A P P L O
S T U D Y   C E N T R E

Transport & Communication		
Std.	**Unit**	**Topic**
7th Term II	2	Tourism
9th	7	Maping skills (7.2 – 7.3)
10th	5	India Population, Transport, Communication, Trade
12th	6	Geo infomatics

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7th Term 2
Unit 2
Tourism

Introduction

The word tourist was derived from an old English word "tourian" which refers to a person who travels out of his usual environment for not more than one year and less than 24 hours. The purpose of travel may be religious, recreation, business, historical and cultural.

The Basic components of Tourism

Tourism has become an important source of income for many regions and even for the entire countries of the world. Tourism is an essential part of the life of the society because of its direct impact on social, cultural, educational and economic sector of the nation and on their international relations too.

The three main components of tourism are

- Attraction
- Accessibility

- Amenities.

These three components are together known as A3 concept.

Attractions

Attractions mainly comprise of two types such as:

- Natural attraction
- Cultural attraction

Natural attraction includes landscape, seascape, beaches, climatic condition and forests. Cultural attractions are historic monuments and other intellectual creations. Apart from this, cultural attractions also includes fairs and festivals.

Accessibility

Accessibility means reachability to a particular place of attraction through various means of transportation such as road, rail, water and air. Transport decides the cost of travel and the time consumed in reaching or accessing a specific attraction.

Amenities

Amenities are the facilities that cater to the needs of a tourist.

1. Accommodations in terms of hotels, restaurants, cafes and other staying units.
2. Travel organizers, Tour operators and Travel Agents
3. Foreign exchange centres, passport and visa agencies
4. Sectors related to Travel Insurance, Safety and Security

Types of Tourism

From the ancient times, travel is a fascination for mankind. Tourism can be divided on the basis of nature, utility, time and distance as indicated below.

- Religious tourism

- Cultural tourism
- Historical tourism
- Eco-Tourism
- Adventure tourism
- Recreational tourism

Religious Tourism

Religious tourism is one of the oldest types of tourism, wherein people travel individually or in groups for pilgrimage to a religious location such as temples, churches, mosques and other religious places. Religious tour to Kasi (Varanasi) by Hindus, to Jerusalem by Christians and to Mecca by Muslims are few of the examples for religious tourism.

Historical Tourism

It focuses on visiting historically important places like museums, monuments, archaeological areas, forts, temples and so on. Angkorwat of Cambodia, Tajmahal of India and Pyramids of Egypt are some of the examples to quote for Historical Tourism.

Eco-Tourism

Eco tourism typically involves travel to destinations where plants and animals thrive in a naturally preserved environment. Amazon rain forest, African forest safari, trekking in the slopes of Himalayas are the famous incredible Eco friendly attractions

Gastronomy refers to an aspect of **cultural tourism.**

Adventure Tourism

Adventure tourism is a type of tourism involving travel to remote or exotic places in order to take part in physically challenging outdoor activities. For e.g. sky dive in Australia, Bungee jumping in New Zealand, mountaineering in the peaks of Himalayas, rafting in the Brahmaputra River at Arunachala Pradesh

Recreational Tourism

This type of tourism aims at enjoyment, amusement or pleasure are mainly for 'fun activity'. Waterfalls, hill stations, beaches, and amusement parks are the attractive spots for recreational tourism.

Apart from this, there are certain modern types of tourism, which got developed in recent years.

They are

- Annual Holiday tourism
- Industrial Tourism
- Seasonal Tourism
- International Tourism
- Group Tourism
- Sports Tourism
- Health Tourism
- Farm and Rural Tourism.

International Tourism

International tourism is undertaken to visit the places of international importance and to gather knowledge about international culture and customs. For this, there are certain travel forms and formalities to be fulfilled by the tourists, such as passport, Visa, Foreign Currency, Air ticket, Travel insurance, and other immigration details.

- VISA – A document issued to a person (or) a stamp marked on the passport of a person who wants to visit other country.
- Tourist VISA - Recreation sight seeing
- Student VISA – Higher education
- Employment VISA – Work in a country
- Medical VISA – Medical treatment in a reputed hospital of a country

Basic Elements of Tourism attractions

Certain elements are fundamental to attract tourists as travel destinations. They are

- Pleasant weather
- Scenic beauty
- Historical and cultural monuments

Geographical Components of Tourism

1. **Landforms:** Mountains, Plateaus, Canyons, Valleys, Caves, Cirques, Sand dunes, Coral reefs, Cliffs, etc.,
2. **Water:** Rivers, Lakes, Waterfalls, Hot springs and Geysers, Snow and Glacier, Water Currents, Tides and Waves.
3. **Vegetation:** Forest, Grasslands, Moors, Deserts etc.,
4. **Climate:** Sunshine, Clouds, Admirable Temperature, Rain and Snow.
5. **Animal life:-**
   (a) Wildlife : Birds, Game Reserves, Zoos.
   (b) Hunting and Fishing
6. **Settlement features:-**
   (a) Towns, Cities, Villages
   (b) Historical remains and Monuments
7. **Culture:-**
   Ways of life, traditions, folklore, arts and crafts.

Game Reserves: An area of land set aside for the protection of wild animals.

Tourism Attractions in India

India is a country known for its gentle hospitality with spicy food and culture. Visitor friendly traditions with varied life style, culture, heritage, colourful fairs and festivals are abiding attractions for the tourists. All types of land form, varied climate, rich resources for eco and adventure tourism are the versatile specialty of India. Technological parks and science museums, pilgrimage centers with wonderful art and architecture are an added advantage for tourists. Yoga, Ayurveda and Natural remedial Health resorts attract tourists from all over the world.

Religious Tourism

India being a multi-religious country, religious tourism is the most popular type of tourism. Various package tours are organized for the

people to attend the religious rituals and to visit places of religious importance. Most famous religious spots of India are as follows:

Rameswaram - Tamil Nadu
Kanchipuram - Tamil Nadu
Varanasi(Kasi) - Uttarpradesh
Saranath - Uttarpradesh
Vaishnavadevi temple - Jammu & Kashmir
St. Francis Xavier Cathedral - Goa
Amritsar - Punjab
Monasteries of Ladakh - Jammu & Kashmir

Scenic attraction is a very important factor in tourism. Scenery consisting of Mountains, Lakes, Waterfall, Glacier, Forests, and Deserts are the major features attracting people to visit them. India is blessed with nature and gifted with immense beauty from rolling hills to deep valley and snow covered mountains to lush green carpet.

Hill Stations in India

The Indian sub continent has seven principal mountains ranges and the largest of all is the Himalayas that lie in the northern part of India. Most of the Himalayan hill stations in India are located in states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal, Arunachal Pradesh, Nagaland and Meghalaya. Maharashtra, Karnataka, Tamil Nadu and Kerala have hill stations in the Western Ghats. Andhra Pradesh, Odisha have hill stations in the Eastern Ghats.

The beautiful hill stations in India

Kodaikanal, Ooty - Tamil Nadu
Nainital, Mussoorie - Uttarakhand
Darjeeling - West Bengal
Gulmarg - Jammu & Kashmir
Shillong - Meghalaya
Shimla, Manali - Himachal pradesh
Munnar - Kerala
Gangtok – Sikkim

ITC – Inclusive Tour Charter

| IATA – International Air Transport Association |
| IATO – Indian Association of Tour Operators |
| TAAI - Travel Agents Association of India |
| TTTHA - Tamil Nadu Tour Travel and Hospitality Association |
| TTDC – Tamil Nadu Tourism Development Corporation |

Water falls in India

In India there are many spectacular and wonderful waterfalls covered by dense forest, huge walls of rock and lush green trees. Among these waterfalls, some are seasonal, while some are perennial. Few of the amazing waterfalls are in swing during the monsoon season. This season brings lot of tourists to these bubbling waterfall sites. Notable waterfalls of India are given below:

S.No	Water falls	Geographical location
1.	Thalaiyar waterfalls	Horse tail type located in Dindugul district of Tamil Nadu
2.	Jog water falls	Segmented waterfall (Raja, Rani and thunder) located in Shimogo district of Karnataka
3.	Nohkalikai waterfalls	Tallest plunge type of waterfall situated in the East khasi hill district of Meghalaya.
4.	Talakona waterfalls	It is the highest waterfall in Andhra Pradesh. A lot of medicinal herbs are seen around the region.
5.	Aathirappally waterfalls	The Niagara of India, is located in Thrissur district of Kerala

Wild life and Bird Sanctuaries

India possesses a wide range of forests and grasslands. Diversity of these lands makes it one of the hotspot for flora and fauna. The dense and dark forest of Indian States provides suitable habitat for a wide and an unique variety of animals and birds. Royal Bengal Tigers, Indian Lions, Elephants, Rhinoceros, Indian leopard and Reptiles are the major tourist attractions. Bird sanctuaries attract attention for their exclusive variety of birds. Diverse range of climate of India invite birds from

remote places to feed, breed and to nurture their young ones in the Indian bird sanctuaries.

Wildlife Sanctuaries in India

S. No.	Wildlife sanctuary	State	Animals
1.	Mudumalai wildlife sanctuary	Tamil Nadu	Tiger, Elephant , Bison, Deer
2.	Kaziranga National Park	Assam	Tiger,Deer, Buffalo
3.	Ranthambor National Park	Rajasthan	Tiger
4.	Kanha National Park	Madhya Pradesh	Swamp Deer
5.	Sundarbans National Park	West Bengal	Bengal Tiger
6.	Gir National Park	Gujarat	Lions
7.	Bhadra Wildlife Sanctuary	Karnataka	Bison, Leopard, Gaur
8.	Periyar National Park	Kerala	Elephant, Deer
9.	Corbett National Park	Uttarakhand	Tiger

Bird Sanctuaries in India

S.No	Bird Sanctuary	State
1.	Koonthankulam bird sanctuary	Tamil Nadu
2.	Kumarakom bird sanctuary	Kerala
3.	Bharatpur bird sanctuary	Rajasthan
4.	Mayani bird sanctuary	Maharashtra
5.	Uppalapadu bird sanctuary	Andhra pradesh
6.	Nal Sarovar bird sanctuary	Gujarat
7.	Nawabganj bird sanctuary	Uttar Pradesh

Beaches

India is a country with 7517 km long coastline comprising the most beautiful beaches bounded by Arabian sea and Bay of Bengal. Indian beaches are enriched with diverse coastal land forms filled with aquatic flora and fauna. Lush backwater in the lagoons of Kerala and picturesque beaches of Goa such as calangute, Aguda are the notable tourist destinations for water sports activities. The most charming and enchanting beaches of India are listed below.

S.No.	Beaches	States	Geographical features
1.	Dhanushkodi	Tamil Nadu	Turquoise blue sea water
2.	Varkala Beach	Kerala	Sea Cliffs for wonderful sunset views
3.	Tarkarli Beach	Maharashtra	Coral reefs and marine adventure
4.	OM Beach	Karnataka	Two semi circular caves that join together forming the inverted symbol of OM
5.	Aguda Beach	Goa	A huge hill dominates the southern side of the beach.
6.	Marari Beach	Kerala	Saddle like rock(Hammock) Beach

Tourist Attraction in Tamil Nadu

Tamil Nadu has various tourist attractions like religious centres, spiritual retreat centres, beaches, hill stations, waterfalls, wildlife, art, culture, architecture, crafts, heritage monuments etc. The Government of Tamil Nadu has recognized the importance of tourism long ago and facilitated its development in desired directions. Exploring new avenues like medical tourism and adventure tourism in the past decades have helped Tamil Nadu tourism to achieve more than twenty percent annual growth. Tamil Nadu earns the largest share of income from tourism in India.

Religious Tourism

Tamil Nadu is a state popularly known as land of Temples and has been the greatest source for spiritual rejunuvation for travellers all over the world. The state is home to around 33,000 ancient temples that mainly belongs to Dravidian style of architecture. Some of the world renowned religious destinations are as follows:

- Thanjavur Big temple
- Madurai Meenakshi temple
- Rameswaram Ramanathaswami temple
- Temples of Kancheepuram
- Velankanni Madha church

- Nagore Dargah

Hill Stations in Tamil Nadu

Tamil Nadu being situated in the Southern end of the Western and Eastern Ghats, is the home for several hill stations. Popular among them are Udagamandalam (Ooty), Kodaikanal, Yercaud, Coonoor, Valparai, Yelagiri, Sirumalai, Kalrayan Hills and Palani Hills, Shevroy hills and Cardamom Hills. They are also abodes of thick forest and wild life.

Ooty - Queen of Hills
Yercaud - Lake forest (Poor Man's Ooty)
Yelagiri - 14 hairpin bends
Kodaikanal - Princess of Hill Stations
Kotagiri - Green Hills
Velliangiri Hills - Kailash of the South
Kolli Hills - motor able terrain with 70 hairpin bends
Anaimalai Hills - Top slip
Meghamalai - High wavy mountains
Javadi - Nature's Heaven

Waterfalls in Tamil Nadu

Mountains and rivers of Tamil Nadu combined together created many endearing waterfalls. Waterfalls in Tamil Nadu with its inspiring natural wonders attracts many tourists. A trek amidst thick green trees, steep hills and a bath in the gushing water is most rejuvenating. Here is the list of famous water falls of Tamil Nadu.

S.No.	Waterfalls	Geographical location
1.	Hogenakal falls	It is a beautiful waterfall located in Dharmapuri district.
2.	Kumbakkarai falls	River Pambar cascades to form this fall at the foot hills of Kodaikanal in Theni district.
3.	Monkey falls	This waterfall lies on Anaimalai hills range in Coimbatore surrounded by Evergreen forests.
4.	Killiyur falls	Situated in the shervarayon hill ranges of

		the Eastern Ghats. Madurai Meenakshi Temple
5.	Courtallam	Courtallam is located in Tirunelveli district. It is known for medical spa
6.	Agaya Gangai	It is a waterfall in Puliacholai on Kolli Hills in Eatern Ghats of Namakkal district.
7.	Suruli Falls	This falls is also called as Cloud Land falls (or) Meghamalai falls. It is located in Theni district.

Wildlife and Bird Sanctuaries in Tamil Nadu

Wildlife sanctuary in Tamil Nadu includes Bird sanctuaries and National Parks. Tamil Nadu is also well known for the diverse natural heritage that it possesses. Hence tourists are highly excited about the wildlife tour across the state. The total area of Tamil Nadu is approximately 130,058 sq.km. 17.6% of the land area comprises of thick forests. Visitors will get to watch a smooth blend of wet evergreen forest, dry and wet deciduous forests, grasslands, sholas, mangroves and thorny scrubs. Besides varied natural vegetation, another prized possession of Tamil Nadu is wildlife Sanctuaries including Tiger, Elephant, Deer, Monkey, Bison etc., for protecting the entire flora and fauna. Wildlife Sanctuaries of the state are enlisted below:

Wildlife Sanctuaries

S.No.	Name of Wildlife Sanctuary	District
1.	Mudumalai Wildlife Sanctuary	Nilgiris
2.	Mundanthurai Wildlife Sanctuary	Tirunelveli
3.	Point Calimere Wildlife Sanctuary	Nagapattinam
4.	Indira Gandhi Wildlife Sanctuary	Coimbatore
5.	Kalakad Wildlife Sanctuary	Tirunelveli

Bird Sanctuaries in Tamil Nadu

S.No.	Name of Birds Sanctuary	District
1.	Vettangudi birds Sanctuary	Sivagangai

2.	Karaivetti birds Sanctuary	Ariyalur
3.	Vellode birds Sanctuary	Erode
4.	Vedanthangal birds Sanctuary	Kancheepuram

National Parks in Tamil Nadu

S.No	Name of National Parks	District
1.	Guindy National Park	Chennai
2.	Gulf of Mannar Marine Park	Ramanatha puram
3.	Indira Gandhi National Park	Coimbatore
4.	Mukurthi National Park	Nilgiris
5.	Mudumalai National Park	Nilgiris

Beaches in Tamil Nadu

Tamil Nadu being a Coastal state in India which consists of several beaches. Some of them are world famous tourist spots. Beach is a lovely place to hang around with friends, families and kids. All these are ideal destinations for sun bath relaxation and water sports activities.

S.No.	Beaches	Geographical features
1.	Kovalam Beach Kanchipuram	Small fishing village
2.	Marina Beach Chennai	Second longest urban beach
3.	Kanyakumari Beach	Multi-coloured sand
4.	Rameshwaram Beach	Waveless beach

5.	ElliotBeach Chennai	Beautiful beach active in day & night
6.	Mahabalipuram Beach Kanchipuram	Architectural and Archeological beach
7.	Silver Beach Cuddalore	Water sports is the entertainment
8.	Muttukadu Beach Kanchipuram	Calm and Shallow

Environmental Impact of Tourism

The quality of the environment is essential for tourism. The tourism industry created several positive and negative impacts on the environment.

Positive Impacts

- Direct financial Contributions
- Contributions to government revenues
- Improved environmental management and planning
- Increasing environmental awareness
- Protection and reservation of environment

Negative Impacts

1. Depletion of Natural Resources
   - Water resources
   - Local resources
   - Land degradation

2. Pollution
   - Air and Noise Pollution
   - Solid Waste and Litering
   - Sewage

3. Destruction and Alteration of Eco system

- Air
- Water
- Soil

Unit 7
Mapping Skills (7.2 – 7.3)

7.2 Remote Sensing as a Source of Map Data

Remote Sensing refers to the observation and measurement of earthly objects without touching them.

'Remote' means far away and 'Sensing' means observing or collecting information. Remote sensing means acquiring information of things/places from a distance, using a variety of tools and methods.

> We operate three remote sensing organs in our body.

Remote sensing has a long history, dating back from the use of cameras carried by balloons and pigeons in the 18th and 19th centuries. During the 20th century, airborne photographs and satellite remote sensing developed swiftly.

Aerial photography

Aerial photography refers to the technique of obtaining information about places or objects or phenomena with the help of photographs taken using cameras mounted on low flying birds, balloons, helicopters, aeroplanes and drones. The aerial photographs are captured continuously with a time gap of 10-30 seconds at a fixed height. Each photo will have a slight overlap of the area in the preceding photo. By making a mosaic of all the photos excluding the overlapping areas, a stereoscopic (3D) image of the study area can be produced.

> Felix Nadar was a French photographer, journalist, novelist and balloonist. In 1858, he became the first person to take aerial photographs. He took his first photograph in 1853 and pioneered the use of artificial lighting in photography, working in the catacombs of Paris. Around 1863, Nadar built a huge (6000 m³) balloon named Le Géant ('The Giant').

Satellite Remote Sensing

Satellite remote sensing is the science of collecting data about an object or area from artificial satellites orbiting the Earth. The term 'satellite imagery' refers to digitally transmitted images of the satellites.

The preliminary data is retrieved from satellites like LANDSAT, CARTOSAT, OCEANSAT, etc. Fire and flood details can be extracted and delivered to relevant authorities within two hours of satellite image capture. E.g. major earthquakes in China and New Zealand, bushfire in Victoria and floods in Kerala. Dynamic phenomena such as flood, movement of wild animals, shoreline changes, finding lost ships and planes. Researchers use satellite imageries for these.

Components of remote sensing

- Energy source
- Transmission path
- Target
- Sensor

People cannot be tracked generally by satellite or aerial photographs but they can be tracked by their mobile phone signals.

Global Navigation Satellite System (GNSS)

Have you ever booked a cab using a smart phone app? Did you see the map showing the route of your travel and movement of your vehicle on mobile phones? How is it possible to calculate the time duration of your travel?

Satellite remote sensing	Aerial Photography
• High cost of satellite systems. Takes at least 10 years to plan, construct, test and launch.	• Surveying can be planned and executed in a shorter time economically.
• Satellites collect large amount of data of the entire area in a short span.	• Takes more time to capture an area. Aircraft needs to fly back and forth.
• It allows global coverage and does not require permission.	• It covers a small area and needs permission from

• Satellites circle the Earth; they can repeat and revisit easily. • Weather does not affect the functioning of satellites. • All information is digital; it can be easily integrated with software for image improvement.	authorities. • Revisits or repeatability involves extra cost. • Adversely affected by bad weather • It is an analogue record, so no further improvement is possible after obtaining photographs.

In the 21st century, GNSS has become a part of our lives to promote the safety and convenience of transport. Global Navigation Satellite System (GNSS) is a satellite system connected with a small electronic receiver or tracker to locate, monitor and track a user's vehicle wherever in the world. It can also set up instant alerts when a driver of a vehicle speeds or deviates from a particular area. GNSS applications are used in tracking or mapping vehicles, ships and aircraft. A group of satellites (Space Segment) working with a network of ground stations (Control Segment) provide location data. The receiver (User Segment) converts satellite signals into location, speed and time data.

Examples of GNSS
""
- Europe-Galileo"""
- USA-NAVSTAR Global Positioning System (GPS)"""
- Russia-Global'naya Navigatsionnaya Sputnikovaya Sistema (GLONASS)"""
- China- BeiDou Navigation Satellite System"""
- India's-IRNSS (NAVIC) system

a. Global Positioning System (GPS)

Without the Global Positioning System (GPS) on our vehicles and mobile phones, we would feel lost. GPS is the U.S. implementation of the world's first and currently the most used Global Navigation Satellite System (GNSS) created by the U. S. Department Of Defense (DOD). It became fully operational in 1995. NAVSTAR (Navigation Satellite Timing and Ranging) is a network of 24 U.S. satellites in six different orbits in space flying 20,350 km above the surface of the Earth; each one

circles the planet twice a day to provide continuous, worldwide coverage. GPS receivers now come in all shapes and sizes, Most are the size of a cellular phone. Some are handheld, others are installed in ships, planes, trucks and cars.

Advantages of GPS

""
- GPS technology has tremendous applications in everything from mobile phones, watches, bulldozers, shipping containers and ATMs."
- The main purpose of GPS is to help in providing accurate transport data (distance, route and direction). It helps in military searches and rescue in wars. It can work as a reliable tourist guide.""
- GPS helps during accident and rescue efforts, speeding the delivery of emergency services and disaster relief.""
- Weather forecasting, earthquake monitoring and environmental protection can be done effectively by using GPS.

b. Geographic Information System (GIS)

Geographic Information System is a computer-based tool for managing a large amount of data collected for a given geographic region through remote sensing, GPS and other sources. The Geographic Information System is a combination of computer hardware, software, geographic data and the personnel.

G - Geographic - A particular area
I - Information - facts in order
S - System - arrangement

GIS was first recognised in the late 1950s by Waldo Tobler and Roger Tomlinson (Canada). Prime examples of importing GIS for public welfare are Google Maps, Yahoo Maps and Google Earth.

The key ingredient is location. We must have a coordinate, an address or a distance from a known point that helps us to link the information to a location on a map. Each type of data of an area is stored as a separate 'layer' of the map. In GIS, layers may be used some times and removed according to need. Examples are hospitals, schools, water

bodies, parks and ATMs. The computers can create maps showing any combination of data.

Bhuvan

Bhuvan (Sanskrit for Earth) is a free internet based computer application launched by the Indian Space Research Organization (ISRO) on August 12th 2009. It enables visualization of Indian Remote Sensing (IRS) images taken over a year ago, by ISRO's seven satellites, including CartoSat-1 and CartoSat-2. Using Bhuvan connected to Internet, one can explore places of interest, scenes of events in the news or parts around the world they may never visit in person, by either entering the names of places or coordinates (latitudes and longitudes). Bhuvan has tremendous uses for scientists, academicians, policy makers and the general public.

Unit – 5
India Population, Transport, Communication, Trade

Introduction

The study on human population is one of the most important aspects in geography of any region. The human population has many components but the most fundamental are its number, composition, distribution and density. Therefore, it is essential to study these components. The study on these aspects also would reveal the workforce of the country.

The population of India as per 2011 census is 1,210.19 million (1,21,01,93,422). It shows an increase of 19.31crores from the population of 2001. Population Census of India provides the detailed information about the demography of India. Along with population, we will study about the transport and communication of India in this chapter.

Population

The total number of people residing in a country at a specified period of time is called the 'Population' of that country. India is the second most populous country in the world next only to china. India covers only 2.4 percent of the land area of the world, but is the home of about 17.5 percent of the world's population. It shows that the proportion of population of India is far higher than the proportion of its area. Thus, a little more than one out of every six persons in the world is from India. Our population is almost equal to the combined population of the USA, Indonesia, Brazil, Pakistan, Bangladesh and Japan and total population of these six countries is 1214.3 million.

Census

Population census is the total process of collecting, compiling, analysing or otherwise disseminating demographic, economic and social data pertaining, at a specific time, of all persons in a country or a well-defined part of a country. It happens in an interval of ten years. The data collected through the census are used for administration, planning,

policy making as well as management and evaluation of various programmes by the government.

Distribution and Density of Population

The term 'Population Distribution' refers to the way the people are spaced over the earth's surface. The distribution of population in India is quite uneven because of the vast variation in the availability of resources. Population is mostly concentrated in the regions of industrial centres and the good agricultural lands. On the other hand, the areas such as high mountains, arid lands, thickly forested areas and some remote corners are very thinly populated and some areas are even uninhabited. Terrain, climate, soil, water bodies, mineral resources, industries, transport and urbanization are the major factors which affect the distribution of population in our country.

In India the first census was carried out in the year 1872. But the first complete and synchronous census was conducted in 1881. And the 2011 census represents the fifteenth census of India.

Uttar Pradesh is the most populous state in the country with a population of 199.5 million followed by Maharashtra (112.3 million), Bihar (103.8 million) West Bengal (91.3 million) and the combined Andhra Pradesh (84.6 million). These five states account for about half of the country's population. More than one fourth of the population live only in the two states of U.P and Maharashtra. Sikkim is the least populous state of India(0.61 million). Delhi with 16.75 million population tops among the Union territories.

The uneven distribution of population in the country is the result of several factors such as physical, socio-economic and historical ones. The physical factors include relief, climate, water, natural vegetation, minerals and energy resources. Socio-economic factors consists of the religion, culture, political issues, economy, human settlements, transport network, industrialization, urbanization, employment opportunity etc.

Density of population

Population density is a better measure of understanding the variation in distribution of population. It is expressed as number of

persons per unit area usually per sq km. According to 2011, the average density of population of India is 382 persons per sq.km. India is one of the most thickly populated ten countries of the world. The most densely populated state of India is Bihar and the state with least population density is Arunachal Pradesh. Among the union territories, Delhi is the densely populated one with 11,297 per sq.km, while Andaman and Nicobar Islands have the lowest density of population.

Spatial pattern of population density	
Density	**Places**
Very Low density (less than 150 persons per sq.km)	Arunachal Pradesh (17), Andaman and Nicobar Islands (46), Mizoram (52), Sikkim (86) Nagaland (120), Manipur (122), Himachal Pradesh (123), Jammu and Kashmir (124) and Meghalaya (132)
Low Density (150 to 300 persons per sq.km)	Arunachal Pradesh (17), Andaman and Nicobar Island s(46), Mizoram (52), Sikkim (86) Nagaland (120), Manipur (122), Himachal Pradesh (123), Jammu and Kashmir (124) and Meghalaya (132)
Moderate Density (300 to 500 persons per sq.km.)	Gujarat (308), The combined Andhra Pradesh (308) Karnataka (319), Tripura (350), Maharashtra (365), Goa (394), Assam (397) and Jharkhand (414) are the states with moderate population density. Assam has tea estates, Andhra Pradesh, Karnataka and Jharkhand
High Density (500 t0 1000 persons per sq.km)	Punjab (550), Tamil Nadu (555), Haryana (573), Uttar Pradesh (827) and Kerala (859) The union territory of Dadra and Nagar Haveli (698)
Very High Density (greater than 1000 persons per sq.km)	West Bengal (1029), Bihar (1102), Lakshadweep (2013), Daman and Diu (2169), Puducherry (2598), Chandigarh (9252) and Delhi (11.297).

Population Growth and Change

The growth rate of population is an important demographic feature. It not only helps in understanding the population change that a

society has undergone in the past but also helps in predicting the future demographic characteristics of an area. Population growth refers to the change in the number of inhabitants of a country/territory during a specified period of time. The growth of population is expressed in percentage and is described as the growth rate of population. The following table shows the decadal growth rate of population from 1901 to 2011.

Growth of population in India has gone through the different phases. Population of the country in 1901 was 238 million and it grew to 1,210 million over a period of little more than a century. The following are the different stages of population growth of India.

The Period of Stagnant Population (1901-1921): During the first phase of 20 years (1901-1921), the population of India grew by 15 million. The year 1921 registered a negative growth rate of -0.31% which happened only once throughout the demographic history of India and is called the year of Great Demographic Divide.

The Period of Steady Growth (1921- 1951): During the second phase of 30 years (1921-1951), the population of India grew by 110 million.

The Period of Steady Growth (1951- 1981): During the third phase (1951- 1981), the population of India grew from 361 million in 1951 to 683 million in 1981. Growth rate in this period is almost doubled when compared to the previous phase of growth rate. This period is often referred to as the period of population explosion.

The period of High Growth with Definite Signs of Slowing Down (1981- 2011): Population of India increased from 685 million to 1210 million during this phase. The growth rate of population decreased from one census to other. This marks the beginning of a new era in the demographic history of India.

Population change refers to an increase or decrease of population of an area from one period to another period. Population growth is influenced by the birth rate, death rate and migration. These three make the changes in population. Birth rate refers to the number of live births per thousand people in a year and the

Death rate refers to the number of deaths per thousand people in a year. The rapid decline in death rate is the major cause of the rapid growth of population in India.

Migration

It is the movement of people across regions and territories. It can be internal (within a country) or international (between the countries). Internal migration does not change the size of population of a country but it influences the distribution of population in a nation. It plays an important role in changing the composition and distribution of population. In India, the mass migration is from rural to urban. Unemployment and under employment in the rural areas are the push factors and the employment opportunity and higher wages in the urban areas caused by the industrial development are the pull factors of migration in the country. 45 out of 121 crores of people in India are reported to be migrants as per 2011 census. Migrants constitute about 37% of population. Migrants are 48% from female and 52% from male.

Population composition

Population composition refers to the characteristics such as age, sex, marital status, caste, religion, language, education, occupation etc. The study of composition of population helps us to understand the social, economic and demographic structure of population.

Age composition

The age composition of population refers to the number of people in different age groups in a country. It is one of the most basic characteristics of a population. It helps us to understand the proportion of population in dependent and independent category. Population of a nation is generally grouped in to three broad categories. In India, the children who have less than 15 years of age constitute 29.5% and the people above 60 years constitute 8.0%. So, the dependent population in India is 37.5%and the independent population (16- 59 yrs) is 62.5%. It shows that our country has enormous manpower.

Sex Ratio

Sex ratio is defined as the number of females per 1000 male population. This is an important social indicator to measure the extent of equality between males and females in a society at a given time.

According to 2011 census, the sex ratio of the country is 940 females per 1000 males. This suggests that the size of female population is lower than males. Only in the state of Kerala and the union territory of Pondicherry the sex ratio is greater than 1000. It is 1084 in Kerala and 1038 in Puducherry. The lowest sex ratio is recorded in the union territory of Daman and Diu(618).

The ratio between the economically active and economically inactive of population is termed as Dependency Ratio.

Literacy Rate

The people who are able to read and write are known as literates. It is an important indicator of quality of people. The percentage of literate people to the total population is termed as literacy rate. There has been a steady improvement in the literacy levels in India. India's literacy rate as per 2011 census is 74.04%. From this, the literacy rate of male is 82.14% and the female is 65.46%. It shows that still there is a vast gap (16.68%) between the male and female literacy rates. Kerala ranks first in the country with a literacy rate of 93.91% followed by union territory Lakshadweep with 92.28%. The lowest literacy rate is found in Bihar (63.82 %).

Occupational structure

The economically active part of a country's population is enumerated during the census operations and stated as workers. Workers are placed under three fold categories in census record. They are main workers, marginal workers and non-workers. According to the Census of India, all those who had worked for the major part of the preceding year (at least 6 months or 183 days) are recorded as main workers. Those who worked for less than six months are recorded as marginal workers and the people who have not worked at all comes under non- workers. Work participation rate denotes the percentage of total workers i.e., total main and marginal workers to the total population in an area. The work participation rate in India is 39.79% in

2011, out of which the work participation rate of male is 53.25% and the female is 25.51%. From the workers, main workers constitute 75.23% and the remaining 24.77% of the people belong to marginal workers.

Population Dynamics

Human population dynamics is a field that tracks factors related to changes in the size of population and its characteristics. Predicting population changes is an important aspect of population studies. The demographic trend affects the economic, social, and environmental systems. An increase in human population can affect the quality of natural resources like biodiversity, air, land, and water. The size of Population and characteristics undergoes changes constantly. These changes are reflected clearly in every other aspect of our country.

Problems of over Population

In India, growing pressure of Population on resource base, created many socioeconomic, cultural, political, ecological and environmental problems. The Population problems vary in space and time and differ from region to region. Some of the major issues created by the overpopulation in our country are overcrowding, unemployment and under employment, low standard of living, malnutrition, mismanagement of natural and agricultural resources, unhealthy environment etc.

Urbanization

The process of society's transformation from rural to urban is known as urbanization. The level of urbanization of a place is assessed based on the size of population of the towns and cities and the proportion of population engaged in non-agricultural sectors. These two are closely linked to the process of industrialization and expansion of the secondary and tertiary sectors of economy.

Urbanization in India

The level of urbanization is measured in terms of percentage of urban population. The level of urbanization in the country has increased more than three times from 1901 to 2011. The percentage of urban

population of India was 27.82% in 2001 and it rose to 31.16% in 2011 shows an increase of 3 % in a decade.

The level of urbanization varies widely among the states. Goa is the most urbanized state with 62.17% of urban population. Himachal Pradesh is the least urbanized state with 10.04% of urban population. Among the Union territories, Delhi is the most (97.50 %) urbanized region followed by Chandigarh (97.25%). Among the major states, Tamil Nadu continues to be the most urbanized state with 48.4% percent of urban population followed by Kerala (47.7%) and Maharashtra (45.2%).

S. No	Type of Towns /UAs / OGs	2001 (in Numbers)	2011 (in Numbers)
1.	Statutory towns	3799	4041
2.	Census Towns	1362	3894
3.	Urban Agglomeration	384	475
4.	Out Growths	962	981

As per 2011 Census, there are 7,935 towns (statutory and census) in the country. The number of towns has increased to 2,774, from 2001 census. In 2011, 475 Urban agglomeration (UAs) with 981 outgrowths (OGs) have been identified as Urban Agglomerations as against 384 UAs with 962 OGs in 2001 Census. Out of 468 UAs belongs to Class I category, 53 UAs have the population of one million and above each and these urban centres are known as "Million Cities". These are the major urban centres in the country. Among the Million Cities, there are three major Urban Agglomerations with more than 10 million population each and are known as "Mega Cities". They are Greater Mumbai UA (18.4 million), Delhi UA (16.3 million) and Kolkata UA (14.1million).

Impact of Urbanization

Urbanization and population concentration go hand – in – hand and are closely related to each other. A rapid rate of urbanization in a society is taken as an indicator of its economic development. Urbanization is increasing rapidly in the developing countries including India. Rural to urban migration leads to population explosion in urban areas. Metropolitan cities like Mumbai, Kolkata and Delhi have more population than that can accommodate. The urban population of India

had already crossed the 377million in 2011, which is more than the total population of USA. By 2030, more than 50% of India's population is Expected to live in urban areas. The following are the major problems of urbanization in India

- It creates urban sprawl.
- It makes overcrowding in urban centres.
- It leads to shortage of houses in urban areas.
- It leads to the formation of slums.
- It increases traffic congestion in cities.
- It creates water scarcity in cities.
- It creates drainage problem.
- It poses the problem of solid waste management.
- It increases the rate of crime.

Human Development

Dr. Mahabub-ul-haq defined as "it is a process of enlarging the range of people's choice, increasing their opportunities for education, health care, income and empowerment. It covers the full range of human choices from a sound physical environment to economic, social and political freedom".

Human Development Indicators: (as per UNDP)

Population trends, health outcomes, education achievements, national income and composition of resources, work and employment, human security, human and capital mobility, supplementary indicators: perceptions of well-being and status of fundamental rights treaties are the human development indicators.

Measuring of Human Development

Human Development Index (HDI) is a composite index focusing on three basic dimensions of human development: i) Health - Life expectancy at birth ii) Education - Expected years of schooling for school age children and average years of schooling for the adult population. iii) Income - Measured by-gross national income and percapita income.

Human Development Classification

HDI classifications are based on HDI fixed cut off points, which are derived from the quartiles of distributions of the component indicators. The HDI of less than 0.550 is used for low human development, 0.550 - 0.699 stands for medium human development, 0.700 - 0.799 for high human development and 0.8 or greater for very high human development.

Transportation

Transport is a system in which passengers and goods are carried from one place to another. Transport system is considered as the lifeline of a country. Earlier man travelled on foot or used animals for transport. With the discovery of wheel, transport was made easier and gradually different means of transport were developed. There are three major means of transport in the world.

Means of Transport		
Land	**Water**	**Air**
• Road ways • Railways • Pipelines	• Inland • waterways • Ocean routes	• Domestic airways • International Airways

Transport Network in India

Transport is one of the most important components of infrastructure and it is essential for economic development of a country, especially for a large country like India. India has a good transport network of roads, railways, airways and waterways providing necessary connectivity between different parts of the country.

Roadways

Roads play an important role in carrying goods and passengers for short, medium and long distances. It is highly suitable for short distance services. It is comparatively easy and cheap to construct and maintain roads. Road transport system can establish easy contact between farms, fields, factories and markets and can provide door to door transport services. Roads are the most universal mode of transport. Indian roads

are cost efficient. It is used by all sections of people in the society. India has the second longest road network in the world with a total length of 56,03,293 km as of 2016. About 85% of passengers and 70 % of freight traffic are carried by roads every year.

> Sher shah suri built the shahi (Royal) road to strengthen and consolidate his empire from the Indus valley to the Sonar valley in Bengal. This road from Kolkata to Peshawar was renamed as Grand Trunk(GT) road during the British period. At present, it extends from Amristar to Kolkata. It is bifurcated into 2 segments: (a) (NH)-1 from Delhi to Amristar, and (b) NH-2 from Delhi to Kolkata.

For the purpose of construction and maintenance, roads are classified into National Highways (NH), State Highways (SH), District Roads, Rural Roads (Village roads), Border Roads and International Highways.

1. Classification of Roads in India
a. National Highways (NH)

National Highways form the most important system of road transportation in India. These highways are running through length and breadth of the country connecting capitals of states, major Ports, rail junctions, industrial and tourist centres. Ministry of Road Transport and Highways of India, is responsible for the development and maintenance of National Highways in India. The total length of the National Highways (NHs) in India is 1,01,011 km which accounts for 1.8 % of the total road network length in 2016. The longest National highway is NH-7 which runs from Varanasi in Uttar Pradesh to Kanniyakumari in Tamil Nadu covering a distance of 2369 km. The shortest national highway is NH-47A, which runs from Ernakulum to Kochi port (Willington Island) covering a distance of 6 km.

b. State Highways

The state highways are usually roads that link important cities, towns and district headquarters within the state and connect them with national highways or highways of neighbouring states. These roads are administered and financed by state governments. State Highway runs to the length of 1, 76,166 km as of 2016.

c. District Roads

District Roads provide connectivity between the district and taluk headquarters with the state highways and national highways. District Roads are constructed and maintained by the Public Works Department of the states. The total length of the road of this category is 5,61,940 km(16.81%) in 2016.

d. Rural Roads (Village Roads)

Rural roads connectivity is a key component of rural development. These roads are vital for providing links in the rural areas. It links the different villages with their neighbouring towns. They are maintained by Village Panchayats. The total length of rural roads in India is 39,35,337 km as of 2016. Rural roads consist of Panchayat roads, (Zilla Parishad, Panchayat Samiti, Gram Panchayat); roads of the Pradhan Mantri Gram Sadak Yojana (PMGSY) and those constructed by the State PWDs.

National Highways Authority of India (NHAI) was established in 1995. It is an autonomous body under the Ministry of Surface Transport.

e. Border Roads

These are the roads of strategic importance in border areas. They are constructed and maintained by Border Roads Organization. It was established in 1960 for the development of the roads of strategic importance in the northern and north-eastern border areas. Border Roads Organization has constructed world's highest road joining Chandigarh and Leh in Ladakh. This road runs at an average altitude of 4,270 meters.

Golden Quadrilateral: 5,846 km long road of 4/6 lanes connecting, India's four metropolitan cities: Delhi-Kolkata-Chennai-Mumbai-Delhi. This project was launched in 1999.

North–South and East-West Corridors: North- South corridor aims at connecting Srinagar in Jammu and Kashmir with Kaniyakumari in Tamil Nadu (including Kochi-Salem Spur) with 4,076km long road. The East-West corridor has been planned to connect Silchar in Assam with

the port town of Porbandar in Gujarat with 3,640km of road length. The two corridors intersect at Jhansi.

f. Expressways

These are multi-lane good quality highways for high speed traffic. Some of the important expressways are; (i)Mumbai-Pune Road, (ii) Kolkata-Dumdum Airport road (iii) Durgapur-Kolkata road and (iv) Yamuna expressway between Delhi and Agra.

g. International Highways

These are the roads that link India with neighbouring countries for promoting harmonious relationship with them. These highways have been constructed with an aid from world bank under an agreement with the Economic and Social Commission for Asia-Pacific (ESCAP). These roads connect important highways of India with those of the neighbouring countries such as Pakistan, Nepal, Bhutan, Bangladesh and Myanmar. In India the densest road network is found in the northern plains where it is relatively easy to construct roads. In mountainous area, it is quite difficult to construct roads. Road density is the highest in Kerala and lowest in Jammu &Kashmir.

Railways

Indian railway system is the main artery of the country's inland transport. Railways cater to the needs of large scale movement of traffic, both for freight and passenger, thereby contributing to economic growth. Railways are considered as the backbone of the surface transport system of India. It promotes national integration by bringing people together. It also promotes trade, tourism, education etc. Railways help in the commercialization of the agriculture sector by facilitating the quick movement of perishable goods. Its role in transporting raw materials to industries and finished goods to markets is invaluable. Indian railway network is the largest in Asia and second largest in the world. The length of Indian railways network as of 2017 is 67,368 km with 7,349 railway stations.

The first train steamed off from Mumbai to Thane in 1853, covering a distance of 34 km. In 1951, the systems were nationalized as one unit

"The Indian Railways". The headquarter of Indian Railways is New Delhi.

For operations and management, the Indian Railways is organized into 16 zones. 1) Northern Railway - Delhi 2) North- Western Railway - Jaipur 3) North-Central Railway- Allahabad 4) North-Eastern Railway - Gorakhpur 5) North-East Frontier Railway - Guwahati 6) Eastern Railway - Kolkata 7) East coast Railway - Bhubaneswar 8) East-Central Railway - Hazipur 9) West-Central Railway - Jabalpur 10) Central Railway - Mumbai (VT) 11) Western Railway - Mumbai (Churchgate) 12) Southern Railway - Chennai 13) South- Central Railway - Secunderabad 14) South Eastern Railway - Kolkata 15) South-Western Railway - Hubball and 16) South East Central Railway - Bilaspur. The Northern Railway accounts for the longest route length, followed by the Western Railway.

• The first sub-urban railway was started in 1925 in Mumbai.
• Chennai becomes the sixth Indian city with metro railway.
• Gatiman Express is the fastest operational train in India. This train connects New Delhi and Agra and touches 160 km/h. This train takes a travel time of 105minutes to cover 200km journey.

a. Konkan railway

One of the important achievements of Indian Railways has been the construction of Konkan Railway in 1998. It connects Roha in Maharashtra to Mangaluru in Karnataka and the track measures 760 km. It is considered as an engineering marvel. On its routes, the railway crosses 146 rivers and streams, nearly 2000 bridges and 73 tunnels. Asia's longest tunnel nearly 6.44 km long is in this route. The states of Maharashtra, Goa and Karnataka are partners in this undertaking. The rail link between Banihal in Jammu region and Qazigund in Kashmir valley was opened in 2013. This rail line passes under the Pir Panjal Range through a 11.2 km long tunnel.

b. Metro Railways in India

There are 8 cities with metro rail connectivity in India. They are Kolkata (West Bengal), Chennai (Tamil Nadu), Delhi, Bengaluru (Karnataka), Gurgaon (Haryana), Mumbai (Maharashtra), Jaipur

(Rajasthan) and Kochi (Kerala). The metro in Kolkata is the first one in India. It is also called as Mass Rapid Transit System (MRTS). As of September 2018, India has 507 km of operational metro lines and 381 stations.

The state of Meghalaya has no railway network.

Pipeline transport:

Pipelines provided a very convenient mode of transport to connect oil and natural gas fields, refineries and to the markets. In the past, these were used to transport water to cities and industries. Now solids can also be transported through a pipeline when converted into slurry. The initial cost of laying pipeline is high but subsequent running cost is minimum. It can be laid through difficult terrain as well as under water. It ensures steady supply of goods and reduces the transhipment losses and delays are the major advantages of pipeline transport. Oil field in upper Assam to Kanpur, from Salaya in Gujarat to Jalandhar in Punjab and gas pipeline from the Hazira in Gujarat ot Jagadispur in Uttar Pradesh are the three important network large network of pipeline in the country.

Waterways

A waterway is an important mode of transport for both passenger and cargo traffic in India. It is the oldest and also the cheapest means of transport and most suitable for carrying heavy and bulky materials from one country to another. It is a fuel-efficient and eco-friendly mode of transport. The water transport is of two types- Inland Waterways and Ocean water ways(sea routes).

a. Inland Waterways

India has an extensive network of inland waterways in the form of rivers, canals, lakes and backwaters. It depends upon the depth and width of the waterways and the continuity of the water flow. The total navigable length of our country is 14,500 km, out of which about 5,200 km length of rivers and 4,000 km length of canals can be used by mechanized crafts. The total cargo carried by inland waterways is just about 0.1% of the total inland traffic of India. For the development,

maintenance and regulation of national waterways in the country, the Inland water ways Authority was setup in 1986. The major national waterways are: National Waterway 1: It extends between Haldia and Allahabad, measures 1620 km and includes the stretches of the Ganga-Bhagirathi-Hooghly river system. National Waterway 2: This waterway includes the stretch of the Brahmaputra river between Dhubri and Sadiya a distance of 891 km. National Waterway 3: This waterway extends between Kollam and Kottapuram in the state of Kerala. It is the first national waterway in the country with 24 hour navigation facilities along its entire stretch of 205 km.

b. Oceanic Routes

Oceanic routes play an important role in the transport sector of India's economy. About 95% of India's foreign trade by volume and 70 percent by value moves through ocean routes.

Coastal shipping plays an important role in transport of bulk goods in India. Shipping is not only the most economical mode of transport, it is also an environment friendly mode. The sea and oceanic routes are mainly used for international trade and are connected through ports. There are 13 major and 200 minor or intermediate ports in India. The major ports are administered by the Central Government and minor ports are managed and administered by various state governments. The major ports on the east coast are Kolkata (including Haldia Dock), Paradip, Visakhapatnam, Chennai, Ennore and Tuticorin. The major ports on the west coast are Kandla, Mumbai, Nhava Seva (Jawaharlal Nehru Port), New Mangalore, Marmagao and Kochi. India has four major shipyards. Hindustan shipyard in Vishakhapatnam, Garden Reach workshop in Kolkata, Mazagaon Dock in Mumbai, Kochi Shipyard in Kochi. India is the second largest ship owning country in Asia and ranks 16th in the World.

Air Transport

Airways are the quickest, costliest, most modern and comfortable means of transport, Air transport facilitates connectivity on a national, regional and international scale. It has made accessibility easier by connecting difficult terrains like high mountains and sandy deserts. It carries passengers, freight and mail. Air transport plays a key role in

times of emergency as well as in the event of natural and man-made calamities like floods, epidemics and wars.

Air transport in India made a beginning on 18th February, 1918 when Henry Piquet carried a mail from Allahabad to Naini. In 1953, eight different airlines which were in operation in the country were nationalised.

Domestic Airways fly within the boundaries of a country and International Airways connect major cities of the world. The Indian Airlines and Air India are the two airline services run by the government of India. Indian Airlines provides the domestic air services and Air India provides international air services. Presently, there are 19 designated international airports available in the country. These airports are managed by Airports Authority of India. Some of them are Netaji Subhash Chandra Bose International Airport, Kolkata, Chennai International Airport, Chennai, Indira Gandhi International Airport, Delhi, Chhatrapati Shivaji International Airport, Mumbai, Thiruvananthapuram International Airport, Thiruvananthapuram, Sardar Vallabh Bhai Patel International Airport, Ahmedabad, Bangalore International Airport, Bengaluru, Rajiv Gandhi International Airport, Hyderbad etc. Besides this, there are about 80 domestic airports and about 25 civil enclaves at defence air fields.

a. Pavan-Hans Helicopter Ltd

Pavan-Hans Helicopter Ltd has been providing Helicopter support services to the petroleum sector, including ONGC and oil India Ltd. It is a public sector company based in New Delhi. Its operations are based at the Juhu Aerodrome in Vile Parle (West) Mumbai. Pavan-Hans is a Mini Ratna–I category public sector undertaking. It often provides services to various state governments in India particularly north east India Inter Island, Ferry services in Andaman & Nicobar Islands, services to Lakshadweep Island etc.,

b. Airports Authority of India (AAI)

Airports Authority of India (AAI) was constituted in 1995. It provides security to Indian Airports. AAI under the ministry of Civil

Aviation is responsible for creating, upgrading, maintaining and managing civil aviation infrastructure in India.

Communication

Communication is a process that involves exchange of information, thoughts and ideas. Technology does wonders in communication fields. Communication is categorized in to personal and mass communications.

Personal Communication

The exchange of information between the individuals is called personal communication. It includes post and telegraph services, telephone, mobile phone, short message services, fax, internet, e-mail etc. Personal Communication system enables the user to establish direct contact.

The Indian postal network is the largest in the world with 1,55,000 post offices. Of these more than 1,39,000 post offices are located in rural areas. The postal service was opened to the public in the country in 1837. The first Indian postal stamp was issued in 1852 in Karachi. Collecting and delivering mail is the primary function of the department of posts. It introduced the Quick Mail Service in 1975 and today it covers the entire country. Them Quick Mail Service functions on the basis of the system of PIN (Postal Index Number) code which was introduced in 1972. The premium products include the Money order, e-money order, Speed Post, Express Parcel Post, Business Post, Media Post, Satellite Post, Retail Post, Greeting Post, Data Post, Speed Net and Speed Passport Services.

In 2007, the Government of India merged the Air India and Indian Airlines under National Aviation Corporation of India Limited (NACIL). In which NACIL (A) provides international services, NACIL (I) provides domestic services and services to neighboring countries in south east Asia and middle East.

Cards and envelopes are considered first class mail and are airlifted between stations covering both land and air. The second class mail includes book packets, registered newspapers and periodicals.

They are carried by surface mail, covering land and water transport. To facilitate quick delivery of mails in large towns and cities, six mail channels have been introduced recently. They are called Rajdhani Channel, Metro Channel, Green Channel, Business Channel, Bulk Mail Channel and Periodical Channel.

India has one of the largest telecommunication networks in Asia. Apart from the urban areas more than two-thirds of the villages in India have already been covered with Subscriber Trunk Dialing (STD) telephone facility, while International communication can be made through ISD (International Subscriber Dialing). There is an uniform rate of STD facilities all over India. Telephone is a form of oral communication. It is considered very essential for the growth of commerce. It is the most preferred form as it provides instant communication. Mobile phone, fax and internet are the other personal communication used in the country.

Mass Communication Systems

Mass Communication enables millions of people to get the information at the same time. It is a great way to provide education as well as entertainment. It helps in creating awareness among the people regard in national policies and programmes. The Mass Communication Systems can provide the information to people in two methods. They are Print Media and Electronic Media.

Electronic Media: Radio broadcasting in India was started in 1923 by the Radio club of Bombay. Since then it gained immense popularity and changed the social and cultural life of people. It was named as All India Radio (AIR) in 1936 and again it was renamed as Akashwani in 1957. It broadcasts a variety of programs related to information, education and entertainment. Special news bulletins are also broadcasted on special occasions like session of parliament and state legislatures.

Television broadcasting has emerged as the most effective audio-visual medium for disseminating information and educating the masses. Television network in India is known as Doordarshan (DD) which started Common National Program (CNP) services and it is extended to the backward and remote rural areas.

Internet (contraction of interconnected network) is the global system of interconnected computer networks that use the Internet protocol suite to link devices worldwide. **Social media** are interactive computer-mediated technologies that facilitate the creation and sharing of information, ideas, career interests and other forms of expression via virtual communities and networks. With over 460 million internet users, India is the second largest online market, ranked only behind China. By 2021, there will be about 635.8 million internet users in India. Despite the large base of internet users in India, only 26 percent of the Indian population accessed the internet in 2015. This is a significant increase in comparison to the previous years, considering the internet penetration rate in India stood at about 10 percent in 2011. Furthermore, men dominated internet usage in India with 71 percent to women's 29 percent.

Print Media: Newspapers are the most common but powerful means of communication come under print media. India has many newspapers which carry information on local, national and international events to the people.

Satellite Communication

The use of Satellite in getting a continuous and synoptic view of larger area has made this communication system very vital for the country. Satellite images are used for weather forecasting, monitoring of natural calamities, surveillance of border areas etc. The communication through satellites emerged as a new era in communication in our country after the establishment of Indian Space Research Organization (ISRO) in 1969.

Satellite system in India can be grouped into two-the Indian National Satellite System (INSAT) and the Indian Remote Sensing Satellite System (IRS).The INSAT, established in 1983, is a multipurpose system for telecommunication, meteorological observation and for various other programs. The INSAT series are used for relaying signals to television, telephone, radio, mobile phone. It is also useful in weather detection, internet and military applications.

The INSAT series, GSAT series, KALPANA-1, HAMSAT, EDUSAT are the major communication satellite used for communication purpose.

GSAT–7A is the recent launch (December 19, 2018) for communication programs. INSAT-1B launched on 30th August 1983 is the first communication satellite in INSAT series.

Trade

Trade is an important phenomenon that decides the economic growth of a country. Trade is an act (or) process of buying, selling or exchanging of goods and services. The primitive method of trade was known as the Barter system where goods were exchanged for goods. Later on, money was introduced as a medium of exchange in buying and selling of goods. The difference in value between the imports and exports is called balance of trade. The situation in which the value of exports exceeds the value of imports is termed as favourable balance of trade and the reverse position is termed as unfavourable balance of trade.

Types of Trade

Trade in general, is of two types. They are Internal and International. The trade carried on within the domestic territory of a country is termed as Internal trade. It is also called as Domestic trade or Local trade. Land transport (roadways and railways) plays a major role in this trade. Local currency is used in internal trade. It helps to promote a balanced regional growth in the country i.e, tea from Assam, coffee from Karnataka, Rubber and spices from Kerala, minerals from Jharkhand etc., are supplied to different parts of our country.

Trade carried on between two or more countries is called International trade. It is also called as external trade or foreign trade. Export and Import are two components of International trade. Export means goods and services sold for foreign currency. Import means goods and services bought from overseas producers. Waterways and Airways play a vital role in this type of trade. Foreign currency is involved in international trade. The trade between any two countries is called Bilateral trade. The trade between more than two countries is called Mutilateral Trade.

Exports

The major exports of India are tea, marine products, ores and minerals, leather products, gems and jewels, sports goods, chemicals and related products, plastics and rubber articles, articles of stones, plaster, cement, asbestos, mica, glass ware, paper and related products, base metals, optical, medical and surgical instruments, electronic items, machinery, office equipment's, textiles and allied products.

Imports

The major imports are petroleum products, pearls, precious stones and semi-precious stones, gold and telecom instruments.

India's Trade Performance

The volume of India's foreign trade has increased many fold since independence. During 2008 -2009, the volume of trade was 840755 crores and it rose to 1039797 crores in 2016-2017. The import during 2008-2009 was 1374436 crores and was with a deficit of 40679 crores. The import during 2016–2017 rose to 1396352 crores and was with the deficit of 356555 crores. It reveals that not only the balance of trade is unfavourable but also the increase in the level of deficit.

12th
Unit – 5
Cultural and Political Geography

Introduction

Geoinformatics is the integration of remote sensing, Global Navigation Satellite System and Geographic Information System dealing with spatial information. The advent of remote sensing, Global Navigation Satellite System and Geographic Information System has made significant changes in surveying and map making. A basic understanding of these components is crucial for carrying out various types of surveys, navigation, hydrology, disaster management, etc.

Remote sensing

Remote sensing is an integrated discipline encompassing some branches of arts, science and technology of collecting information about the terrestrial objects using camera and sensor system. The field of Remote Sensing and GIS has become exciting with rapidly expanding opportunities. Geoinformatics has three major components namely remote sensing, GIS and GNSS.

Elements of Remote Sensing
1. Energy Source

The primary requirement for remote sensing is to have an energy service, which provides electromagnetic energy to the target of interest. The sun being a major source of energy, radiation and illumination having a sharp power allows capturing reflected light with conventional cameras and films.

2. Radiation and the Atmosphere

The energy is required to illuminate the target. This energy is in the form of Electromagnetic radiation. Electromagnetic radiation is a dynamic form of energy that propagates as wave motion at a velocity in space.

3. Interaction with the target

The interaction of Electromagnetic radiation with the target is important to remote sensing for two main reasons. First, information carried Electromagnetic radiation reflected by the earth's surface is modified while traversing through the atmosphere. Second, the interaction of Electromagnetic radiation with the atmosphere can be used to obtain useful information about the atmosphere itself. The total energy is subjected to modification by the several physical process, scattering, absorption and refraction. Scattering is the re-direction of Electromagnetic radiation by particles suspended in the atmosphere or by large molecules of atmospheric gases. The amount of scattering depends upon the size of the particles and their abundance. The wave length of radiation, depth of the atmosphere through which the energy is travelling. Absorption is the process by which the gas molecules present in the atmosphere strongly absorb the Electromagnetic radiation through the atmosphere in certain spectral bands.

4. Recording of energy by the sensor

After the energy has been scattered by or emitted from the target, we require a sensor (remote not in contact with the target) to collect and record the electromagnetic radiation. A sensor is highly sensitive to all the wave lengths yielding spatially detailed data on absolute brightness. On the basis of the source of electromagnetic energy, the sensor can be classified into two ways. They are active sensor or passive sensor. Active sensor generates and uses its own energy to illuminate the target and records the reflected energy. It operates in the microwave regions of the electromagnetic spectrum. Their wave lengths are longer than 1 mm.

5. Transmission, Reception and Processing

The energy recorded by the sensor has to be transmitted in electronic form, to a receiving and processing station where the data processed into an image. The Image processing methods may be grouped into three functional categories such as Image Restoration, Image Enhancement and Information Extraction.

Image Restoration: Restoration processes are designed to recognize and compensate for errors, noise and geometric distortion introduced into

the data during the scanning transmission and recording processes. The objective is to make the image resemble the original scene. Image restoration is relatively simple because the pixels from each band are processed separately.

Image Enhancement: Enhancement is the modification of an image, to alter its impact on viewer. General enhancement distorts the original digital values; therefore enhancement is not done until the restoration processes are completed.

Information extraction: Image restoration and enhancement process utilize computers to provide corrected and improved images for study by human interpreters. The computer makes no decision in these procedures. The human operator must instruct the computer and must evaluate the significance of the extracted information.

6. Interpretation and Analysis

Image interpretation is defined as the act of examining images to identify objects and judge their significance. An interpreter studies remotely sensed data and attempts through logical process to detect, identify, measure and evaluate the significance of environment and cultural object pattern and spatial relationship.
The quality of an image is based on the inherent characteristics of the objects. Further it depends on the following aspects.
- Sensor characteristics
- Season of the year, time of the day when the photo is taken
- Atmospheric effects
- Resolution of the image on scale.
- Image motion etc.
Image interpretation is essential for the efficient and effective use of the data. The elements of image interpretation such as image tone, shape, size, pattern, image texture, shadow and association are helpful to identify the exact target and to analyze.

Classification of remote sensing

On the basis of the sources of electromagnetic energy, the remote sensing can be classified as passive and active remote sensing. In a simple way, we can understand that the passive remote sensing is

similar to taking a picture with an ordinary camera where as active remote sensing is analogous to taking picture with camera having built-in flash.

On the basis of the energy source, the active remote sensing generates and uses its own energy to illuminate the target and records the reflected energy whereas the passive remote sensing depend on solar radiation to illuminate the target. On the basis of region of spectrum in which they operate, the active remote sensing operates in the microwave region of the electromagnetic spectrum whereas the passive remote sensing operates in the visible and infrared region of the electromagnetic spectrum. The wave lengths of the active remote sensing are longer than 1 mm whereas the passive remote sensing, the wave length range from 0.4 to 1.0 mm.

Some examples of active sensors are fluorosensor and Synthetic Aperture Radar (SAR). Passive sensors record radiation reflected from the earth's surface. The source of this radiation must come from outside the sensor; in most cases, this is solar energy. Because of this energy requirement, passive solar sensors can only capture data during daylight hours. Active sensors are different from passive sensors. Unlike passive sensors, active sensors require the energy source to come from within the sensor. A laser-beam remote sensing system is an active sensor that sends out a beam of light with a known wavelength and frequency. This beam of light hits the earth and is reflected back to the sensor, which records the time it took for the beam of light to return.

Remote sensing platform

The platform is a stage to mount the camera or sensor to acquire the information about a target under investigation. Based on the altitude above the earth surface, the platform can be classified as Ground borne platform, Air borne platform and Space borne platform.

Ground borne platform

Ground based platforms are used to record detailed information about the surface which is compared with information collected from aircraft or satellite sensors. They are close to the ground. These sensors may be placed on a ladder, scaffolding tall-building, crane etc.

A wide variety of ground based platforms are used in remote sensing. Some of the more common ones are hand held devices, tripods, towers and cranes. Instruments that are ground-based are often used to measure the quantity and quality of light coming from the sun or for close range characterization of objects Permanent ground platforms are typically used for monitoring atmospheric phenomenon although they are also used for long-term monitoring of terrestrial features.

Air borne platform

Aircrafts are generally used to acquire aerial photographs for photo interpretation and photogrammetric purposes. They are classified into two types. They are
• Low altitude aerial remote sensing
• High altitude aerial remote sensing

Balloon

Balloons are used for remote sensing observation (aerial photography) and nature conservation studies. The first aerial images were acquired with a camera carried aloft by a balloon in 1859. Balloon floats at a constant height of about 30 km.

Drone

Drone is a miniature remotely piloted aircraft. It is designed to fulfill requirements for a low cost platform, with long endurance, moderate payload capacity and capability to operate without a runway or small runway. Drone includes equipment of photography, infrared detection, radar observation and TV surveillance. It uses satellite communication link. An onboard computer controls the payload and stores data from different sensors and instruments. The unique advantage is that it could be accurately located above the area for which data was required and capable to provide both night and day data.

Aircraft

The first known aerial photograph was taken in 1858 by French photographer and balloonist, Gaspar Felix Tournachon, known as "Nadar". In 1855 Special aircraft with cameras and sensors on vibration

less platforms are traditionally used to acquire aerial photographs and images of land surface features. While low altitude aerial photography results in large scale images providing detailed information on the terrain, the high altitude smaller scale images offer advantage to cover a larger study area with low spatial resolution.

Space borne platform

The satellites are normally used for the space borne remote sensing. The satellite moves in their orbit. The closed path of a satellite around the earth is called its orbit. These platforms are freely moving in their orbit around the earth and the entire earth or any part of the earth can be covered at specified intervals. The coverage mainly depends on the orbit of the satellite. It is through these space borne platforms, we get the enormous amount of remote sensing data. In space borne remote sensing, sensors are mounted on-board a spacecraft (space shuttle or satellite) orbiting the earth. Space borne remote sensing provides the following advantages:

1. Large area coverage.
2. Frequent and repetitive coverage of an area of interest.
3. Quantitative measurement of ground features using radio metrically calibrated sensors.
4. Semi-automated computerised processing and analysis.
5. Relatively lower cost per unit area of coverage.

Types of satellite orbits

Satellite orbits are designed according to the capacity and objective of the sensors they carry. Depending on their altitude, orientation and rotation relative to the earth satellites can be categorized as

1. Geostationary satellite
2. Polar Orbiting and Sun-Synchronous satellite
3. Spy satellite

Geostationary Satellites

Geostationary Satellite is an equatorial west to east satellite orbiting the earth at an altitude of 35000 km, the altitude at which it

makes on revolution in 24 hours. These platforms are covering the same place and give continuous near hemispheric coverage over the same area day and night. These satellites are put in equatorial plane orbiting from west to east. Its coverage is limited to 70°N to 70°S latitudes and one satellite can view one-third globe. These are mainly used for communication and meteorological applications viz. GOES, METEOSAT, INTELSAT, and INSAT satellites. On June 19, 1981 India launched its first geostationary satellite called APPLE. It was an experimental communication satellite launched by the Indian Space Research Organisation (ISRO) with a C-band transponder.

The Ariane Passenger Payload Experiment (APPLE) was ISRO's first indigenous, experimental communication satellite.

India is the only one country which has reached to the mars in its first attempt.

Sun-synchronous satellites

As the satellite orbits the Earth from pole to pole, its east-west position would not change if the Earth did not rotate. However, as seen from the Earth, it seems that the satellite is shifting westward because the Earth is rotating (from west to east) beneath it.
This apparent movement allows the satellite swath to cover a new area with each pass. All the remote sensing resource satellites may be grouped in this category. Few of these satellites are LANDSAT series, SPOT series, IRS series, NOAA SEASAT, TIROS, HCMM, SKYLAB, and SPACE SHUTTLE etc.

Spy satellites

Spy satellites are robotic observational platforms that orbit the Earth in order to image its surface and to record radio signals for military and political purposes. They transmit their data to Earth, where it is interpreted by specialists in centralised, secretive facilities such as the U.S. National Photographic Interpretation Centre in Washington, D.C. Spy satellites have been essential not only to military operations and the formation of national policy but to the verification of arms control treaties such as SALT I, SALT II, etc.

The four basic types of spy satellite are: (1) photo reconnaissance systems that take pictures in visible and infrared light, (2) infrared telescopes designed to detect missile launches, (3) radars that image sea or land even through cloud cover and in darkness, and (4) signals intelligence (SIGINT) satellites (also termed "ferrets"), which are optimised either for characterising ground-based radar systems or for eavesdropping on communications. Sometimes photo reconnaissance and SIGINT functions are combined in single, massive platforms such as the U.S. Keyhole-series satellites.

Although a number of nations have launched spy satellites, the U.S. and the Soviet Union are responsible for by far the greatest number. The Russian Federation, which inherited most of the Soviet Union's space system after 1991, has been unable to afford the cost of adequately updating its spy satellite network. In contrast, the U.S. has continued to deploy ever-more-sophisticated systems in a steady stream. Thus, the majority of spy satellites in orbit today, including all the most capable units, are U.S.-owned. Early U.S. Spy Satellites: Corona, MIDAS, SAMOS.

The Gaofen 4 is the world's most powerful GEO spy satellite (launched in 2015) which can provide instant coverage of earthquake or typhoon hit areas to support humanitarian relief. It will also allow China to monitor strategic foreign sites such as WMD facilities and naval bases inside its observation box.

Applications of remote sensing

1. **Agriculture**

   The satellites have ability to image individual fields, regions and countries on a frequent revisit cycle. Customers can receive field-based information including crop identification, crop area determination and crop condition monitoring (health and viability). Satellite data are employed in precision agriculture to manage and monitor farming practices at different levels.

2. **Forest Management**

The forest - fire, sudden deforestation, encroachment of forest-land are recent challenges to the ecologist. It can be easily identified and curbed with the help of remote sensing satellite pictures.

3. Geology

Various fields Remote sensing techniques used in geology are
- Lithological mapping
- Structural mapping
- Geomorphological mapping
- Mineral exploration
- Hydrocarbon exploration
- Sedimentation mapping and monitoring
- Geo-hazard mapping

India once again broke a global space record by launching the world's lightest satellite weighing a mere 64 grams, called Kalamsat. It was designed and developed not by professional space scientists and engineers, but by 18-year-old Tamil Nadu student Rifath Sharook and his team. The tiny satellite, named after Abdul Kalam, was flown by a NASA sounding rocket on 22 June, 2017 and Kalamsat was the only Indian payload in the mission. Mission director Srimathy Kesan that the total flight time of the rocket was 240 minutes. The satellite, assembled at her T.Nagar residence in Chennai. The satellite was separated from the rocket after spending 125 minutes in the space's micro-gravity environment. Sharook's project, the first to be manufactured via 3D printing, got selected through a competition, 'Cubes in Space', sponsored jointly by NASA and 'I Doodle Learning'. The project aims to take the performance of new technology to space.

4. Oceanography

Satellite remote sensing plays an important role in coastal zone management. There it allows us to locate and regularly monitor various aspects such as bathymetry (the measurement of the depth of water in water bodies), chlorophyll content, suspended sediment concentration, etc.

5. Cartography

Remote sensing aids in extensive surveys that are made from high altitudes to show the urban development, rural development, mountain areas, desserts, etc. which help the cartographers. High-resolution satellite cameras located at altitudes of several hundred kilometers can record details as small as a few meters on the surface of the Earth.

6. Meteorology

The radar system is basically used to collect the weather data. It collects meteorological data from unmanned land/ ocean based Data collection platforms and serves as a communication satellite for rapid exchange of meteorological data among centres and for rapid dissemination of weather forecasts warnings etc, to user agencies.

7. Topography

Topography specifically involves the recording of relief or terrain, the three-dimensional quality of the surface, and the identification of specific landforms. Topographic maps usually portray both natural and manmade features. They show and name works of nature including mountains, valleys, plains, lakes, rivers, and vegetation. They also identify the principal works of man, such as roads, boundaries, transmission lines, and major buildings.

8. Urban Planning

These information systems also offer interpretation of physical (spatial) data with other socio-economic data, and thereby providing an important linkage in the total planning process and making it more effective and meaningful. Digitization of planning base maps has facilitated updating of base maps wherever changes have taken place in terms of land development etc. Superimposition of any two digital maps which are on two different scales is feasible.

Geographic Information System (GIS)

The Geographic information systems have emerged in the past two decades as an essential tool for urban and resource planning and

management. It includes the functions of data entry, data display, data management, information retrieval and analysis. While GIS deals with entire geography of the earth including land, ocean and atmosphere, the art, science and technology dealing with the acquisition, storage, processing, production, presentation and dissemination of the earth's information is called the Geoinformatics. It is the popular means of studies in recent decades which cater the real and useful information to the field of Geography, Environmental Studies, Town planning, rural development studies, and Defense and Agricultural promotion.

Generation of the computers

1940 – 1956: First Generation – Vacuum Tubes
1956 – 1963: Second Generation – Transistors
1964 – 1971: Third Generation – Integrated Circuits
1972 – 2010: Fourth Generation – Microprocessors
2010 – Fifth Generation – Artificial Intelligence

Components of GIS

The components of GIS can be broadly classified into five types. They are mentioned below.

a. Hardware

Hardware is Computer on which GIS software runs. Nowadays there are a different ranges of computer, it might be Desktop or server based. ArcGIS Server is server based computer where GIS software runs on network computer or cloud based. For computer to perform well all hardware components must have high capacity. Some of the hardware components are: Motherboard, Hard driver, processor, graphics card, printer and so on. These all component function together to run GIS software smoothly.

b. Software

Next component is GIS software which provides tools to run and edit spatial information. It helps to query, edit, run and display GIS data. It uses RDBMS (Relational Database

Management System) to store the data. Few GIS software list: ArcGis, ArcView 3.2, QGIS, SAGA GIS. Software Components: GIS Tools, RDBMS, Query Tools, GUI and Layout.

c. Data

Geographic data and related tabular data can be collected in-house compiled to custom specifications and requirements (or) purchased from a commercial data provider.

A GIS can integrate spatial data with other existing data resources often stored in a corporate data base management System. The data can be broadly classified as

   a. Attribute data
   b. Spatial data
   c. Remote sensing data
   d. Global data base.

You will learn in detail about each of the above classification of data in higher studies.

d. People

The GIS technology is used by a huge number of industrialists and agencies to help plan, design, engineer, build and maintain information infrastructures that affects our everyday lives.

e. Methods or Procedures

Methods here refer to well-defined, consistent procedures that are required to produce accurate, reproducible result. A neatly conceived implementation plan and business rules are the models and operating practices are unique to each organization. There is need to properly integrate the sophisticated tool through bringing out well-defined procedures in well documented form into the entire business strategy and operation to make the technology effective. Meta data i.e., (data about the data) is the key for documenting these processes.

Functions of GIS

The functions of GIS describe the steps that have to be taken to implement a GIS. These steps have to be followed in order to obtain a systematic and efficient system. The steps involved are data capture, data storage (GIS Data Models), manipulation and analysis.

Data Capture

The input of data into a GIS can be achieved through many different methods of gathering. For example, aerial photography, scanning, digitizing, GNSS is just a few of the ways a GIS user could obtain data. Digitization: A conversion process which converts paper maps into numerical digits that can be stored in the computer. Digitizing simplifies map data into sets of points, lines or cells that can be stored in the GIS computer. In this stage, digitization is carried out. There are two basic methods of digitization: Manual digitizing & scanning.

Data Storage

Some data is stored such as a map in a drawer, while others, such as digital data, can be as a hardcopy, stored on CD or on your hard drive. Once the data have been digitally compiled, digital map files in the GIS are stored on magnetic or other digital media. Data storage is based on a Generic Data Model that is used to convert map data into a digital form. The two most common types of data models are Raster and Vector. Both types are used to simplify the data shown on a map into a more basic form that can be easily and efficiently stored in the computer.

Data Manipulation

The digital geographical data can be edited, this allows for many attribute to be added, edited, or deleted to the specification of the project. Once data are stored in a GIS, many manipulation options are available to users. These functions are often available in the form of "Toolkits." A toolkit is a set of generic functions that a GIS user can employ to manipulate and analyse geographical data. Toolkits provide processing functions such as data retrieval measuring area and perimeter, overlaying maps, performing map algebra, and reclassifying map data. Data manipulation tools include coordinate change, projections, and edge matching, which allow a GIS to reconcile irregularities between map layers or adjacent map sheets called Tiles.

Query and Analysis

GIS was used widely in decision making process for the new commission districts. We use population data to help establish an equal representation of population to area for each district. The heart of GIS is the analytical capabilities of the system.

Global Navigation Satellite System (GNSS)

GNSS refers to the collection of the world's global satellite based positioning systems. It includes GPS (United States) GLONASS (Russia) GALILEO (European Union) BEODOU (China) IRNSS (India) QZSS (Japan). GNSS can provide centimeter level accuracy with a low-cost receiver, if an error correction technique is used. GNSS are recognized to be the systems of choice in outdoor environments and, to a great extent, one of the most accurate source of position (and precise timing) information when it is available.

The first satellite navigation system was Transit, a system deployed by the US military in 1960's. Transit's operations were based on the Doppler Effect: the satellites travelled on well-known paths and broadcast their signals on well-known radio frequency. The received frequency will differ slightly from the broadcast frequency because of the movement of the satellite with respect to the receiver. The satellite broad cast signals that contains orbital data (from which the position of the satellite can be calculated) and the precise time, the signals is transmitted. There are multiple constellations of GNSS satellites orbiting the earth. GNSS satellites' orbit situated about 20,000 km above the earth's surface. They are moving very fast, several kilometers per second. The latest generation of GNSS satellites (Block IIF) weight over 1,400 kg.

GNSS system operated in different countries

The following are the Global Navigation satellite Systems:

GPS (United States)

GPS was the first GNSS system. GPS was launched in the late 1970s by the United States Department of Defence. It uses a constellation of 24 satellites, and provides global coverage.

GLONASS (Russia)

The premier Soviet military navigation network was to be comprised of Uragan satellites. At the end of the Cold War, the constellation was unclassified under the name GLONASS -- a Russian abbreviation of Global Navigation Satellite System. Global Navigation Satellite System by Russian Aerospace Defense Forces is a space-based satellite navigation system.

The life style of GNSS satellites 5-7 years and new satellites are to be launched after a specific time interval in order to fill the gap due to ageing satellites. GLONASS proves very beneficial for Russian territory by 2010. In 2011, restoration of system is improved to enable full global coverage.

GALILEO (European Union)

Galileo is Europe's own global navigation satellite system, providing a highly accurate, guaranteed global positioning service under civilian control. Currently providing Initial Services, Galileo is interoperable with GPS and Glonass, the US and Russian global satellite navigation systems. By offering dual frequency as standard, Galileo is set to deliver real-time positioning accuracy down to the meter range. The Galileo constellation in space will comprise 30 satellites in total. There will be 24 operational satellites, plus 6 spare satellites, circulating in medium Earth orbit on three orbital planes.

BEIDOU (China)

BeiDou Navigation Satellite System (BDS) is a Chinese satellite Navigation system. It consists of two separate satellite constellations. The first BeiDou system is officially called the BeiDou Satellite Navigation Experimental System and also known as BeiDou-1.
On December 27, 2018, Beidou-3 officially began to provide global services. The Beidou-3M/G/I satellites represent the orbital segment of the third phase of the Chinese Beidou navigation system which uses

satellites in Medium Earth Orbit and Geosynchronous Orbit and is also known as the Compass Navigation Satellite System.

Japan Aerospace Exploration Agency (QZSS Japan)

QZSS is a regional navigation satellite system that provides service to Japan and the Asia-Oceania region. QZSS (nickname of Michibiki - meaning to 'guide' or 'show the way') QZSS is a Japanese satellite positioning system composed mainly of satellites in quasi-zenith orbits (QZO). However, the term "Quasi-Zenith Satellite (QZS)" can refer to both satellites in QZO and geostationary orbits (GEO). For that reason, the name "QZO satellite" is used when it is necessary to specifically refer to satellites in QZO. Satellite positioning systems use satellite signals to calculate position information. The QZSS is sometimes called the "Japanese GPS."

IRNSS (Indian Regional Navigational Satellite System)

IRNSS is an autonomous regional satellite navigation system being developed by ISRO (Indian Space Research Organization). It is designed to provide geospatial positioning information within the Indian sub-continent. It enables users to map out their location (altitude, longitude and latitude). The objective of developing IRNSS was to cut down India's dependency on foreign navigation satellite systems.

It provides location information service to users in India and the region extending for up to 1,500 km from the Indian boundary. This is the primary service area of IRNSS information service to users in India and the region extending up to 1500 km from Indian boundary.

IRNSS aims to provide the following services:

1. Standard Positioning Service (SPS) for civilian, research & commercial use,
2. Restricted Service (RS) for authorized users. For example in defense, IRNSS is used for ground, aerial and marine navigation, disaster management, mobile phone integration, mapping and visual & voice navigation for drivers, among others.

> **The battle for the world's fastest supercomputer has a new victor: Summit**
>
> According to IBM, Summit is able to achieve 200 peta flops of performance, or 200 quadrillion calculations per second. This power marks a significant gain on Sunway TaihuLight, which performs a still-staggering 87 petaflops. Summit holds more than 10 peta bytes of RAM, and its funding came as part of a $325 million program funded by the United States Department of Energy. Each of Summit's 4,608 nodes holds two IBM Power9 chips that run at 3.1 GHz.

Applications of GNSS

GNSS applications are widely used to get the quick information about a particular field. Some of the commercial applications are Consumers, Transportation, GIS, Machine Control Port Automation, Precision Agriculture, Construction, Marine Mining, Unmanned Vehicles Surveying, Defence, and Aerial Photogrammetry, etc.

Consumer

GNSS technology has been adopted by the consumer market, in an ever-increasing range of products. GNSS receivers are now routinely integrated into smart phones, to support applications that display maps showing the location of and best route to stores and restaurants.

Transportation

In rail transportation, GNSS is used to track the location of locomotives and rail cars, maintenance vehicles and wayside equipment, for display at central monitoring consoles. Knowing the precise location of rail equipment reduces accidents, delays, and operating costs, enhancing safety, track capacity, and customer service. In aviation, GNSS is being used for aircraft navigation from departure, en route, to landing.

Port Automation

Using GNSS, shipping hubs can improve their operating efficiency by tracking the movement and placement of containers about their yards. Many cranes are equipped with GNSS based steering devices that determine the crane's position and keep it travelling in the desired path, improving accuracy and productivity as well as the safety of operators and workers on the ground.

Machine Control

GNSS technology is being integrated into equipment such as bulldozers, excavators, graders, pavers and farm machinery to enhance productivity in the real-time operation of this equipment, and to provide situational awareness information to the equipment operator.

Precision Agriculture

In precision agriculture, GNSS-based applications are used to support farm planning, field mapping, soil sampling, tractor guidance, and crop assessment. More precise application of fertilizers, pesticides and herbicides reduces cost and environmental impact.

Surface Mining

GNSS information is being used to efficiently manage the mining of an ore body and the movement of waste material. GNSS equipment installed on shovels and haul trucks provides position information to a computer-controlled dispatch system to optimally route haul trucks to and from each shovel.

Survey

Using GNSS, it is possible for a single surveyor to accomplish in one day what might have taken a survey crew of three people a week to complete. Determining a new survey position once required measuring distances and bearings from an existing (known) survey point to the new point.