...ency and academic excellence about the competitive exams.

GEO-76P-304-Practical-II

(B.A/B.Sc-VIth Semester Geography Practical)

Code of Course	Title of the Course	Level of the Course	Credits of the Course
GEO-75P-304	Practical-II	7	2
Types of the Course	Delivery type of the Course		
Major	60 contact hrs- Laboratory lectures and field study including diagnostic and formative assessments during lecture hours		
Prerequisites	Central Board of Secondary Education or Equivalent		
Objectives of the Course	To develop students' ability to represent, analyze, and interpret geographical data through three-dimensional diagrams, computer applications, and map projections for effective spatial understanding.		

*** Note: - 1. Each practical batch of 30 students will be allotted a teaching of 4 hours per week for practical.**

2. It is compulsory for the Non-collegiate students to attend 48 hours practical training camp. One batch of practical training camp will comprise of maximum 30 students per batch.

Duration- 4 Hours **Max. Marks- 10+40**

Min. Marks- 4+16

Pattern of Examination	Bifurcation of Marks	Time
Written Test	20	2 Hours
Model/ Chart and Viva-Voce	7+3	2 Hours
Record and Viva-Voce	7+3	

**Note-*

1. *The students will have to prepare A3 Size Record Book which will be simultaneously checked by the Teacher in the class after teaching and evaluated during the*

अतिरिक्त कुलसचिव
राजस्थान विश्वविद्यालय, जयपुर

examinations.

2. *There will be 6 questions (3 questions from each unit) in written paper out of which student have to compulsorily attempt 2 questions from each unit.*
3. *The student will have to prepare Model/Chart INDIVIDUALLY form the practical syllabus of Geography and have to submit during the examination.*
4. *Simple Calculator is permitted in practical examination.*

Unit –I

Three Dimensional Diagrams – Cube, Sphere, Block Pile, Stil-Gen-Bauer's and Sten-de-Geer's Method, Traffic Flow Diagram

Application of Computer in Geography- MS Word & MS Excel

1. तीन आयामी आरेख – घन, क्षेत्र, ब्लॉक ढेर, स्टिल-जनरल-बाउर और स्टेन-डी-गीयर विधि, यातायात प्रवाह आरेख

भूगोल में कंप्यूटर का अनुप्रयोग- एमएस वर्ड और एमएस एक्सेल

Unit –II

Zenithal Projections (Equidistant, Equal Area, Gnomonic, Stereographic, Orthographic), Conventional Projection (Mollweide and Sinusoidal)

जेनिथल प्रोजेक्शन (समदूरस्थ, समान क्षेत्र, ग्नोमोनिक, स्टीरियोग्राफिक, ऑर्थोग्राफ़िक), पारंपरिक प्रोजेक्शन (मोलवीड और साइनसॉइडल)

B.A./B.Sc. 6th Semester Geography Practical Examination (A)

M.M. 20 H 2.00

प्रत्येक खंड में से दो-दो प्रश्न का चयन करते हुए कुल चार प्रश्न हल करें

Unit - 1

प्रश्न 1. निम्नलिखित आंकड़ों को (CUBE) घन आरेख के द्वारा प्रदर्शित कीजिए

(भारत में प्रमुख खनिजों के अनुमानित संचित भंडार)

खनिज	संचित भंडार	खनिज	संचित भंडार
कोयला	8577	ताम्र अयस्क	40
लोह् अयस्क	2300	सीसा-जस्ता	21
बॉक्साइट	240	मैंगनीज अयस्क	08

प्रश्न 2. एमएस वर्ड (MS word) क्या है? भूगोल में इसकी उपयोगिता लिखिए।

प्रश्न 3. क्षेत्रीय स्टिल जनरल बाउर (Stil-Gen-bauer)विधि के बारे में बताईए

Unit - 2

प्रश्न 4. उत्तरी गोलार्ध को प्रदर्शित करने के लिए एक ध्रुवीय खमध्य समदूरस्थ (polar Equidistant projection) प्रक्षेप की रचना कीजिए। प्रक्षेप की मापनी 1: 200,000,000 तथा रेखान्तराल 30 डिग्री है।

प्रश्न 5. 30 डिग्री उत्तरी गोलार्ध से 90 डिग्री उत्तरी गोलार्ध के मध्य क्षेत्र 1:225,000,000 मापनी पर मानचित्र बनाने के लिये एक (polar Gnomonic projection) नोमानिक ध्रवीय खमध्य प्रक्षेप की रचना कीजिए प्रक्षेप में अन्तराल 20 डिग्री रखिए।

प्रश्न 6. किन्हीं दो पर संक्षिप्त टिप्पणी लिखिए

(1) त्रिविम ध्रुवीय खमध्य प्रक्षेप की पहचान तथा गुणधर्म (Stereographic)

(2) मालवीड प्रषेप की पहचान तथा गुणधर्म (Mollweide)

(3) साइनसाइडल प्रषेप की पहचान तथा गुणधर्म (Sinusoidal)

B.A./B.Sc. 6th Semester Geography Practical Examination (B)

M.M. 20

H 2.00

Unit - 1

प्रश्न 1. आयतनी या स्टेन डी गीयर विधि (Sten-de-Geer) के बारे में लिखिए

प्रश्न 2. निम्नलिखित आंकड़ों की सहायता से (Block Pile diagram) एक ब्लॉक पुज आरेख बनाइए

संसार में मत्स्य उत्पादन 1978

देश	उत्पादन (लाख मीटरी टन)	देश	उत्पादन (लाख मीटरी टन)
जापान	110	नार्वे	35
सोवियत संघ	102	संयुक्त राज्य अमेरिका	31
चीन	70	भारत	25
पीरू	44	डेनमार्क	21

प्रश्न 3. एमएस एक्सेल (MS Excel) क्या है भूगोल में इसकी उपयोगिता वर्णन कीजिए

Unit - 2

प्रश्न 4. 250,000,000 मापनी पर उतरी गोलार्ध के लिए (polar Stereographic projection) एक त्रिविम ध्रुवीय खमध्य प्रक्षेप की रचना की जिए। प्रक्षेप की अन्तराल 15 डिग्री रखिये|

प्रश्न 5. 1:250,000,000 मापनी पर संसार का मानचित्र बनाने के लिए एक मॉलवीड प्रक्षेप (Mollweide projection) की रचना की जिये प्रक्षेप में अन्तराल 15 डिग्री रखिये|

प्रश्न 6. इनमें से किसी दो पर संक्षिप्त में टिप्पणी लिखिए

(1) नोमानिक ध्रुवीय खमध्य प्रक्षेप पहचान एवं गुणधर्म (Polar Gnomonic projection)

(2) ध्रुवीय खमध्य समदूरस्थ के पहचान एवं गुणधर्म (polar Equidistant projection)

(3) त्रिविम ध्रुवीय खमध्य प्रक्षेप की पहचान एव गुणधर्म (polar Stereographic projection)

B.A./B.Sc. 6th Semester Geography Practical Examination (C)

M.M. 20

H 2.00

प्रत्येक खंड में से दो दो प्रश्न का चयन करते हुए कुल चार प्रशन हल करें

Unit - 1

प्रश्न 1. यातायात प्रवाह् आरेख (Traffic Flow Diagram) क्या है सचित्र वर्णन कीजिए

प्रश्न 2. निम्नलिखित आंकड़ों को (Sphere Diagram)गोलीय आरेख द्वारा प्रकट कीजिए

भारत के महानगरीय शहरों की जनसंख्या 1981

महानगर	जनसंख्या	महानगर	जनसंख्या	महानगर	जनसंख्या
कोलकाता	9165650	बैंगलोर	2913537	पुणे	1685266
वृहत मुंबई	8202759	हैदराबाद	2565536	नागपुर	1297977
दिल्ली	5227730	अहमदाबाद	2515195	लखनऊ	1006843
चेन्नई	4276635	कानपुर	1685308	जयपुर	1004669

प्रश्न 3. भूगोल में एमएस वर्ड MS Word और एमएस एक्सेल MS Excel को समझाइए

Unit - 2

प्रश्न 4. 1:200,000,000 मापनी पर उतरी गोलार्ध का मानचित्र बनाने के लिए(Polar Zenithal equal area project) एक ध्रुवीय खमध्य समक्षेत्र प्रक्षेप की रचना कीजिए। प्रक्षेप में अन्तराल 30 रखिये

प्रश्न 5. 1:125,000,000 मापनी पर उतरी गोलार्ध का मानचित्र बनाने के लिए(Orthographic polar Zenithal projection) एक लम्बकोणिय ध्रुवीय खमध्य प्रक्षेप बनाइए | प्रक्षेप में अन्तरात 15 रखिये ।

प्रश्न 6. 1:250,000,000 मापनी पर संसार का मानचित्र बनाने के लिये (Sinusoidal projection) एक साइनसाइडल प्रेक्षप की रचना कीजिये। प्रक्षेप में अन्तराल 15 है।

B.A/B.sc-VIth Semester Geography (Practical)

DATE / /
PAGE NO.:

Unit-I

(A) त्रिविम - आरेख -(Three-Dimensional Diagrams)
(i) घन - आरेख (Cube diagram)
(ii) ब्लॉक -पुंज आरेख (Block Pile diagram)
(iii) यातायात प्रवाह आरेख (Traffic flow Diagram)
(iv) गोलीय आरेख -(Sphere diagram)

(B) वितरण मानचित्रण की विधियाँ :-
(i) बिन्दु -विधि (Dot Method):- बिन्दु-मूल्य निश्चित करने की विधियाँ :-
(A) स्टिल-जेन-बोअर विधि-(Stil-Gen-Baver method)
(B) स्टेन -डी -गीर विधि (Sten-de-Geer's method)

(C) भूगोल में कंप्यूटर का अनुप्रयोग :-(Application of Comp. in Geo.)
(i) एम० एस वर्ड (MS Word)
(ii) एम. एस एक्सेल (MS Excel)

Unit-II

(D) खमध्य प्रक्षेप (Zenithal Projections):-
(i) ध्रुवीय खमध्य समदूरस्थ प्रक्षेप (Equidistant Projections)
(ii) खमध्य समक्षेत्र प्रक्षेप (Equal Area):-
(iii) नोमॉनिक खमध्य प्रक्षेप (Gyomonic Zenit. Projection)
(iv) त्रिविम खमध्य प्रक्षेप (Stereographic Zenith. Projection).
(V) लम्बकोणीय खमध्य प्रक्षेप (Orthographic Zenith Projection)

(E) पारंपरिक प्रक्षेप (Conventional Projection):-
(i) मोलवीड प्रक्षेप (Mollweide Projection):-
(ii) साइनसॉइडल प्रक्षेप (Sinusoidal Projection):-

(F) Model/Chart(अ) ⇒ 7+3 ⇒ 10 अंक

Teacher's Signature..........

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common ...
according to an index, ...
(area here) in figures.

Unit-I

THREE-DIMENSIONAL DIAGRAMS

In three-dimensional diagrams, all the three dimensions-length, breadth and height are used. So the given values are shown by three dimensional figures such as cubes, blocks, or spheres, etc. The data is represented in their ratio to volume of these figures. That is why three-dimensional diagrams are also called **volume-diagrams.** Such type of diagrams are preferred when there is big difference in the value of data. This means that data of an item is very big and that of the other, very small. Main kinds of three-dimensional diagrams are explained below.

(A) Spherical Diagram

Spherical diagrams are different from wheel diagrams in two respects—**First,** in spherical diagrams (3-dimensional), spheres are drawn instead of circles (2-dimensional) and **Second,** the radii of these spheres are in the ratio of the cube root of the figures/data. Cube root of any figure is found out by log tables or antilog tables of cube roots. If cube roots are to be found out only for the purpose of spherical diagrams, the help can be taken of table in the appendix of cube roots given at the end of this book. In this appendix table, calculated cube roots from 1 to 1000 figures are given. For using these tables, first of all, actual figures whose cube root is to be found is rounded off in 3-digit figures (as tables are upto 1000 figures and only 3-digit figures shall be calculated upto 1000). For example, if cube root of 53,635,000; 72,340,000 and 35,833,000 are to be found out, these figures in 3-digits will be 536 lakh, 723 lakh and 358 lakh. Now from appendix table, cube roots of these figures will be found out which are 8·1231; 8·9752 and 7·1006.

As in the construction of ring diagram, the radii of various spheres representing different data are calculated first beginning with taking a radius either of the biggest or the smallest sphere. Thereafter, radii of other spheres in its ratio are calculated. For representing population of big cities, these spheres are often drawn.

Q. *Example 14* : Represent the following data by spherical diagrams—

Population of Metropolitan Cities in India, 1981

Metropolitan Cities	Population	Metropolitan Cities	Population
Calcutta	9,165,650	Ahmadabad	2,515,195
Greater Mumbai	8,202,759	Kanpur	1,685,308
Delhi	5,227,730	Pune	1,685,266
Chennai	4,276,635	Nagpur	1,297,977
Bangalore	2,913,537	Lucknow	1,006,843
Hyderabad	2,565,536	Jaipur	1,004,669

Write the given data in nearest round figures and find out the radii of spheres in the following way—

Metropolitan Cities	Population	Nearest figures (lakh)	Cube root	Radius of the sphere (in cm)
Calcutta	9,165,650	91·66	4·505	$\frac{4{\cdot}505}{4{\cdot}505} \times 2 = 2{\cdot}00$
Greater Mumbai	8.202,759	82·03	4·345	$\frac{4{\cdot}345}{4{\cdot}505} \times 2 = 1{\cdot}93$
Delhi	5,227,730	52·28	3·740	$\frac{3{\cdot}740}{4{\cdot}505} \times 2 = 1{\cdot}66$
Chennai	4,276,635	42·77	3·497	$\frac{3{\cdot}497}{4{\cdot}505} \times 2 = 1{\cdot}55$
Bangalore	2,913,537	29·14	3·077	$\frac{3{\cdot}077}{4{\cdot}505} \times 2 = 1{\cdot}37$
Hyderabad	2,565,536	25·66	2·949	$\frac{2{\cdot}949}{4{\cdot}505} \times 2 = 1{\cdot}31$
Ahmadabad	2,515,195	25·15	2·932	$\frac{2{\cdot}932}{4{\cdot}505} \times 2 = 1{\cdot}30$
Kanpur	1,685,308	16·85	2·564	$\frac{2{\cdot}564}{4{\cdot}505} \times 2 = 1{\cdot}14$
Pune	1,685,266	16·85	2·564	$\frac{2{\cdot}564}{4{\cdot}505} \times 2 = 1{\cdot}14$
Nagpur	1,297,977	12·98	2·351	$\frac{2{\cdot}351}{4{\cdot}505} \times 2 = 1{\cdot}04$
Lucknow	1,006,843	10·07	2·159	$\frac{2{\cdot}159}{4{\cdot}505} \times 2 = 1{\cdot}96$
Jaipur	1,004,669	10·05	2·158	$\frac{2{\cdot}158}{4{\cdot}505} \times 2 = 1{\cdot}96$

In the above table the radius of 2 cm for the metropolitan city of maximum population has been taken according to suitability, for the calculation of the radii of other metropolitan cities. Now, on the basis of these radii, draw spheres and write titles, etc. (Fig. 14).

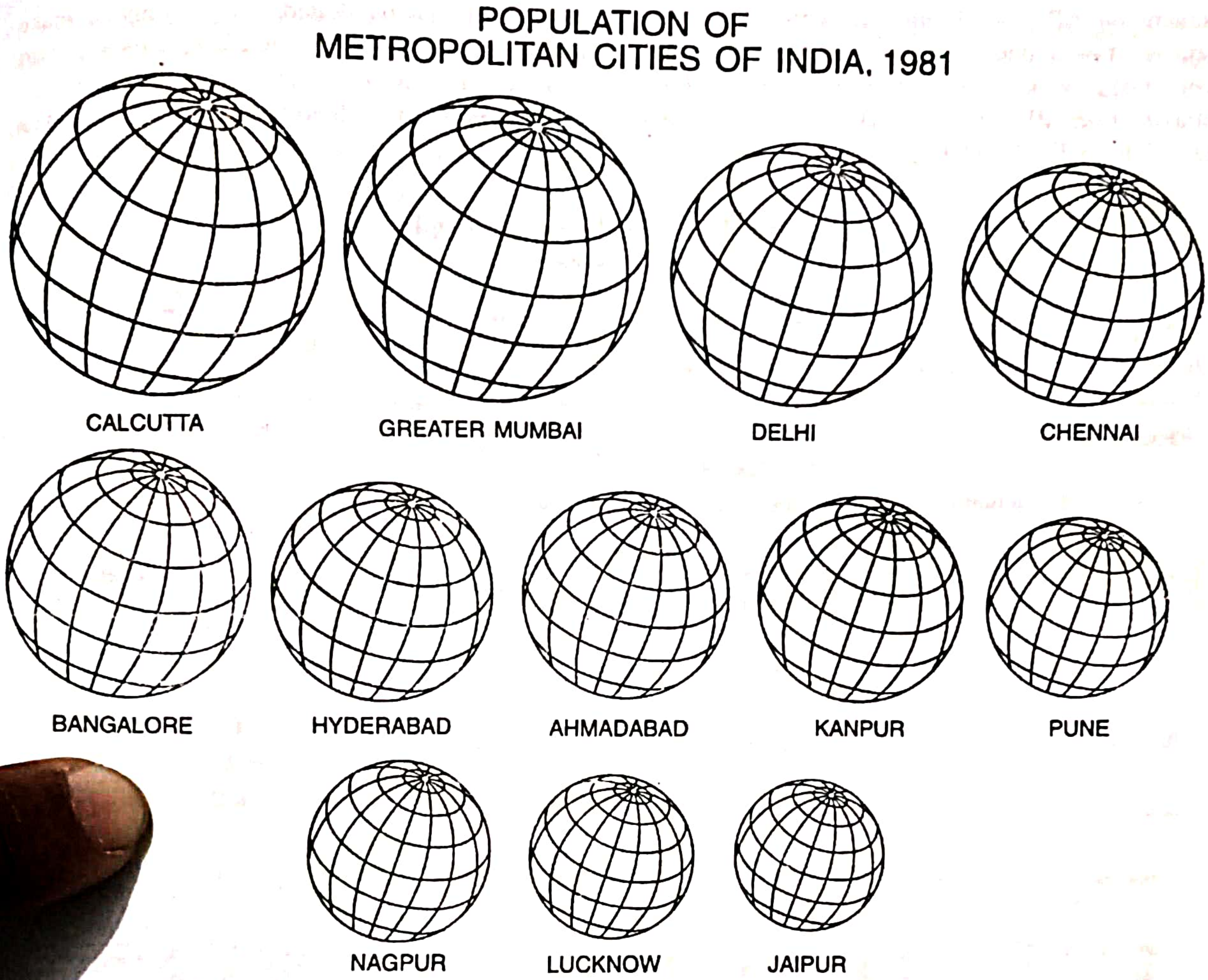


Fig 14. Sphere diagram.

(B) Cube Diagram

The given data is represented by cubes in these diagrams. The volume of these cubes is kept in accordance to the cube root of those data. First of all, cube roots of given values are therefore, found out. Thereafter, the side of the cube representing the smallest or the largest figure is chosen according to convenience. The sides of remaining cubes are calculated according to the preceding method. As the length, width and height, all three measures are the same in a cube, a cube can be easily drawn if its one side is known. In Fig.15 the method of drawing a cube is explained. Suppose there is a side AB on which a cube is to be drawn. Draw an ABCD

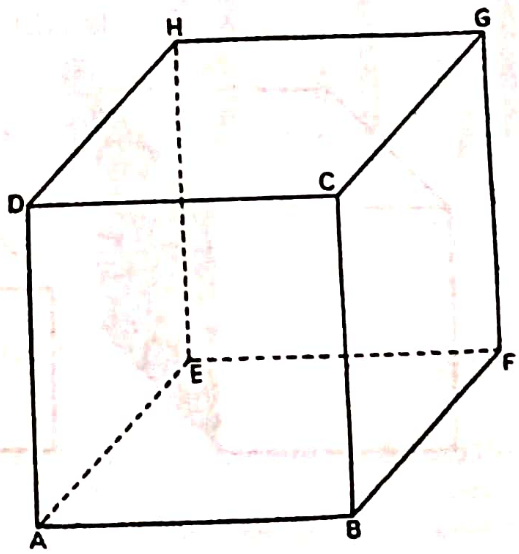


Fig 15

square on AB line. From the centre E of this square draw a line EF parallel and equal to AB and make another square EFGH. Now draw straight lines BF, CG and DH joining B, C and D points to F, G and H points respectively. The purpose of making dotted lines is only to make another square clear and therefore, showing them in the diagram is not necessary at all.

Example 15 : Represent the following data by cube diagram—

Estimated Mineral Reserves in India
(crore tons)

Minerals	Reserves	Minerals	Reserves
Coal	8,577	Copper ore	40
Iron ore	2,300	Lead zinc ore	21
Bauxite	240	Manganese ore	8

Carry out calculation to make cube diagram in the following manner—

Mineral	Reserves (Crore tons)	Cube root	Side of a cube (in cm)
Coal	8,577	20·46	$\frac{20\cdot46}{2} \times 0\cdot25 = 2\cdot56$
Iron-ore	2,300	13·20	$\frac{13\cdot20}{2} \times 0\cdot25 = 1\cdot65$
Bauxite	240	6·21	$\frac{6\cdot21}{2} \times 0\cdot25 = 0\cdot77$
Copper ore	40	3·42	$\frac{3\cdot42}{2} \times 0\cdot25 = 0\cdot43$
Lead zinc ore	21	2·76	$\frac{2\cdot76}{2} \times 0\cdot25 = 0\cdot35$
Manganese ore	08	2·00	$\frac{2\cdot00}{2} \times 0\cdot25 = 0\cdot25$

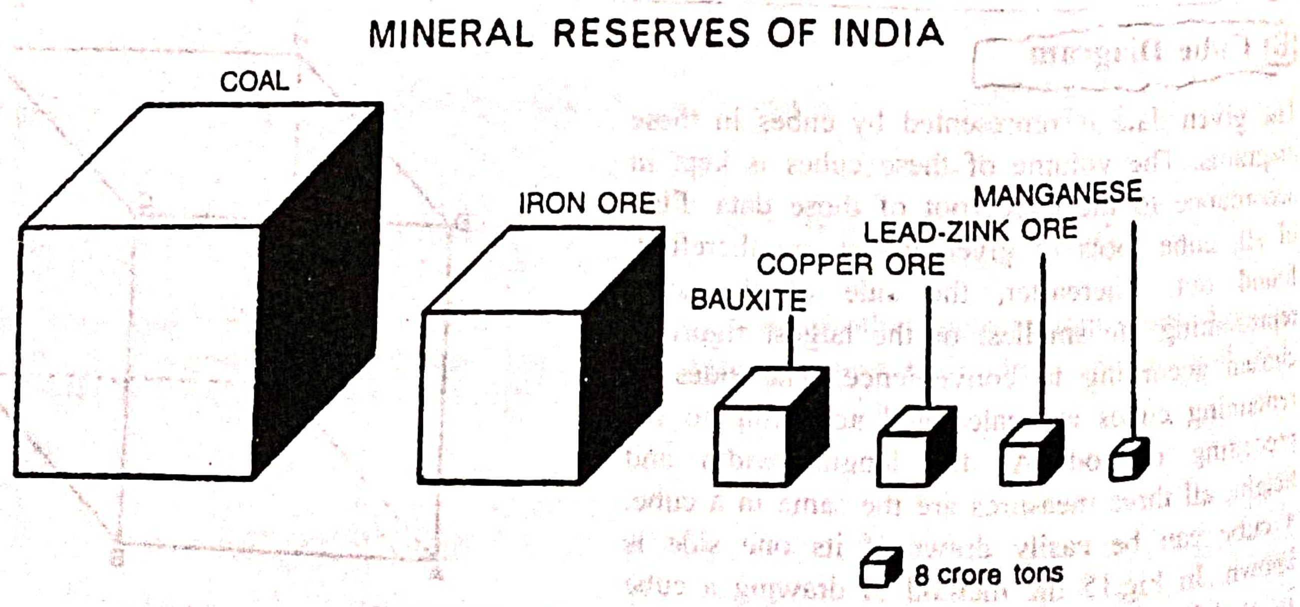


Fig 16. Cube diagram.

In above table, minimum cube root is (2·0). The cube representing it may be taken with a side of 0·25 cm according to convenience. On the basis of this scale for minimum figure, the side of other cubes are found out as 2·56, 1·65, 0·77, 0·43, 0·35 and 0·25 cm. Finally the cubes are drawn for representing reserves of coal, iron ore, bauxite, copper ore, lead-zink ore and manganese ore (Fig. 16).

(C) Block Pile Diagram

On a pre-decided scale of one cube, total number of cubes are calculated to represent any value and then are drawn as a pile of cubes. For example, if a scale 1 cube = 5 ton is chosen, to represent 100 tons, 100/5 = 20 cubes of the same size will form a pile. In each pile, cubes are drawn in such a way that all of them may be counted easily. Keeping 10 cubes in a pile is, therefore, quite convenient for counting even at a glance. Suppose 400 cubes are to be shown in a pile, it is obvious that there shall be 40 columns of 10 cubes each. Now, these columns may be conveniently put as 10×4 or 8×5 rows to form the pile. If some cubes are left out after making column of 10 cubes, smaller columns of these cubes must be drawn in the front part of the piles so that each cube could be counted.

~~Example~~ *16* : With the help of the following data, construct a block-pile diagram.

Production of Fisheries in the World, 1978

Country	Production (lakh metric tons)	Country	Production (lakh metric tons)
Japan	110	Norway	35
Soviet Union	102	United States of America	31
China	70	India	25
Peru	44	Denmark	21

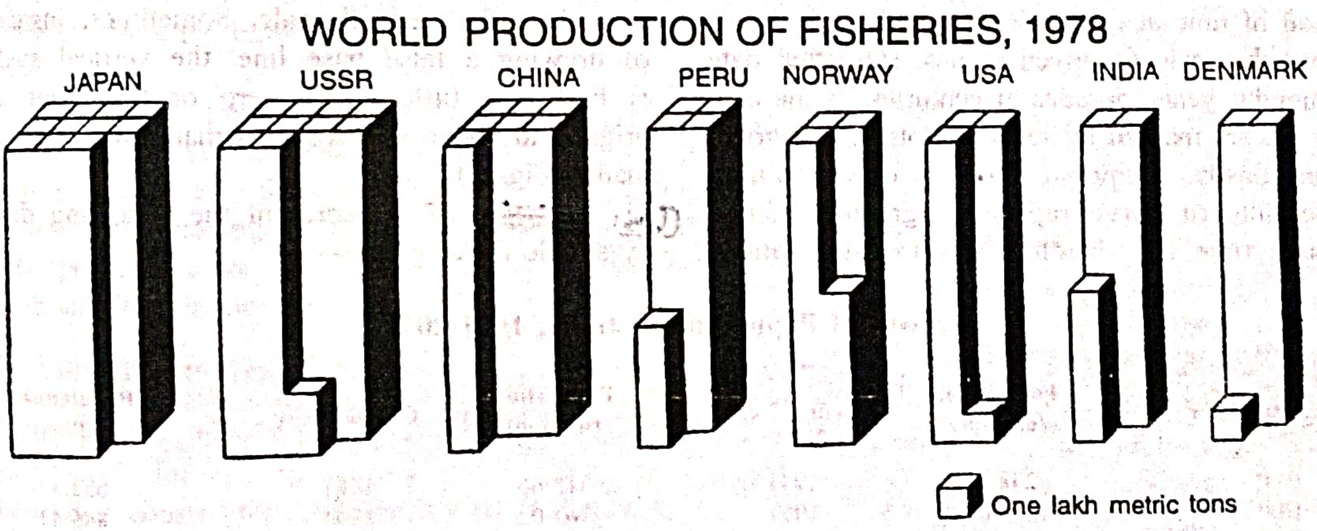


Fig 17. Block-pile diagram.

Choosing a suitable scale, supposing 1 unit cube = 1 lakh metric tons, find out the number of cubes for each country. According to above scale, the number of cubes for Japan, Soviet Union, China, Peru, Norway, United States of America, India and Denmark shall be 110, 102, 70, 44, 35, 31, 25 and 21 respectively. Now keep cubes of various countries in the columns of 10 and draw 8 piles at equal mutual distance (Fig.17).

(C) Dot Method

This method of making distribution maps uses dots for showing distribution of any thing/theme. A value is determined for a dot, such as a dot represents 5,000 persons or 1,000 animals or 500 hectares, etc. According to scale selected for one dot, their number is found out for all administrative divisions like a country, state, district, tehsil or development block, as the data given requires. The number of dots found out are placed within administrative unit. For example, the distribution of area under rice cultivation in districts of Uttar Pradesh is shown by dots (Fig.5). In this map, each dot represents 500 hectares of rice-area. From the above description it is clear that dot map is such a choroschematic map in which only one symbol of dot is repeated again and again.

Making of dot map is, infact, not as easy as it appears. This is because of the following four problems, whose solution is absolutely necessary before making the map.

1. Determining the dot-value. The success or failure of a dot map depends on the decision as to what quantity or number is determined for a dot. For example, if the value of a dot is determined very low, then in areas of high density, overwhelming number of dots will make the area black totally blurring the clarity of each dot. On the contrary if the dot-value is chosen very high, then some areas of less quantity or density will remain empty. So, keeping in mind the size of map and the range of data, point-value be chosen in such a way that each statistical unit (like district) has at least 2-3 dots and in more dense areas, number of dots does not become so high as the area becomes black by coalescing.

For a dot map showing distribution of population, it is difficult to select a dot-value by which accurate distribution of urban and rural population could be shown, as there is far more population in cities as compared to the villages. So even if only one dot is selected for a village of the smallest population, a metropolitan city will need very large number of such dots and it will become very difficult to put all the dots within the boundary of a metropolis. This will result in some dots being put beyond the boundary of metropolis where, in reality, population is not that big. There are the following two methods of solving this problem—

(a) 'Areal' or Stilgenbauer's method. In this method, rural population is shown by uniform dots and urban population by circles. The area of each circle is proportionate to its population. Its radius is calculated by the method as used in ring diagram. This is notable here that for finding out radius of any circle, in the formula of ring diagram, in place of minimum population, population of a uniform dot representing rural population should be used. By so doing the ratio between the radius and population represented by it remains the same as is

between the 'radius' of a dot and the rural population represented by it. For example, suppose one dot represents 2500 rural persons. Now if its 'radius' is 0·5 millimetre, the radius (R) of the circle representing 1000000 population of a city will be found out thus—

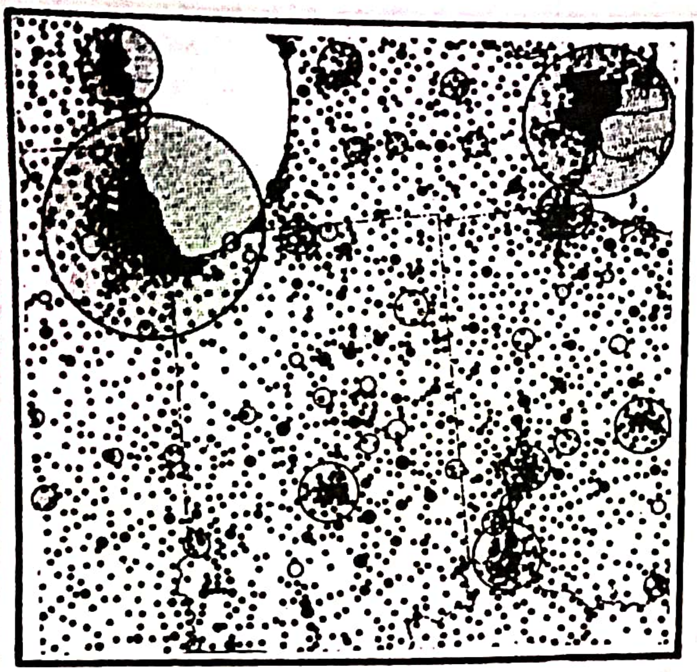


Fig 6. Stilgenbauer's method (From E.Raisz, *General Cartography*).

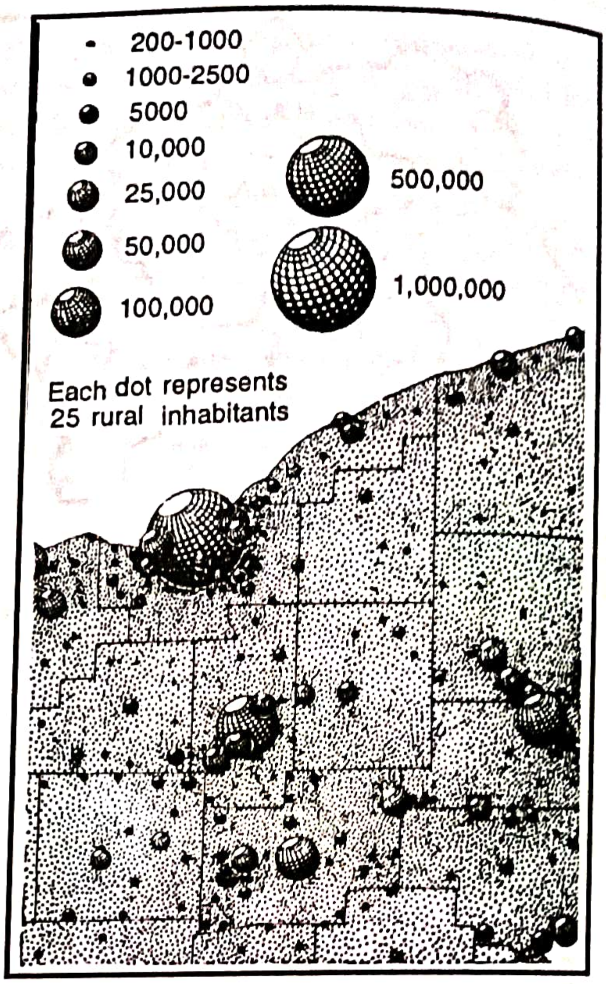


Fig 7. Sten de Geer's method (From E.Raisz, *General Cartography*).

$$R = \frac{\sqrt{1000000}}{\sqrt{2500}} \times 0{\cdot}5 \text{ mm}$$

$$= \frac{1000}{50} \times 0{\cdot}5 = 10 \text{ mm or } 1 \text{ cm}$$

Circles with their radii are drawn at the location of cities as their centres. These circles are left unshaded or very lightly shaded, so that dots within them could be easily identified.

(b) Volumetric or Sten de Geer's method. This method is similar to Stilgenbaur's method with the difference that population of cities is represented by spheres in place of circles (Fig.7). The radii of these sphere is found out according to the method explained under spherical diagrams in chapter 14. A sphere occupies less space in the map in comparison to a circle and this is the greatest merit of this method. For example, for a city of 1000000 population,

$$R = \frac{\sqrt[3]{1000000}}{\sqrt[3]{2500}} \times 0{\cdot}5 \text{ mm}$$

$$= \frac{100}{13{\cdot}57} \times 0{\cdot}5 = 3{\cdot}7 \text{ mm}$$

which is quite less than the radius for circle which was 10 millimetres.

A comparison of above methods throws light on many facts. **First**, dissimilarity in the distribution of population is represented more lively, clearly and effectively but it is relatively difficult to determine their equivalence. **Secondly**, dots showing rural population can not be marked within spheres as they can be placed within circles with the result that dots of rural areas become obscure around a city in Sten de Geer's method. **Thirdly**, circles can be converted into wheel/pie diagrams if need arises but spheres can not be subdivided. **Fourthly**, construction of overlapping spheres is difficult in comparison to overlapping circles.

It should be heeded that in none of these two methods, place names should be written within the map to avoid obscuring many dots that may be covered By such writing.

Computer Software for Your Use

In the preceding paragraphs, a number of data processing softwares have been referred. However, it would be difficult to discuss the capabilities and functions of each one of these softwares under the constraints of time and space. We will, therefore, describe the procedure that is followed in data processing and the preparation of graphs and diagrams using **MS Excel or Spreadsheet** program. The **spreadsheet** enables us to feed data, compute various statistics and represent the raw data or computed statistics through graphical methods.

MS Excel or Spreadsheet

As mentioned earlier, MS Excel, Lotus 1 – 2 – 3, and d – base are some of the important softwares used for data processing, and drawing graphs and diagrams. MS Excel being most widely used and commonly available software program in all parts of the country has been chosen among other software to carry out the data processing. Besides, it is also compatible with map-making software as one can easily feed data in MS Excel and attach it to the map-making software to create maps.

MS Excel is also called a spreadsheet programme. A spreadsheet is a rectangular table (or grid) to store information. The spreadsheets are located in Workbooks or Excel files.

Most of the MS Excel screen is devoted to the display of the worksheet, which consists of rows and columns. The intersection of a row and column is a rectangular area, which is called a **cell**. In other words, a worksheet is made up of cells. A cell can contain a numerical value, a formula (which after calculation provides numerical value) or text. Texts are generally used for labelling numbers entered in the cells. A value entry can either be a number (entered directly) or result of a formula. The value of a formula will change when the components (arguments) of the formula change.

An Excel worksheet contains 16,384 rows, numbered 1 through 1,6384 and 256 columns, represented by default through letters A through Z, AA through AZ, BA through BZ, and continuing to IA through IZ. By default, an Excel workbook consists of three worksheets. If you require, you can insert more, up to 256 worksheets. This means that in the same file/workbook you can store a large number of data and charts. *Fig.4.1* shows how an excel workbook looks like.

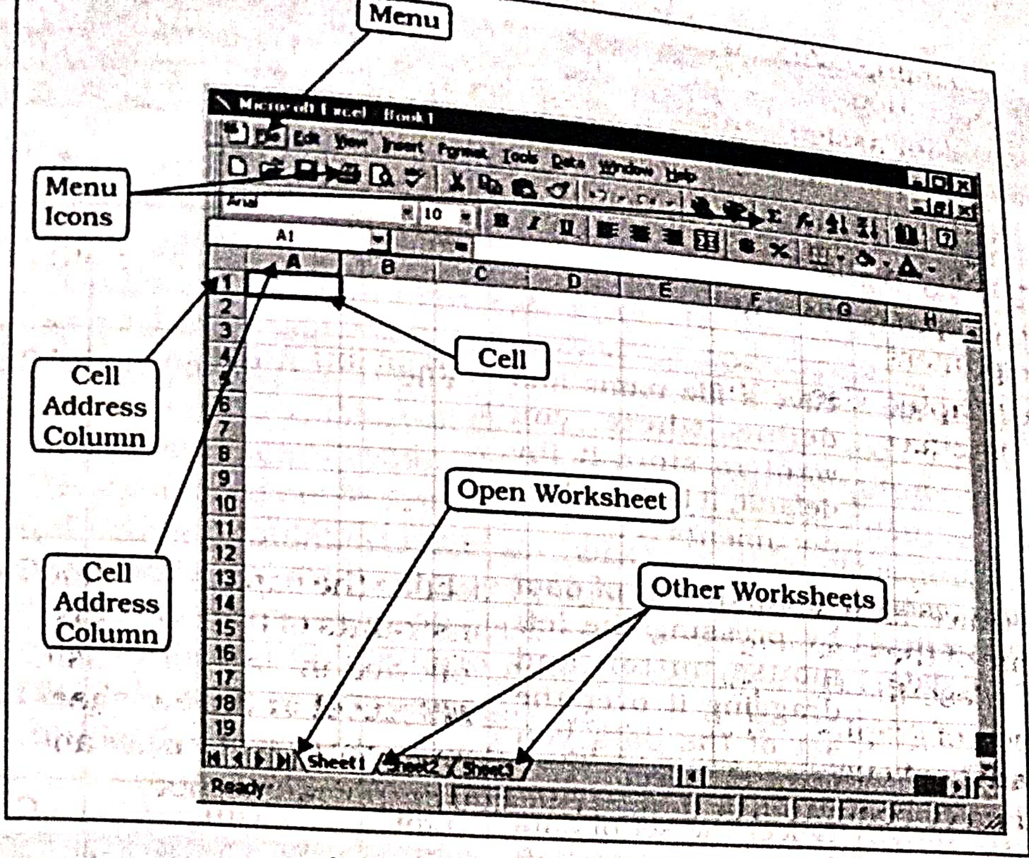


Fig. 4.1 : MS Excel Workbook

Data Entry and Storing Procedures in Excel

The data entry and storing procedures are very simple in Excel. You can enter, copy and move any data from one cell to another and save them. You may also delete incorrect or unwanted data entry or a complete file, if it is not required for further use. The elementary functions of Excel that you would require for entering data and storing them are described in *Table 4.1*. You can learn more on your own by exploring other menus and options by yourself. Further, you will find it easier to feed data if you use the **number pad** given on the right side of your keyboard. For entering data column-wise, you need to press 'enter key' or 'down arrow' after typing a number. While row-wise pressing right arrow key after typing a number can enter data.

Data Processing and Computation

Often raw data need to be processed for further use. You can easily add, subtract, multiply, and divide numbers using the keyboard signs of +, -, *, and /, respectively. These signs are known as **operators** and they connect elements in a **formula** or **expression**. For example, if you want to solve the expression 5 + 6 – 8 – 5, then you can easily work it out in steps below :

Step 1 : Click on any cell (with the help of mouse).

Step 2 : Type =, followed by the expression. Thus, the expression becomes = 5 + 6 – 8 – 5.

Step 3 : Press enter key, and you will get the result in the same cell that you had chosen in Step 1.

Note : The numerical operations can only be performed in excel by first typing = sign.

Table 4.1: Important Functions for Entering and Storing Data

S. No.	Function	Instructions	Menu	Secondary Menu (from dropdown list)	Keyboard Shortcuts
1.	For opening a new file		File	New	Ctrl N
	For opening an existing file		File	Open	Ctrl O
2.	Save a file	Give a file name and define where you want to store it (by default, it is c:\....\my documents\)	File	Save	Ctrl S
3.	Copy, move and paste a set of data	Select the set of data by pressing the left mouse button and dragging it over the set of the data you want to select	Edit	Copy	Ctrl C
4.	Cut, move and paste a set of data	Select the set of data by pressing the left mouse button and dragging it over the set of the data you want to select	Edit	Cut	Ctrl X
5.	Paste a set of data	Take the cursor to the cell where you want to paste it	Edit	Paste	Ctrl V
6.	For undoing the last action*		Edit	Undo	Ctrl Z
7.	For redoing the last action*		Edit	Repeat	Ctrl Y

*Note: * You cannot undo or redo any action if you have saved the file after the last action.*

These operators that connect elements in a formula are solved in an order. The expressions enclosed in 'brackets' are solved first and are followed by the 'exponents', 'division', 'multiplication', 'addition' and 'subtraction'. For example, expression/formula within a cell given as =A8/(A9 + A4) will be solved using Excel as under:

It will first add the values entered in cells A9 and A4, and then will divide the value of A8 by the sum.

Further, if you want to supplement your understanding on the percentage share of urban population to the total population, in that case, you have to calculate the percentage of urban population in various states of India. To do so, you will require the data on urban population and total population for each

State of India

You have already been introduced to some basic statistical methods, such as measures of central tendency, dispersion and correlation in Chapter 2. You must have understood the concept and rationale behind these techniques. The use of worksheet functions to compute these statistics will be discussed in the subsequent paragraphs.

In MS Excel, there are numerous inbuilt statistical and mathematical functions. These functions are located in **Insert** menu. To use the function, click on the **Insert** menu, and choose f_x **(Function)** from the dropdown list. Note that your cursor should be located in the cell where you want the formula to appear. Some examples of application of statistical functions are given below.

Central Tendencies

Central tendencies are represented by mean, median and mode. Arithmetic mean, also called average, is a commonly used method for calculating the central tendency. In MS Excel, it is denoted by its popular name **average.** As an example, we shall calculate mean cropping intensity in India during various decades using the average function in Excel. The following steps are to be undertaken :

Step 1 : Enter year-wise cropping intensity data in a worksheet, as shown in *Fig.4.4.*

Step 2 : Click on cell **B12** using mouse.

Step 3 : Click on **Insert Menu** and choose f_x **(Function)** from dropdown list, this will open **Insert Function dialogue box.**

Step 4 : Select **Statistical** from **select a category** menu on the dialogue box. This will bring forth the statistical functions available in Excel in the box below in the same dialogue box.

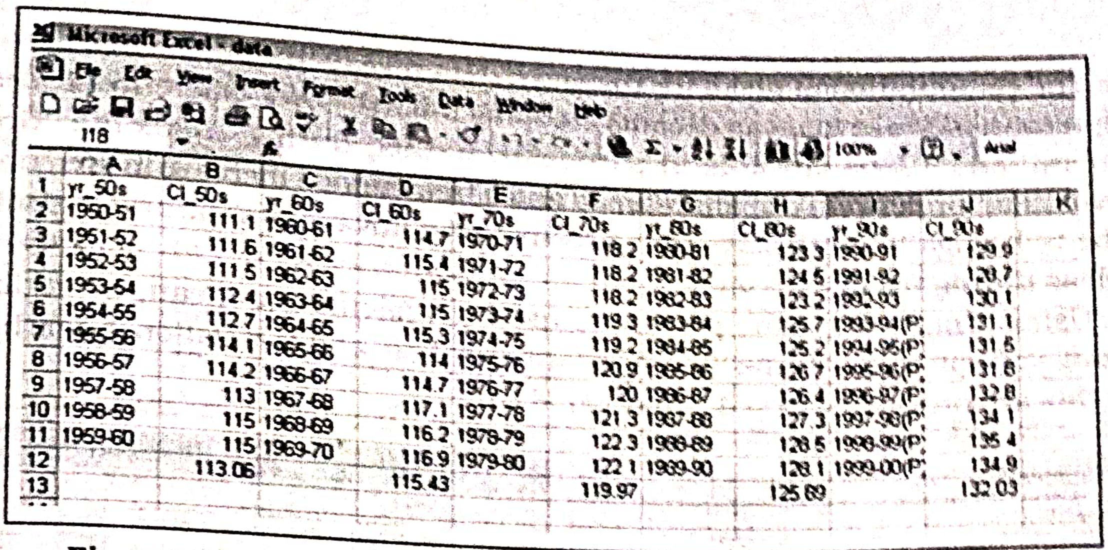
Step 5 : In the box **Select a Function,** click on **Average** and press **OK** button. This will open another dialogue box called **Function Argument.**

Step 6 : Either enter the cell range of data of the first decade CI_50s (which shows year-wise cropping intensity in 1950s) in the **Number 1 box** on **Function Argument** dialogue box of data, or drag cursor pressing the left button of mouse over the cell range of data.

Step 7 : Press OK button on the **Function Argument** dialogue box. This calculates mean cropping intensity for the decade 1950s in cell **B12**, where you had put your cursor in the beginning.

Step 8 : Now, calculate the mean for other decade either following Steps 1–7 given above or dragging cursor right handward in the same row selecting the small square from rectangle of cell B12 or you can copy the cell B12 and paste it on D12, F12, H12 and J12. This will give you the mean value of cropping intensity for the decades 1960s, 1970s, 1980s and 1990s, respectively.

These steps are further explained in *Fig. 4.4* through *Fig.4.6.*



yr_50s	CI_50s	yr_60s	CI_60s	yr_70s	CI_70s	yr_80s	CI_80s	yr_90s	CI_90s
1950-51	111.1	1960-61	114.7	1970-71	118.2	1980-81	123.3	1990-91	129.9
1951-52	111.6	1961-62	115.4	1971-72	118.2	1981-82	124.5	1991-92	128.7
1952-53	111.5	1962-63	115	1972-73	118.2	1982-83	123.2	1992-93	130.1
1953-54	112.4	1963-64	115	1973-74	119.3	1983-84	125.7	1993-94(P)	131.1
1954-55	112.7	1964-65	115.3	1974-75	119.2	1984-85	125.2	1994-95(P)	131.5
1955-56	114.1	1965-66	114	1975-76	120.9	1985-86	126.7	1995-96(P)	131.8
1956-57	114.2	1966-67	114.7	1976-77	120	1986-87	126.4	1996-97(P)	132.8
1957-58	113	1967-68	117.1	1977-78	121.3	1987-88	127.3	1997-98(P)	134.1
1958-59	115	1968-69	116.2	1978-79	122.3	1988-89	128.5	1998-99(P)	135.4
1959-60	115	1969-70	116.9	1979-80	122.1	1989-90	128.1	1999-00(P)	134.9
	113.06		115.43		119.97		125.69		132.03

Fig. 4.4 : Calculation of Mean Using Statistical Function in MS Excel

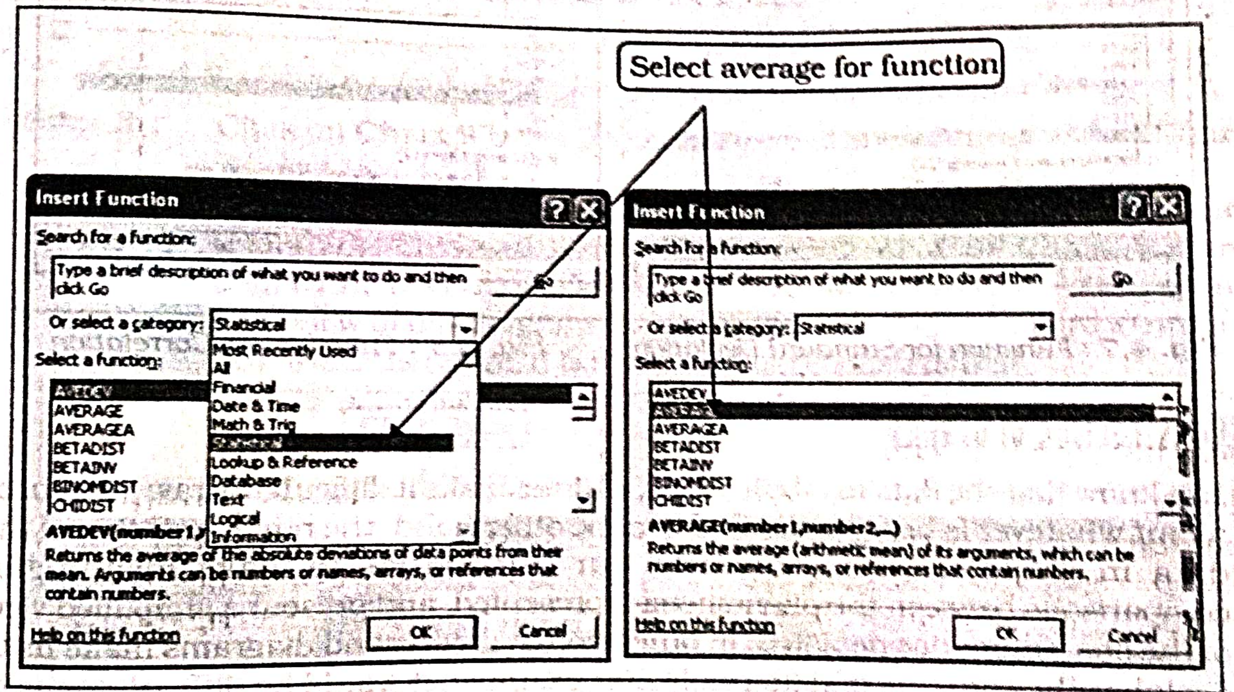


Fig. 4.5 : Selection of Statistical Function

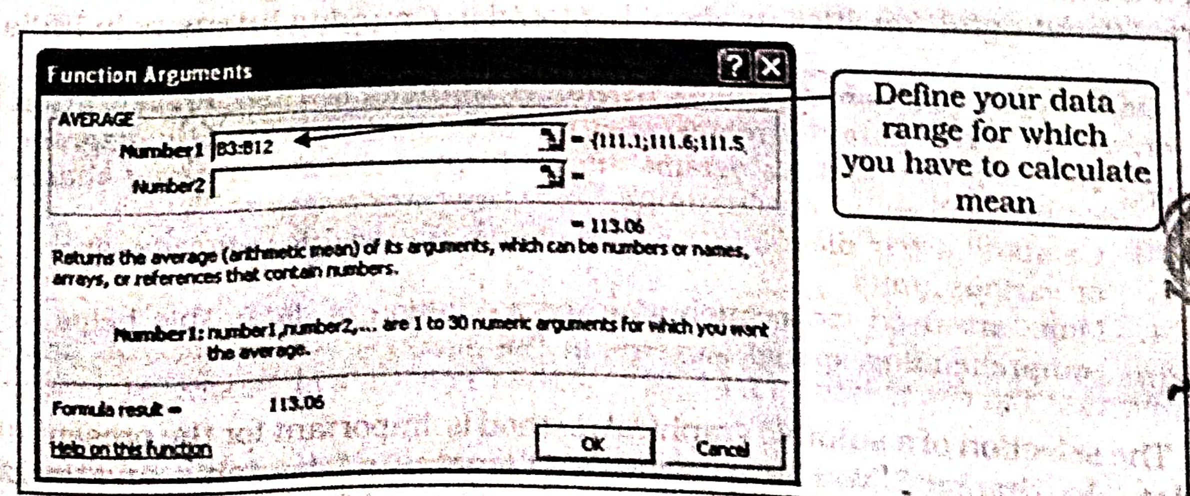


Fig. 4.6 : Defining Range in Function Arguments dialogue box

The computation of mean for the given data reveals that there has been an impressive increase in mean decadal cropping intensity over different decades in general, and 1980s onwards in particular. In fact, during 1980s the "Green Revolution" underwent a spatial spread and a tremendous increase in area under tube-well irrigation took place, which facilitated cultivation in the arid regions as well as during the dry seasons.

Using almost the same procedure used for calculating mean, as outlined above, you can calculate median, standard deviation, and correlation. Some hints for this are provided in *Fig.4.7* and *Fig. 4.8*.

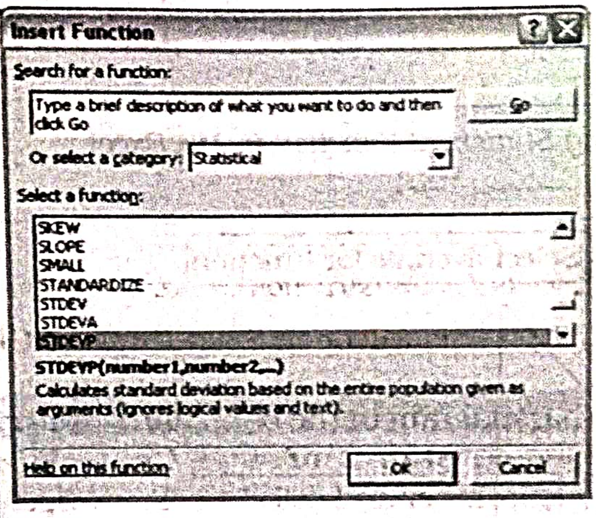


Fig. 4.7 : Function for Standard Deviation

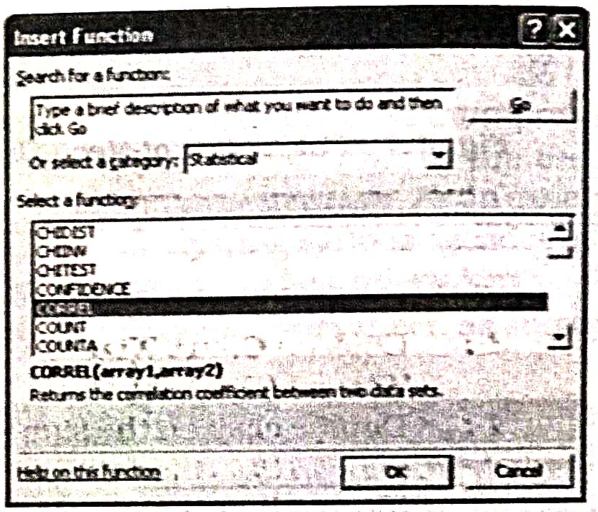


Fig. 4.8 : Function for Correlation

Construction of Graphs

You know that the data in tabular form, at times make it difficult to draw inferences about whatever is being presented. On the other hand, the representation of the data in graphical form enhances our capabilities to make meaningful comparisons between the phenomena represented, and present a simplified view of the characteristics depicted. In other words, graphs and diagrams make us to decipher the contents of data easily. For example, it would be difficult to make sense of the Cropping Intensity in India if the data for all 50 years are presented in a tabular form. However, through a line graph or bar diagram, we can easily draw meaningful conclusions about the trend in Cropping Intensity in India.

Data Types and Some Suitable Graphical Methods of their Presentation

1. Time series data are represented through line graphs or bar diagram.
2. Bar diagrams and histograms are, generally, used for showing shares or frequencies of various units.
3. Compound bar diagrams, and pie charts are used for showing shares of various units.
4. Maps are used for location-wise representation of data. This helps in comprehending spatial patterns in the data.

The selection of a suitable graphical method is important for the presentation of data. In Chapter 3, you have learnt about graphs and diagrams, and the kind of data suitable for. Here, you will learn how graphs and diagrams are constructed in Excel.

Computer Assisted Mapping

The maps may also be drawn using a combination of computer hardware and the mapping software. The computer assisted mapping essentially requires the creation of a spatial database alongwith its integration with attribute or non- spatial data. It further involves the verification and structuring of the stored data. What is most important in this context is that the data must be geometrically registered to a generally accepted and properly defined coordinate system and coded so that they can be stored in the internal database structure within the computer. Hence, care must be taken while using the computer for mapping purposes.

Spatial Data

The spatial data represent a geographical space. They are characterised by the points, lines and polygons. The point data represent positional characteristics of some of the geographical features, such as schools, hospitals, wells, tube-wells, towns and villages, etc., on the map. In other words, if we want to present the occurrence of the objects on a map in dimensionless scale but with reference to location, we use points. Similarly, lines are used to depict linear features, like roads, railway lines, canals, rivers, power and communication lines, etc. Polygons are made of a number of inter-connected lines, bounding a certain area, and are used to show area features such as administrative units (countries, districts, states, blocks); land use types (cultivated area, forest lands, degraded/waste lands, pastures, etc.) and features, like ponds, lakes, etc.

Non-spatial Data

The data describing the information about spatial data are called non-spatial or attribute data. For example, if you have a map showing positional location of your school, you can attach the information, such as the name of the school, subject stream it offers, number of students in each class, schedule of admissions; teaching and examinations, available facilities, like library, labs, equipment, etc. In other words, you will be defining the attributes of the spatial data. Thus, non-spatial data are also known as attribute-data.

Sources of Geographical Data

The geographical data are available in analogue (map and aerial photographs) or digital form (scanned images).

The procedure of creating spatial data in the computer has been discussed in Chapter 6.

Mapping Software and their Functions

There are a number of commercially available mapping softwares, such as ArcGIS, ArcView, Geomedia, GRAM, Idrisi, Geometica, etc. There are also a few freely downloadable softwares that can be downloaded with the help of Internet. However, it would be difficult to discuss the capabilities of each one of these softwares under the constraints of time and space. We will, therefore, describe the procedure in general used in choropleth mapping using a mapping software.

A mapping software provides functions for spatial and attribute data input through onscreen digitisation of scanned maps, corrections of errors, transformation of scale and projection, data integration, map design, presentation and analysis.

11. माइक्रोसॉफ्ट–वर्ड बेसिक्स (Microsoft Word Basics) (भूगोल में):-

11.1 वर्ड प्रोसेसिंग और माइक्रोसॉफ्ट–वर्ड का परिचय (Word Processing & Microsoft Word)

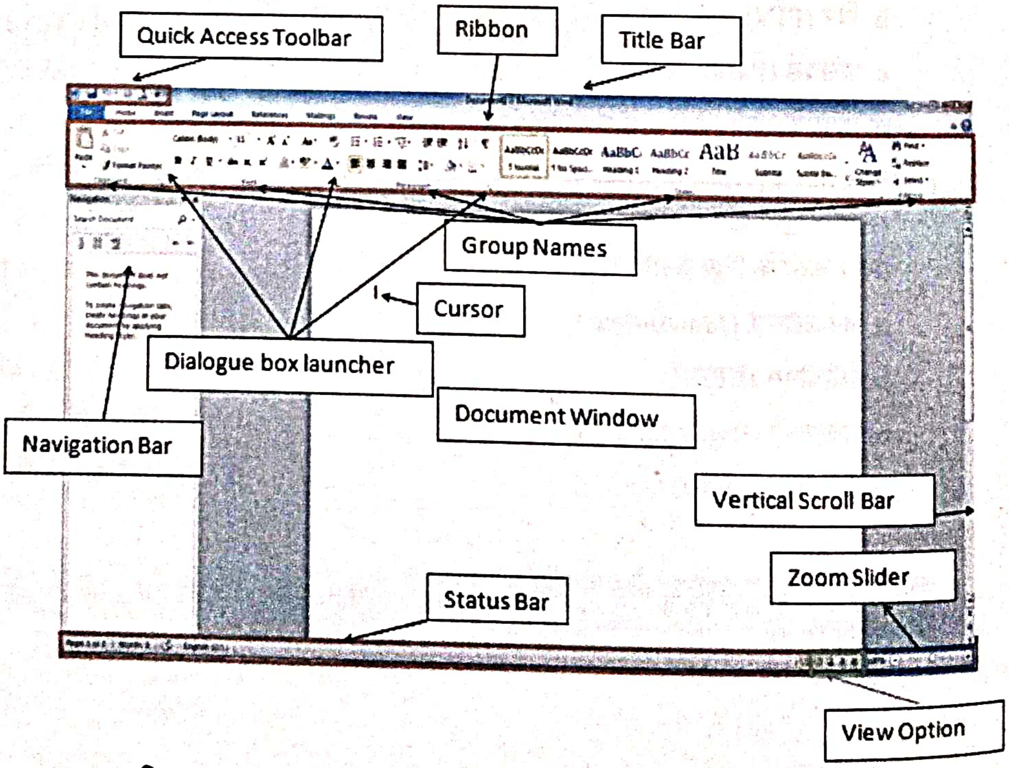
वर्ड प्रोसेसिंग हमें टाइपिंग (Typing), एडिटिंग (Editing), फोर्मैटिंग (Formatting) एवं किसी प्रकार के भी लिखित सामग्री को प्रिंट (Print) करने की सुविधा प्रदान करता है। हम दस्तावेजों को माइक्रोसॉफ्ट वर्ड के माध्यम से सहेज (Save) कर रख सकते हैं। वर्ड प्रोसेसिंग (Word Processing) को अत्याधुनिक शार्टहैण्ड (Shorthand) तकनीक के प्रकार से भी देखा जा सकता है जिसका नाम कई बार मॉडिफाइड टाइपराइटर (Modified Computer) या कंप्यूटर के विशेष प्रसंग में कहा जाता है।

माईकोसोफ्ट वर्ड एक वर्ड प्रोसेसिंग साफ्टवेयर (Software) है जो एप्लीकेशन सॉफ्टवेयर (Application Software) की श्रेणी में आता है इसे माईकोसॉफ्ट कम्पनी द्वारा विकसित किया गया है। माइक्रोसॉफ्ट वर्ड का मूल उद्देश्य लेटर टाइपिंग (Letter typing), रिपोर्ट्स (Reports) एवं विभिन्न प्रकार के डॉक्यूमेंट तैयार करना है | यह आपको आपके लैपटॉप (Laptop), पर्सनल कंप्यूटर (Personal Computer) या होम कंप्यूटर पर डेस्कटॉप पब्लिशिंग (Desktop publishing) की सुविधा प्रदान करता है|

11.2 डॉक्यूमेंट पर कार्य करना (Working with Documents)

11.2.1 माइक्रोसॉफ्ट- वर्ड 2010 शुरू करना (Starting MS Word 2010 application)

Start बटन पर क्लिक करें, **All Programs** पर क्लिक करें, इसके पश्चात् **Microsoft Office** पर क्लिक करें और उसके बाद **Microsoft Word-2010** पर क्लिक करने पर एक नया खाली डाक्यूमेंट ओपन होगा



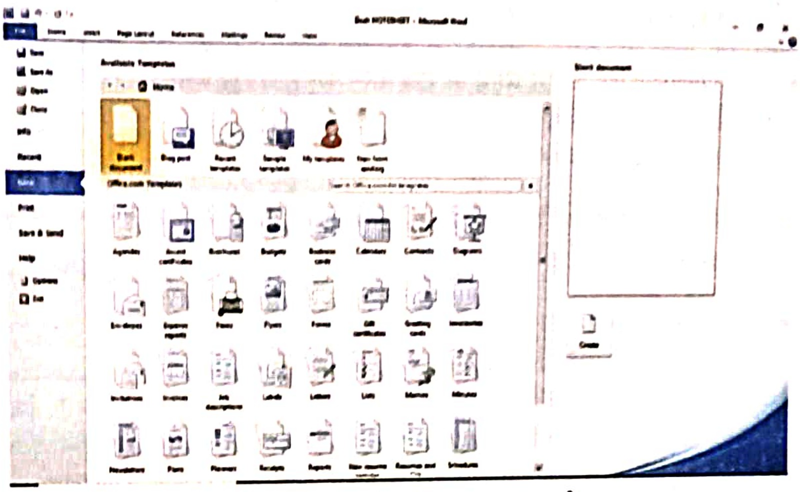
चित्र 11.1: वर्ड में कार्य करना (Working in Word Environment)

11.2.2 माइक्रोसॉफ्ट वर्ड 2010 में नयी फाईल बनाना एवं सेव करना (Creating & Saving a New file in MS Word 2010)

जब आप पहले से सेव किसी डॉक्यूमेन्ट को खोले बिना वर्ड 2010 प्रारम्भ करते हैं तो एक खाली डॉक्यूमेन्ट प्रदर्शित होता है जो कि आपके द्वारा content प्रविष्ट करने हेतु तैयार होता है। जब वर्ड 2010 चल रहा हो उस दौरान भी आप नया डॉक्यूमेन्ट बना सकते हो। पेज के ऊपरी बायें कार्नर में कर्सर (Cursor- एक टिमटिमाती हुई लाइन) यह प्रदर्शित करता है कि आपके द्वारा टाईप किया हुआ Character (करेक्टर अथवा अक्षर) कहाँ दिखाई देगा। जब cursor दाये मार्जिन तक पंहुच जाता है तो जो शब्द आप टाईप कर रहे हो अपने आप अगली लाईन पर चला जाता है। नया पैराग्राफ प्रारम्भ करने के लिये Enter Key दबायें।

नया डॉक्यूमेन्ट बनाने के लिये:

- **File** टैब पर क्लिक करें, **New** पर क्लिक करें। **Backstage View** के अन्दर **New Page** उपलब्ध टेम्पलेट और टेम्पलेट की श्रेणियां की थंबनेल प्रदर्शित करता है।
- उपलब्ध Templates में से **Blank Document** पर क्लिक करें।
- **Create** बटन पर क्लिक करें। नई विन्डों में एक नया खाली डॉक्यूमेन्ट खुलता है।



चित्र 11.4 – बैकस्टेज व्यू का न्यू पेज
(New Page of Backstage View)

टिप : आप Ctrl+n Key दबाकर भी नया डॉक्यूमेन्ट बना सकते हैं।

डॉक्यूमेंट सेव करना (Saving Documents)

प्रत्येक डॉक्यूमेन्ट तब तक अस्थायी होता है जब तक कि आप उसे एक विशिष्ट नाम देकर विशिष्ट लोकेशन पर फाइल के रूप में सेव नही करते हैं। आप वर्ड 2010 द्वारा एक डॉक्यूमेन्ट को वर्ड 97-2003 फॉर्मेट में भी सेव कर सकते हैं जिससे वह वर्ड के पूर्व वर्जनों (versions) के अनुकूल हो जायें।

पहली बार एक डॉक्यूमेन्ट को सेव करने के लिये:

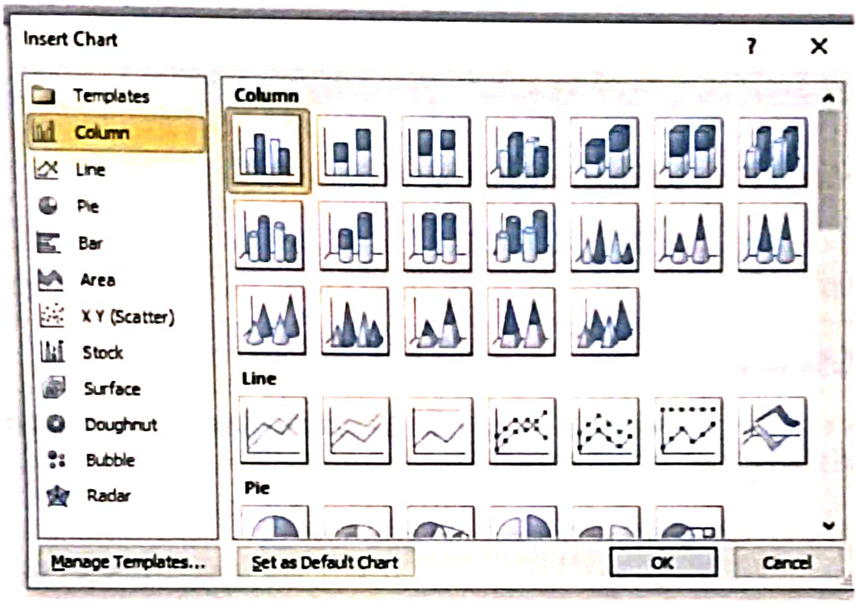
- **Quick Access Toolbar** पर **Save** बटन पर क्लिक करें या **Ctrl+s** दबायें। **Save As** डायलाग बॉक्स खुल जायेगा।
- बायें नेवीगेशन भाग में फाईल को जिस स्थान पर सेव करना है उसका चुनाव करें या डिफाल्ट स्थान पर ही सेव कर दें।
- File name बॉक्स में डॉक्यूमेन्ट के लिये एक नाम टाईप करें।
- अब Save बटन पर क्लिक करें।

11.5.3 चार्ट के साथ कार्य करना (Working with Charts)

चार्ट्स (Charts) किसी भी सूचना को कुशल एवं संक्षिप्त तरीके से दिखाने का यह एक प्रभावी तरीका है। Charts का उपयोग अनेक प्रकार की जानकारी के प्रदर्शन करने हेतु किया जाता है जैसे प्रेसेन्टेशन (Presentation), लेक्चर (Lecture), टूटोरियल (Tutorial) आदि।

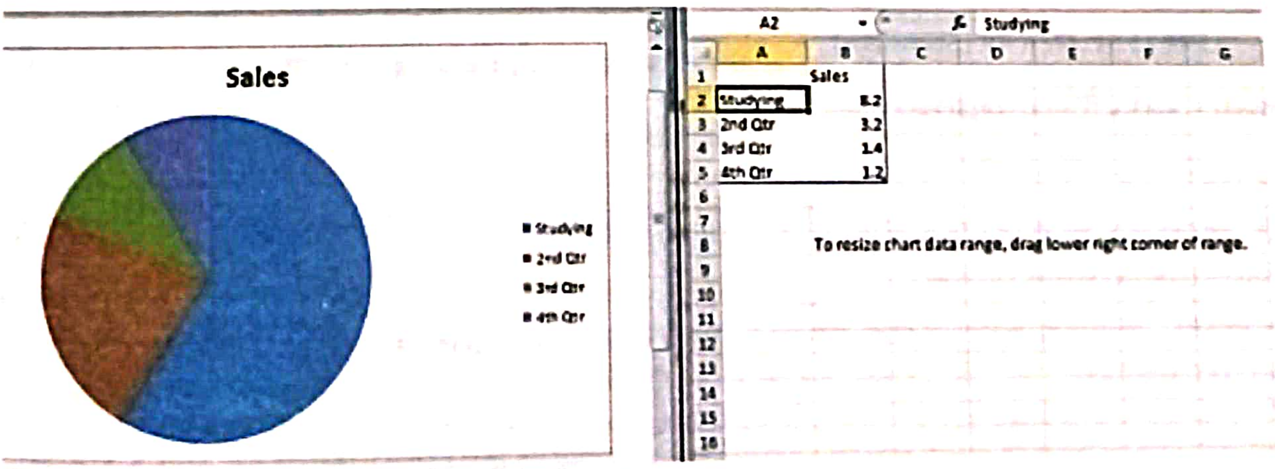
11.5.4 चार्ट इन्सर्ट करना (Inserting a Chart)

- **Insert** टैब का चयन करे।
- **Chart** विकल्प पर click करने पर एक Dialog box दिखाई देगा जिसमें से वर्ड द्वारा उपलब्ध करवाये गये अपेक्षित चार्ट का चुनाव करेंगे।



चित्र 11.48: इन्सर्ट चार्ट ऑप्शन (Insert Chart Option)

- उस चार्ट का चुनाव करे जिसे आप डाक्यूमेंट में इन्सर्ट करना चाहते हैं।
- OK बटन पर क्लिक करने पर आप देखेंगे कि आपकी स्क्रीन दो भागों में बंट जायेगी जिसके एक भाग में चार्ट दिखाई देगा और दूसरे भाग में माइक्रो सॉफ्ट एक्सेल शीट दिखाई देगी।



चित्र 11.49 पाई चार्ट इन्सर्ट करना (Inserting Pie Chart)

एक्सेल स्प्रेडशीट (Excel Spreadsheet) के आंकड़ों में संशोधन कर आप कम्प्यूटर द्वारा उपलब्ध करवाए गए चार्ट के आकार में परिवर्तन कर सकते हैं। उक्त संशोधन अपने आप वर्ड डाक्यूमेंट में दिखाई देने लगेंगे।

11.5.5 चार्ट को एडिट करना (Editing a Chart)

- Screen के दाएँ तरफ के आधे भाग में दिखाई गई एक्सेल स्प्रेडशीट आप अपनी प्राथमिकता के अनुसार भर सकते हैं | चार्ट के आंकडों, उसके विशिष्ट भागो के नाम आदि में आप संशोधन कर सकते हैं जो स्वतः ही वर्ड डाक्यूमेंट में दिखाई देंगे।

- शीर्षक (Title) में संशोधन करने के लिए वर्ड डाक्यूमेंट में ही संशोधन करे।

11.5.6 चार्ट डिलीट करना (Deleting a Chart)

- उस चार्ट को चुनें जिसे डिलीट करना चाहते है।

- की-बोर्ड (Keyboard) पर Delete बटन दबाए।

(Unit-II)

(ZENITHAL PROJECTION)

A network of latitude and longitudes made on a plane paper touching the globe at one point is called zenithal projection.

(A) Polar Zenithal Equidistant Projection

This is a very simple projection, in which the projections plane is supposed touching the globe at pole. Parallels of latitude are concentric equal distance circles drawn from pole and longitudes are made as straight lines at equal angles from pole. Only one hemisphere (north or south) can be shown on it.

Q. ~~Example 4~~ : Construct a polar zenithal equidistant projection for north hemisphere. Scale of the projection is 1 : 200,000,000 and interval is 30°.

Method of construction. According to given scale,

$$(1)\ R = \frac{635,000,000}{200,000,000} = 3{\cdot}17 \text{ cm}$$

$$(2)\ \text{Length of the arc of } 30° = \frac{2\pi R \times 30°}{360°}$$

$$= \frac{2 \times 22 \times 3{\cdot}17 \times 30°}{7 \times 360°} = 1{\cdot}66 \text{ cm}$$

For constructing the projection, draw two straight lines AB and CD at right angle intersecting each other at N point (Fig. 14). N point represents north pole in the projection. Now, mark three points E, F and B at an interval of 1·66 cm on NB line. N as centre and NE, NF and NB as radii, draw three circles which will represent 60°N, 30°N and 0° parallels of latitude. With the help of compass draw 12 straight lines at 30° angle from centre N. These lines are longitudes in the projection at an interval of 30°. Write degrees of parallels and longitudes according to the figure.

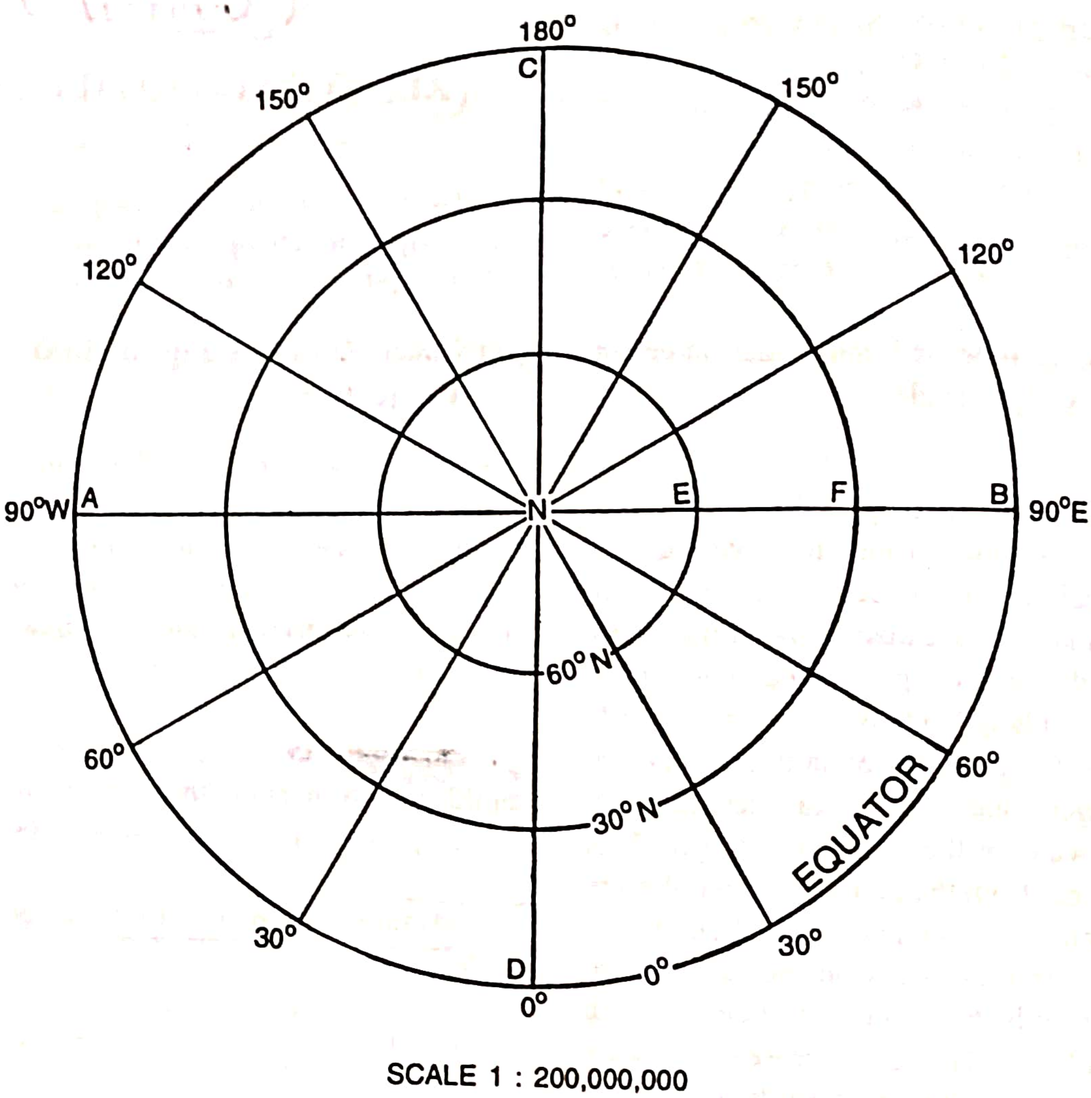


Fig 14. Polar zenithal equidistant projection.

Identification

(1) Parallels of latitude are concentric circles with pole as their centre. Distance between parallels of latitude is equal.

(2) Longitudes are straight lines radiated from the pole with real angular distance.

(3) Parallels of latitude and longitudes intersect each other at right angle.

(4) Pole is represented by a point.

Properties

(1) Scale is true at all longitudes as parallels of latitude are being drawn at actual distance.

(2) From pole towards equator, scale on parallels of latitude increases; it is found increased 1·2% at 75°, 4·5% at 60° and 11·0% at 45° parallels of latitudes.

(3) Though it is not an orthomorphic (true shape) projection, yet shape remains considerably true from pole (90°) to 60° latitude. From 60° onwards towards the equator, shape in east-west direction begins to be elongated.

(4) Area is also not truly shown in this projection, but the distance and direction of places from the centre of the projection remain accurate.

(5) Maximum half of the globe can be shown on this projection.

Uses. This projection is specially useful for making maps of arctic region for general purpose. Besides, this projection is also used for polar discoveries and polar navigation.

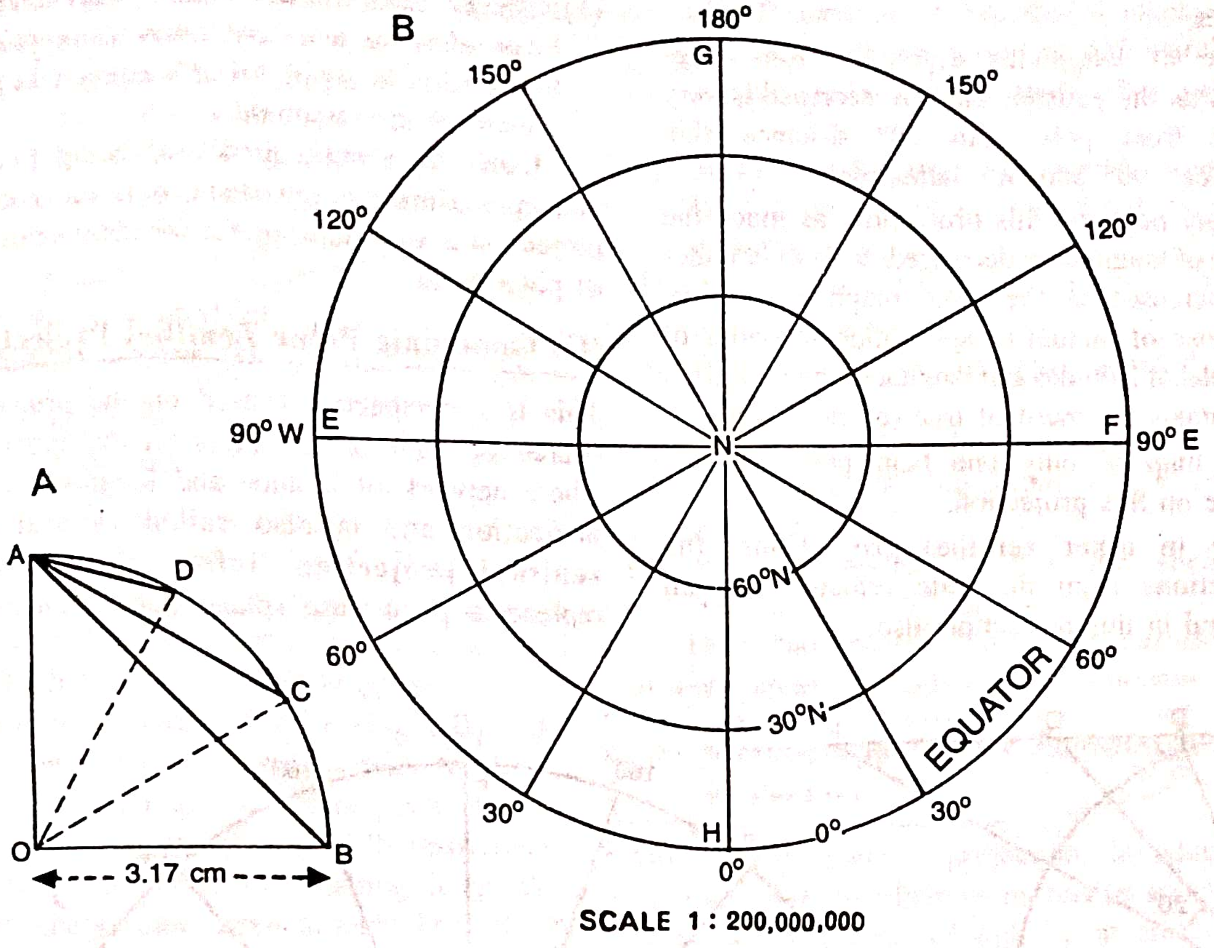


Fig 15. Polar zenithal [redacted] projection.

(Equal-area)

(B) Polar Zenithal Equal-area Projection

This is a non-perspective projection, the credit of first constructing it is given to cartographer **J.H. Lambert**. It is, therefore, also called **Lambert's zenithal equal-area projection**. Construction of this projection is very simple.

O'[redacted] At 1 : 200,000,000 scale, construct polar zenithal equal-area projection for making a map of northern hemisphere; interval of the projection is 30°,

Method of construction. According to the scale, the radius of the reduced sphere of the earth, i.e.

$$R = \frac{635,000,000}{200,000,000} = 3{\cdot}17 \text{ cm}$$

Following Fig.15A draw a quadrant ABO with a radius of 3.17 cm. Draw lines OC and OD making 30° angles at O point of OB line. Join BCD points to A with straight lines. Now two straight lines EF and GH which intersect each other at right angle at N point (Fig. 15 B). Draw three circles with N centre and AB, AC and AD chords as radius. These circles will be 0°, 30°N and 60°N parallel of latitudes. The centre of the projection N point represents north pole. For making longitudes draw 12 straight lines from N point of NF line at an interval of 30°. Write degrees on parallel of latitudes and longitudes as in the figure.

Identification

(1) Parallels of latitude are concentric circles drawn from centre of the projection.

(2) Longitudes are radial straight lines radiated from the pole at actual angular distance.

(3) Parallels of latitude and longitudes intersect one-another at right angle.

(4) Spacing between parallel of latitudes decreases from pole (centre of the projection) towards equator.

Properties

(1) Scale of longitudes decreases from poles towards the equator, but this decrease is very little from pole upto 30° distance (i.e. between 90° and 60° latitudes).

(2) At any point on this projection, as much the scale of longitude is decreased, scale of latitudes is increased in the same magnitude. Thus, because of mutual compensation in scales of parallel of latitudes and longitudes the projection maintains the merit of true (correct) area.

(3) The map of only one hemisphere can be made on this projection.

(4) Like in other zenithal projections, the directions from the pole remains true all around in this projection also.

(5) Shape and areas near pole remains considerably true, but away from pole, the distortion in shape towards equator begins to increase in magnitude.

Uses. As a subsequence of being true area and approximately true shape near the pole, this projection is especially useful for distribution maps of polar areas.

(C) Gnomonic Polar Zenithal Projection

This is a perspective (based on the principle of source of light or the point in the globe from where network of latitude and longitude is seen) projection and is also called **central polar zenithal projection.** Infact, this projection represents polar case (plane paper touching the

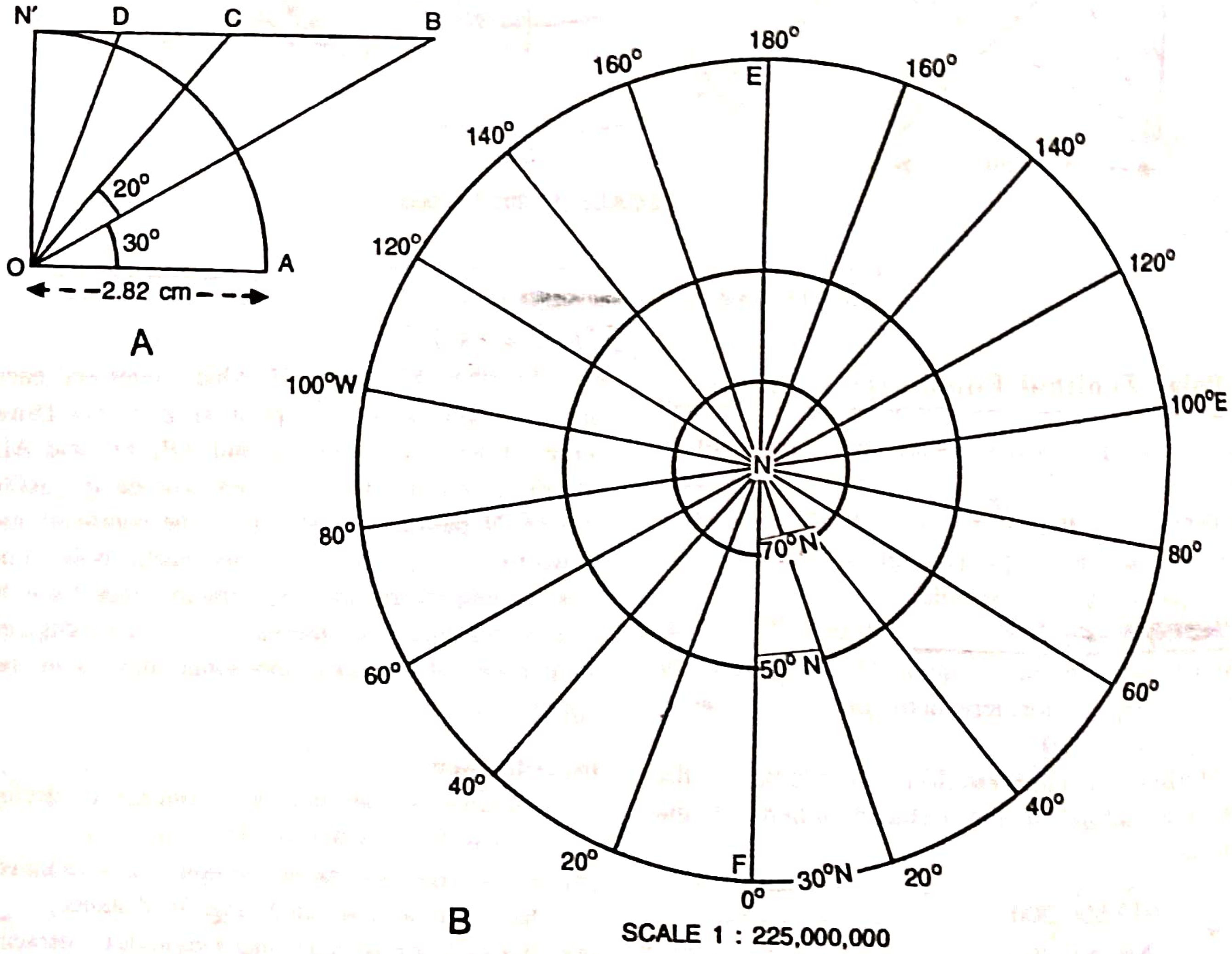


Fig 16. Gnomonic polar zenithal projection.

globe at the pole) of the gnomonic zenithal projection. The network of this projection is based on two assumptions-**first**, plane of projection touches the globe at pole and **second**, the source of light is at the centre of the globe.

Q. ~~*Example*~~ *11* : For making a map for area between 30°N to 90°N, construct a gnomonic polar zenithal projection on a scale 1 : 225,000,000 with graticular interval of 20°.

Method of construction. On the given scale,

$$R = \frac{635,000,000}{225,000,000} = 2{\cdot}82 \text{ cm}$$

As in Fig. 16 A, draw a quadrant N′ AO with a radius of 2·82 cm. Draw a line N′ B parallel to AO from N′ point. Now, first make an angle of 30° followed by 20° interval whose lines will intersect N′ B line at B, C and D points.

Now draw a vertical line EF (Fig.16B). Take a point N on it and draw circles with N′ B, NC and N′ D radii in Fig.16A. These circles will be parallel of latitude 30°, 50° and 70°N respectively. The centre N is 90°N. For making longitudes, taking NF line as base, draw straight lines at 20° interval around centre N. As shown in the figure, write degrees of latitudes and longitudes to complete the construction of the projection.

Identification

(1) Parallels of latitude are concentric circles drawn from pole as centre, the distance between which increases rapidly outwards from the pole. The equator can not be represented on this projection.
(2) Longitudes are straight lines radiated from the pole at an interval of equal angular distance.
(3) Parallels of latitude and longitudes intersect each other at right angle.

Properties

(1) Scale of longitudes continuously increases as the consequence of increasing distance between parallels of latitude outwards from the pole; this increase being about 10 per cent at 60° latitude and more than 27 per cent at 45° latitude.
(2) Scale of parallels of latitude increases with increasing distance from the pole; the scale of 60° parallel of latitude is increased 15 per cent and the scale of 45° parallel of latitude is increased more than 40 per cent.
(3) Shape remains true considerably from pole to 30° but thereafter the shape begins to distort very much.
(4) With increasing distance from the pole, area begins to increase.
(5) Direction from the pole towards each direction is true.
(6) Any straight line drawn on the map makes a segment of the great circle on this projection.
(7) It is not possible to show the whole of a hemisphere on this projection.

Uses. Navigational and general purpose maps of arctic areas are made on this projection.

(D) Stereographic Polar Zenithal Projection

This is a perspective projection, in which it is supposed that the plane of projection touches one pole and the source of light is at another pole and thus is the network of parallels of latitude and longitude constructed. Construction of this projection is very simple.

Q. ~~*Example*~~ *12* : On a scale of 1 : 250,000,000, construct a stereographic polar zenithal projection for northern hemisphere. Keep an interval of 15° in the projection.

Method of construction. According to the scale,

$$R = \frac{635,000,000}{250,000,000} = 2{\cdot}54 \text{ cm}$$

Draw a semicircle N′ A S as shown in Fig.17A with a radius of 2·54 cm. In this semicircle, point N′ represents the north pole, S point the south pole and O point, the centre of the earth. Thus N′ S line shows polar diameter and OA line, the equatorial radius. Draw from O centre and base as OA line, the lines of angles 15°, 30°, 45°, 60° and 75°, which intersect N′ A arc at B, C, D, E and F lines respectively. Join point S to A, B, C, D, E and F drawing straight lines, which intersect N′ A′ tangent at A′, B′, C′, D′, E′ and F′ points respectively.

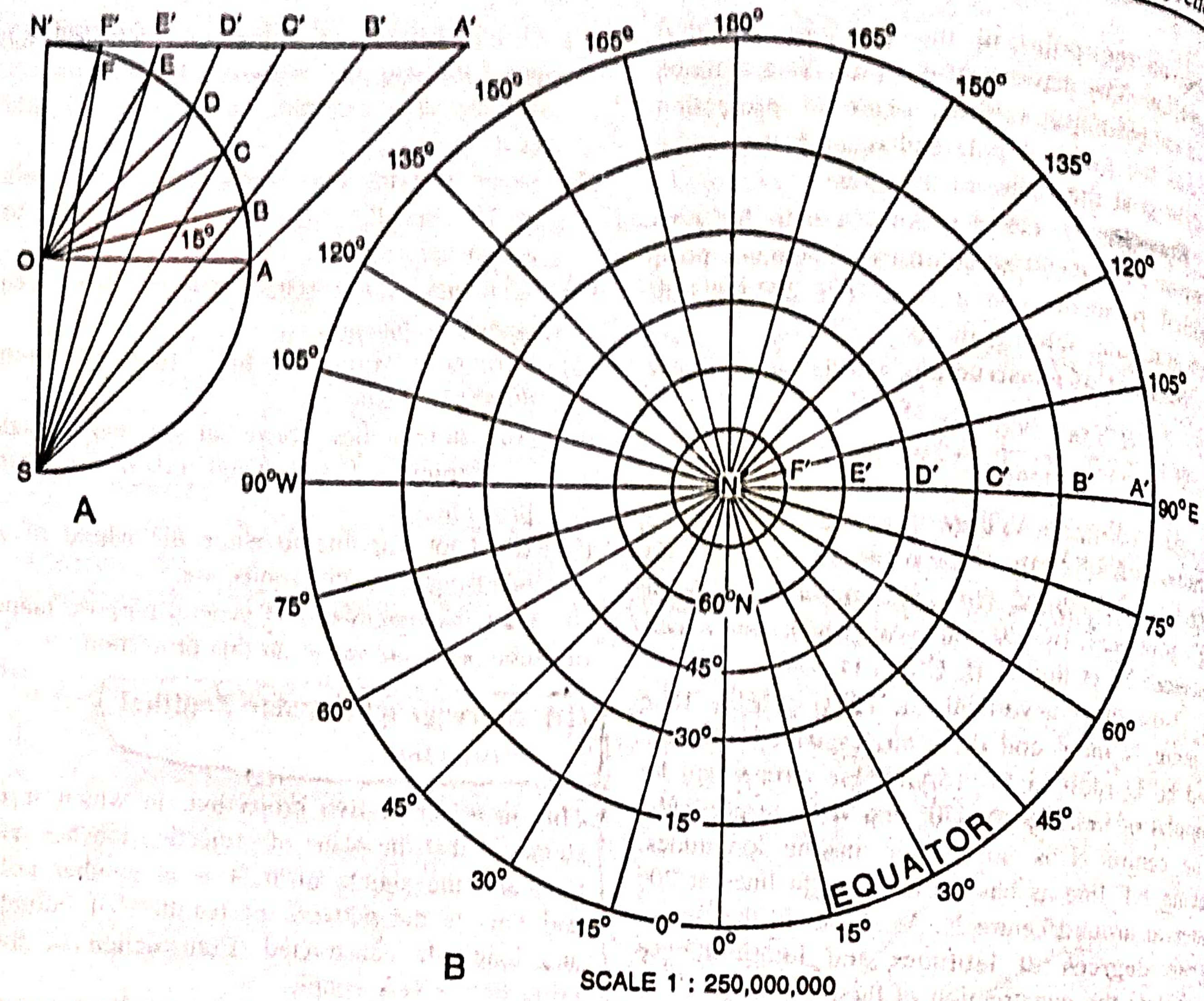


Fig 17. Stereographic polar zenithal projection.

Now draw a vertical straight line (Fig.17B). Taking a point N on this line, draw concentric circles with radii N'A', N'B', N'C', N'D', N'E' and N'F'. These circles will represent O° (equation), 15°N, 30°N, 45°N, 60°N and 75°N parallels of latitude and N point represents the north pole. For drawing longitudes make straight lines from N point at the interval of 15° and write the degrees of longitudes they show as in the figure.

Identification

(1) Parallels of latitude are concentric circles drawn from pole as centre and their spacing towards equator keeps on increasing.

(2) Longitudes are straight lines radiated from the pole at equal angular distance.

(3) Parallel of latitude and longitudes intersect each other at right angle.

(4) The distance of the equator from the pole is equal to the diameter of the reduced sphere of the earth (according to given scale).

Properties

(1) This has become an orthomorphic (true shape) projection because with the rate by which increase in the length of parallels of latitude from centre of projection towards the equator happens, with the same rate meridional distances towards the equator also increases.

(2) Direction remains true all around from the centre of projection. So, it is an orthomorphic as well as an azimuthal projection.

(3) As opposed to gnomonic polar zenithal projection, the equator can be drawn in this projection.

Uses. Until a few years ago, this projection was very much used to show the earth in two hemispheres or for making maps of different continents or countries. But owing to much variation in the scale on this projection, its importance has declined in the present times.

(D) Orthographic Polar Zenithal Projection

The construction of this projection is based on two suppositions—**First**, projection-plane touches globe at pole and **Second**, the source of light is supposed to be situated at a point of infinite distance. The method of construction of this projection is very simple.

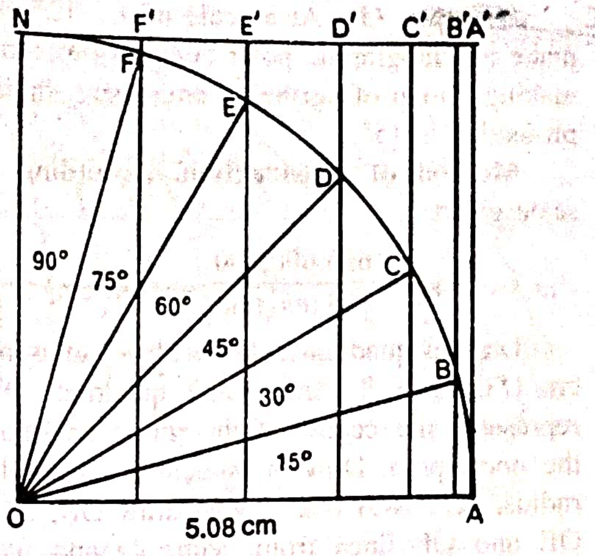
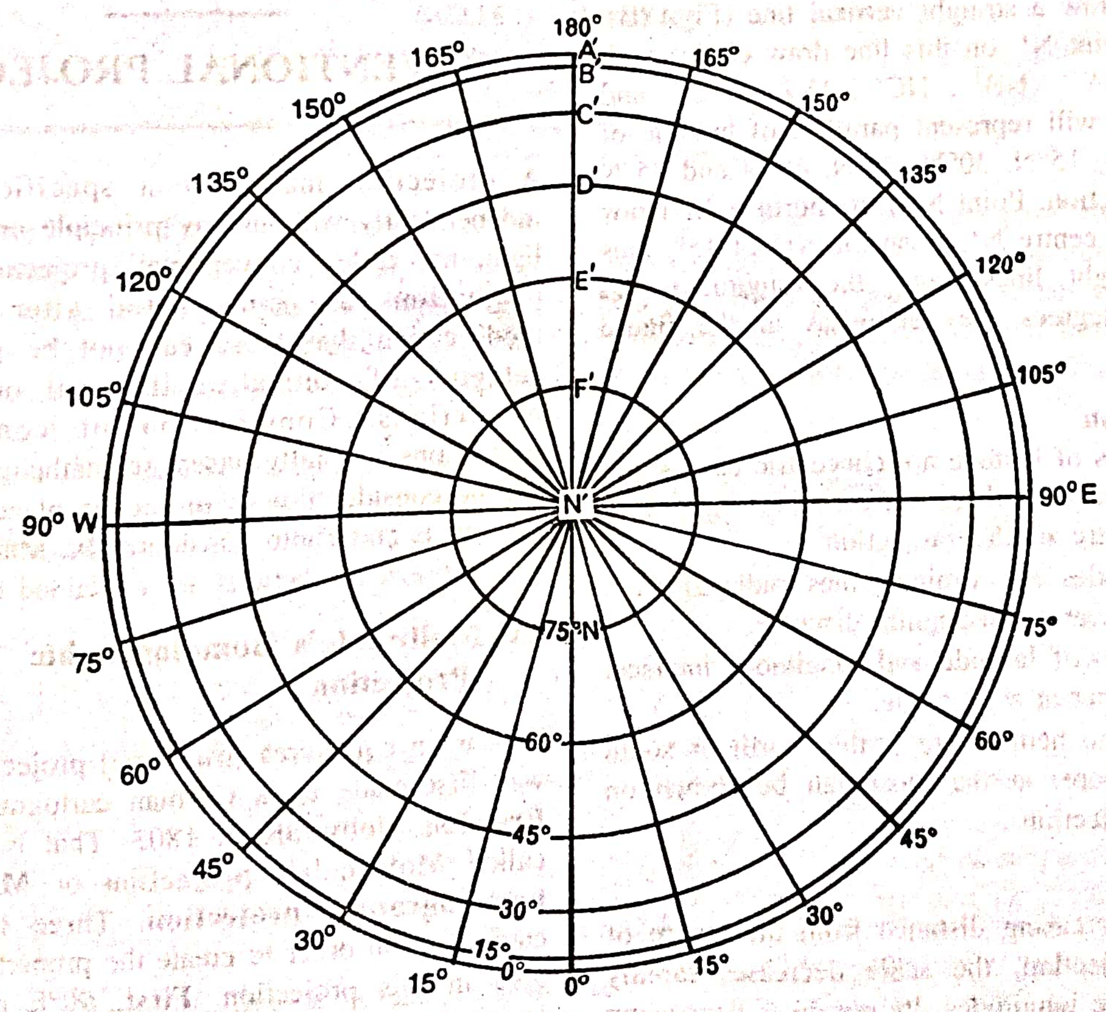


Fig 18 A.



SCALE 1 : 125,000,000

Fig 18 B. Orthographic polar zenithal projection.

[redacted] *13* : At a scale of 1 : 125,000,000 make a orthographic polar zenithal projection for making a map of northern hemisphere. Interval of projection is 15°.

Method of construction. According to the scale given,

$$R = \frac{635{,}000{,}000}{125{,}000{,}000} = 5{\cdot}08 \text{ cm}$$

Draw a quadrant NAO with a radius of 5.08 cm (Fig.18A). In this NAO quadrant, O point represents the centre of the globe and point N, the north pole. Draw a tangent (right angle at a radius, here NO) NA′. Now draw OB, OC, OD, OE and OF lines from centre O and base-line OA at an interval of 15°. Draw lines from points A, B, C, D, E and F parallel to NO which intersect NA′ tangent at points A′, B′, C′, D′, E′ and F′ respectively.

Now, draw a straight vertical line (Fig.18B). Taking a point N′ on this line draw circles with the radii NA′, NB′, NC′, ND′, NE′ and NF′ which will represent parallels of latitude of 0° (equator), 15°N, 30°N, 45°N, 60°N and 75°N in the projection. Point N is the north pole. Draw angles from centre N′ at an interval of 15°, thus drawn straight lines being the longitudes and write the degrees they show as in the figure given.

Identification

(1) Parallels of latitude are concentric circles and space between them decreases outwards from the centre of the projection.

(2) Longitudes are straight lines radiated from the pole at equal angular distance.

(3) Parallels of latitude and longitudes intersect each other at right angle.

(4) Only one hemisphere (either north or south hemisphere) at the most can be shown on this projection.

Properties

(1) With increasing distance from the centre of the projection, the scale decreases rapidly along the longitudes. Its reason is decreasing distance between parallels of latitudes from the centre of the projection.

(2) This projection is neither orthomorphic nor homolographic but the direction remains true in all directions.

(3) Distortion in area and shape increases in marginal parts of the projection.

Uses. The importance of this projection is very little from geographical view-point. But the cartographers of the U.S.A. have shown interest in this projection in last few years. **R.E.Harrison** has published many interesting maps on this projection in an atlas called '*A War Atlas for Americans*'. Though area and shape in maps made on these maps is very much erroneous, yet delusion of the presence of undulating parts occurs while seeing these maps. So, by using suitable colours and shades, relief features can be brought out more effectively in these maps. It is especially useful for astronomical maps.

CONVENTIONAL PROJECTION

A projection made for a specific use and independently without any principle or source of light, are called conventional projections. These projections are constructed after so much modification that these can not be put in the category of conical, cylindrical or zenithal projections. Construction of conventional projections is totally based on mathematical rules and no consideration of projection-plane or source of light is taken into consideration. Main types of conventional projections are explained below.

(A) Mollweide's Homolographic Projection

This is an equal-area (true area) projection which was first made by a German cartographer **Karl Branden Mollweide** in 1805. That is why it is called **Mollweide's projection** or **Mollweide's homolographic projection**. Three things are carried out in order to create the property of equal area in this projection. **First,** 90°E and 90°W longitudes together are shown by a circle, whose radius is equal to $\sqrt{2}R$. By doing so, this circle correctly represents the area of one hemisphere.

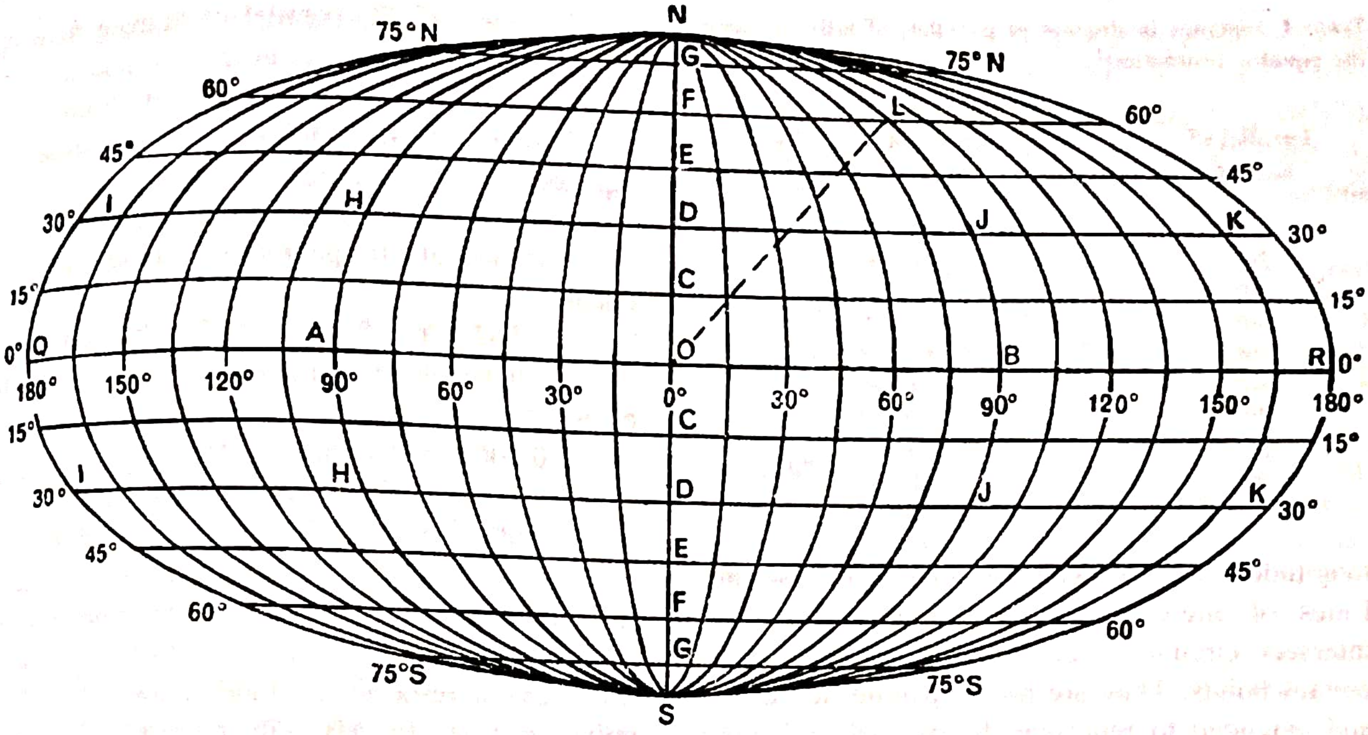


Fig 19. Mollweid's projection.

Secondly, the length of equation is kept twice the length of central meridian or fourfold of the radius of the circle made in the projection i.e. $4 \times \sqrt{2}R$. **Thirdly**, the distance of each parallel of latitude from the equator is found out with the help of Table-2. Distance of different parallels of latitude from the equator can also be determined with the help of Table-3. In this table, values of the angles in degrees are given to be drawn from the centre of the central circle (made up of 90°E and 90°W

Table 2. **Distance of parallels of latitudes from the equator[1].**

Parallels	Distance	Parallels	Distance
5°	0·097×R or 0·069×r	50°	0·920×R or 0·651×r
10°	0·197×R or 0·139×r	55°	1·001×R or 0·708×r
15°	0·289×R or 0·205×r	60°	1·077×R or 0·762×r
20°	0·384×R or 0·272×r	65°	1·150×R or 0·814×r
25°	0·479×R or 0·339×r	70°	1·218×R or 0·862×r
30°	0·571×R or 0·404×r	75°	1·281×R or 0·906×r
35°	0·661×R or 0·468×r	80°	1·336×R or 0·945×r
40°	0·750×R or 0·531×r	85°	1·382×R or 0·978×r
45°	0·837×R or 0·592×r	90°	1·414×R or 1·000×r

R = Radius of the reduced sphere of the earth at a given scale.
r = Radius of the circle made by 90°E and 90°W longitudes i.e. $\sqrt{2}R$

1. Values of R and r may differ slightly from those given in other books because calculation of these values is based on the values acquired by estimated values of θ from graph; but the difference is so insignificant that it does not affect the construction of projection significantly.

Table 3. **Distance in degrees of parallels of latitudes from the equator (estimates)**[1] **.**

Parallel of latitude	Angle to be made of centre from equator
10°	8° 0′
20°	15° 45′
30°	24° 0′
40°	32° 0′
50°	40° 30′
60°	49° 25′
70°	59° 30′
80°	71° 0′
90°	90° 0′

longitudes together) with the equator as base line. Lines of angles drawn according to the table intersect circumference of the central circle at certain points. They are joined parallel to equator and extended to represent the parallel of latitude of that degree. A line parallel to the equator from one intersection point can also be drawn.

Q. ~~Example 11~~ : Construct Mollweid's projection at a scale of 1 : 250,000,000 for making a world map, keep interval of 15° in the projection.

Method of construction. According to the given scale, radius of the reduced sphere of the earth, i.e.,

$$R = \frac{635{,}000{,}000}{250{,}000{,}000} = 2{\cdot}54 \text{ cm}$$

The radius of central circle of the projection comprising of 90°E and 90°W longitudes together, i.e.

$$r = \sqrt{2}R = 1{\cdot}414 \times 2{\cdot}54 = 3{\cdot}59 \text{ cm}$$

For constructing the projection, first of all draw a circle NBSA with a radius of 3.59 cm (Fig. 19). Draw AB equatorial diameter and NS polar diameter (central meridian) in this circle which intersect each other at O point. Now calculate distance of different parallels of latitude from the equator with the help of Table-2 in the following way[2]—

Distance of 15° parallel of latitude from the equator,

$= 0{\cdot}205 \times r = 0{\cdot}205 \times 3{\cdot}59 = 0{\cdot}74$ cm

Distance of 30° parallel of latitude from the equator,

$= 0{\cdot}404 \times r = 0{\cdot}404 \times 3{\cdot}59 = 1{\cdot}45$ cm

Distance of 45° parallel of latitude from the equator,

$= 0{\cdot}592 \times r = 0{\cdot}592 \times 3{\cdot}59 = 2{\cdot}12$ cm

Distance of 60° parallel of latitude from the equator,

$= 0{\cdot}762 \times r = 0{\cdot}762 \times 3{\cdot}59 = 2{\cdot}73$ cm

Distance of 75° parallel of latitude from the equator,

$= 0{\cdot}906 \times r = 0{\cdot}906 \times 3{\cdot}59 = 3{\cdot}25$ cm

Distance of 90° (pole) from the equator,

$= 1{\cdot}000 \times r = 1{\cdot}000 \times 3{\cdot}59 = 3{\cdot}59$ cm

For using these results, mark C, D, E, F and G points on both sides of NS line from O point with a distance of 0·74, 1·45, 2·12, 2·73 and 3.25 cm respectively. Lines drawn from these points parallel to AB will represent 15°, 30°, 45°, 60°, 75° N and S parallel of latitudes respectively.

Now extend AB on both sides so long that AQ equals OA and BR equals OB. In the same way, make all latitudes double the length of each within the circle. For example, HI has been made equal to DH and JK equal to DI. Divide each latitude including the equator into 360/15 = 24 equal parts. Then join these points of the same longitudes marked on latitudes to the poles (N and S points) making ellipsoids which will represent longitudes in this projection.

It is obvious from the above description that the equator QR is made double the length of the central meridian NS i.e. $4 \times \sqrt{2}R = 14{\cdot}36$ cm.

Identification

(1) All parallels of latitude are parallel lines and their spacing decreases from the equator to the poles.

(2) Central meridian is a straight line; 90°E and 90°W longitudes are two halves of one circle and the remaining longitudes are ellipsoids.

(3) Only central meridian intersects parallels of latitude at right angle; remaining longitudes intersect them obliquely and the obliqueness

1. Steers, J.A., *An Introduction to the Study of Map Projection*, London, 1965, p.168.
2. For finding out distances of latitudes from the equator, angles will be drawn from point O according to Table-3. For example in Fig-19, OL line drawn on OB line with an angle of 49°25′ intersects circumference of NBSA circle at L point. So a line drawn from L point parallel to AB will represent 60°N parallel of latitude.

continuous to increase towards the east and the west from central meridian.

(4) Central meridian is half the length of the equator.

(5) The distance between successive longitudes at any parallel of latitude is equal.

Properties

(1) As the length of equator is smaller than its actual length ($2\pi R$), scale on it, therefore, is also smaller. As a matter of fact, scale on the equator and upto 45° parallels of latitude from the equator is reduced and the scale on parallels of latitude from 45° latitude to poles is increased.

(2) Scale is reduced on central meridian as it is made half the length of the equator. But with the increasing distance of longitudes from central meridian their scale also increases. It is increased very much on boundary areas.

(3) Due to above mentioned changes of the scale, this projection has become homolographic (equal-area).

(4) From the central meridian upto 30°, shape is fairly well shown in this projection. Though the shape of maps is very much distorted in the boundary areas of the projection, yet this distortion is less than that occurs in sinusoidal projection.

(5) Direction is not represented true in this projection.

Uses. Enough use has been made of Mollweid's projection in atlases for distribution maps of the world. Since shape is very much distorted in boundary areas of world maps in this projection, interrupted Mollweid's projection is much used in atlases these days in place of simple Mollweid's projection.

(D) Sanson-Flamsteed's Sinusoidal Projection

This projection was first made in 1650 by **Nicolas Sanson**, a French cartographer and geographer. About 50 years later famous British Astronomer **John Flamsteed** used this projection; that is why this projection is called Sanson-Flamsteed's projection after the name of both of these scholars.

As the consequence of the use of sine curves in the construction of this projection, it is also called **Sinusoidal or Sine curved projection.** This is a homolographic (equal-area) projection which is considered as a specific form of Bonne's projection on the basis of the method of construction.

Equator is true according to the scale in this projection i.e. this is made equal to $2\pi R$ and the central meridian is half the length of equator, i.e. equal to πR. Construction of this projection is easy in comparison to Mollweid's projection.

Q. [redacted]ple 15 : Construct a sinusoidal projection on a scale 1 : 250,000,000 for making a map of the world. Interval in the projection is 15°.

Method of construction :

(1) Radius of the reduced sphere of the earth, i.e.,

$$R = \frac{635{,}000{,}000}{250{,}000{,}000} = 2{\cdot}54 \text{ cm}$$

(2) True length of the equator $= 2\pi R$

$$= \frac{2\times 22\times 2{\cdot}54}{7} = 15{\cdot}96 \text{ cm}$$

(3) Length of central meridian

$$= \frac{2\pi R}{2} = \frac{15{\cdot}96}{2} = 7{\cdot}98 \text{ cm}$$

First of all draw a quadrant NMO with a radius of 2·54 cm (Fig. 20 A). Draw lines of 15° angles on OM line from O point. The line of 15° angle intersects the circumference of quadrant at L point. Draw small quadrant with O point as centre and ML arc as radius at which lines of angles 0°, 15°, 30°, 45°, 60° and 75° will intersect at A, B, C, D, E and F points. Perpendiculars BB′, CC′, DD′, EE′ and FF′ dropped on ON line from A, B, C, D and E points will be spacing of adjoining longitudes at respective latitudes in the projection.

Now draw a horizontal line QR equal to 15.96 cm as shown in Fig.20B and divide it into 360°/15° = 24 equal parts. At the central point P of this line, draw N′ S′ perpendicular on both sides of this line. Divide N′ S′ perpendicular (central meridian) into 6 parts each on both sides from point P with the same distance with

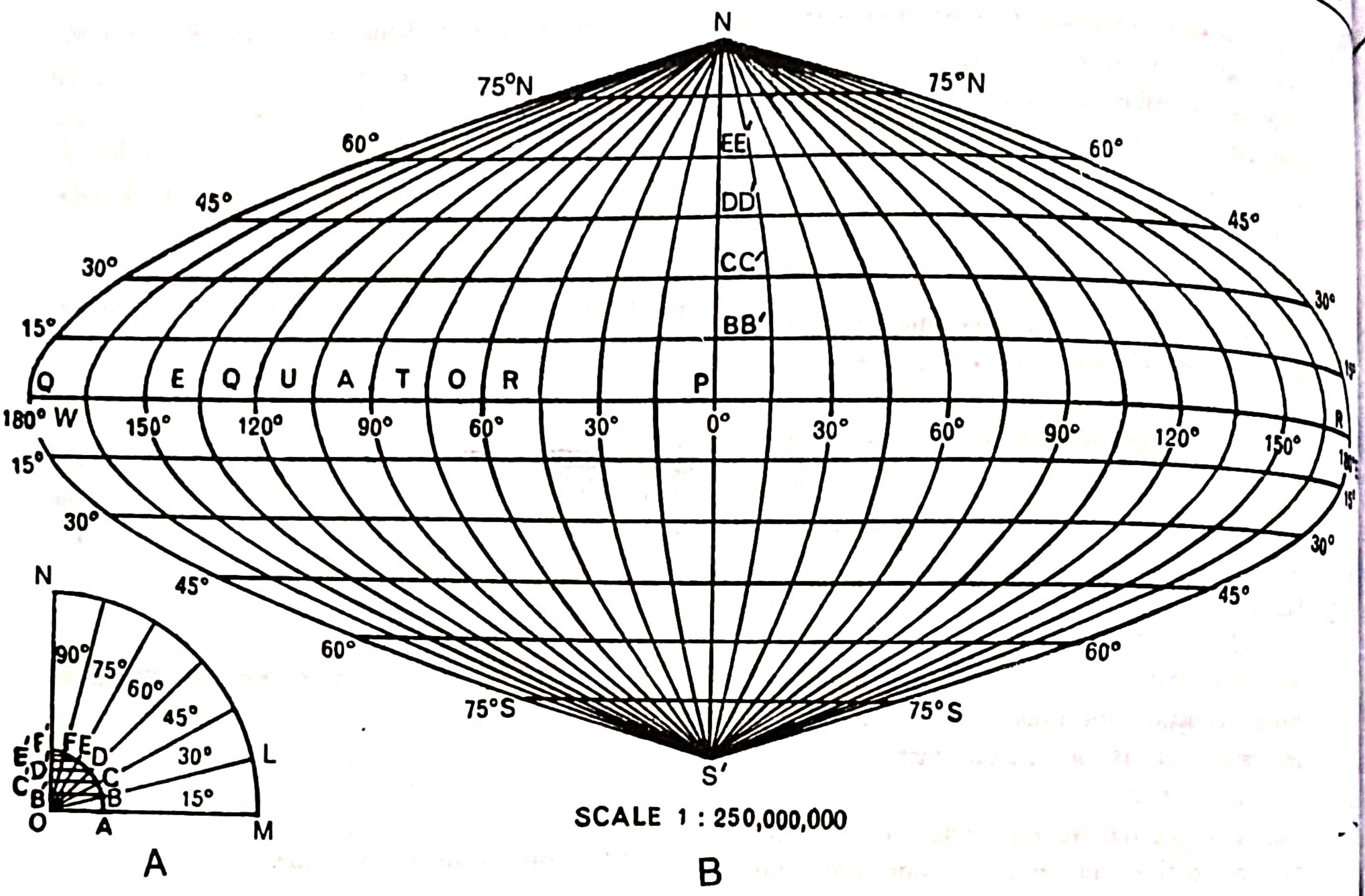


Fig 20. Sinusoidal projection.

which QR line (equator) was divided. From the marks of division draw lines parallel to QR. These parallel lines will show northern and southern parallels of latitude at an interval of 15° (Fig. 20).

For drawing longitudes, divide equally on both sides of the latitudes of 15° NS, 30°NS, 45°NS, 60°NS and 75°NS with distances of BB′, CC′, DD′, EE′ and FF′ respectively putting 12 marks on each side (see figure). Complete drawing longitudes by joining division marks for the same longitude to poles (N′ and S′ points) with smooth curves. Taking central meridian as 0° longitude, write degrees they represent on all longitudes.

Identification

(1) Parallels of latitude are drawn straight parallel lines at equal distance. The length of parallels of latitude and their spacing is true according to scale.

(2) Central meridian is a straight vertical line and its length is half of the length of equator. All other remaining longitudes are mixed curves.

(3) Spacing of longitudes at any one parallel of latitude is equal.

(4) The equator and the central meridian is divided with the same and equal distance.

(5) Only central meridian intersects the equator at right angle; other longitudes intersecting latitudes obliquely. Obliqueness of intersection continuously increases with increasing distance from the equator and central meridian.

Properties

(1) Scale at each latitude including the equator is true.

(2) Scale at central meridian is true (correct) but with increasing distance to east and west from it, increase of scale of longitudes also begins to occur.

(3) In the boundary areas of this projection, the shape of the landmasses is very much distorted.

(4) This is an equal-area projection.

(5) Direction is not represented truly on this projection.

Uses. Though the world map can be made on this projection, yet due to extreme distortion of the shape in boundary areas, sinusoidal projection is not often used for this purpose. Shape is relatively less distorted in Mollweid's projection as compared to the sinusoidal projection. So, world map is better made on Mollweid's projection than on sinusoidal projection. Sinusoidal projection is very much useful in making equal-area projection for continents located near the equator with less east-west extension i.e., Africa and South America.

CHOICE OF PROJECTIONS

From the description given above, it is clear that there are many kinds of map projections, but till now no such projection could be made on which correct representation of spherical earth from all viewpoints could be made. If any projection is orthomorphic (true shape), area on it becomes incorrect. Similarly, if the merit of equal area is present, then scale, direction or shape related some shortcomings crop up. In addition, in some projections only one of the eastern or western hemisphere can be mapped.

Owing to above mentioned difficulties, the choice of appropriate projection for a map is always made keeping in view the purpose of that map.

(A) Distribution Maps

Distribution maps need some of the equal-area projections so that areas shown on that map be mutually compared. For making distribution maps of tropical areas, choice of any one of Lambert's cylindrical equal-area projection, Mollweide's projection and sinusoidal projection is appropriate. For distribution maps of the whole world, the choice of Mollweide's or sinusoidal projection is made. A good distribution map of the world can not be made on cylindrical equal-area projection.

(B) General Purpose Maps of the World

Mercator's projection is very much useful for navigational maps. Though this projection is largely used for representing the direction of ocean currents and winds, yet general purpose maps are not made on Mercator's projection due to huge increase in area of high latitude zones. So choice of one of either Mollweide's or sinusoidal projection is beneficial for this purpose. For showing true direction, in addition to Mercator's projection, zenithal projection can also be chosen in accordance to the need.

(C) Maps of Continents

Continents located in only one hemisphere and having relatively less longitudinal (east-west) extention as North America, Europe and Australia's distribution maps are very well made on Bonne's projection. South America and Africa are such continents as are extended in both the hemispheres; so either sinusoidal or Mollweide's projection should be chosen for these continents.

(D) Maps of Small Countries

Small countries with less north-south extension are effectively presented on conical projection with two standard parallels.