Assessment Questions**

1. a) Topographical map represents physical and cultural features.
   
   b) Survey of India and United States Geological Survey.
2. a) i-B, ii-A, iii-C
   b) F44K09, F44K05, F44K06, F44K07, F44K11, F44K15, F44K14, F44K13.

3. Map maker provides the information with regard to the surveyed toposheets on its margins.

4. Contours are lines which connect the points of same elevation on a map.

5. Physical features: mountains, river and reserved forest; Cultural features: monuments, roads and wooded lands.

**Terminal Questions**

1. Topographical map shows various features of relief, hydrological, vegetation and human-made etc. These maps are produced by different national organizations for their country needs from time to time. Topomap contains latitude and longitude values and map scale. It mainly represents earth’s physical and cultural features that existed during the period of survey. Refer to the Sec. 11.2.

2. India and Adjacent Countries series maps are covered in the entire region of India and each map is divided by 4° latitude and 4° longitude. Open series maps are printed in UTM Projection on WGS-84 datum. For further information, you may refer to Sub-Secs. 11.3.2 and 11.3.3.

3. Relief can be represented by using different techniques such as hachures, form lines, spot heights and contouring etc. You may refer to the Sec. 11.5.

4. Refer to the Sec. 11.5.

5. Refer to the Sec. 11.6.

**11.10 REFERENCES/SUGGESTED FURTHER READING**


- http://www.surveyofindia.gov.in/pages/view/10-about-us-**