

**BALANCED DIET**

- The components of food are : Carbohydrates, Fats, Proteins, Minerals, Vitamins , Water and Roughage.

**CARBOHYDRATES**

- Constitutes 3 elements: Carbon, Hydrogen and Oxygen
- Carbohydrates form a better fuel than proteins and fats because their molecules have relatively more oxygen.
- Main source of energy providers.
- Glucose, often called blood sugar.
- An adult man of average weight and doing moderate work needs about 500 gms of carbohydrates daily. Growing child, nursing mother and sports-persons need more carbohydrates.
- Is of 3 types: Cellulose, Sugar and Starch.
- Cellulose is present in the cell-wall of plants. It cannot be digested and simply acts as roughage.
- D-fructose is the sweetest of sugars. It is found in fruit juices, honey etc.
- Excess sugar is stored as glycogen in liver (by a process called glycogenesis). The sugar which is still left is converted into fat and stored in various parts of the body a adipose tissue (by a process called lipogenesis). In case the food provides inadequate glucose, reserve glycogen is converted into glucose for use in energy production. This conversion is known as Glycogenolysis.
- Sources of Carbohydrates are : 3 main cereals (wheat, rice and maize), sugarcane, milk (contains lactose-a type of sugar) , fruits honey, beet, etc.
- **Monosaccharides:** They are the simplest carbohydrates and are made up of one unit only (eg. glucose, fructose, galactose).
- **Disaccharides:** 2 units of monosaccharides (eg. sucrose, lactose and maltose)
- **Polysaccharides:** Those carbohydrates which contain a no. of monosaccharide units. (eg: starch in plants and glycogen in animals)
- During the process of digestion, all carbohydrates are broken down to monosaccharides.

**FATS**

- Provides twice the energy of carbohydrates
- Acts as the reserve food material because excess fat is stored in the liver and as adipose tissue. Stored fat is used as fuel when glucose is not available.
- An enzyme called Lipase digests fats. It breaks down into fatty acids and glycerol.

- Our diet should contain less saturated fats. Excess of saturated fats increases the blood-cholesterol level and may cause arteriosclerosis
- **Hydrogenation:** Process by which unsaturated fatty acids are converted into saturated fatty acids by the addition of hydrogen.
- Requirement : 50 gms daily.

**Note:**

- In whales and seals, the fat of the skin forms a thick layer called blubber.

**PROTEINS**

- Made up of Carbon, Hydrogen, Oxygen, Nitrogen and sometimes Sulphur.
- Important for growth and repair of the body (75% of our body is proteins only)
- Made up of amino acids.
- Proteins are first broken into amino acids and then digested.
- **As Enzymes:** As catalyst in digestion (Eg – Pepsin, Trypsin)
- **As a Hormone:** To regulate body functions
- **In transport of different substances:** (Eg- Haemoglobin- Transports O<sub>2</sub> in blood, Myoglobin – Stores O<sub>2</sub> in muscles)
- **As contractile proteins for contraction in muscles:** (Eg Actin and Myosin)
- **Structural proteins:** (Eg- Collagen Component of connective tissue, cartilage Keratin- Component of skin)
- **Protective proteins:** (Eg. Gamma globulins)
- **Visual proteins:** Rhodopsin and Iodopsin of rods and cones are proteins only. (Rods and Cones are the cells which are present in Retina of the eye).
- About 70-100 gms of proteins are daily needed.
- sources: Groundnuts, soyabean, pulses, lean meat, fish, eggs, milk, etc.

**PROTEIN ENERGY MALNUTRITION**

- In the age-group of 1-5 years.

**Kwashiorkar**

- Due to the deficiency of protein.
- When mother stops breast feeding.
- anaemia
- In infants under 1 year of age.

**Marasmus**

- Deficiency of proteins, carbohydrates and fats.
- between 6 months and 3 years.

**MINERALS**

## BIOLOGY

- Apart from organic chemicals such as C, H, O, N human body needs inorganic chemical elements, called minerals, for a wide range of functions. These elements are present in the form of ions.
- Minerals help maintain the volume of water necessary to life processes in the body.
- Macroelements (more than 1 gm)
- Microelements (less than 1 gm)
- Deficiency of any of these leads to metabolic disorders.

### VITAMINS

- Discovered by Funk
- Do not provide energy but help in different physiological processes.
- Vitamins are of 2 types:
- Water soluble, Fat Soluble

### IMPORTANT VITAMINS REQUIRED IN HUMAN BEINGS

B1 (Thiamine) – Beri-beri

B2 or G (Riboflavin) – Cheilosis

B3 or PP3 (Nicotinic acid or Niacin) – Pellagra

B6 (Pyridoxine) – Dermatitis, anaemia

B5 (Pantothenic acid) – Dermatitis

Vit.H (Biotin) –

Folic acid group – Megaloblasticanaemia (low Hb content)

B12 (Cyanocobalamin) – Pernicious anaemia

Vit. C (Ascorbic acid) – Scurvy

### FAT-SOLUBLE VITAMINS

Vit.A(Retinol) – Xerophthalmia due to non function of lacrimal gland of conjunctiva. night-blindness

Vit.D (Ergocalciferol and Cholecalciferol) – Rickets, Osteomalacia

Vit E (Tocopherol) – Reversible sterility

Vit K (Phylloquinone) - Haemorrhages

### Water

- Important in digestion, transportation, excretion and to regulate body temperature (body contains 65% water)

### ROUGHAGE

- Fibrous material present in the cell wall of plants.
- Mainly contains cellulose.
- It does not provide energy but only helps in retaining water in the body.

### Note:

- Excessive intake of food calories leads to obesity. It leads to high B.P. and heart problems and the person gets prone to diabetes, hypertension and other disorders.
- Excessive intake of saturated fats like butter, ghee, etc, leads to hypercholesterolemia.

## HUMAN DISEASES

### I. BACTERIAL DISEASES

#### TUBERCULOSIS

- mycobacterium tuberculosis, infection in lungs that causes high fever.
- BCG (bacillus – calmette-guerin) vaccine

#### DIPHTHERIA

- Mainly from 2-5 yrs, corynebacterium diphtheria.
- using DPT vaccine (Diphtheria, whooping cough and tetanus)

#### WHOOPING COUGH or Pertussis

- Bacillus Pertussis
- Use of DPT Vaccine

#### CHOLERA

- Vibrio comma

#### DIARRHOEA

- Pathogens responsible for these diseases are Escherichia coli, Shigella sp., Campylobacteria and Salmonella

#### LEPROSY or Hansen's disease

- rod –shaped bacterium Mycobacterium leprae.

#### TETANUS

- clostridiumtetani. Disease of the C.N.S. (also called lock-jaw)
- ATS (Anti-tetanus serum) is prescribed

#### PNEUMONIA

- Streptococcus pneumoniae

#### TYPHOID

- Caused by Salmonella typhi which is found in the intestine of humans.
- Vaccine TAB (Typhoid Para A & B)

#### PLAQUE

- Plague is primarily a disease of rat. It is caused by rod shaped bacterium Pasteurella/ Yersineapestis

#### ANTHRAX

- Bacillus anthracis
- It is most common in agricultural regions where it occurs in animals, but it can also occur in humans.

#### GONORRHOEA

- Neisseria gonorrhoeae. It is transmitted through sexual contact (It is an infection of the mucous membrane of the urinogenital tract)

## BIOLOGY

- It may result in female sterility.

### SYPHILIS

- Sexual disease caused by a bacteria, *TreponemaPallidum*, transmitted through sexual contacts.

## II. VIRAL DISEASES

### MUMPS

- caused by a virus : Paramyxovirus.

### MEASLES

- rubella virus.

### CHICKEN POX

- Varicella-zoster virus

### POLIOMYELITIS

- enterovirus

### INFLUENZA (or FLU)

- influenza virus.
- Orthomyxoviridae.

### COMMON COLD

- Rhinovirus ('rhino' means nose) which belongs to picornavirus group.

### RABIES (Hydrophobia)

- Caused by RNA virus called Rabies virus.
- Vaccine against rabies was developed by Louis Pasteur

### HEPATITIS

- viral infection of liver.
- Hepatitis A (epidemic jaundice): hepatitis A virus (HAV).
- Hepatitis B (Serum hepatitis) : hepatitis B virus (HBV)

### DENGUE FEVER

RNA containing dengue virus. It is transmitted by the bite of female tiger mosquito *Aedesaegypti* during day time.

### YELLOW FEVER

- Arbovirus. It is haemorrhagic disease transmitted by the infected *Aedesaegypti*.

## III. PROTOZOAN DISEASES

### MALARIA – Chloroquin vaccine

- Anopheles mosquito only female anopheles
- Quinane, a product of Cinchona tree, is administered for Malaria.

### KALA AZAR (Leishmaniasis)

- Leishmaniadonovani. sandfly (*Phlebotomus*)
- dum dum fever

### GIARDIASIS

- Giardia intestinalis (first parasitic protozoan known).

### Trypanosomiasis

- Trypanosoma. Main disease is Gambian fever or West African sleeping sickness the vector of which is Tsetse.

### AMOEBIASIS (Amoebic dysentry or Enteritis)

- Entamoebahistolytica

### HELMINTHIC DISEASES

#### Ascariasis

- Ascarislumbricoides (Vector: Cockroach and Flies)

#### Filariasis

- Wucherariabancrofti. Transmitted by female Culex mosquito
- Elephantiasis

#### Taeniasis

- Taeniasolium (or pork tapeworm)  
Transmitted by pig.

## V. FUNGAL DISEASES

### Ringworm

- Caused by Microsporum.

### ENDOCRINE SYSTEM

#### ENDOCRINE GLANDS

##### Hypothalamus

- part of fore-brain, secretes neurohormones, which effect the release of hormones from pituitary.
- Acts as the thermostat.

##### PITUITARY GLAND

- smallest endocrine gland.
- Somatotrophicharmone: Its hypersecretion leads to acromegaly in adults and gigantism in children. Its hyposecretion leads to dwarfness in children.
- Gonadotrophic hormone (GTH) : Stimulates the primary sex hormones
- Lactogenic hormone: Initiates milk production in the pregnant females.
- Thyrotrophic hormone: regulation of thyroid secretion.
- Adrenocorticotrophic hormone (ACTH)
- Diabetogenic or Metabolic Hormone:
- Oxytocin or Pitocin: smooth muscle contractions, helps in the secretion of milk.
- Vasopressin or ADH (Anti-Diuretic Hormone): Hypoactivity leads to Diabetes.

### THYROID GLAND

## BIOLOGY

- It is the largest endocrine gland located in the neck between the trachea and larynx. Controls BMR (Basal Metabolic Rate) it is 1600 Kcal/day

### Secretes:

- Thyroxine: Hypoactivity in children leads to cretinism.
- A diet, poor in iodine which is insufficient for the synthesis of thyroxin, leads to simple goiter.
- Its hyperactivity leads to increased metabolic activities
- Thyrocalcitonin – controls the amount of calcium in the body.

**Hashimoto Disease:** thyroid gland is destroyed. It is known as suicide of the thyroid.

### PARATHYROID GLAND

- Secretes Parathormone, which is also known by the name of Collip's Hormone.
- It influences calcium and phosphorus metabolism ( $\text{Ca level} = 12 \text{ mg}/100 \text{ ml of blood}$ )
- Removal of this gland leads to death due to tetany (cramps, tremors and convulsions in muscles)
- Hyperactivity withdraws calcium from bones

### THYMUS GLAND

- near the heart.
- thymine
- formation of antibodies

### PANCREAS

- It is an exocrine as well as an endocrine gland. Its endocrine part is known as Islets of Langerhans.
- Beta cells secrete Insulin which controls the amount of sugar in the blood. Its hyposecretion leads to Diabetes Mellitus.
- Alpha cells secrete Glucagon which increases blood sugar level.
- Gamma cells secrete Somatostatin which controls the functioning of alpha and beta cells.

### ADRENAL GLANDS

- 2, on each kidney. Sugar metabolism, Salt retention, Sex hormone and Source of energy
- Outer cortex and inner medulla.
- Adrenaline or epinephrine 3F Gland

### GONADS

- in addition to producing, sperms and ova, also produce hormones.

### TESTES

## BIOLOGY

- Its interstitial cells (Leydig's cells) secrete testosterone
- Deficiency leads to sterility (eunuchoidism)

### OVARIES

- Follicular cells produces Oestrogen which controls the female secondary sexual characters.
- Corpus luteum secretes Progesterone which is essential for the completion of each menstrual cycle.
- Relaxin at the end of gestation period, and helps in easy birth by relaxing the uterus and ligaments of the pelvic girdle.

### SKELETAL SYSTEM

- Skeletal system constitutes hard internal or external living or non-living parts that form the supporting framework of body.
- It is divided into 2 parts.
- **Exoskeleton:** Which is produced by ectoderm. It is present on the outside of the body (made of either dead tissues or biochemical secretion). Found in both invertebrates and vertebrates
- **Endoskeleton:** Which is produced by mesoderm. It occurs inside the body and is made of cartilages and bones.

### HUMAN ENDOSKELETON

- Divided into two main parts: Axial Skeleton and Appendicular Skeleton.

#### A. AXIAL SKELETON (Total 80 bones)

##### SKULL

- Skull consists of two main parts cranium and face.
- Cranium (brain box) is formed by 8 bones and provides a bony protection for the brain.
- Face: There are 14 bones which form the skeleton of face.
- There are also present 6 ear ossicles in the skull.
- Another bone is hyoid.

##### VERTEBRAL COLUMN

- It is made up of 33 vertebrae in which 26 bones are visible because five sacral vertebrae are fused to form one sacrum and four coccygeal vertebrae are fused to form one coccyx

##### RIBS

- Ribs are 12 pairs ( $12 \times 2$ ) of bony bars which form the sides of chest cage. They protect the delicate organs (heart, lungs, etc)

##### STERNUM or Breast Bone

## BIOLOGY

- It is a narrow, elongated and flattened structure, present just under the skin in the middle front of the chest.

### B. Appendicular Skeleton (Total 126 bones)

- This skeleton lies laterally and is attached to axial skeleton at an angle. It is made up of girdles (pectoral and pelvic) and limb bones (forelimb and hindlimb)

#### PECTORAL GIRDLE

- Shoulder girdle
- Has 4 bones (two in each pectoral girdle)

#### LIMB BONES:

- Forelimbs – Consists of 60 bones.
- Hindlimbs – Consists of 60 bones.
  - Femur (2) – Thigh (longest bone in the body)
  - Fibula (2) – Shank (thinnest bone)

PELVIC GIRDLE – Has 2 hip bones.

#### DISEASES OF SKELETAL SYSTEM:

1. **Gout:** Accumulation of uric acid crystals in joints leading to painful movement.
2. **Dislocation:** In this case, the bones at the joints are dislodged from their positions e.g., the ball of one bone may slip out of the socket.
3. Hard tissue deposits over articular cartilage along with higher secretion of synovial fluid causing pain and stiffness lead to rheumatoid arthritis.
4. Tearing of articular cartilage and development of bony lumps at places causing pain, stiffness and permanent bending lead to osteoarthritis.
5. **Bursitis** is inflammation of the bursae present within synovial joint as small membrane bound pockets which stores synovial fluid.
6. Osteitis is inflammation of bone.
7. **Osteoporosis** is loss of bone density due to excessive absorption of calcium and phosphorus from the bone.
8. Osteomyelitis is infection of bone.
9. **Osteopetrosis** is a hereditary disease marked by abnormally dense bone, and by the common occurrence of fractures of affected bone.

#### ARTICULATION OF BONES – THE JOINTS

- A bone joint or articulation may be defined as the junction of two bones. The study of such joints is known as arthrology.

#### Note:

- Femur (in hind limbs) is the longest bone and stapes (in middle ear) is the smallest bone of the body.
- Sternum is absent in fish.
- Fibula – thinnest bone
- Osteology is study of skeleton.

- Chondrology is study of cartilages.
- Arthrology is study of joints.
- Masseters of jaw is the strongest muscle.
- Birds have spongy bones with air filled spaces, called pneumatic bones.

#### MUSCULAR SYSTEM

- Human body has about 639 types of muscles.
- Muscles specialized to contraction are of 3 types: striated, unstriated and cardiac

#### Striated Muscles/Voluntary / Skeletal muscles

- Also called skeletal muscles.
- These muscles are mostly attached to bones by tendons and takes part in voluntary movements under conscious control of brain. Therefore they are called voluntary muscles.
- Each muscle fibre shows dark and light striations and is covered by a sheath, the sarcolemma.
- Its cytoplasm is called sarcoplasm in which are present large number of contractile myofibrils.

#### Unstriated Muscles

- These smooth muscles are involuntary muscles.
- Functionally they are of two types –single unit and multi unit.
- Single unit smooth muscles are present in urinary bladder and gastro intestinal tract.
- Multi unit smooth muscles are present in walls of large blood vessels.

#### CARDIAC MUSCLES

- They are involuntary, striated and non fatigued fibres which are found in the wall of heart where they form myocardium.

#### RESPIRATORY SYSTEM

All physical and chemical reactions in which atmospheric air oxidizes food in the body cells resulting in production of energy and liberation of CO<sub>2</sub> are included in respiration.

#### TYPES OF RESPIRATION

##### I. Anaerobic Respiration

- When nutrients are oxidized without using O<sub>2</sub> (also called fermentation)
- In yeast, glucose forms ethyl alcohol and CO<sub>2</sub>. In bacteria and muscles, glucose is converted into lactic acid. Endoparasites like Ascaris, Fasciola, Taenia also respire anaerobically.
- It is a low energy yielding process.

## BIOLOGY

### II. Aerobic Respiration

- Cells utilize O<sub>2</sub> for oxidising nutrients. O<sub>2</sub> is used either from atmospheric air or from water.

## RESPIRATORY ORGANS

### I. NASAL CAVITY

- The air in the nasal cavity gets warmed (because nasal cavity has a very good blood supply) and moistened before it enters lungs.

### II. PHARYNX

- From the nasal cavity the air enters the pharynx. It serves as a common passage for both air and food.
- The opening into the wind pipe or trachea is a narrow slit, the glottis. The glottis is protected against the entrance of food by a triangular flap of tissue, the epiglottis.

### III. LARYNX (VOICE BOX)

- Called Adam's apple in man. It is the first part of trachea present in the neck.

### IV. TRACHEA

- It is four and a half inch long tube with C-shaped ring of cartilages in its walls. These rings of cartilage make the wall non-collapsible.

### V. LUNGS

- Surrounding each lung is a double walled sac, the pleural cavity. Hence the covering of lung are called pleural membrane.
- The right lung is divided into three lobes and left into two. The left lung is smaller than the right and has a concavity, the cardiac notch, where the heart lies.
- Inside the lung, each bronchi divides into numerous bronchioles, each of which terminates into an elongated saccule, the alveolarduct, which bears on its surface air sac or alveoli. The latter provide a large surface for gaseous exchange.

## PULMONARY VOLUMES & CAPACITIES

### I. PULMONARY VOLUME

- Volume of air in the lungs.
- Tidal volume (TV): The volume of air inspired or expired involuntarily in each normal breath. It is about 500 ml of air in average young adult man.
- Inspiratory Reserve volume (IRV): It is about 3000 ml.
- Expiratory Reserve Volume (ERV): It is about 1200 ml

### II. PULMONARY CAPACITIES

- Combination of two or more pulmonary volumes.
- Total lung capacity (TLC): TV + IRV + RV + ERV. It is about 5800 ml.

## RESPIRATORY DISORDERS

- COPD: Chronic Obstructive Pulmonary Disease which includes Emphysema, chronic bronchitis and Asthma.
- Tuberculosis: A bacterial disease caused by Mycobacterium tuberculosis.

## BLOOD

- Blood is a fluid connective tissue.
- It is 6.8 litres in man and 500ml less in woman.
- 6-8% of body weight (pH 7.4)

## CONSTITUENTS

- Solid or cellular part called blood cells and fluid part called the blood plasma

## BLOOD CELLS

### 1. Red Blood Corpuscles (RBC)

- Also called Erythrocytes, disc-shaped (for increased surface area), no nucleus contains a pigment called Haemoglobin, which gives blood its red color.
- Average man: Amount of Haemoglobin is 14-15.6 gm/100cc of blood (11 - 14 in woman)
- RBC are produced in spleen and liver in foetus and in bone marrow after birth @ 1.2 million/sec
- Life of RBC is 120 days after which they are broken down in spleen or liver. Product of breakdown of haemoglobin is a pigment (yellow colour), called bilirubin which normally disposed off through bile whereas haem transferred to red bone marrow. Retention of bilirubin leads to jaundices.
- More: Polycythaemia. Less : Anaemia

### 2. White Blood Corpuscles (WBC)

- Also called Leucocytes rounded, with a nucleus, far less numerous than RBCs (1:400 - 500) (5,000-10,000/cu mm), life 3-4 days, soldiers of body's defence system.
- Are of 2 types: Granulocytes (Basophils, Eosinophils, Neutrophils) and Agranulocytes (Monocytes: Lymphocytes)
- Basophils: Take up basic stains. Have an S-shaped nucleus. Secrete an anti-coagulant Heparin, which prevents clots within the blood vessels.
- Neutrophils: Stain equally well with both acidic and basic dyes. Most numerous of the WBCs (65-70%). Defence.
- Monocytes: Largest of all.

## BIOLOGY

- Lymphocytes: 25% of the WBC. Takes part in antigen and antibody formation.

### 3. Platelets

- Also called Thrombocytes, formed in bone marrow, about 2,50,000/cu mm of blood life 3-7days, sets off blood clotting

### PLASMA (65%)

- Watery part of blood, clear, yellow fluid. Contains about 90% water, proteins and orgains salts.
- Plasma contains 7% proteins which include Albumin, Globulin and Fibrinogen.
- Plasma transports nutrients from the small intestine to the body tissues, and return the waster material to the kidneys, where it is filtered out.
- Regulates pH of blood.

### LYMPH

- Lymph = Blood – RBC i.e. Plasma + WBC.
- Lymph forms second circulatory system. It acts as middle man between blood and tissue.
- All interchanges of nutrients and waster products between blood and tissue takes place through lymph only.
- It has more of lymphocytes as compared to that of blood (Blood has more of neutrophils.)
- Spleen produces lymph. At the same time it also acts as the graveyard of lymph.
- Spleen is also known by the name of ‘Blood Bank’ because RBCs, WBCs and Lymph are produced in spleen. It is situated above left kidney behind the stomach.

### COMPARISON BETWEEN BLOOD AND LYMPH

BLOOD	LYMPH
It is red colourdue to presence of haemoglobin in erythrocytes	It is colourlessdue to absence of haemoglobin
Circulation starts from the heart	Circulation starts from the tissue space
Act as vehicle	Act as middle man

### BLOOD GROUPS

- Father of blood grouping Karl Landsteiner (Australian pathologist). He discovered A, B and O blood groups in 1900.
- Decastello and Sturle in 1902 discovered AB blood group.
- ABO system of blood groups is based on antigens and antibodies.
- Antigens: They are proteins and are found on the surface of RBC's Antigens are A and B.

- Antibodies: They are produced in lymph glands and are present in blood plasma .
- AB: Universal recipient.
- O: Universal donor.
- RH factor: It is based on RH antigen. Discovered in 1940 by Landsteiner and A.S. Veiner. It discovered in Rhesus monkey. Rh+ can receive blood from Rh- but no vice-versa.
- Blood transfusion technique was first developed by James Blundell in 1825
- Blood circulation by William Harvey
- Blood grouping – by Karl Landsteiner
- Inlargerons – Antiviral proteins increases immunity of our body by producing antibodies.

### NERVOUS SYSTEM

- Its unit is Neuron
- Largest cell of our body is neuron only.
- Types: A. Central nervous system: Brain + spinal cord  
B. Peripheral Nervous system : Nerves  
C. Autonomic Nervous system : Sympathetic + Parasympathetic nervous system.

#### A. CENTRAL NERVOUS SYSTEM

- Brain is covered by 3 layers Meninges
  1. Durameter (toughest)
  2. Arachnoid mater
  3. Plamater
- Cerebrospinal fluid is filled between the meninges.

##### (a) Cerebrum

- Grey matter controls activities such as speech, taste, smell, hearing (conscious activities)

##### (b) Cerebellum

- Concerned with equilibrium of the body and brings about co-ordination and control of muscular activities of the body.

##### (c) Medulla Oblongata

- Lowest part of the brain and is connected to the spinal cord.
- Controls the involuntary actions (respiration, heart beat, flow of blood in blood vessels, secretion of glands, etc)

### REFLEX ACTION

- First discovered by Marshal Hall.
- Co-ordinated by spinal cord

### CONDITIONAL REFLEX

- First shown by Payloy on dog
- It is controlled by the cerebrum

## BIOLOGY

### PERIPHERAL NERVOUS SYSTEM

- Composed of Cranial nerves and spinal nerves.
- Cranial are 12 pairs while spinal are 31 pairs.  
Trigeminal : Mixed  
Facial : Mixed  
Vagus : Mixed(largest)

### AUTONOMOUS NERVOUS SYSTEM

- Not under voluntary control.
- Controlled by Central Nervous system.

### SENSORY ORGANS

#### 1. SCLEROTIC LAYER

- The transparent bulging, circular part of sclerotic layer which lies in the front is called cornea.
- Cornea is covered by the thin conjunctiva.

#### 2. CHOROID LAYER

- Choroid layer starts from iris which is next to cornea. It controls the amount of light entering into the eye.
- The circular aperture of iris is called pupil.
- Next is lens (proteinous). It is biconvex in nature.
- Space between lens and cornea is filled with a transparent watery fluid called Aqueous Humour.
- The space behind the lens is filled with Vitreous Humour.

#### 3. RETINA

- Image of the object is formed on retina.
- Rod cells: Sensitive to dim light
- Cone cells: Color sensitive for 3 primary colors (Red, Blue and Green)
- Yellow spot (Macula Lutea): On retina, finest image is formed here.
- Blind spot: No image formation takes place here as the optic nerves innervate the eyeball here. Also the rods and cones are absent here.
- Color of eye is the color of the iris.
- Cornea is donated in eye donation
- Eyes glow in animals due to tapetum

### DEFECTS OF EYE

- Myopia: Cannot see distant objects, image formed before retina, concave lens is used.
- Hypermetropia: Cannot see near objects, image formed behind retina, convex lens is used.
- Astigmatism: Curvature of cornea becomes irregular and image is not clear. Cylindrical lens is used.
- Cataract: Due to defective protein metabolism the lens becomes opaque.

- Glaucoma: Due to defect in aqueous humour.
- Xerophthalmia: It is due to deficiency of Vitamin A.
- Presbyopia: In this, power of accommodation of lens decreases due to age factor and defected metabolism. Can be removed by bifocal lens.

### EAR

#### MIDDLE EAR

- It encloses 3 ear ossicles.
- Middle ear is connected to the pharynx by Eustachian tube.

#### INTERNAL EAR

- Various parts are there which perform 2 acts: Maintenance of balance and hearing.
- Succulus and cochlea parts are associated with hearing. It is filled with a fluid, perilymph.
- In the internal ear are 3 semi-circular canals and utriculus which are filled with a fluid, endolymph. They perform the balancing act.

### DIGESTIVE SYSTEM

- The process of converting food into energy giving substances is carried out by this system.

#### 1. Buccal Cavity

- In the mouth salivary glands secrete saliva which contains the enzyme ptyalin.
- Also contains Lysozyme which kills bacteria
- Teeth: They are produced in two sets temporary and permanent. The teeth are of four types: Incisors, Canines, Premolars and Molars

#### Structure of a Tooth:

- It is covered by a shining material called Enamel.
- Enamel is the hardest substance in the human body.

#### Dental Formula:

- 2123/2123. This means that there are 2 incisors, 1 canine, 2 premolars and 3 molars in half of the upper jaw and exactly the same arrangement in half of the lower jaw. i.e. 32
- The premolars and the molars are called the grinding teeth. The last molars are called the wisdom teeth.
- Linked with pharynx.

#### Pharynx

- Trachea opens into pharynx through an aperture called Glottis. It also receives the opening of the Eustachian tubes from the middle ear through an aperture called Gullet.

**Oesophagus**

- 25 cm long tube.
- Leads to stomach

**Stomach**

- In stomach, the food is called chime.
- Has 3 parts: Fundus, Cardiac and Pyloric
- It is a warehouse, where food can be stored to await the main process of digestion.
- Gastric juices produced in the stomach help in digestion of food. Also contains HCl which kills bacteria and provides acidic medium.

**Small intestine(Duodenum + Jejunum + Ileum)**

- Here the food from the stomach is mixed with bile (from liver) and pancreatic juice (from pancreas) and moves forward by peristaltic movement.
- Duodenum receives the bile-pancreatic duct formed by the union of bile duct and pancreatic duct.
- Both jejunum and ileum have numerous fingerlike projections called the villi.
- Bile doesn't take direct part in digestion of fat, it just makes the food alkaline.

**Large Intestine (Caecum+colon + Rectum)**

- It receives undigested material from the small intestine and absorbs water.
- Cellulose digestion takes place in it.
- Vermiform appendix is a part of caecum, which produces antibodies.

**TONGUE**

- Saliva, secreted by the salivary glands, is mixed with the chewed food by the tongue.
- Tongue also contains taste buds due to which we sense bitter, sour, salty or sweet taste.

**DIGESTIVE GLANDS****Parotid Glands**

These are largest salivary glands.

**Liver**

- It is bilobed, right lobe being the larger and left lobe the smaller.
- Secretes Bile, which is yellowish in color.
- Bile helps in digestion in three ways.
- Liver is a gland which has got diverse functions.
- Digestion: With the help of bile (already discussed)
- Regulation of Blood Sugar: The liver separates the excess of sugar from the blood and stores it in its cells as glycogen (animal

starch). This process is called Glycogenesis and is aided by pancreatic hormone insulin.

- During the days of food shortage, the stored glycogen is changed into glucose and added to the blood stream for distribution to the body.
- Formation of Glycogen from Non-carbohydrate sources: Excess of amino acids/ fats are also changed into glycogen. This process is called Glyconeogenesis.
- Their amino radical separating as ammonia and carbon chain changing into a keto acid. This process is known as Deamination.
- Excretion: Liver collects haemoglobin while keto acid takes part in metabolism.
- Blood clotting: liver produces heparin, prothrombin and fibrinogen.
- Formation of Red Blood Corpuscles: Liver produces RBCs in the embryo.
- Phagocytosis: Foreign matter, dead cells and bacteria are disposed off in the liver.
- Synthesis of Vitamin A
- Storage: Besides glycogen liver stores (a) lipids such as fats fatty acids and cholesterol

**Pancreas**

- Endocrine – $\alpha$ ,  $\beta$ ,  $\gamma$  cells
- Exocrine – pancreatic juice
- It is both an exocrine and an endocrine gland. The endocrine part (called islets of langerhans) secretes hormones . The exocrine part secretes pancreatic juice.

**HUMAN HEART AND ITS FUNCTIONING**

- Size 12 x 9 cm and 300 gm weight
- Enclosed in a tough, 2 layer connective tissue sac, the pericardium.
- Has 4 chambers: 2 upper smaller auricles and 2 lower larger ventricles.
- The right auricle opens into right ventricle through tricuspid valve.
- This blood vessel is guarded by semi-lunar valve to prevent backflow of blood into ventricles.
- Blood again returns to heart from the lungs in left auricle. Now the blood is oxygenated.
- The left auricle opens into the left ventricle through a bicuspid valve.
- From the left ventricle the blood flows throughout the body through a large blood vessel called aorta.
- To pump-out blood, the heart chambers undergo alternate contraction called systole and relaxation called diastole.

**COMPARISON OF ARTERY, CAPILLARY AND VEIN**

<b>Artery</b>	<b>Vein</b>	<b>Capillary</b>
Transports	Transports	Link arteries to

blood away from the heart	blood towards the heart	veins.
Except where they leave heart	Semilunar valves	No semilunar valves
Blood oxygenated except in pulmonary artery	Blood deoxygenated except in pulmonary vein	Mixed oxygenated and deoxygenated blood.

- Lubbis produced by the closing of tricuspid and bicuspid valves while dupp is produced by the closing of semi-lunar valves.
- This patch is the sino-auricular node which is called the pacemaker. Normal heart beat is 72/min.
- Heart failure: When S.A. node does not initiate any impulse.
- Sphygmomanometer measure the B.P. BP is 120/80 mm of Hg.

Pulmonary artery: The only artery which carries deoxygenated blood. It carries blood from right ventricle to lungs.

Pulmonary vein: The only vein which carries oxygenated blood. It carries blood from lungs to left auricle.

### EXCRETORY SYSTEM

- Nitrogenous substances carbondioxide, pigments, excess water, etc.
- The nitrogenous waste can be excreted in the following forms:
- Ammonia, Urea, Uric acid- conservation of water is needed.

### EXCRETORY SYSTEM OF MAMMALS

#### 1. Kidneys

- Left kidney is higher than the right kidney.
- A kidney is composed of 1.2 million microscopic structural and functional units called nephrons or uriniferoustubules.

#### Urethra

Act of passing urine is called Micturition.

### EXCRETORY PRODUCTS

#### Ammonotelic Animals

- These animal excrete nitrogen in the form of ammonia, e.g., aquatic invertebrates Amoeba, Hydra, Prawn, Pila, and freshwater fishes Bony Fish, Frog's tadpole.

#### Ureotelic Animals

- They excrete nitrogen in the form of urea, e.g., mammal (man), frogs, toads, other amphibians and cartilaginous fishes like sharks.

### Uricotelic Animals

- They excrete the nitrogenous wastes in the form of uric acid e.g., reptiles, snakes, lizards, crocodiles and birds.

### NEPHRON

Functional unit of kidney. It is a long tube differentiated into 4 regions.

#### 1. Bowman's Capsule

The Bowman's capsule and the glomerulus together form a globular body called Malpighian body.

- The yellow colourof urine is caused by the pigment urochrome, which is a breakdown product of haemoglobinfrom worn out RBCs
- The urine on standing gives a pungent smell. It is due to conversion of urea into ammonia by bacteria
- pH of urine is between 5-8. Average pH is 6.0 (slightly acidic)
- kidney stones: Calcium Oxalate.

### REPRODUCTIVE SYSTEM

#### 1. Binary Fission

It occurs in unicellular organisms e.g., Amoeba, Euglena, Paramecium, etc.

#### 2. Multiple Fission

The nuclei move towards the periphery and each one is surrounded by small amount of cytoplasm which gives rise to new daughter cells.

It occurs in protozoa e.g., Plasmodium.

#### 3. Sporulation

In many protozoa and bacteria the asexual reproduction occurs by the division of nucleus into several daughter nuclei and then each daughter nucleus gets enclosed by small amount of cytoplasm to form a spore

#### 4. Budding

Budding is an unequal division of the parent where the identity of the parent body is still maintained.

It is common in Hydra.

#### 5. Fragmentation

The body may break into two or more fragments and each fragment develops into a complete individual e.g., Filamentous algae, Spirogyra

### SEXUAL REPRODUCTION

- In a certain animals, the male and female sex organs are present in the same individual. Such species are called monoecious or bisexual e.g. earthworm, leech.

- Parthenogenesis is a specialized reproduction in which eggs develop without fertilization e.g., bees, ants, wasps, etc.

### MAMMALIAN REPRODUCTIVE SYSTEM

- The reproductive system of sexually reproducing animals consists of:
- Primary sex organs called gonads which produce gametes and hormones.
- Secondary sex organs/glands which participate in reproduction but do not form gametes
- Accessory sex organs/characters which distinguish the two sexes in appearance.

### MALE REPRODUCTIVE SYSTEM

- Testes are paired structures which lie outside the abdominal cavity in a thin pouch of skin called scrotum.
- Temperature of scrotum is 2°C below the body temperature.
- Interstitial cells or cells of leydig which secrete male sex hormone (testosterone)

### SECONDARY SEX ORGANS

**Seminal Vesicles:** They secrete viscous fluid which constitute the main part of the ejaculate. Seminal fluid contains fructose (as a source of energy which provide nourishment for the activity of sperm), citric acid and prostaglandins (these two stimulate the movement of sperms in female tract). **Prostate gland:** It contributes an alkaline component to the seminal fluid for sperm motility. It also provides a characteristic odour to the seminal fluid.

### FEMALE REPRODUCTIVE SYSTEM

**Uterus:** Its walls are composed of smooth muscle fibres called myometrium.

**Vagina:** The opening of the vagina in young females is partially closed by a thin membrane called hymen.

**Mammary glands:** Its secretion is under the control of prolactin hormone (of pituitary), while milk ejection is under the control of oxytocin hormone.

### GAMETOGENESIS

- Process of formation of gametes in gonads. It includes spermatogenesis (formation of sperms by the testes) and oogenesis (formation of eggs by the ovaries)
- It is controlled by gonadotrophic hormones (FSH, LH, ICSH etc) secreted by pituitary gland. Meiosis forms the most significant part of the process of gametogenesis.

### MENSTRUAL CYCLE

- The reproductive period of the human female continues from about the age of about 12 years to 45-50 years.
- This period is marked by a characteristic event repeated almost every month (28 days with minor variation) in the form of a menstrual flow.
- Menopause is stopping of ovulation and menses.
- Menstrual cycle is controlled by FSH, LH, estrogen and progesterone.
- Menstrual phase: Due to the shedding of the uterine lining rupturing the blood vessels which is mainly due to decrease of estrogen and progesterone secretion.
- Estrous cycle: At the time of ovulation sexual urge increases due to rising level of estrogen. This is called period of heat.

### Note:

- Hernia is the protrusion of body part through an abnormal opening.
- If the number of sperms falls below 20 million the person become infertile.
- Surrogate motherhood is by-product of the artificial insemination.

### TEST TUBE BABIES

- The technique of in-vitro fertilization (IVF) and in-vitro development followed by the embryo transfer in the uterus of the normal female to start the development and finally leading to normal birth is called test tube baby.
- Zygote is stimulated to develop in vitro upto 32 celled stage.
- First attempt to produce a test tube baby was made by an Italian scientist Dr. Petrucci in 1959.
- The world's first test tube baby (a baby girl) named as Louise Joy Brown was born on July 25, 1978 in Great Britain. India's first test tube baby was born in Calcutta on October 3<sup>rd</sup> 1978. Her name is Durga.

### CLONIC

**Therapeutic cloning:** The goal of therapeutic cloning is to produce a healthy copy of a sick person's tissue or organ for transplant.

### STRUCTURAL ORGANISATION OF THE CELL

- Study which deals with the cell is called cytology.
- Cell was first discovered by Robert Hook in 1665 in sections of cork. He only coined the term 'cell'
- The cell Theory was given by Schleiden and Schwan.

**TYPES OF CELLS**

- In a typical cells, the protoplasm consists of nucleus and cytoplasm
- Depending on the type of nucleus present, the cells are of two types.
- Prokaryotic cell and Eukaryotic cell.

<b>Prokaryotic cell</b>	<b>Eukaryotic cell</b>
It is a simple and primitive in nature	It is developed and comparatively complex in nature
The nucleus is not well organized.	The nucleus is well organized.
The cell has no membrane bound organelles except ribosomal granules	The cell contains almost all the membrane bound organelles
Chromosomes are not formed in this cell during cell division	Chromosomes are formed in the nucleus during cell division
Single DNA thread remains freely in the nuclear material	DNA is present in the nuclear reticulum or chromosomes

- On the basis of number of cells, the organisms are classified as Unicellular and Multicellular organisms.

<b>Plant cell</b>	<b>Animal cell</b>
A plant cell has a rigid wall on the outside. It is usually larger in size	Cell wall is absent. An animal cell is comparatively smaller in size.
It cannot change its shape	An animal cell can often change its shape.
Plastids are found in plant cells	Plastids are usually absent.
Plant cells exposed to sunlight possess chlorophyll containing plastids called chloplasts	Chlorophyll is absent.
Nucleus lies on one side in the peripheral cytoplasm	Nucleus usually lies in the centre.
Lysosomes are rare.	Typical lysosomes occur in animal cell
Reserve food is generally starch and fat	Reserve food is usually glycogen and fat

- Huxley called protoplasm 'Physical basis of life'.
- Human nerve cell is the longest animal cell.
- Largest acellular plant acetabularia is 10 cm and animal is amoeba, which is 1 mm.
- In human beings, cells of kidney are the smallest.
- Smallest cell is  $0.1 - 0.3 \mu\text{m}$  in size. It is PPLO (Mycoplasma gallisepticum)

**CELL ORGANELLES****1. CELL MEMBRANE**

- Cells are enclosed by a thin film like membrane called plasma membrane, cytoplasmic membrane or plasmalemma.
- Lies immediately outside the cytoplasm.
- Structure was defined by Singer and Nicholson in 'Fluid Mosaic Model'.
- Selectively permeable in nature.
- Endocytosis: Taking of substance inside the cell by the plasma membrane.
- Exocytosis: Reverse of endocytosis, i.e., material is removed from the cells including reverse pinocytosis.

**2. CYTOPLASM**

It is part of protoplasm lying between plasma membrane and nucleus, Jelly-like fluid. Participates in the intracellular distribution of nutrients, metabolites and enzymes.

**3. CELL WALL**

- It is absent in animals.
- In true bacteria and cyanobacteria, cell wall is of peptidoglycan, in some fungi it is of chitin and in most of the algae and higher green plants it is of cellulose.

**4. NUCLEUS**

- Discovered by Robert Brown.
- RBCs of mammals don't have nucleus.
- Contains nucleoplasm (nuclear sap) which contains chromatin.
- Nucleolus is also present which helps in the production of ribosomes.
- Nucleus controls the metabolic activities of the cell by controlling the synthesis of enzymes.

**5. CHROMOSOMES**

- Waldeyer coined the term chromosome.
- Sutton and Boveri proved that chromosome is the physical basis of heredity.
- Each chromosome is made up of DNA and this DNA by replication gives rise to messenger RNA which carry the genetic information in the form of code.
- Diploid number ( $2n$ ) of chromosomes are there in somatic cells (all body cells except sperms and ova) and haploid ( $n$ ) of chromosomes are there in gametes (sperms and ova).
- In humans, the diploid number is 46. Of these, 23 are from egg cell and 23 from sperm cell.

**6. Mitochondria**

- Powerhouse of the cell or energy converting organelles, as oxidation of 'fuel' occurs

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stepwise in these, resulting in the release of chemical energy. This energy is stored as ATP.

- Each mitochondria is enclosed by a double-membraned envelope, outer and inner.
- Fluid called matrix is there between these 2 layers inner membrane has many folds called cristae.

### ENDOPLASMIC RETICULUM

- Provides mechanical support to the cytoplasm
- Both smooth Endoplasmic reticulum and rough endoplasmic reticulum form passages for transport of secretory proteins, lipids and sterols.

### 8. GOLGI COMPLEX

- Main function is secretion.

### 9. LYSOSOMES

- Also called Suicidal bags.
- Contain powerful enzymes (acid hydrolases), rupture of lysosome membrane releases these enzymes.
- Digest worn-out or unnecessary parts of the cell, or even whole cells by process called 'Autophagy'.

### 10. RIBOSOMES

- Sites of protein synthesis (Ribosomes are inactive for protein synthesis, but after combining with mRNA form polyribosomes which play important role in protein synthesis)

### 11. VACUOLES

- Found in plant cells only.
- Membrane surrounding the vacuole in tonoplast.
- Function: Regulation of water, in osmoregulation, in storage and in digestion.

### 12. PLASTIDS

- Chloroplast: Green, contains the pigment chlorophyll. Contains the matrix (fluid), stroma which has many flat membranous structures called thylakoids.
- Leucoplasts: Colorless, occur in large no in cells of fruits, seeds, etc. They store nutrients (eg. Amyloplasts of potato store starch)
- Chromoplasts: Colored, containing fat soluble yellow, orange and red pigments (chiefly carotenoids) Found in flowers and fruits.

**Centrosomes**—Plays an important role in the formation of spindle during cell-division.

**Ribosomes**-Act as factories of the cell and synthesize proteins from amino acids.

### DNA and RNA

- DNA stands for Deoxyribose Nucleic Acid while RNA stands for Ribose nucleic Acid.
- Made up of Nucleotide monomers (Polynucleotides)

### DNA MOLECULE

- Long and highly complex, spirally twisted, right-handed double helix, ladder like structure formed by 2 polynucleotides strands.
- Wilkins, Watson and Crick (1953)-Noble prize for DNA Structure.
- DNA contains 'BLUE PRINT' of life.

### ORIGIN OF LIFE

- Theory of Spontaneous Generation or Abiogenesis held that life originated repeatedly from non-living materials by spontaneous generation.
- The 1st scientific account of the origin of life was given by Russian scientist A.I. Oparin in his book 'Origin of Life'.

### DARWINISM

- The theory of natural selection was given by him.
- He, in his book Origin of species; mentioned the following factors for the formation of species by natural selection.
- The organisms show struggle for existence.
- The advantageous variations in organisms results in 'Survival of the Fittest'.

### MUTATIONS

- Darwin in his theory explained the origin of species due to some changes.
- Hugo de Vries was the 1 to give much importance to these discontinuous variations.

### FATHERS OF BIOLOGY

Aristotle	Father of Zoology, biology, political science
Theophrastus	Father of botany
Linnaeus	Father of modern botany
G.J. Mendel	Father of Genetics
Bateson	Father of Modern Genetics
Robert Koch	Father of Bacteriology
Edward Jenner	Father of immunology
Louis Pasteur	Father of microbiology
Francis Galton	Father of eugenics
Hugo de Vries	Father of Mutation
Robert Hooke	Father of Cytology
Micheli	Father of Mycology
Hippocrates	Father of Medicine

Landsteiner	Father of Blood groups
Empedocles	Father of Evolutionary ideas
V.Korenchevsky	Father of Gerontology
Thomas Addison	Father of Endocrinology
Stephen Hales	Father of plant physiology
Prof. R. Mishra	Father of Indian ecology
Prof. Birbal Sahani	Father of Indian palaeobotany
Carolus Linnaeus	Father of Taxonomy and Nomenclature
Pavlov	Father of Conditional Reflex
Einthovan	Father of ECG
William Harvey	Father of Blood circulation
Kolreuter	Father of Polygenic inheritance
Basu	Indian Med. Plant
Bujwani	Father of Indian embryology
Khatwal	Indian botanist
Reiter	Ecology coined UV rays
Hershell	IR rays

### Biological Evaluation

#### Evidence of Organic Evolution

More and More creation of organism by gradual changes from low categories animal to higher animal is called organic evolution. There are several evidences regarding organic evolution.

#### Homologous Organs

- The organs which are similar in basic structure and origin but dissimilar in functions are called homologous organs, e.g., wings or bat, cat's paw, front foot of horse, human's hand and wings of birds
- These show divergent evolution.

#### Analogous Organs (Homoplastic)

- These are developed in widely different organism phylogenetically due to similar habitats and modes of life e.g., wings of insects, birds and bats eyes of octopus and mammals.
- Analogous structures are a result of convergent evolution.

#### Vestigial Organs

- These are degenerate, non-functional organs which were functional earlier.
- Human body has been described to possess about 90 vestigial organs. Some of these are muscles, ear, pinna, canine, teeth and third molar teeth, body hairs, vermiform appendix, nictitating membrane of eye, caudal vertebral (coccyx or tail bone), etc.

#### Atavism or Reversion

Compiled by Rex Christopher

- It is the sudden reappearance of some ancestral features. Appearance of thick body hair, large canines, monstral face, short temporary tails, addition, fairs of nipples, etc., examples of atavism.

#### Evidence from connecting Links

- Connecting link is one which exhibit characteristics of more than one groups.

#### Intermediate Forms between Two groups of Organisms

Organism	Connecting Link Between
Virus	Living and non-living
Euglena(Protozoa)	Plants and animals
Proterospongia (Protozoa)	Protozoa and Porifera
Peripatus (Arthropoda)	Annelida and Arthropoda
Neopilina (Mollusca)	Annelida and Mollusca
Balanoglossus (chordata)	Non-chordata and chordata
Dipnoi (Lung fish)	Pisces and Amphibia
Archaeopteryx (Aves)	Reptiles and Aves
Prototheria (Mammalia)	Reptiles and Mammalia

#### Theories of Evolution

##### Lamarckism

- Jean-Baptiste de Lamarck give the idea than an organism can pass on characteristics that it acquired during its lifetime to its offspring (also known as heritability of acquired characteristics)
- Lamarck's theory of evolution was published in Philosophie Zoologique and had four propositions viz.
  - i. Living organisms and its parts are tend to increase in size due to internal force of life.
  - ii. Formation of new organs is the result of a new need and new involvement.
  - iii. Use and disuse-Individuals lose characteristics they do not require (or use) and develop characteristics that are useful.
  - iv. Inheritance of acquired traits Individuals inherit the traits of their ancestors.

##### Mutation Theory

- Hugo de Vries proposed the theory of mutation, working while on Oenothera lacerations plant.
- Mutations are discontinuous variation.
- Mutations are due to changes in chromosomes, genes and DNA.
- These may or may not be inherited.

## Synthetic Theory

According to it the five basic factors are:

- i. Gene mutation
- ii. Changes in chromosomes structure and number.
- iii. Genetic recombinations
- iv. Natural selection
- v. Reproductive isolation

First three factors are responsible for genetic variability.

### Note:

- Devonian period is known as Age of fishes.
- Mesozoic era is known as Age of reptiles.
- Caenozoic era is known as Age of Mammals.
- South America is known as Bird Continent.

## Classification of Organisms

In Linnaeus time, a two kingdom system of classification with Plantae and Animalia kingdoms was developed. The system did not distinguish between the eukaryotes and prokaryotes, unicellular and multicellular and photosynthetic organisms.

**PH Whittaker (1969)** proposed a five kingdom classification. The kingdom named were Monera, Protista, Fungi, Plantae and Animalia.

## Characteristics of the Five Kingdoms

Character	Monera	Protista	Fungi	Plantae	Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non-cellulosic	Present in some	Present (without cellulose)	Present (cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body Organization	Cellular	Cellular	Multicellular/loose tissue	Tissue/organ	Tissue organ/organ system
Mode of nutrition	Autotrophic	Autotrophic	Heterotrophic	Autotrophic	Heterotrophic

## Classification of Animals

Storer and Usinger classified animals into following phylums.

### Phylum-Protozoa

- These are unicellular animals, i.e., made up of only one cell.

- In these, all the metabolic activity like digestion, respiration, excretion and reproduction takes place in unicellular body.
- Respiration and excretion take place through diffusion.  
Example- Amoeba, Paramecium, Euglena, etc.

### Phylum- Porifera

- These all are found in marine water and have porous body. The pores are called ostia.
- These are multicellular animals.
- Their skeleton is made up of minute calcareous or silicon spicules.  
Example- Sycon, Sponge, etc.

### Phylum-Coelenterata

- These are aquatic animals have thread-like structures called tentacles around the mouth which help in holding the food.
- They have specialized cnidoblast cell to help in catching the food.  
Example- Hydra, Jelly fish, Sea Anemone, etc.

### Phylum- Platyhelminthes

- Animals of this phylum have alimentary canal with single opening, anus is absent.
- Excretion takes place by flame cells.
- There is no skeleton, respiratory organ, circulatory system, etc.
- These are hermaphrodite animal. Example- planaria, Liver fluke, Tape worm, etc.

### Phylum-Aschelminthes

- These are long cylindrical, unsegmented worms.
- Their alimentary canal is complete in which mouth and anus both are present.
- There is no circulatory and respiratory systems but nervous system is developed. Excretion takes place through protonephridia.
- They are unisexual.
- Most form are parasitic but some are free living in soil and water.  
Example- Ascaris, Thread worm, etc.

### Phylum-Annelida

- Their body is long, thin soft and metamerically segmented.
- Alimentary canal is well-developed.
- Nervous system is normal and blood (called haemolymph) is red (Iron rich haemoglobin).
- They respire through skin, in some animals it takes place through coelom.
- Excretion by nephridia.
- They move through setae made up of chitin.
- Example – Earthworm, Nereis, Leech, etc.

**Phylum-Arthropoda**

- Jointed leg is their main feature.
- Their body is divided into three parts-Head, thorax and abdomen.
- Circulatory system is open type. Cockroach's heart has 13 chambers.
- Trachea, book lungs, body surface are respiratory organs.  
Example-Cockroach, Prawn, crab, bug, fly, mosquito, bees, etc.

**Phylum-Mollusca**

- Their body is soft divided into head and muscular foot.
- Mantle is always present in it, which secretes a hard calcareous shell.
- Their alimentary canal is well developed.
- Respiration takes place through gills or ctenidia.
- Blood is colourless.
- Excretion takes place through kidneys.  
Example- pila, Aplysia (Sea rabbit), Doris (Sea lemon), Octopus (Devil-fish), Sepia (Cuttle-fish)

**Phylum-Echinodermata**

- All the animals in this group are marine.
- They have water vascular system
- Brain is not developed in nervous system.
- They have a special capacity of regeneration.  
Example – Star fish, sea urchin, sea cucumber, etc.

**Phylum-Chordata**

- They have notochord. A dorsal hollow tubular nerve cord and paired pharyngeal gill slits.
- This phylum is sub-divided into two sub-phylum i.e., protochordates and Vertebrata. Some main classes of phylum Chordata are

**Pisces**

- These are aquatic animal (cold-blooded animals)
- Their heart pumps only impure blood and have two chambers.
- Respiration takes place through gills.  
Example – Scoliodon, Torpedo etc.

**Amphibia**

- These are found both on land and water. All these are cold-blooded.
- Respiration takes place through gill, skin and lungs.
- They have three chambered heart Example – Frog, Necturus, Toad, Ichthyophis, Salamander.

**Reptilia**

- These are crawling animals.
- These are cold blood and contains two pairs of limbs.
- The skeleton is completely flexible.
- Respiration takes place through lungs.
- They have  $3\frac{1}{2}$  chambered heart. (from chambered in crocodile)
- Their eggs, are covered with shell made up of calcium carbonate. Example – Lizard, snake, tortoise, crocodile, Turtle, Python, etc.

**Aves**

- The animals of this group are warm-blooded tetrapod vertebrates with flight adaptation.
- Their fore-feet are modified into wings to fly.
- They respire through lungs.
- Birds have no teeth, beak helps in feeding.
- They have single ovary and pneumatic bones.  
Example- Crow, Peacock, Parrot etc.

**Mammalia**

- These are warm-blooded animals.
- Tooth comes twice in these animals (diphyodont)
- There is no nucleus in their red blood cells (except in camel and llama)
- Skin of mammals have hair.
- External ear is present.
- Mammalia is divided into three sub-classes
  - i. Prototheria It lays eggs, e.g., Echidna.
  - ii. Metatheria It bears the immature child e.g. Kangaroo
  - iii. Eutheria It bears the well developed child, e.g., human. They give birth to young ones, but Echidna and duck-billed platypus are the egg-laying mammals.

**Integumentary system**

The human skin (integumentary) is composed of a minimum of three major layers of tissue, the epidermis, the dermis and hypodermis.

**Epidermis**

- The top layer of skin made up of epithelial cells and does not contain blood vessels.

**Dermis**

- It gives elasticity to the integument, allowing stretching and conferring flexibility, while also resisting distortions, wrinkling and sagging.

**Hypodermis**

- It is made up of adipose tissue.
- It performs several important functions:
  - i. Protect against invasion by infectious organisms.

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- ii. Protect the body from dehydration.
- iii. Maintain homeostasis
- iv. Act as a receptor for touch, pressure, pain, heat and cold.
- v. Protect the body against sunburns by secreting melanin.
- vi. Generate vitamin-D through exposure to ultraviolet light.
- vii. Store water, fat, glucose and vitamin-D

### Vaccination

- It is the process of artificial introduction of germs or the germ substance called antigen into the body for developing resistance to a particular disease. The material introduced into the body is called vaccine.
- A vaccine is dead or weakened microbes. They are unable to produce disease as they are less in number but they stimulate the body to produce antibodies.
- World Health Organization (WHO) in 1974 officially launched a global vaccination programme to protect children from six fatal diseases. Diphtheria, pertussis, tetanus, polio, TB (Tuberculosis) and measles. It was launched in India in 1985.

### Genetics

It is the study of heredity and variations. The term 'Genetics' was coined by W Bateson in 1905. Gregor John Mendel (commonly called Father of Genetics) proposed three laws.

- (a) **Law of Dominance** It states that crossing of plant with red and white flower produced plants only with red flower i.e., dominant appear and recessive disappeared.
- (b) **Law of Segregation** It states that allele of a gene separate during gamete formation. It is also called law of purity of genetics or law of splitting of hybrids. It gives 3 : 1 ratio in F<sub>2</sub> generation.
- (c) **Law of Independent Assortments** It states that two or more genes assort independently during inheritance. It gives 9 : 3 : 3 : 1 ratio in F<sub>2</sub> generation. Linkage is an exception to this law.
- The 7 characters studied by Mendel were present as four different chromosomes. To know heterogeneity of F<sub>1</sub>, he crossed F<sub>1</sub> hybrid with recessive parent, this is called test cross.
- There are a number of exceptions to mendelian characters like incomplete dominance in *mirabilis jalapa* giving pink colored flowered in F<sub>1</sub> generation by crossing red and white flowered plants.
- Pleiotropy is the phenomenon, where a gene affects many aspects of phenotypes.

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- Haemophilia and colourblindness are two important sex-linked diseases in human, whose allele is found on X-chromosome.

### Biotechnology

- It is the use of micro-organisms, their parts or processes for the manufacture of useful or commercial substances. It has two core techniques i.e., genetic engineering and technique to facilitate the growth and multiplication of only desired microbes. In genetic engineering (also called recombinant DNA technology) restriction endonucleases are most useful. They cleave the DNA at specific locations called restriction sites.
- Vectors are organisms or their parts used to transfer the desired DNA from one organism to another. The common vectors are bacteriophage, cosmids, phagemids, plasmids etc.
- Polymerase Chain Reactor (PCR) developed by Carrey Mullis (1983) can clone or amplify the small amount of DNA. It involved denaturation, primer annealing and polymerization in the definite sequence.

### Applications of Biotechnology

A number of transgenic plants, medicines, acids are produced through genetic engineering.

#### Bt cotton

- It was developed to reduce the heavy reliance on pesticides.
- The bacterium *Bacillus thuringiensis* (Bt) naturally produces a chemical harmful only to a small fraction of insects

#### Bt Brinjal

- It is transgenic brinjal (also known as an egg plant or aubergine) created by inserting a crystal protein gene (*cry IAc*) from the soil bacterium *Bacillus thuringiensis* into the genome of various brinjal varieties.

#### Golden Rice

- It is a variety of *Oryza sativa* rice produced through genetic engineering to biosynthesis beta-carotene, a precursor of pro-vitamin-A in the edible parts of rice. Golden rice was developed as a fortified food to be used in areas, where there is a shortage of dietary vitamin-A
- **Golden Rice 2** produces up to 23 times more beta-carotene than the original variety of golden rice. Golden rice was created by Ingo Potrykus of the Institute of Plant Sciences at the Swiss Federal Institute of Technology, working with Peter Beyer of the University of Freiburg.

## BIOLOGY

- Carotene gives carrots their orange colour and is the reason why genetically modified rice is golden. For the golden rice to make beta-carotene three new genes are implanted: two daffodils and the third from a bacterium.

### **FlavrSavr**

By the use of antisense RNA technology the enzyme polygalactouronase, which causes damage to pectin is deactivated and the tomato is kept afresh for longer duration.

### **Canola**

- It is the oil of either rape seed (*Brassica napus* L) or field mustard (*Brassica campestris* L or *Brassica rapa* var.). Its modes are used to produce edible oil suitable for consumption by humans and livestock. The oil is also suitable for use as biodiesel.
- Cheese is prepared by the coagulation of casein and other minor milk proteins (curdling of milk) by an enzyme rennin extracted from calf gastric mucosa.
- Streptococcus and Lactobacillus species are involved in the manufacture of most cheese.
- In cheese manufacture, micro-organisms are important in both souring and ripening processes.
- Semisoft blue Roquefort cheese of France is produced using the mold *Penicillium roqueforti*.
- Yoghurt is a preserved milk product having a distinct taste and a thick texture than milk.
- Yoghurt is made by fermenting whole milk with a mixture of *Lactobacillus bulgaricus*, *Streptococcus lactis* and *S. thermophilus* at 40° to 46°C.
- Vitamin C was the first vitamin to be produced by a fermentation process using *Acetobacter*, a wild bacterium.
- Bacteria used for industrial production of vitamin B<sub>12</sub> are *propionibacterium shermanii*, *P. freudenreichii* and *Pseudomonas denitrificans*.
- Vitamin B<sub>2</sub> (Riboflavin) is synthesized by many micro-organisms including bacteria, yeasts and fungi. The fungus, *Ashbya gossypii* is used for the microbial production of vitamin B<sub>2</sub>.
- **Monoclonal antibodies** are made outside the body by the hybrid cell cultures known as hybridomas.
- Monoclonal antibodies (mAb) are antibodies that are identical because they were produced by one type of immune cell and are all clones of a single parent cell.

- **A biochip** is a discrete collection of gene fragments on a stamp-sized chip that can be used to screen for the presence of particular gene variants.
- Biochips allow rapid screening gene profiles, a tool that promises to have a revolutionary impact on medicine and society.
- Biochips can **help in identifying precise forms of cancer**.
- **Gene therapy** is the treatment of disease by replacing, altering or supplementing a gene that is absent of abnormal and whose absence or abnormality is responsible for the disease. Gene therapy is unique in that it employs the genetic material, DNA itself as the means of treatment.
- DNA finger printing is the technique, in which the banding pattern of DNA fragments is compared and can be used in many species, including human, to indicate relatedness (used for rape victim, paternity, other criminals).
- **Human insulin or humulin** is the first genetically engineered pharmaceutical product, developed by Eli Lilly and company in 1982.
- Genentech, a California-based company, have produced human growth hormone (HGH) form genetically engineered bacteria. Somatostatin is the first polypeptide, which was expressed in *E. coli* as a part of the fusion peptide.
- **BST or Bovine Somatotropin** is produced for a large quantity of milk production in cows.
- It is possible to cure phenylketonuria disease by using recombinant DNA techniques in early period of pregnancy.
- **Urokinase** is involved in dissolution of blood clots. It has been synthesized in huge quantity by using genetically engineered bacteria with urokinase genes.

### **Organic Acids synthesized by Various Microbes**

<b>Micro-organism</b>	<b>Organic Acid</b>
Lactic Acid	<i>Lactobacillus delbreuic</i> , <i>L. bulgaricus</i> , <i>Streptococcus lactis</i> and <i>Rhizopus</i> species
Acetic acid (Vinegar)	<i>Acetobacter aceti</i>
Citric acid	<i>Aspergillus niger</i> , <i>Penicillium sp.</i> And <i>Mucor sp.</i>
Cluconic acid	<i>Aerobacter aceti</i> , <i>Aspergillus niger</i> , <i>Penicillium</i> and <i>chrysogenum</i>
Propionic acid	<i>Bacterium Propionic</i>
Butyric acid	<i>Clostridium acetobutylicum</i>
Oxalic acid	<i>Aspergillus sp</i>

BIOLOGY

Gallic acid	Aspergilusniger
Same amino acids	Escherichia coli

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## CHEMISTRY

### Matter:

Matter is anything that has mass and occupies space. It can be changed from one form to another or into energy but can never be completely destroyed.

### Elements:

A pure substance which contains only one kind of atom, e.g. Fe (Iron), Na (Sodium)

### Compounds:

A compound is a pure substance which contains more than one kind of element or atom in fixed proportion by weight e.g. NaCl (Sodium chloride), SO<sub>2</sub> (Sulphur dioxide) etc.

### Mixtures:

A material containing two or more elements or compounds in any proportion is a mixture.

### Types of Mixtures

- a) Homogeneous
- b) Heterogeneous
- c) Homogeneous if its composition is uniform throughout.
- d) heterogeneous if its composition is not uniform
- e) A mixture with definite boiling point is known as azeotropic mixture.

### Separation of Mixtures:

a) **Sublimation**: A solid substance passes directly into its vapours.

b) **Sedimentation and decantation**: when one component is liquid and the other is insoluble solid.

c) **Crystallization**: Based on the difference in solubility of the various compounds in a solvent, e.g. mixture of KNO<sub>3</sub> and NaCl can be separated by this process

d) **Filtration**: Removal of solid suspended particles from a liquid.

e) **Evaporation**: the solution is heated so that the solvent vaporizes to give the solute (solid substance)

f) **Distillation**: A mixture of two substances, only one of which is volatile.

g) **Fractional distillation**: Both the components of a mixture are volatile.

h) **Steam distillation**: Used to separate a liquid (should be immiscible with water) from a mixture by heating with steam.

i) **Mechanical separation**: Two immiscible liquids can be separated by using a separatory funnel.

j) **Atmolytic separation**: A mixture of gases can be separated based on their rates of diffusion.

h) **Chromatography**: most versatile separation method which can be applied to solid, liquid or gas.

### ATOM

- Smallest particle of an element which does not always exist independently molecule of hydrogen which exists independently.

### Atomicity:

It is the number of atoms present in a molecule of an element.

### Molecule:

It is the smallest part of an element or compound that can normally exist separately.

### Atomic weight or Atomic mass

The number of times its atom is heavier than  $\frac{1}{12}$  th of the mass of carbon atom. Unit atomic mass of hydrogen is 1 amu.

### Mole:

- (Or Mol) One mole is equal to the number of atoms present in 12 gram C<sub>12</sub> i.e., 1 mole =  $6.022 \times 10^{23}$  amu
- Avagadro's number

### Equivalent weight

The number of the parts of a substance by weight.

### PHYSICAL AND CHEMICAL CHANGES

a) **Physical Change**: A change of state only and is not accompanied by an alteration in the chemical composition, weight or chemical properties of any substance e.g. melting of ice, magnetizing a needle etc.

b) **Chemical Change**: A chemical change gives rise to a new substance having composition and properties altogether different from those of the original substances. e.g. radioactive decay, rusting of iron, photosynthesis etc. Energy is absorbed or released during a chemical change.

### PHYSICAL AND CHEMICAL PROPERTIES

a) **Physical Properties**: The properties which do not depend on reaction with any other substance. e.g. colour, melting point, boiling point, density etc

b) **Chemical Properties**: The chemical properties of a substance are those that describe its reactions with other substances.

### EMPIRICAL FORMULA

Simple whole number ratio between the number of atoms of the different elements forming the compound. e.g. H<sub>2</sub>O

### MOLECULAR FORMULA

The number of atoms in a molecule of a molecular substance.

## CHEMISTRY

### COLLOIDS

May be crystalline or non-crystalline. When these are dispersed in a liquid, solid or gas they result in formation of a colloidal system e.g. top soil of earth, protoplasm etc.

- a) **Sol:** When a solid is dispersed in a liquid.
- b) **Gel:** The liquid contains a colloidal solid.
- c) **Aerosol:** When the dispersed colloidal particle is solid.

**Smoke:** When it is liquid, the result if fog.

- d) **Emulsion:** When one liquid is dispersed into another in which it is not soluble e.g., milk, paint etc.

### Properties of Colloids

- When the beam of light is passed through a true solution the path of the beam is not visible but when it is passed through a sol its path is visible. This effect is known as Tyndall Effect.

### METALLURGY

The production of metal from the ore which generally contains a large percentage of rocky material, called gangue or matrise.

### RUSTING

It is caused in iron due to presence of moisture, oxygen,  $\text{CO}_2$  in the air. Rusting is prevented by surface coating with film of oil, paint or metal coating such as chromium coating, nickel plating, tin plating and copper plating.

### ALLOY

It is a mixture of two or more metals and small amount of non-metals also.

### ORES

These are minerals from which metals are produced.

### MINERALS

The natural materials extracted from the earth that are formed through geological processes.

### ATOMIC STRUCTURE

In 1809, Dalton suggested that atom is the smallest particle of the element and it is indivisible. But in the beginning of 20<sup>th</sup> century Rutherford, J.J. Thomson etc. suggested that atom is divisible and made up of electrically charged particles.

### CHARGE AND MASS OF FUNDAMENTAL SUBATOMIC PARTICLES

Electron	-1	$9.1093 \times 10^{-31}$	0.000548	e, -ve	J.J. Thomson
Proton	+1	$1.672 \times 10^{-27}$	1.007276	p, +ve	Rutherford and Goldstein
Neutron	0	$1.6747 \times 10^{-27}$	1.008665	n, no charge	Chadwick

**Electron-** negative charge – J.J. Thomson.

**Proton** – positive charge - Rutherford and Goldstein.

**Neutron-** no charge – Chadwick 1932

### Properties of Cathode Rays (-ve)

- a) Mechanical motion
- b) Are deflected when magnetic field is applied on them
- c) cause ionization of gas
- d) Produce green fluorescence on the glass, tube
- e) Have penetrating power.

### Properties of Anode Rays (+ve)

- a) Deflect in electric and magnetic field.

### Properties of Nucleus (P +ve)

- a) The forces that bind the electrons to the nucleus are electrical or coulombic in nature.
- b) Density of nucleus is enormous and is of order of  $10^{14} \text{ g/cm}^3$
- c) Instability of the nucleus is due to high neutron/proton ratio.
- d) The radius of the nucleus is around  $5 \times 10^{-13} \text{ cm}$  (4 Fermi)

### Atomic Number (Z)

Atomic number of an element

= Total no. of protons present in the nucleus no. of protons/electrons.

= Total no. of electrons present outside the nucleus

$$\text{Or } Z = p = e.$$

### Mass Number (A)

➤ Mass number = number of protons + number of neutrons.

$$A = p + n$$

### Representation

Mass Number → A

Atomic Number → Z X

### Isotopes

Atoms having same atomic number but different atomic masses.

### Isobars

Particle	Charge	Mass		Symbol	Discovered by
		Kg	Amu.		

## CHEMISTRY

Atoms having same atomic mass but different atomic number.

### Isomers

Atoms of radioactive elements having same atomic number and same mass number but different radioactive properties.

### Isotones

Having same number of neutrons.  
 $^{14}_{\text{6}}\text{C}$ ,  $^{15}_{\text{7}}\text{N}$ ,  $^{16}_{\text{8}}\text{O}$ , etc. No. of neutrons = 8

### Isosters

Molecules of different substances which contain the same number of atoms and the same total number of electrons.

### Properties of Isotopes

- i) Same chemical properties
- ii) Different physical properties
- iii) Radio active properties can be different
- iv) Kept at the same place in the periodic table.

### Properties of Isobars

- i) Atomic masses are nearly equal
- ii) Different chemical and physical properties
- iii) Take different places in the periodic table
- iv) Different radioactive properties.

### Nuclear Stability

- Stability of nucleus depend upon neutron-proton ratio.
- The nuclei of the atoms having atomic number 84 or more than 84 are unstable.

### Binding Energy of the Nucleus

- The energy which lessens the effect of repulsive forces of protons in the nucleus is called the binding energy of the nucleus.

### DIFFERENCE BETWEEN ORBIT AND ORBITAL

Orbit	Orbital
An orbit is a well-defined circular path around the nucleus in which the electrons move.	An orbital is a three-dimensional space around the nucleus within which the probability of finding an electron is maximum (upto 90%)
All orbits are circular in shape	Different orbitals have different shapes i.e., s-orbitals are spherical, p-orbitals are dumbbell shaped etc.
Orbits do not have any directional	Orbitals except s-orbitals have directional

characteristics	characteristics
The maximum number of electrons present in any orbit is $2n^2$ . where n is the number of the orbit.	The maximum number of electrons present in any orbital is two
The concept of an orbit is not in accordance with the wave character of electrons and uncertainty principle.	The concept of an orbital is in accordance with the wave character of electrons and uncertainty principle.

### QUANTUM NUMBER

The set of four numbers which give complete information about the electron.

### Types of Quantum Numbers

- a) Principal Quantum Number (n)
  - Gives the major energy level
- b) Azimuthal Or Subsidiary Or Angular Momentum Quantum Number (l)
  - Gives the energy level of subshells.
  - $n = 4$  (N),  $l = 0, 1, 2, 3$  i.e., four subshells (s,p,d,f)
  - Order of energies : s < p < d < f
  - It was proposed by Sommerfeld.
- c) Magnetic Quantum Number (m)
  - Tells the number of orbitals present within the same subshell.  $(2l + 1)$  values.
  - It was given by Lande

### d) Spin Quantum Number (s)

- Arises due to the spinning of the electron about its own axis. It was introduced by Uhlenbeck and Goudsmit

### PAULI'S EXCLUSION PRINCIPLE

- 'No two electrons in an atom can have the same set of four quantum numbers.' 'An orbital can have a maximum two electrons and these must have opposite signs.'

### AUFBAU PRINCIPLE

- 'Orbital of lowest energy is filled first, before the filling of orbitals having a higher energy starts.'

### Exceptions of Aufbau Principle

The electronic configurations having half-filled or completely filled orbitals are more stable.

### HUND'S RULE OF MAXIMUM MULTIPLICITY

'Electron pairing in any orbital (s,p,d,f) cannot take place until each orbital of the same sublevel contains one electron.'

## CHEMISTRY

### HEISENBERG'S PRINCIPLE (1926)

'It is impossible to specify at any given moment both the position and momentum of an electron.' If  $\Delta x$  and  $\Delta p$  be the uncertainties w.r.t the position and the momentum, then uncertainty principle can be expressed as:

$$\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$$

### BOHR'S PRINCIPLE

- 'An electron can resolve only in those orbits whose angular momentum ( $mv\tau$ ) is an integral multiple of the factor  $h/2\pi$ '

### Bohr-Burry Scheme

- Max. no. of electrons in each shell is  $2n^2$ .
- Max. no. of electrons in outermost orbit can be 8 and its penultimate orbit can be 18.
- Outermost shell can contain not more than 2 electrons.

### PERIODIC TABLE (SEE PAGE NO.18)

#### Mandeleev's Periodic Law (1869)

The elements are arranged in order of their increasing atomic weights.

#### Modern Periodic Law by Mosseley

-  
Atomic numbers.

#### Main features of Modern Periodic Table

- a) It has 7 horizontal rows called periods and 16 vertical columns
- b) The first period is the shortest period consisting of 2 elements.
- c) The second and third periods contain 8 elements, fourth and fifth periods contains 18 elements, sixth period contains 32 elements and seventh period is incomplete with 27 known elements.
- d) The elements of second period are known as bridge elements.
- e) The elements of I, II, XIII, XIV, XV, XVI, XVII and XVIII groups are collectively known as normal or representative elements.
- f) XVIII group are known as inert gases or noble gases.
- g) III group to XIII group are known as transition elements.
- h) Z = 58 to Z = 71 which occur in periodic table after lanthanum are called lanthanides or lanthanoids. The series of elements with Z = 90 to Z = 103 which occur in the periodic table after actinium are called actinides or actinoids.

### s-Block Elements

- I and II groups are s-block elements

### Properties:

### UNCERTAINTY

- i) Soft metals
- ii) Low ionization
- iii) Metallic character
- iv) good conductors of heat and electricity.

### p-Block Elements

- The XIII to XVIII groups (excluding He) have p-block elements. The elements of XVII group are known as halogens (salt producers) and that of XVI group are known as chalcogens (ore-forming)

### Properties

- Metallic character

### d-Block Elements

- groups III to XII belong to this category.

### Properties

- hard, malleable and ductile metals.
- good conductors of heat and electricity
- coloured and paramagnetic
- Most of the transition elements form alloys.

### f-Block Elements

- Inner-transition elements.

### Properties

- Heavy metals with high m.p and b.p
- Compounds are generally coloured.
- Most of the elements of the actinide series are radioactive.

### IMPORTANT TERMS

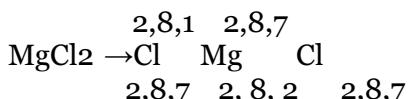
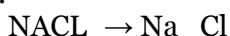
- a) **Metals**: Metals comprise 75% of all known elements and appear on the left hand side of the periodic table. Metals are solids at room temperature except mercury gallium and francium.
- b) **Non-metals**: These can be gases, liquids or even solids with low m.p and b.p.
- c) **Metalloids**: Show the properties of both metals and non-metals are known as metalloids or semi-metals.
- d) **Valency**: Equal to number of valence electrons. The electrons present in outer-most orbit are called valence electrons.'

Which give outermost electrons acquire positive charge and other which take electrons acquire negative charge.

- e) **Atomic radius**: The distance between the centre of nucleus and the outer most shell of electrons.
- f) **Van der Waal's radius**: Half of the distance between the nuclei of two adjacent atoms belonging to two neighbouring molecules of an element.
- g) **Ionisation energy (Ionization potential or Ionization enthalpy)**: The minimum amount of energy required to remove an electron from an atom.

**CHEMICAL BONDING – Three types****I. Electrovalent or Ionic Bond**

- Transferring of electrons between two atoms.
- Mainly formed between metals and non-metals.

**Properties of Ionic Compounds**

- Compound exist in solid form

**II. Covalent Bond**

- Equal sharing of electrons between two atoms. This type of bond is mainly formed between non-metals.

**III. Co-ordinate or Dative Bond**

- Unequal sharing of electrons between two atoms.
- Semipolar bond

**Properties of co-ordinate compounds**

- insoluble in  $\text{H}_2\text{O}$
- do not conduct electricity

**Note:** With respect to B.P., M.P., solubility, thermal stability

**OXIDATION AND REDUCTION**

1. Removal of hydrogen atom – oxidation  
addition of hydrogen atom – reduction
2. addition of oxygen atom – oxidation  
removal of oxygen atom – reduction
3. Increase in valency of an element is oxidation  
decrease in valency of an element is reduction.
4. Addition of an electronegative element is oxidation.  
Removal is reduction.
5. Removal or electropositive element is oxidation and addition is reduction.
6. Loss of electrons is oxidation and gain of electrons is reduction.
7. Increase in oxidation number is oxidation while decrease in oxidation number

**Rules for finding oxidation number**

1. Oxidation number of element in free state is zero i.e.  $\text{P}_4$
2. Oxidation number of hydrogen is +1
3. Oxidation number of oxygen atom is always equal to -2 except.

- a)  $\text{F}_2\text{O}$ (in this compound the oxidation number of oxygen is +2)
- b) The oxidation number of oxygen atom in all peroxides is equal to -1.

**Oxidising and Reducing Agents**

- Compounds having higher oxidation number will be more acidic and act as oxidizing agent.
- Lower oxidation number will be less acidic and act as reducing agent.
- Compounds with oxygen atom are called oxidizing agent and compounds with hydrogen atom are called reducing agent.

**DIFFERENT FORMS OF CARBON ALLOTROPY****Allotropy**

- A phenomenon in which an element is found in different forms having different physical properties but similar chemical properties.
- Phosphorus, sulphur, carbon etc. are elements which occur in different allotropic forms.

**Carbon**

- Classified into crystalline form (diamond, graphite) and amorphous

**Crystalline forms of Carbon**

1. **Diamond:** Diamond is the purest form of carbon. It is found very deep inside the earth, in South Africa, Congo, Angola.

**Properties**

- hardest
- insoluble
- non-conductor of heat and electricity
- occurs as octahedral crystals

**Uses**

- making jewellery
- cutting hand tools

2. **Graphite:** Also called as black lead. As compared to diamond, it is widely available in nature in countries like India, Sri Lanka, Canada, Russia etc. It can also be produced artificially by heating anthracite coal with little iron oxide or silica in electric furnace.

**Properties**

- soft
- good conductor of heat and electricity
- insoluble
- hexagonal crystals

**Uses**

- writing pencils and lead
- lubricant for high temperature

- electro-typing and manufacturing of gramophone

### **Amorphous forms of Carbon**

**3. Coal:** Its common variety is bituminous which is like hard stone and burns with smoky flame. The superior quality coal burns without smoke and is called anthracite. It is formed out of carbonization of organic and fossil matter buried deep into the earth, under high pressure and high temperature with very-very limited supply of air, during centuries. Anthracite, Bituminous, Lignite and Peat are the types of coal with decreasing C%

#### **Uses:**

- fuel
- coal gas.
- Coal-tar is a source for making dyes, explosives, chemicals etc.

**4. Coke:** It is a coal deprived of volatile constituents such as coal gas, ammonia, benzene, phenol, tar etc. It is manufactured from coal by destructive distillation.

#### **Uses:**

- making graphite and water gas.
- reducing agent in iron and steel industry.

### **5. Wood charcoal:**

#### **Uses:**

- a fuel
- constituent of gun-powder.
- purification of water
- deodorant and

**6. Bone black or Animal charcoal:** bones

**7. Lampblack:** when tar or vegetable oil

#### **Uses:**

- making Indian ink
- Making printer ink
- ladies for eyelids decoration.

**8. Carbon Black:** obtained by burning natural gas in the presence of limited supply of air

#### **Uses:**

- In the rubber for making automobile tyres.

### **9. Gas carbon and Petroleum coke:**

- Petroleum mainly contains – automatic hydrocarbon.

#### **Uses:**

- Indane gas – Butane + Propane

**10. Sugar charcoal:** The poorest form of carbon.

- it can be converted into a solid state, known as dry ice which is used as a mobile refrigerant.

### **11. Carbon-14**

- useful radioactive isotope for tracer studies in organic and bio chemical system, including the determination of the age of materials that were once alive.

### **Important Elements and Compounds**

#### **Hydrogen**

- lightest known substance (gas). found in water ( $H_2O$ ) and all living things.
- Can be produced in the laboratory by Bosch process and by electrolysis.

#### **Oxygen**

- It is colourless, tasteless, odourless, combustible slightly heavier than air, somewhat soluble in water. Atmospheric air contains oxygen by about 21% by weight.

#### **Nitrogen**

- non-combustible in active non poisonous gas forming about 80% of the atmospheric air by volume and 75% by weight.

#### **Ozone O<sub>3</sub>**

- It is an allotropic form of oxygen containing three atoms in the molecule and is formed when oxygen or air is subjected to silent electric charge. very active chemically and a powerful oxidizing agent.
- In the upper atmosphere some 25 to 30 km from the earth's surface, called ozonosphere layer. absorbs a large proportion of the sun's ultraviolet radiation.

#### **Carbon**

- It is universal constituent of living matter. Two forms: Allotropic form and amorphous form.
- Atoms are capable of uniting with each other

#### **Diamond**

- very costly stone and hardest. It is transparent to x-rays only.

#### **Graphite**

- It is soft, easily powdered and gives a greasy feeling. It is good conductor of heat and electricity. Also used as a moderator in nuclear reactors.

#### **Coal**

- carbonization

#### **Hydrocarbons**

- compounds of hydrogen and carbon viz. found abundantly in nature viz., petroleum, natural gas and coal etc. From these natural

## CHEMISTRY

hydrocarbons or parent organic compounds  
many other.

### Petroleum

- Hydrocarbon compound

### Noble gases

- gaseous elements and are also known as rare gases.
- Helium, neon, argon, krypton, xenon and radon.
- Radon of course, is not present in the atmosphere. It is produced in the radioactive decay of radium.

### Halogens:

- Halogens are the four elements fluorine, chlorine, bromine and iodine. Fluorine and chlorine are gases, bromine is volatile liquid and iodine is a volatile solid. Halogens are highly reactive.

### Chlorine

- Used in drinking water supply as germicide.
- Manufacturing bleaching powder, disinfectants, hydrochloric acid

### Sulphur

- Non metallic element.
- Vulcanising rubber, manufacturing of dyes and chemicals

### Phosphorus

- It is necessary for life. White phosphorus is very inflammable and poisonous solid. Its compounds are employed as fertilizers and detergents.

### Silicon

- non-metal, found abundantly in earth's crust and sand.

### Alkalies

- Bases soluble in water are called alkalies viz. Turn red litmus blue and yellow turmeric powder

### Uranium

- Its main ore is pitchblende. It is a radioactive metal, occurring in nature, comprising of 99.28% ( $^{238}_{92}\text{U}$ ) and 71% ( $^{238}_{92}\text{U}$ ) has the capacity of sustaining a nuclear chain reaction and is used in nuclear reactors and nuclear weapons.

### Thorium

- dark grey radio active metal used in alloys and as a source of nuclear energy. Its compounds occur in monazite and thorite.

### Plutonium

- It is a transuranic element (element having atomic number more than 92) which do not occur in nature but may be obtained by nuclear reaction. It is radio active.

### Iron

- It is extracted from its ores by the blast furnace process. Iron obtained from blast furnace is called pig iron or cast iron containing about 5% carbon. Pure iron is called wrought iron which does not contain carbon more than 0.2%, or any other impurities or constituents.

### Copper

- It is a metal element, malleable, ductile and best conductor of electricity after silver.

### Zinc

- It is a metal element, bluish white in colour. It occurs as calamine, zincite and zinc blende.

### Aluminium

- It is metal element, light white in colour, occurring widely in nature in clays, extracted mainly from ore: bauxite.

### Silver

- It is a metal element, soft, white malleable, best conductor of electricity.

### Gold

- It is a metal element, bright yellow, soft, malleable, non-corrodible by air and unaffected by most acids, but dissolves in aqua regia. It is alloyed with silver and copper. It is the best conductor of electricity.

### Potassium

- It is a metal used extensively in the form of various salts which are further used as fertilizers. It is a necessary for life and is found in all living matter.

### Calcium

- It occurs in nature in the form of calcium sulphate (gypsum) and calcium carbonate (lime stone, marble and chalk). Calcium is an essential constituent of bones and teeth.

### Magnesium

## CHEMISTRY

- It occurs as magnesite, dolomite, carnallite as well as in many compounds.

### Mercury

- It is a silver white, liquid form metal, widely used in thermometers. It is a very heavy metal.

### WATER

- Of the total global water, the oceans and inland saline water bodies hold 97.3% and the fresh water amounts to only 2.7%
- 65% our our body

#### Note:

- Water has maximum density (1g) at 4° C
- M.P. is 273.2 K and B.P. is 373.2 K

### HEAVY WATER

- deuterium oxide ( $D_2O$ )
- discovered by Urey
- use in nuclear reactors as a moderator because it slows the fast moving neutrons.

### Properties of water

- The freezing point, boiling point, heat of fusion and heat of vaporization of water are higher as compared to the hydrides of the other members of same group of oxygen.

### HARD AND SOFT WATER

- Water which produces lather with soap solution readily is called soft water e.g. Rain-water, demineralized water.
- Water which does not produce lather with soap solution readily is called hard water e.g. Sea-water, river water, well water, tap-water.

### Cause of hardness of water

- Due to presence of the bicarbonates, chlorides and sulphates of calcium and magnesium.

### TYPES OF HARDNESS OF WATER

#### A) Temporary hardness

- presence of bicarbonates of calcium and magnesium. It can be removed by boiling.

#### B) Permanent hardness

- Presence of bicarbonates of calcium and magnesium.

### SOFTENING OF WATER

- The process of removal of hardness from water is called softening of water
- Water is treated with calculated amount of washing soda ( $Na_2CO_3$ )

### Iron exchange method:

A) **Inorganic cation exchanges:** Permutit method. These complex salts are known as 'Zeolites'.

B) **Organic ion exchanges:** ion exchange.

**Note:** Mass of 1 mole of  $D_2O$  and  $T_2O$  are 20 gm and 22gm respectively.

### CEMENT

#### PORTLAND CEMENT

The approximate composition of Portland cement is:

1. Cal. oxide → 62%
2. Silica → 22%
3. Alumina → 7.5%
4. Magnesia → 2.5%
5. Ferric oxide → 2.5%

The above compounds are provided by the two raw materials:

1. lime stone  $CaCO_3$
2. Clay

### GLASS

- solid mixture of silica ( $SiO_2$ ), sodium silicate ( $Na_2SiO_3$ ) and calcium silicate ( $CaSiO_3$ )
- no definite crystal structure and melting point.
- $Na_2O.CaO.6SiO_2$  – a mixture not a compound.

#### Annealing of Glass

- process of slowly cooling of glass in annealing kiln.

### TYPES O GLASS

1. **Soft-glass** –  $Na_2O.CaO.6SiO_2$
2. **Hard –glass** –  $K_2O.CaO.6SiO_2$
3. **Flint-glass** –  $K_2O.PbO.6SiO_2$
4. **Crookes-glass** – Containing circum oxide which cut off ultra violet rays harmful to eyes and used in manufacturing of lens of spectacles.
5. **Pyrex-glass** – mixture of sodium aluminum borosilicates. It has high percentage of silica, about 80%. It does not melt at very high temperature.
6. **Quartz-glass** – It is obtained from pure silica.
7. **Ground glass** – It is prepared by grinding ordinary sand (soft) glass by emery and turpentine oil.
8. **Reinforced glass** – It has network of wires embedded in and does not shatter easily.
9. **Safety –glass** – It is also known as shatter proof glass. It is prepared by placing a layer of transparent plastic glass (usually a sheet of vinyl acetate resin) between two layers of glass by means of a suitable adhesive.

## CHEMISTRY

### DYES

- used for colouring textiles, foodstuffs, silk, wool, etc. are called dyes. But all coloured substances are not dyes.
- It should absorb light in the visible region.

**Nitro dyes:** These are polynitro derivatives of phenol.

### ORES OF METALS

Aluminium (Al)      a) Bauxite –  $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$   
                         b) Corundum –  $\text{Al}_2\text{O}_3$   
                         c) Kryolite –  $\text{Na}_3\text{AlF}_6$

Iron (Fe)      a) Haematite -  $\text{Fe}_2\text{O}_3$   
                         b) Magnetite -  $\text{Fe}_3\text{O}_4$   
                         c) Iron Pyrite -  $\text{FeS}_2$   
                         d) Siderite -  $\text{FeCO}_3$

Zinc (Zn)      a) Zinc Blende -  $\text{ZnS}$   
                         b) Calamine -  $\text{ZnCO}_3$

Lead (Pb)      a) Galena       $\text{PbS}$

Manganese (Mn)      a) Pyrolesite

Rock salt      NaCl  
  Mohr's salt       $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$   
  Basic Salt       $\text{NaHC}_3 / \text{PbCoH NO}_3$   
  Complex salt       $\text{K}_4\text{Fe}(\text{CN})_6$  [coordination salt]  
  Epsom salt       $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$

Mercury(Hg)      a) Cinnabar       $\text{HgS}$

Magnesium(Mg)      a) Dolomite       $\text{MgCO}_3 \cdot \text{CaCO}_3$

### COMMON AND CHEMICALS NAMES OF SOME COMPOUNDS

Common Name	Chemical Name	Chemical Formula
Dry Ice	Solid Carbon di oxoide	$\text{CO}_2$
Bleaching Powder	Calcium Oxychloride	$\text{CaOCl}_2$
Caustic Soda	Sodium Hydroxide	$\text{NaOH}$
Rock Salt	Sodium Chloride	$\text{NaCl}$
Caustic Potash	Potassium Hydroxide	$\text{KOH}$
Epsom salt	Magnesium Sulphate	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
Quick Lime	Calcium Oxide	$\text{CaO}$
Mohr's salt	Ammonium Ferrous Sulphate	$\text{FeSO}_4 (\text{NH}_4)_2 \text{SO}_4 \cdot 6\text{H}_2\text{O}$
Blue Vitriol	Copper Sulphate	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
White Vitriol	Zinc Sulphate	$\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$
Vinegar	Acetic Acid	$\text{CH}_3\text{COOH}$

Baking Powder	Sodium Bicarbonate	$\text{NaH CO}_3$
Washing Soda	Sodium carbonate	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
Chalk (Marble)	Calcium Carbonate	$\text{CaCO}_3$
Lunar Caustic	Silver Nitrate	$\text{AgNO}_3$
Laughing Gas	Nitrous Oxide	$\text{N}_2\text{O}$
Chloroform	Trichloro Methane	$\text{CHCl}_3$
Tartaremic	Potassium antimonyl tartrate	
Phenol	Carbolic Acid	
Alcohol	Ethyl Alcohol	$\text{C}_2\text{H}_5\text{OH}$

### EXTRA DOSE

#### IMPORTANT CHEMICAL PROCESSES

**1. Bessemer process:** converting pig iron to steel by blowing.

**2. Clemmensen reduction :**to convert aldehydes and ketones to the corresponding hydrocarbons.

**3. Gatterman reaction:** convert an aromatic amine into the corresponding halogen.

**4. Haber process:** Producing ammonia

**5. Kolbe reaction:** preparation of saturated or unsaturated hydrocarbons by the electrolysis.

**6. Solvay process:**process of shaking sodium carbonate from calcium carbonate and sodium chloride.

**7. Bayer process:**Used to extract aluminium oxide  $\text{Al}_2\text{O}_3$  or aluminium by treating powdered bauxite with hot caustic soda solution.

**8. Bergius process:**making lubricants and synthetic fuel.

**9. Bosch process:**used to make industrial hydrogen by passing steam over white-hot coke to produce water gas.

**10. Down process:** making sodium metal by electrolysis of molten sodium chloride.

**11. Frasch process:** It is used to extract sulphur from subterranean deposits in which superheated water.

**12. Hall-Heroult process (Hall-Heroult):**Prepare aluminium by electrolysis.

**13. Parkes process:**extraction of silver traces from lead ore galena Molten zinc.

#### IMPORTANT GENERAL CHEMICAL TEST

**1. Brown-ring test**for chemical analysis of nitrates.

**2. Flame test**to identify certain elements in which a clean platinum. Using a busen flame.detected by the change in the colour of flame.

**3. Beilstein's test**is used for the detection of halogen in an organic compound.

**4. Fehling's test**used to detect sugars and aldehydes in a solution.

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5. **Kjedahl method** is used to measure nitrogen in an organic compound.
6. **Molish's test** is used to detect carbohydrates in a solution.
7. **Rast's method**: Used to determine molecular weight.
8. **Schiff's test**: Used to distinguish between aldehydes and ketones.

### REACTIONS AND THEIR RESULTS

Reactions – Phosphorous kept in water

Result – with air it catches fire and in water it is insoluble.

Reactions – milk curdle

Result – Lactose (milk sugar) content of milk undergoes fermentation and changes into lactic acid which on reacting with lactose forms curd.

### SOME CHEMICAL CHANGES

**Hydrolysis** : double decomposition reaction in which water reacts with a second substance.

**Neutralisation reactions**: The interaction of an acid with an equivalent quantity of a base.

### Electrolysis

- The process of decomposition of an electrolyte (a compound formed by electrovalent bonds) by the passage of an electric current through its molten state or its aqueous solution.

### Application of Electrolysis

i) **Electroplating**: is a process of depositing one metal over another metal for preservation of decoration.

ii) **Electrorefining**: Metals can be refined (purified)

iii) **Electroprinting** : Is made on wax of plaster of Paris.

iv) **Electrometallurgy**: process of extraction of metal from its ore.

v) **Industrial Preparations**: A large number of chemicals used in industry and medicine are prepared electrolytically.

### RADIOACTIVITY

- Naturally occurring heavy elements like radium, actinium, uranium, thorium etc, with the emission of alpha, beta and gamma rays.

### Discovery of Radioactivity

- Discovered in 1896 by French physicist Henry de Becquerel.

### Radioactive Emissions

#### i) Sub-atomic Particles (Radiation)

- a) Alpha ( $\alpha$ ) particles : very little penetrating power.
- b) Beta ( $\beta$ ) particles: penetrating power is greater than that of alpha-ray.
- ii) Penetrating Particles (Radiation)

Also called Gamma( $\gamma$ ) emission. These are electromagnetic radiations of low wavelength, high frequency and high energy.

### NUCLEAR REACTION AND ATOMIC ENERGY

#### Nuclear Reaction

- first nuclear reaction – Rutherford
- nuclear fission – Otto Hahn and F. Strassmann
- Nuclear model of atom – Rutherford
- Empirical atomic model – J.J. Thomson
- Elliptical orbits of electrons in an atom – Sommerfeld.
- Hydrogen atom model – Bohr.

#### Radioactivity

- It was discovered by Henry Becquerel but term radioactivity was given to Madam Curie. It is the process of spontaneous process of disintegration of nucleus and is measured by Geiger counter.
- It is a nuclear phenomenon, thus remains unaffected by external factors like temperature, pressure etc.
- It involves emission of  $\alpha$ ,  $\beta$  and  $\gamma$  rays/particles and has units Curie, Becquerel, Rutherford.

#### Alpha ( $\alpha$ )-particles

- These are positively charged helium nuclei ( ${}_{2}He^{4+}$ ). They have +2 unit charge and 4u mass.
- They have low penetrating power but very high ionizing power and kinetic energy.
- An  $\alpha$ -emission reduces the atomic mass by 4 and atomic number by 2, thus, the new nuclei formed occupy a position two places left to the parent nuclei in the Periodic Table. (Soddy Fajans group displacement law)

#### Beta ( $\beta$ )-particle

- These are negatively charged electrons (-1e<sup>-</sup>) and have -1 unit charge and 0 mass.
- These are more dangerous than  $\alpha$ -rays.
- These have high penetrating power as compared to  $\alpha$ -rays.
- A  $\beta$ -emission increases the atomic number by one with no change in atomic mass, occupying a position one place right to the parent nuclei in the Periodic Table (Soddy Fajans group displacement law).

#### Gamma ( $\gamma$ )-rays

- These are electromagnetic radiation and have very high penetrating power.
- These have low, ionizing power and kinetic energy.
- Their emission does not affect the position of nuclei in the Periodic Table.

### Nuclear Fission

- It is a process in which a heavy nucleus is broken down into two or more medium heavy fragments.
- It is usually accompanied with the emission of neutrons and large amount of energy. It is used in nuclear reactor and atom bomb.

### Nuclear reactor

- It is a device that is used to produce electricity and permits a controlled chain nuclear fission.
- It contains fules e.g.,  $_{92}^{235}\text{U}$ , moderator (e.g. graphite and heavy water,  $\text{D}_2\text{O}$ ) to slow down neutrons and control rods (made up of boron steel or cadmium) to absorb neutrons.
- It may also contain liquid sodium as coolant.

### Half-life Period

- It is the time in which a radioactive substance remains half of its original amount.

### Atom Bomb

- It is based on uncontrolled nuclear fission. It contains  $^{235}\text{U}$  or  $^{239}\text{Pu}$  as fuel.

### Nuclear Fusion

- It is a process which involves fusion of two or more lighter nuclei to give a heavier nuclei.
- It occurs only at extremely high temperature ( $> 10^6$  K), so also called thermonuclear reactions.
- It is used in hydrogen bomb. Energy of Sun is also a result of a series of nuclear fusion reactions.

### Hydrogen Bomb

- It contains a mixture of deuterium oxide ( $\text{D}_2\text{O}$ ) and tritium oxide ( $\text{T}_2\text{O}$ ) in a space surrounding an ordinary atom bomb.

### Uses of Radioisotopes

- Iodine-131 is employed to study the structure and activity of thyroid gland. It is also used in internal radiation therapy for the treatment of thyroid disease.
- Iodine-123 is used in brain imaging.
- Cobalt-60 is used in external radiation therapy for the treatment of cancer.

- Sodium-24 is injected along with salt solution to trace the flow of blood.
- Phosphorus-32 is used for leukemia therapy.
- Carbon-14 is used to study the kinetics of photosynthesis.

### Radiocarbon Dating

- It is used in determining the age of carbon bearing materials such as wood, animal fossils etc.
- It is based on the concentration of  $\text{C}^{12}$  and  $\text{C}^{14}$  isotopes.

### Uranium Dating

- It is used to determine the age of earth, minerals and rocks.

### Types of Chemical Reactions

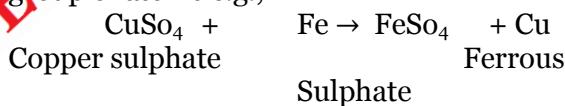
- Chemical reactions are of following types.

#### 1. Addition reactions

- In such reactions, two or more substances combine to give a single substance, e.g.,
- $$\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$$
- Calcium Oxide                      water                      calcium hydroxide

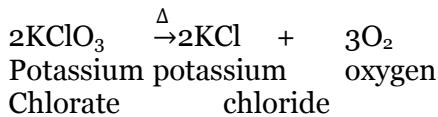
#### 2. Substitution reactions

In such reactions, an atom or a group of atoms of a molecule is replaced by another atom or group of atoms e.g.,



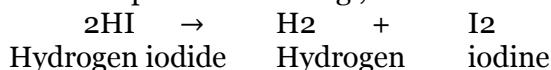
#### 3. Decomposition reactions

- These are those irreversible reactions in which, a molecule decompose into two or more simpler molecules e.g.,



#### 4. Dissociation reactions

- These are those reversible reactions in which a molecule dissociates into two or more simple molecules e.g.,



**Reversible reactions** are those which occurs in forward as well as in Backward direction but never go to completion.

**Irreversible reactions** occur only in forward direction and go to completion.

#### 5. Double decomposition reactions

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- These involve exchange of ions between two compounds.e.g. ,  
 $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$
- Reactions occurring between the ions or ionic compounds are very fast.

### 6. Exothermic reactions

- These are those reactions in which energy is released, e.g. burning of natural gas, respiration, decomposition of vegetable matter into compost, combustion reactions etc.

### 7. Endothermic reactions

- These are those in which energy is consumed, e.g., digestion.

### Catalysis

- It was discovered by Berzelius.
  - It is a term, used for the reactions/ processes which occur in the presence of certain substances that increase the rate of the reaction without being consumed. Such substances are called catalysts.
  - Catalysis is called homogeneous when reactants and catalyst are in same phase e.g., for the manufacture of sulphuric acid.
- $$\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \xrightarrow{\text{NO(g)}} \text{SO}_3(\text{g})$$
- Catalysis is called heterogeneous when reactants and catalyst are in different phase e.g., Haber process for the synthesis of ammonia.
- $$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \xrightarrow{\text{Fe(s)}} 2\text{NH}_3(\text{g})$$
- Catalysis is called autocatalysis, when one of the product increases the rate of the reaction i.e., acts as catalyst e.g.,
- $$\text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH}$$

### Acid, Bases and Salts

- These are the substance, which have sour taste and turn blue litmus red.
  - These are the substance which gives  $\text{H}^+$  ions in their aqueous solution (Arrhenius concept) e.g.,  $\text{HCl}$  or which gives proton (Bronsted Lowry concepts) e.g.,  $\text{CH}_3\text{COOH}$  or which accepts electrons (Lewis concepts) e.g.  $\text{BF}_3$ ,  $\text{AlCl}_3$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{PF}_3$ ,  $\text{SF}_4$ ,  $\text{PF}_5$  etc.
  - Acids give hydrogen with more reactive metals, e.g.,
- $$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$$
- Metal acid      salthydrogen
- Acids give carbon dioxide gas ( $\text{CO}_2$ ) with carbonates e.g.,
- $$\text{CaCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4$$
- Marble or calcium sulphuric  
Carbonate      acid      +  $\text{H}_2\text{O} + \text{CO}_2 \uparrow$

- These in aqueous solution are conductor of electricity.

### Sources of Some Important Acids

Acid	Source
Citric acid	Lemon, orange, grapes
Maleic acid	Unripe apple
Tartaric acid	Tamarind
Acetic acid	Vinegar
Lactic acid	Milk
Hydrochloric acid	Stomach
Oxalic acid	Tomato

- Acid –  $\text{H}^+ \rightarrow$ conjugate base
- Base +  $\text{H}^+ \rightarrow$ conjugate acid
- Generally most of the acids contain hydrogen.
- Pickles are always kept in glass jar because acid present in them reacts with the metal of metallic point.
- Basicity represents the number of replaceable H-atoms.e.g., it is 1 for  $\text{HCl}$ , 2 for  $\text{H}_2\text{SO}_4$ .

### Uses of Some Acids

1. **Hydrochloric acid (HCl)** It is present in gastric juices and is responsible for the digestion. It is used as bathroom cleaner, as pickling agent, tanning of leather, in dying and in the manufacture of gelatin from bones.

2. **Nitric Acid ( $\text{HNO}_3$ )** It is used for the manufacture of fertilizers like  $\text{NH}_4\text{NO}_3$ ; explosive like TNT, picric acid, dynamite etc. rayon, dyes and drugs.

3. **Sulphuric acid ( $\text{H}_2\text{SO}_4$ )** It is also known as oil of vitriol and is used in manufacture of fertilizers, drugs, detergents and explosives.

4. Acetic acid ( $\text{CH}_3\text{COOH}$ ) is used in vinegar, medicines and as a solvent.

### Bases

- These are the substances, which have bitter taste and turn red litmus blue.
- Bases give  $\text{OH}^-$  ion in their aqueous solution (Arrhenius concept) e.g.,  $\text{NaOH}$ ,  $\text{KOH}$ ,  $\text{CsOH}$ ;  $\text{Mg}(\text{OH})_2$  etc., or accept proton (Bronsted-Lowry concept) e.g.,  $\text{NH}_3$ ,  $\text{H}_2\text{O}$  etc., or donate electrons (Lewis concept) e.g., simple anions like  $\text{Cl}^-$ ,  $\text{F}^-$ ,  $\text{OH}^-$ , molecules with unshared (lone) pairs of electrons like  $\text{NH}_3$ ,  $\text{ROH}$ ,  $\text{R}_2\text{O}$ , pyridine etc.

### Indicators

- These are the substances which give different colours in acid and base solutions.

- Some indicators and their colours in acid and base medium are
- Water soluble bases are called alkali e.g., NaOH, KOH.
- Basicity is the number of replaceable OH<sup>-</sup> ions. E.g., It is 1 for NaOH, 2 for Ca(OH)<sub>2</sub>

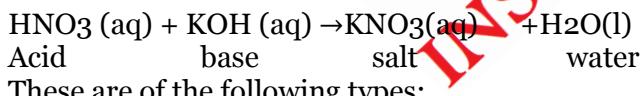
**pH Value**

- It is a measure of acidity or basicity of a solution.
- It is defined as the negative logarithm of the concentration in (mol/L) of hydrogen ions which it contains, i.e.,
$$\text{pH} = -\log [\text{H}^+] = \log \frac{1}{[\text{H}^+]}$$
or  $[\text{H}^+] = 1 \times 10^{-\text{pH}}$
- It is 7 for neutral solution, greater than 7 for basic solution and less than 7 for acidic solution.
- pH of some common substances are

<b>Substance</b>	<b>pH</b>	<b>Substance</b>	<b>pH</b>
Gastric juice	1.0 – 3.0	Rain water	6.0
Soft drinks	2.0 – 4.0	Tears	7.4
Lemon	2.2 – 2.4	Sea water	8.5
Vinegar	2.4 – 3.4	Milk of magnesia	10.5
Urine (human)	4.8 – 8.4	Milk (cow)	6.3-6.6
Saliva(human)	6.5 – 7.5	Blood plasma (human)	7.39 7.42

**Salts**

These are the product of neutralization reaction between an acid and a base e.g.,



These are of the following types:

**1. Mixed Salt**

- These are obtained by neutralization of an acid by two base or a base by two acids. E.g., bleaching powder (CaOCl<sub>2</sub>)

**2. Double Salt**

- It is obtained by mixing two or more salt, e.g., Alum ( $\text{K}_2\text{SO}_4 \text{Al}_2(\text{SO}_4)_3 \text{ 24H}_2\text{O}$ ), Mohr salt ( $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4\text{6H}_2\text{O}$ )

**Washing Soda**

It is chemically sodium carbonate decahydrate ( $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ), and is used in glass, soap and paper industries and for removing permanent hardness of water.

**Baking Soda**

- It is sodium hydrogen carbonate ( $\text{NaHCO}_3$ ). It is a mild non-corrosive base.
- When mixed with a mild edible acid such as tartaric acid it is called baking powder and is used to make bread or cake soft and spongy.
- It is used as mild antiseptic for skin infections, in soda-acids and as fire extinguishers.

**Bleaching Powder**

- It is chemically  $\text{Ca}(\text{OCl})_2$  Cl or  $\text{CaOCl}_2$ .
- It is used for bleaching cotton and linen in the textile industry, for bleaching wood pulp in paper factories.
- It is used for disinfecting drinking water.

**Plaster of Paris**

- It is chemically calcium sulphate hemihydrates ( $\text{CaSO}_4 \frac{1}{2}\text{H}_2\text{O}$ ) and obtained by heating gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ). It contains half molecule of water of crystallization.

**Periodic properties**

- Periodic properties are those which show a regular trend along a period and a group.

**1. Atomic size**

- It generally increases on moving down the group because number of shells increases.
- It decreases along a period from left to right. Thus, size of alkali metal is largest and that of halogens is smallest in a period.

**2. Valency**

- It is the combining capacity of an element.
- It increases from 1 to 7 along a period with respect to hydrogen whereas with respect of oxygen, it first increases from 1 to 4 and then decreases to 0.
- It remains the same in a group.

**3. Metallic character**

- It is the tendency of an element to form cation by the loss of electrons.
- It decreases along a period from left to right and increases in a group on moving downwards.

**4. Ionisation energy**

- It is the energy required to remove an electron from the outermost shell of an isolated gases atom.
- It generally increases along a period from left to right but ionization energy of Be, Mg, Ca, Sr is larger than the ionization energy of

## CHEMISTRY

- N, P, is larger than ionization energy of O, S, Se respectively.
- It generally decreases along a group on moving downwards.

### 5. Electron affinity (EA)

- It is defined as the energy liberated when an extra electron is added to an atom.
- It increases across a period from left to right, but EA of II(2), 15 group and o group is o or positive.
- It decrease on moving down a group. It is highest for chlorine.

### 6. Electronegativity

- It is the tendency of an atom in a molecule to attract the shared electrons towards itself. It increases regularly along a period from left to right and decreases on moving down a group.
- It is highest for fluorine.

## Metals, Non-Metals and Metallurgy

### Metals

- These are the elements which are hard, lustrous, ductile, malleable, sonorous and conductor of heat and electricity in their solid as well as molten state.
- These form oxide with air. These oxides are generally basic, but oxides of zinc and aluminium are amphoteric, i.e., have acidic as well as basic properties.
- These evolve hydrogen gas when reacts with water and acids.
- Metals which are highly reactive displace the less reactive metals from their salts. The order of reactivity is, potassium (K) > sodium (Na) > calcium (Ca) > magnesium (Mg) > aluminium (Al) > zinc (Zn) > iron (Fe) > lead (Pb) > hydrogen (H) > copper (Cu) > mercury (Hg) > silver (Ag) > gold (Au) (Thus, gold is less reactive metal)

### Non-metals

- These may be solid, liquid or gas (bromine is the only liquid non-metal)
- These are soft, non-lustrous, brittle, non-sonorous and non-conductor of heat and electricity.
- These have low melting and boiling points.
- These form oxides with oxygen which are generally acidic.
- Their examples include noble gases (i.e., helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe) and some other p-block elements.

### 1. Helium

- It is a noble gas (discovered by Lockyear and Janssen)
- It is used for filling balloons and other lighter aircraft.
- He, when mixed with O<sub>2</sub>, is used by deep-sea divers for breathing and for respiratory patients.
- It is used as a heat transfer agent in gas cooled nuclear reactors.

### 2. Neon

- It was discovered by Ramsay and Travers. It is used in neon signs.

### 3. Argon

- It was discovered by Rayleigh and Ramsay.
- It is used to generate inert atmosphere for welding and to fill incandescent light bulbs.

### 4. Xenon

- It is called stranger gas.
- Xe, when mixed with Kr, used in high intensity, short exposure photographic flash tubes.

### Metalloids

These have properties of metals as well as non-metals. They are present only in p-block e.g., arsenic, antimony, germanium etc.

### Metallurgy

- It is the process of extraction of metal from its ores.

It involves the following sequence of steps:

### 1. Minerals

- These are the substances in the form of which metal is found in nature.
- The main constituent of pearl is calcium carbonate (CaCO<sub>3</sub>)
- Ruby and sapphire are chemically aluminium oxide Al<sub>2</sub>O<sub>3</sub>.
- In haemoglobin and myoglobin, iron is present as Fe<sup>2+</sup>

### 2. Ores

- These are the minerals from which metal can be obtained conveniently and beneficially.
- All ores are minerals but all minerals are not ores.

### 3. Gangue or Matrix

- These are the impurities associated with the ore.

### 4. Calcination

- It is the process of heating the concentrated ore in absence or in limited supply of air,

## CHEMISTRY

- below its melting point. It is done for hydroxide or carbonate ore.
- It is done in reverberatory furnace.

### 5. Roasting

- It is the process of heating the concentrated ore in excess of air.
- It is used for sulphideores.
- It is done in reverberatory furnace.

### 6. Flux

- These are the substances which converts infusible impurities into fusible substances, called slag. These are of two types: Acidic flux such as  $\text{SiO}_2$ (used to remove basic impurities) and basic flux such as  $\text{CaO}$ ,  $\text{MgO}$  (used to remove acidic impurities)
- In electrolytic refining, anode is made up of impure metal and cathode is made by, thin strip of pure metal.

### 7. Smelting

- It is the process of heating the oxides of elements with cock and flux above their melting point.

### Corrosion

- It is the process of oxidative deterioration of a metal surface by the action of environment to form unwanted corrosion products.
- e.g., conversion of iron into rust  $[\text{Fe}_2\text{O}_3 \cdot x \text{H}_2\text{O}$ , tarnishing of silver](due to the formation of  $\text{Ag}_2\text{S}$ ), development of green coating [of  $\text{Cu}(\text{OH})_2\text{CuCO}_3$  basic copper carbonate)] on copper and bronze. It is basically an electrochemical process.
- Corrosion of iron is called rusting. It is accelerated by the present of impurities,  $\text{H}^+$ , electrolytes such as  $\text{NaCl}$ , gases such as  $\text{CO}_2$ ,  $\text{SO}_2$ ,  $\text{NO}$ ,  $\text{NO}_2$  etc.

**Formation of a layer** of aluminium oxide over aluminiumsurface protects the metal from further corrosion.

**A sliced apple** turns brown if kept open for some time due to the oxidation of iron present in the apple.

It is prevented by the following methods,

- By electroplating
- By surface coating (i.e., coating of surface with oil, grease, paint and varnish).
- By alloying
- By galvanization of iron (process of deposition of a thin layer of zinc over iron surface)

### Alloys

- These are mixture of two metals or a metal and a non-metal. They have properties different from the main metal.
- Alloys of mercury are called amalgam.

### Aqua-regia

- It is a mixture of concentrated hydrochloric acid  $\text{HCl}$  and concentrated nitric acid ( $\text{HNO}_3$ ) in the ratio of 3 : 1. It is used to dissolve noble metals like gold and platinum.

### Uses of some important metals and non-metals

1. **Ferrous oxide ( $\text{FeO}$ )**is used to prepare ferrous salts and green glass.
2. **Ferric oxide ( $\text{Fe}_2\text{O}_3$ )** is used in jeweler rough.
3. **Silver nitrate ( $\text{AgNO}_3$ )** is called lunar caustic and is used to prepare the ink used during noting.
4. **Silver iodide ( $\text{AgI}$ )**is used for artificial rain.
5. **Mercuric chloride ( $\text{HgCl}_2$ )** is used to prepare calomel and as a poison.
6. **Hydrogen peroxide ( $\text{H}_2\text{O}_2$ )**is used as a oxidizing agent, bleaching agent, as a insecticide, and for washing old oil paintings.

### Coal and Petroleum

#### Natural resources

- These are given by nature like air, water, mineral, sunlight etc.
- There are of two types:

##### 1. Renewable natural resources

- These are available in excess amount i.e., never end. E.g., air, sunlight etc.

##### 2. Non-renewable natural resources

- These are available in limited quantity e.g., minerals, coal, petroleum, natural gas, etc.

### Coal

- It is believed to have been formed by the slow carbonization of vegetable matter buried underneath the earth centuries ago, in limited supply of air under high temperature and pressure prevailing there.
- It is available in different varities: Peat (60% C), lignite or brown coal (70% C), bituminous coal (80% C), anthracite coal (90% C).
- Bituminous is the most common variety of coal
- Coal is used for the synthesis of water gas and producer gas.

### Charcoal

- It can be wood charcoal, animal charcoal, and activated charcoal depending upon the source from which it is obtained. Wood

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charcoal absorbs colouring matter and odorous gases, thus used in decolorising sugar solutions and in gas masks.

- These are the substance which produce heat and light on combustion.
- Some important gaseous fuels and their compositions are as follows.

### Lamp black or carbon black

- It is the most pure amorphous form of carbon (contain about 98-99% carbon)
- It is used for making printer ink, black paint, varnishes and carbon papers.

### Petroleum

- It is a dark coloured oily liquid with offensive odour. It is also called rock oil, mineral oil, crude oil or black gold.
- When subjected to fractional distillation, it gives different products at different temperatures.

### Liquified Petroleum gas (LPG)

- It is a mixture of n-butane, iso-butane and some propane.
- It is easily compressed under pressure as liquid and stored in iron cylinders.

### Compressed natural gas (CNG)

- It consists mainly of methane (95%) which is a relatively unreactive hydrocarbon and makes its nearly complete combustion possible.
- It has octane rating 130

### Octane number

- Octane number is the percentage of iso-octane in the mixture of iso-octane and n-heptane which has same knocking properties as the fuel sample.
- It is a measure of quality of petrol (gasoline). It is zero for heptanes and 100 for iso-octane. (i.e., 2, 2, 4-trimethyl pentane).
- **Higher the octane number, better is the fuel.**

### Antiknock compounds

- These are used to reduce the knocking property. E.g., tetraethyl lead (TEL).

### Cetane number

- Cetane number is the percentage of cetane in the mixture of cetane and
- A-methyl naphthalene which has same knocking properties as the fuel sample.
- It is a measure of quality of diesel. It is 100 for Cetane and 0 for α-methyl naphthalene.

### Fuels and Flame

#### Fuels

Fuel	Composition	Sources
Water gas	Carbon monoxide (CO) + hydrogen (H <sub>2</sub> )	By passing steam over red hot coke
Producer gas	Carbon monoxide (CO) + nitrogen (N <sub>2</sub> )	By passing insufficient air over red hot coke
Oil gas	Methane (CH <sub>4</sub> ) + ethylene (C <sub>2</sub> H <sub>4</sub> ) + acetylene (C <sub>2</sub> H <sub>2</sub> )	By destructive distillation of kerosene
Coal gas	Hydrogen (H <sub>2</sub> ) + methane (CH <sub>4</sub> ) + ethylene + acetylene + CO	By fractional distillation of wood
Natural gas	Methane(83%) + ethane	From petroleum
LPG	Butane (C <sub>4</sub> H <sub>10</sub> ) + propane (C <sub>3</sub> H <sub>8</sub> )	From oil wells
Biogas or Gobar gas	Methane (CH <sub>4</sub> ) + carbon dioxide (CO <sub>2</sub> ) + hydrogen (H <sub>2</sub> ) + nitrogen (N <sub>2</sub> )	From organic wastes

### Calorific Value

- It is defined as the heat obtained when 1 g of a fuel is burned in excess of oxygen and is expressed in kcal/g.
- Calorific value of some important fuels are

Fuel	Calorific value (kJ/g)
Coal	25-32
Kerosene oil	48
Petrol	50
Diesel	45
Bio-gas	35-40
LPG	50
Wood	17
Cow dung	6-8
Ethanol	30
Methane	55
Hydrogen	150
Natural gas	35-150

- **Hydrogen** is the fuel of future.
- Alcohol, when mixed with petrol, is called power alcohol. It is an alternative source of energy.
- For the combustion of a substance, its ignition temperature should be low.

### Flame

- It is the hot part of fire and has three parts:

### 1. Innermost region of flame

- It is black because of the presence of unburned carbon particles.
- It has the lowest temperatures.

### 2. Middle region

- It is yellow luminous due to partial combustion of fuel.

### 3. Outermost region

- It is blue (non-luminous) due to complete combustion of fuel.
- It is the hottest part of flame and is used by the Goldsmith to heat the gold.
- **Water** is a common fire extinguisher.
- In case of electric fires and oil fires water cannot be used as an extinguisher as it is a conductor of electricity and oil being lighter comes above the water. Such fires are extinguished by carbon di oxide.

### Safety match

- Safety match stick contains a mixture of antimony trisulphide and potassium chlorate at its one end. Its box side contains a mixture of powdered glass and red phosphorus.

## Electrochemistry

### Electrolysis

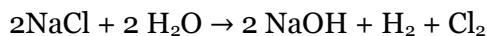
It is used

- i. In production of oxygen for space craft and nuclear submarines.
- ii. In layering metals to fortify them
- iii. In production of hydrogen for fuel
- iv. In electrolytic etching of metal surfaces like tools or knives with a permanent mark or logo.

**Electrometallurgy** is the process of reduction of metallic compound into pure metal by electrolysis.

**Anodisation** is an electrolytic process that makes the surface of metals resistant to corrosion.

- Electrolysis of brine (the water, saturated or nearly saturated with salt, usually sodium chloride) gives hydrogen and chlorine. The products are gaseous



## Faraday's Laws of Electrolysis

### First law of electrolysis

- It states that the quantity of elements separated by passing an electric current through a molten or dissolved salt is

proportional to the quantity of electric charge passed through the circuit.

$$w \propto Q$$

$$w = ZQ = Zit \quad (\text{charge} = \text{current} \times \text{time})$$

### Second law of electrolysis

- It states that the mass of the resulting separated elements is directly proportional to the atomic masses of the elements when an appropriate integral divisor is applied.

$$w \propto E \quad \text{or} \quad \frac{W_1}{W_2} = \frac{E_1}{E_2}$$

## Electrochemical Cell

- It is a device that produces an electric current from energy released by a spontaneous redox reaction (in short which converts chemical energy into electrical energy). This kind of cell includes the galvanic cell or voltaic cell.
- It has two conductive electrodes, i.e., anode (at which oxidation occurs) and cathode (at which reduction occurs)
- It contains electrolyte in between the electrodes, which contains ions that can move freely.

### Battery

- It is an arrangement of one or more cells connected in series.
- It is basically a galvanic cell.
- These are of two types.
  - i. Primary batteries (non-rechargeable) e.g., dry cell, mercury cell etc.
  - ii. Secondary batteries (rechargeable) e.g., lead storage battery, nickel cadmium battery.

### Lechlanche Cell or Dry Cell

- It consists of a zinc container that acts as anode and carbon (graphite) rod surrounded by powdered manganese di oxide and carbon which acts as cathode.
- It contains a paste of  $\text{NH}_4\text{Cl}$  and  $\text{ZnCl}_2$  in between the electrodes.
- It is used in transistors and clocks.
- It has a potential of really 1.5 V.

### Mercury Cell

- It is suitable for the low current devices like hearing aids and camera etc.
- It consists of zinc-mercury amalgam as anode and a paste of  $\text{HgO}$  and carbon as cathode. The electrolyte is a paste of  $\text{KOH}$  and  $\text{ZnO}$ .
- It has potential 1.35 V. This potential remains constant during its whole life.

**Lead Storage Battery**

- It is a secondary battery.
- It acts as electrochemical cell during discharging (i.e., during use) and as electrolytic cell during charging.
- It is used in automobiles and invertors.
- It consists of lead anode and a grid of lead packed with lead di oxide ( $PbO_2$ ) as cathode. A 38% solution of sulphuric acid is used as an electrolyte.
- It consists of a series of six identical cells assembled in series. Each cell may produce a potential of 2 V, hence overall voltage produced is 12 V.
- $PbSO_4$  is formed when lead storage battery is in use and lead di oxide are formed when it is charged.

**Fuel cells**

- These are galvanic cells which use energy of combustion of fuels like hydrogen ( $H_2$ ), methane ( $CH_4$ ), methanol ( $CH_3OH$ ) etc., as the source to produce electrical energy. E.g., hydrogen-oxygen fuel cell.

**Air, Water and their Pollution****Air**

- It is a homogeneous mixture of different gases.
- It has the following composition: 78% nitrogen ; 21% oxygen, 0.03-0.05% carbon dioxide ( $CO_2$ ), argon etc.
- It has different density at different heights from sea level. Thus, several layers are formed. These layers are

**1. Troposphere**

- It is the lowest layer of atmosphere, extend up to a height of 10 km from sea level.
- It is a turbulent and dusty zone which contains air ( $N_2$ ,  $O_2$ ,  $CO_2$ ) much water vapours and clouds.

**2. Stratosphere**

It is the layer which contains ozone layer (which protects us from harmful UV rays coming from the Sun), so called ozonosphere.

- **Temperature of mesosphere** decreases with height and reaches to  $-100^{\circ}C$ . That's why when any meteors enter in mesosphere, it burns up.
- In thermosphere, although the temperature can rise to  $1500^{\circ}C$ , a person would not feel warm because of the extreme low pressure.
- The international space stations orbit is also in thermosphere.
- It extends up to 10-50 km above sea level.

- Mesosphere , thermosphere and exosphere are the other layers of atmosphere.

**Oxygen ( $O_2$ )**

- It was discovered by K. Scheele.
- It is obtained during photosynthesis .
- It is colourless, odourless, neutral gas which gets absorbed over alkaline pyrogallol.
- It is non-combustible but helps in combustion. It forms oxides with metals and non-metals.
- It is used for artificial respiration and in oxy-hydrogen flame, oxygen-ethylene flame and oxygen acetylene flame (used for welding and as a rocket fuel)

**Ozone ( $O_3$ )**

- It is an allotrope of oxygen.
- It is used as insecticide, in purification of water to preserve food, to synthesis artificial silk and camphor and as a bleaching agent.

**Nitrogen ( $N_2$ )**

- It was discovered by Rutherford (in 1771)
- It is a colourless, odourless, non-combustible, non-poisonous gas.
- It is neutral and lighter than air.
- It is filled in sealed packets and bulbs to create inert atmosphere.
- Living beings die in an environment of nitrogen.
- Soil contains several pores filled with air. At the time of raining these pores get filled with water. That's why earthworm come at the surface to breath.

**Carbon dioxide ( $CO_2$ )**

- It is used by plants for photosynthesis.
- It is 1.5 times heavier than water.
- It turns the lime water milky which disappears in the excess of  $CO_2$  due to conversion of milky calcium carbonate ( $CaCO_3$ ) into soluble calcium bicarbonate.
- It is used to extinguish fire and for artificial respiration when mixed with oxygen (carbogen).
- It is dangerous to have charcoal fire burning in a closed room because it produces carbon monoxide gas, which is suffocating.
- Plants respire at night and give out  $CO_2$  which reduces oxygen content of air required for breathing, so it is dangerous to sleep under trees at night.
- ENO produces effervescence if dissolved in water due to evolution of  $CO_2$  gas.

**Water**

- It contains two elements: hydrogen and oxygen ( $H_2O$ ). It constitutes about 70% part of earth.
- It is a universal solvent and maintains the body temperature due to its high specific heat.
- It has boiling point  $100^{\circ}C$  and freezing point  $0^{\circ}C$ . Its density is maximum at  $4^{\circ}C$ .

### Soft Water

Soft water easily lathers with soap.

### Hard Water

It does not lather with soap.

It is of two types

#### 1. Temporary Hard Water

- It contains bicarbonate of calcium and magnesium.
- It is converted into soft water by boiling or by adding calculated quantity of calcium hydroxide. (Clark's process)

#### 2. Permanent Hard Water

- It contains sulphates and chlorides of calcium and magnesium.
- It is converted into soft water by adding sodium carbonate ( $Na_2CO_3$ ), or calgon or zeolite

### Heavy Water

- It is deuterium oxide,  $D_2O$ . (molecular mass 20)
- It is used as a moderator in nuclear reactors, in the study of mechanisms of chemical reactions involving hydrogen and its compounds etc.

### Pollutants

These are the substances that contaminate the environment and of two types.

#### 1. Primary Pollutants

- These persist in the environment in the form, they are formed example sulphur dioxide ( $SO_2$ ), nitrogen dioxide ( $NO_2$ ) etc.

#### 2. Secondary Pollutants

- These are the products of reaction of primary pollutants e.g., PAN, ozone ( $O_3$ ), aldehydes etc.
- The order of different pollutants to cause pollution is carbon monoxide ( $CO$ ),  $SO_2 >$  hydrocarbon  $>$  particulates  $>$  nitrogen oxides.

### Green House Effect

- It is the heating of earth and its objects because of the trapping of IR radiations by

carbon dioxide ( $CO_2$ ), methane ( $CH_4$ ),  $NO$ , ozone ( $O_3$ ), chloro-fluorocarbons and water vapours.

### Global Warming

- It is a result of increased concentration of green house gases.
- It may result in melting of ice caps and glaciers, spreading of several infectious diseases like malaria, sleeping sickness etc.

### Acid Rain (By Robert Augus)

- It has pH less than 5. It is due to oxides of nitrogen and sulphur.
- It damages the buildings and other structures made up of limestone as marble, corrodes metal pipes, results in several diseases.
- pH of normal rain water is 5.6

### Particulates

- These are minute solid particles and liquid droplets dispersed in air. E.g. mists, dusts, smoke, fumes etc.

Diseases	Cause
Pneumoconiosis	Due to inhalation of coal dust
Silicosis	Due to inhalation of free silica
Black lung disease	Found in workers of coal mines
White lung disease	Found in textile workers
Byssinosis	Due to inhalation of cotton fibre dust

### Smog

- It is a consequence of particulate pollution and is of two types.

#### 1. Classical Smog

- It is also called London type smog.
- It is reducing in nature.
- It is formed in cool humid climate when carbon soot particles combine with gaseous oxides of sulphur.

#### 2. Photochemical Smog

- It is also called Los Angeles smog
- It occurs in warm, dry and sunny climate by the action of sunlight on unsaturated hydrocarbons and nitrogen oxide.
- It is oxidizing in nature.
- Troposphere Pollution Presence of undesirable solid or gaseous particles in the air. Gaseous air pollutants are  $S$ ,  $N$  and  $C$ ,  $H_2S$ , hydrocarbons, ozone and other oxidants. Particulate pollutants are dust, mist, fumes, smoke, smog etc.

**Stratospheric Pollution**

- Stratospheric pollution means depletion of ozone layer (ozone hole) by certain compounds like chlorofluorocarbons (CFCs), oxides of nitrogen (which are released into upper atmosphere from engines of supersonic transport planes).
- $\text{CCl}_4$ , halons and methyl chloroform also deplete ozone layer.
- Depletion of ozone layer can cause skin cancer, sunburn, ageing of skin, cataract or even blindness and increase in evaporation of surface water.

**Water Pollution**

- It is due to the presence of foreign substances like sewage, algae, soluble salts etc., in water.
- It can also be due to metals. These causes following diseases

<b>Mercury</b>	<b>Minamata disease</b>
Chromium & arsenic	Cancer
Cadmium	Itai-itai disease
Mercury	Minamatodisease

- For a healthy aquatic life, dissolved oxygen (DO) is 5-6 ppm.
- For clean water BOD (bio chemical oxygen demand) is less than 5 ppm while for highly polluted water, it is 17 ppm or more.

**Soil Pollution**

It is alteration in soil. It is caused by pesticides like insecticides (e.g. DDT, BHC etc), herbicides (e.g. sodium chlorate and sodium arsenate), fungicides (e.g., organomercurycompounds):

**Carbon and Its Compounds****Carbon**

It is a member of group 14 in the Periodic Table, with symbol C and atomic number 6.

It has three crystalline allotropes.

**1. Graphite**

- It is opaque and black.
- It is a very good conductor.
- It is soft enough to form a streak on paper.

**Diamond**

- It is highly transparent.
- It is the hardest materials known.
- It has a very low electrical conductivity.
- Under normal conditions, it has the highest thermal conductivity of all known materials.

**Fullerenes**

Compiled by Rex Christopher

- It ( $\text{C}_{60}$ ) looks like a soccer ball (or bucky ball)
- It contains 20 six membered and 12 five membered rings of carbon atoms.
- It acts as wonderful lubricant and the alkali metal compounds of  $\text{C}_{60}$  are used as superconducting substance at the temperature range of 10-40K.

**Other Difference between Diamond and Graphite**

<b>Diamond</b>	<b>Graphite</b>
Diamond is the ultimate abrasive	Graphite is a very good lubricant, displaying super lubricity
Diamond is an excellent electrical insulator	Graphite is a conductor of electricity.
Diamond is the best known naturally occurring thermal conductor	Some forms of graphite are used for thermal insulation (i.e., firebreaks and heat shields)
Diamond is highly transparent	Graphite is opaque

**Graphene**

➤ Graphene is an allotrope of carbon. Its structure is one-atom-thick planar sheets of carbon atoms that are densely packed in a honeycomb crystal lattice. The term graphene was coined as a combination of graphite and the suffixene by Hanns-Peter Boehm, who described single-layer carbon foils in 1962.

**Carbon Monoxide (CO)**

- It is formed by incomplete combustion. It is a colourless, odourless gas.
- It contains a triple bond and are fairly polar, resulting in a tendency to bind permanently to haemoglobin molecules, displacing oxygen, which has a lower binding affinity.

**Organic Compounds**

- These are the compounds of mainly carbon and hydrogen or compounds of carbon and hydrogen with other elements like phosphorus, oxygen, nitrogen, sulphur, halogens etc.
- Urea is the first synthesized organic compound (by Wheler)
- Acetic acid was the first organic compound synthesized in the laboratory from its elements.

**Hydrocarbons**

- These are the compounds of only carbon and hydrogen.

These are of three types:

**1. Saturated Hydrocarbons**

- These compounds contain only single bonds. These are also called alkanes or paraffins and have general formula  $C_n H_{2n+2}$  where, n = 1, 2, 3 .....
- Methane is the first member of this group.

**2. Unsaturated Hydrocarbons**

- These have general formula  $C_n H_{2n}$  for alkene and  $C_n H_{2n-2}$  for alkynes.
- These have at least one double (==) or triple ( $\equiv$ ) bond, and are called alkene and alkynes respectively.
- Ethylene ( $C_2H_4$ ) is the first member of alkene and acetylene ( $C_2H_2$ ) is the first member of alkyne.

**3. Aromatic Hydrocarbons**

- These have ring structure with alternate double bonds and  $(4n + 2)\pi e^-$  (Hucke's rule)
- **Benzene** is the first member of aromatic hydrocarbons.

**Functional Group**

- It is an atom or group of atoms in a molecule, which is responsible for the chemical properties of the molecules.
- -OH is alcoholic group, -CHO is aldehyde group,  $>C=O$  is keto group, -COOH is carboxylic acid group, -o- ether group.

**Homologous Series**

- It is a series of compounds in which adjacent members differ by a  $-CH_2$  unit (14 unit mass)
- All members of a homologous series have same functional group and same chemical properties.

**Isomerism**

- Compounds having the same molecular formula but different structure are called isomers and the phenomenon is called isomerism. E.g.,  $C_2H_6O$  can have the following structure  $CH_3OCH_3$  and  $C_2H_5OH$ .

**Uses of Some Important Organic Compounds**

- **Methane ( $CH_4$ )** is used to manufacture printer ink, methyl alcohol and to obtain light and energy.
- **Ethylene ( $C_2H_4$ )** is used to prepare mustard gas (war gas) and for ripening of fruits.
- **Glycol ( $C_2H_6O_2$ )** is used as a antifreeze mixture in car radiator and to prevent the freezing of fuel in space crafts.

- **Acetylene ( $C_2H_2$ )** is used to generate light, to weld metals as oxy-acetylene flame and to prepare synthetic rubber (neoprene)
- **Methyl alcohol ( $CH_3OH$ )** is used as a fuel with petrol, used to synthesise varnish and polish, used to denature ethanol
- **Chloroform ( $CHCl_3$ )** is used as an anaesthetic and to preserve substances obtained from plants and animals. It converts into poisonous phosgene ( $COCl_2$ ), when exposed to sunlight. So, it is kept in dark bottles.
- **Glycerene ( $C_3H_8O_3$ )** is used to synthesis explosive nitroglycerine, stamp ink and boot polish.
- **Formic acid ( $HCOOH$ )** is used as a preservative for fruits and juices, in leather industry and in coagulation of rubber.
- **Acetic acid ( $CH_3COOH$ )** is used in vinegar, medicines, and as a solvent.
- **Oxalic acid ( $C_2H_2O_4$ )** is used in printing of clothes, in photography and in the synthesis of coaltar.
- **Glucose ( $C_6H_{12}O_6$ )** is used for the synthesis of alcohol and as a preservative for fruit juice.
- **Benzene ( $C_6H_6$ )** is used as a solvent for oil fat and in dry cleaning. Sodium benzoate is a food preservative.
- **Toluene ( $C_6H_5CH_3$ )** is used to synthesis explosive TNT, for dry cleaning and for the synthesis of medicines like chloramine.
- **Phenol ( $C_6H_5OH$ )** is used to synthesis explosive, 2, 4, 6-trinitrophenol (picric acid) and Bakelite.
- **Ethyl alcohol ( $C_2H_5OH$ )** is used for drinking, in medicine to prepare tincture and as insecticide. And as a fuel with petrol.

**MAN MATERIALS****Soaps**

These are sodium and potassium salts of higher fatty acids. E.g., sodium palmitate, sodium stearateetc.

**Detergents**

- These are sodium or potassium salts of long chain alkyl or aryl sulphonates or sulphates e.g., sodium alkyl sulphonate, sodium alkyl benzene sulphonate, etc.
- These are also called soapless soap.
- Detergents lather with hard water.
- Detergents cause pollution but straight chain alkyl group containing detergents are biodegradable and do not cause pollution.
- The cationic detergents are used as fabric softeners and germicides while non-ionic

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detergents are used as liquid dish washing detergents.

### Fertilizers

- These substances increase the fertility of soil by providing elements essential for the growth of plants like nitrogen, phosphorus and potassium. E.g., basic calcium nitrate [ $\text{CaO} \cdot \text{Ca}(\text{NO}_3)_2$ ], ammonium sulphate [ $(\text{NH}_4)_2\text{SO}_4$ ]. These two increases the acidity of soil. Which is removed by adding lime.
- Other examples are calcium cyanamide or nitrolim ( $\text{CaCN}_2$ ), Urea or carbonate (it does not effect the pH of soil), calcium super phosphate or super phosphate of lime [ $\text{Ca}(\text{H}_2\text{PO}_4)_2 + 2\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ]

### Glass

- It is an amorphous or transparent solid, also called supercooled liquid.
- It contain mainly silica ( $\text{SiO}_2$ )

### Different Substance give Different Colour to Glass

Colour	Substance added
Red	Copper oxide
Green	Chromium oxide
Violet	Manganese oxide
Blue	Cobal oxide
Brown	Iron oxide

It can be of the following types

**1. Soda or soft glass** is sodium calcium silicate ( $\text{Na}_2\text{O} \cdot \text{CaO} \cdot 6\text{SiO}_2$ ). It is the ordinary glass and used for making bottles, window panes etc.

**2. Potash glass or hard glass** contains potassium (from  $\text{K}_2\text{CO}_3$ ). It has higher softening temperature. It is used for chemical apparatus: beakers, flasks, funnel etc.

**3. Crown glass** contains potassium oxide ( $\text{K}_2\text{O}$ ), barium oxide ( $\text{BaO}$ ), boric oxide ( $\text{B}_2\text{O}_3$ ) and silica ( $\text{SiO}_2$ ). It is used for optical apparatus.

**4. Flint glass** contains lead oxide ( $\text{PbO}$ ) and used in optical instruments like lenses, prisms.

**5. Crook's glass** contains cesium oxides. It is used for spectacles as it absorbs UV rays.

**6. Jena glass** contains  $\text{B}_2\text{O}_3$  and alumina. It is stronger and more resistant to acids and alkalies, that's why used for making laboratory bottles, for keeping acids and alkalies.

**7. Milky glass** is prepared by adding tin oxide ( $\text{SnO}_2$ ), calcium phosphate [ $(\text{Ca}_3(\text{PO}_4)_2$ ] or cryolite ( $\text{Na}_3\text{AlF}_6$ ) to the melt glass

**8. Glass laminates** is made by fixing polymer sheets between layers of glass. It is used to make windows and screens of cars, trains and aircraft. Specially manufactured glass laminates are used as bulletproof material.

### Cement or Portland Cement

- It is a complex material containing the silicates and aluminates of calcium with small amount of gypsum.
- It has the following composition calcium oxide ( $\text{CaO}$ ) = 50-60%, silica ( $\text{SiO}_2$ ) = 20-25%, alumina ( $\text{Al}_2\text{O}_3$ ) = 5-10%; magnesium oxide ( $\text{MgO}$ ) = 2-3%
- It is manufactured from limestone and clay.
- Cement if contains excess lime, cracks during setting and if lime is less, cement is of weak strength.
- Gypsum decreases the rate of setting of cement.
- A paste of sand, cement and water is called mortar and is used for joining bricks and plastering walls.
- A mixture of stone chips (gravel), sand, cement and water is known as concrete and is used for flooring and making roads.
- Concrete with steel bars and wires is called reinforced concrete (RC) and is used for constructing roofs, bridges and pillars.

### Medicines

- These are the chemicals used for treating diseases and reducing suffering from pain.
- These are classified as

**Analgesics** are used to reduce pain. E.g., aspirin, paracetamol, morphine etc.

**Antipyretics** is used to reduce body temperature during high fever, e.g., paracetamol, aspirin, phenacetin, analgin, novalgin.

**Tranquilizers** are used to treat stress, mild and severe mental disease. These are also called psychotherapeutic drugs. E.g., equanil, valium, veronal, serotonin, chlorodiazepoxide, meprobamate etc.

**Antiseptic** prevent the growth of microorganisms or kill them but are not harmful to living tissues. E.g., dettol, savlon, iodine tincture, boric acid, hydrogen per oxide etc.

**Antibiotics** are obtained from microorganisms and used to destroy the other microorganisms e.g.,

## CHEMISTRY

penicillin, ampicilin, amoxycilin (all are narrow spectrum), ofloxacin, tetracycline, chloramphenicol (all are broad spectrum). Penicillin was discovered A. Fleming in 1929.

- **Antimalarial** are used to treat malaria. E.g. chlorquin
- **Sulpha drugs** are alternatives of antibiotics, e.g., sulphanilamide, sulphadiazine etc.
- **Antacids** are used as a remedy for acidity. E.g., magnesium hydroxide, sodium bicarbonate (baking soda) etc.
- **Pesticides** are used to destroy the organisms that harm the crop.

These are of the following types.

**1. Insecticide** e.g., DDT, aluminium phosphate, gammexane.

**2. Fungicide** e.g., bordeaux mixture

**3. Herbicide** e.g., benzipam, benzadox

**4. Rodenticide** e.g. aluminium phosphide.

### Plastics

These are cross-like polymers (a substance having high molecular weight and repeating unit) and are very tough.

- Lac is a natural plastic (polymer)
- Polymers are made up of monomers

There are of two types.

**1. Thermoplastics** are the polymers which can be easily softens on heating e.g., polythene, polystyrene, polyvinyl chloride, Teflon etc.

**2. Thermosetting plastics** are the polymers which undergo permanent change on heating due to excessive cross-linking. These cannot be reused, e.g., Bakelite.

### Some important Polymers and their Monomers

Polymer	Monomers
Polyethylene	Ethylene
Polystyrene	styrene
Polyvinyl chloride (PVC)	Vinyl chloride
Polytetrafluoroethylene (PTFE) or Teflon	Tetrafluoroethane
Bakelite	Formaldehyde + phenol
Urea formaldehyde resin	Urea + formaldehyde
Melmac	Melamine + formaldehyde

### Fibres

These have strong intermolecular forces like hydrogen bonding e.g., nylon-66, Dacron, orlon etc.

### Natural rubber

- It is an elastomer. It is a polymer of cis-isoprene e.g., it is cis-polyisoprene. Synthetic rubber (neoprene) is a polymer of chloroprene.
- It is insoluble in water, dilute acids and alkalies, absorbs a large amount of water and has low tensile strength and elasticity.
- It is heated with sulphur compounds at 373K in the presence of ZnO to improve these properties. This process is called vulcanization of rubber.
- If vulcanized with 5% S, it is used for making tyres and if with 30% sulphur, it is used in making battery cases.

### Explosives

Some examples of explosives are trinitrotoluene (TNT), nitroglycerine or trinitroglycerine, cyclotrimethylenetrinitroamine (RDX, also called cyclonite).

# CHEMISTRY

1 <b>H</b> Hydroge n 1.00794													2 <b>He</b> Helium 4.003				
3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryli um 9.01218 2																
11 <b>Na</b> Sodium 22.98977 0	12 <b>Mg</b> Magnesi um 24.3050	Transitio n Element s															
19 <b>K</b> Potassiu m 39.0983	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandi um 44.955 910	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> 5.9415	24 <b>Cr</b> Chromi um 51.9961	25 <b>Mn</b> Manga nese 54.938	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.9332 00	28 <b>Ni</b> 58.6934	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.39	31 <b>Ga</b> Galli um 69.723	32 <b>Ge</b> Germa nium 72.61	33 <b>As</b> 74.921 60	34 <b>Se</b> 78.96	35 <b>Br</b> 79.904	36 <b>Kr</b> Krypton 83.80
37 <b>Rb</b> Rabid ium 85.4678	38 <b>Sr</b> Strom ium 87.62	39 <b>Y</b> Yttrium 88.905 85	40 <b>Zr</b> 91.224	41 <b>Nb</b> 92.90 638	42 <b>Mo</b> Molybe num 95.94	43 <b>Tc</b> (98)	44 <b>Ru</b> 101. 07	45 <b>Rh</b> Rhodiu m 102.905 50	46 <b>Pd</b> 106. 42	47 <b>Ag</b> Silver 107.868 2	48 <b>Cd</b> Cadmi um 112.41 1	49 <b>In</b> 114.818	50 <b>Sn</b> Tin 118.710	51 <b>Sb</b> 121.76 .60	52 <b>Te</b> 127 .47	53 <b>I</b> Iodine 126.904 47	54 <b>Xe</b> Ele non 131.29
55 <b>Cs</b> Cesium 132.9054 5	56 <b>Ba</b> Barium 137.327	57 <b>La</b> 138.90 55	72 <b>Hf</b> 178.49	73 <b>Ta</b> Tantalu m 180.947 9	74 <b>W</b> Tungste n 183.84	75 <b>Re</b> 186.207	76 <b>Os</b> 190. 23	77 <b>Ir</b> 192. 217	78 <b>Pt</b> Platin um 195.078	79 <b>Au</b> Gold 196.966 55	80 <b>Hg</b> Mercur y 200.59	81 <b>Tl</b> Thalli um 204.383 3	82 <b>Pb</b> Lead 207.2	83 <b>Bi</b> 208.98 038	84 <b>Po</b> (209)	85 <b>At</b> (210)	86 <b>Rn</b> Rado (222)
87 <b>Fr</b> Franciu m (223)	88 <b>Ra</b> Radium (226)	89 <b>Ac</b> Actiniu m (227)	104 <b>Rf</b> Rutherfo rdum (261)	105 <b>Db</b> (262)	106 <b>Sg</b> (263)	107 <b>Bh</b> Borium (262)	108 <b>Hs</b> Hassi um (265)	109 <b>Mt</b> (266)	110 (269)	111 (272)	112 (277)	113	114				
Inner Transitio n elements		58 <b>Ce</b> 140.90 116	59 <b>Pr</b> 140.90 765	60 <b>Nd</b> 144.2 4	61 <b>Pm</b> (145)	62 <b>Sm</b> 150.36	63 <b>Eu</b> 151. 964	64 <b>Gd</b> 157.2 5	65 <b>Tb</b> 158.925 34	66 <b>Dy</b> 162. 50	67 <b>Ho</b> 164.93 032	68 <b>Er</b> 167. 26	69 <b>Tm</b> 168.93421 04	70 <b>Yb</b> 173. 04	71 <b>Lu</b> 174.96 7		
		90 <b>Th</b> 232.03 81	91 <b>Pa</b> 231.03588	92 <b>U</b> 238.028 9	93 <b>Np</b> (237)	94 <b>Pu</b> (244)	95 <b>Am</b> (243)	96 <b>Cm</b> (247)	97 <b>Bk</b> (247)	98 <b>Cf</b> (251)	99 <b>Es</b> (252 )	100 <b>Fm</b> (257 )	101 <b>Md</b> (258)	102 <b>No</b> (258)	103 <b>Lr</b> (262)		

## CONSTITUTIONAL DEVELOPMENT IN INDIA

### Regulating Act of 1773

- The first step taken by the British Parliament to control and regulate the affairs of the East India Company in India.
- It designated the **Governor** of Bengal (Fort William) as the **Governor-General (of Bengal)**.
- Warren Hastings became the first Governor-General of Bengal.
- Executive Council of the Governor-General was established (Four members). There was no separate legislative council.
- It subordinated the Governors of Bombay and Madras to the Governor-General of Bengal.
- The Supreme Court was established at Fort William (Calcutta) as the Apex Court in 1774.
- It prohibited servants of the company from engaging in any private trade or accepting bribes from the natives.
- Court of Directors (governing body of the company) should report its revenue.

### Pitt's India Act of 1784

- Distinguished between commercial and political functions of the company.
- Court of Directors for Commercial functions and Board of Control for political affairs.

## THE CONSTITUTION OF INDIA

- Reduced the strength of the Governor General's council to three members.
- Placed the Indian affairs under the direct control of the British Government.
- The companies territories in India were called "the British possession in India".
- Governor's councils were established in Madras and Bombay.

### Charter Act of 1813

- The Company's monopoly over Indian trade terminated; Trade with India open to all British subjects.

### Charter Act of 1833

- **Governor-General (of Bengal)** became as the Governor-General of India.
- First Governor-General of India was Lord William Bentick.
- This was the final step towards centralization in the British India.
- Beginning of a Central legislature for India as the act also took away legislative powers of Bombay and Madras provinces.
- The Act ended the activities of the East India Company as a commercial body and it became a pure administrative body.

**Charter Act of 1853**

- **The legislative and executive functions of the Governor-General's Council were separated.**
- 6 members in Central legislative council. Four out of six members were appointed by the provisional governments of Madras, Bombay, Bengal and Agra.
- It introduced a system of open competition as the basis for the recruitment of civil servants of the Company (Indian Civil Service opened for all).

**Government of India Act of 1858**

- The rule of Company was replaced by the rule of the Crown in India.
- The powers of the British Crown were to be exercised by the Secretary of State for India
- He was assisted by the **Council of India**, having 15 members
- He was vested with complete authority and control over the Indian administration through the Vice roy as his agent
- The Governor-General was made the Viceroy of India.
- Lord Canning was the first Viceroy of India.
- Abolished Board of Control and Court of Directors.

**Indian Councils Act of 1861**

- It introduced for the first time Indian representation in the institutions like Viceroy's executive and legislative council (non-official). **3 Indians entered Legislative council.**
- Legislative councils were established in Center and provinces.
- It provided that the Vice-roys Executive Council should have some Indians as the non-official members while transacting the legislative businesses.
- It accorded statutory recognition to the portfolio system.
- Initiated the process of decentralisation by restoring the legislative powers to the Bombay and the Madras Provinces.

**India Council Act of 1892**

- Introduced indirect elections (nomination).
- Enlarged the size of the legislative councils.
- Enlarged the functions of the Legislative Councils and gave them the power of discussing the Budget and addressing questions to the Executive.

**Indian Councils Act of 1909**

1. This Act is also known as the Morley-Minto Reforms.

2. Direct elections to legislative councils; first attempt at introducing a representative and popular element.
3. It changed the name of the Central Legislative Council to the Imperial Legislative Council.
4. The member of Central Legislative Council was increased to 60 from 16.
5. Introduced a system of communal representation for Muslims by accepting the concept of 'separate electorate'.
6. **Indians for the first time in Viceroy's executive council.** (Satyendra Prasad Sinha, as the law member)

### Government of India Act of 1919

- This Act is also known as the Montague-Chelmsford Reforms.
- The Central subjects were demarcated and separated from those of the Provincial subjects.
- The scheme of dual governance, 'Dyarchy', was introduced in the Provincial subjects.
- Under dyarchy system, the provincial subjects were divided into two parts – transferred and reserved. On reserved subjects Governor was not responsible to the Legislative council.
- The Act introduced, for the first time, **bicameralism at center.**
- **Legislative Assembly** with 140 members and **Legislative council** with 60 members.
- Direct elections.

### THE CONSTITUTION OF INDIA

- The Act also required that the three of the six members of the Viceroy's Executive Council (other than Commander-in-Chief) were to be Indians.
- Provided for the establishment of Public Service Commission.

### Government of India Act of 1935

- The Act provided for the establishment of an All-India Federation consisting of the Provinces and the Princely States as units, though the envisaged federation never came into being.
- Three Lists : The Act divided the powers between the Centre and the units in items of three lists, namely the Federal List, the Provincial List and the Concurrent List.
- The Federal List for the Centre consisted of 59 items, the Provincial List for the provinces consisted of 54 items and the Concurrent List for both consisted of 36 items
- The residuary powers were vested with the Governor-General.
- The Act abolished the Dyarchy in the Provinces and introduced 'Provincial Autonomy'.
- It provided for the adoption of Dyarchy at the Centre.
- Introduced bicameralism in 6 out of 11 Provinces.

- These six Provinces were Assam, Bengal, Bombay, Bihar, Madras and the United Province.
- Provided for the establishment of Federal Court.
- Abolished the Council of India.

## THE CONSTITUTION OF INDIA

- The development of portfolio system and budget points to the separation of power.
- Lord Mayo's resolution on financial decentralization visualized the development of local self-government institutions in India (1870).
- 1882: Lord Ripon's resolution was hailed as the 'Magna Carta' of local self government. He is regarded as the 'Father of local self-government in India'.
- 1921: Railway Budget was separated from the General Budget.
- From 1773 to 1858, the British tried for the centralization of power. It was from the 1861 Councils act they shifted towards devolution of power with provinces.
- 1833 Charter act was the most important act before the act of 1909.
- Till 1947, the Government of India functioned under the provisions of the 1919 Act only. The provisions of 1935 Act relating to Federation and Dyarchy were never implemented.
- The Executive Council provided by the 1919 Act continued to advise the Viceroy till 1947. The modern executive (Council of Ministers) owes its legacy to the executive council.
- The Legislative Council and Assembly developed into Rajyasabha and Lok Sabha after independence.

## Indian Independence Act of 1947

- It declared India as an Independent and Sovereign State.
- Established responsible Governments at both the Centre and the Provinces.
- Designated the Viceroy India and the provincial Governors as the Constitutional (normal heads).
- It assigned dual functions (Constituent and Legislative) to the Constituent Assembly and declared this dominion legislature as a sovereign body.

## Points to be noted

- Laws made before Charter Act of 1833 were called **Regulations** and those made after are called **Acts**.
- Lord Warren Hastings created the office of District Collector in 1772, but judicial powers were separated from District collector later by Cornwallis.
- From the powerful authorities of unchecked executives, the Indian administration developed into a responsible government answerable to the legislature and people.

## NATIONAL SYMBOLS

### National Flag

- The National Flag is a horizontal tricolour of deep saffron (kesaria) at the top, white in the middle and dark green at the bottom in equal proportion
- The ratio of width of the flag to its length is two to three.
- In the centre of the white band is a navy-blue wheel which represents the charka.
- Its design is that of the wheel which appears on the abacus of the Sarnath Lion Capital of Ashoka.
- Its diameter approximates to the width of the white band and it has 24 spokes.
- The design of the National Flag was adopted by the Constitution Assembly of India on 22 July 1947.
- Apart from non-statutory instructions issued by the Government from time to time, display of the National Flag is governed by the provisions of the Emblems and Names (Prevention of Improper Use) Act, 1950 and the prevention of Insults of National Honour Act, 1971.
- The Flag Code of India, 2002 is an attempt to bring together all such laws, conventions, practices and instructions for the guidance and benefit of all concerned.
- The Flag Code of India, 2002, took effect from 26 January 2002 and suspected the 'Flag Code-Indias' as it existed.
- As per the provisions of the Flag Code of India, 2002, there are no restriction on the display of the National Flag by members of general public, private organisations, educational institutions, etc., except to the extent provided in the Emblems and Names (Prevention of Improper Use) Act, 1950 and Prevention of Insults of National Honour Act, 1971 and any other law enacted on the subject.

### National Emblem

- The state emblem is an adaptation from the Sarnath Lion Capital of Ashoka.

Compiled by Rex Christopher

## THE CONSTITUTION OF INDIA

- In the original, there are four lions, standing back to back, mounted on an abacus with a frieze carrying sculptures in high relief of an elephant, a galloping horse, a bull and a lion separated by intervening wheels over a bell shaped lotus.
- Carved out of a single block of polished sandstone, the Capital is crowned by the Wheel of the Law (Dharma Chakra).
- In the state emblem, adopted by the Government of India on 26 January 1950, only three lions are visible, the fourth being hidden from view.
- The wheel appears in relief in the centre of the abacus with a bull on right and a horse on left and the outlines of other wheels on extreme right and left.
- The bell-shaped lotus has been omitted.
- The words Satyameva Jayate from Mundaka Upanishad, meaning 'Truth Alone Triumphs', are inscribed below the abacus in Devanagari script.

### National Anthem

- The song "Jana-gana-mana", composed originally in Bengali by Ravindra Nath Tagore, was adopted in Hindi version by the Constituent Assembly as the National Anthem of India on 24th January 1950.
- It was first sung on 27th December 1911 at the Calcutta session of the Indian National Congress.

### National Song

- The song Vande Mataram, composed in Sanskrit by Bankim Chandra Chatterji, was a source of inspiration to the people in their struggle for freedom.
- It has an equal status with 'Jana-gana-mana'.
- The first political occasion when it was sung was the 1896 session of the Indian National Congress.

## National Calendar

- The national calendar based on the Saka Era, with Chaitra as its first month and a normal year of 365 days was adopted from 22 March 1957 along with the Gregorian calendar for the following official purposes:
  - Gazette of India,
  - news broadcast by All India Radio,
  - calendars issued by the Government of India and
  - Government communications addressed to the members of the public.
- Dates of the national calendar have a permanent correspondence with dates of the Gregorian calendar, 1 Chaitra falling on 22 March normally and on 21 March in leap year.

## Flag Code of India, 2002

- 'Flag Code-India' is neither a statute nor a statutory rule or regulation. It is, in reality, a mere consolidation of executive instructions issued by the Government of India from time to time and contains detailed instruction in regard to the shape, size and colour of the National Flag, the correct display, instances of misuse and display on National Days or special occasions.
- And now, Flag Code of India, 2002 is an attempt to bring together all such laws, conventions, practices and instructions for the guidance and benefit of all concerned.
- For the sake of convenience, Flag Code of India, 2002 has been divided into three parts. Part I of the code contains general description of the National Flag. Part II by members of public, private organizations and educational institutions. Part III of the Code relates to display of the National Flag by Central and State governments and organizations and agencies.

## The New Flag Code

- One can hoist the flag only from sunrise to sunset
- The ratio of width to length of the flag should be 2:3.
- Don't print it on a costume, cushion or napkin either.
- Don't drape the flag on vehicles.
- Don't hoist it upside down. Must not touch the ground.
- must fly higher than all other flags except that of the UN or other nations.
- Don't fly a damaged flag.
- The amended code came into effect from January 26, 2003.

## National animal.

- The magnificent tiger, *Panthera tigris*, is the National Animal
- The combination of grace, strength, agility and enormous power has earned the tiger its pride of place as the national animal of India.
- To check the dwindling population of tigers in India, 'Project Tiger' was launched in April 1973.
- So far, 29 tiger reserves have been established in the country under this project.

## National Bird

- The Indian peacock, *Pavo cristatus*, the national bird of India, is a colourful, swan-sized bird, with a fan-shaped crest of feathers, a white patch under the eye and a long, slender neck.
- The male of the species is more colourful than the female, with a glistening blue breast and neck and spectacular bronze-green train of around 200 elongated feathers.

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- The female is brownish, slightly smaller than the male and lacks the train.
- The peacock is widely found in the Indian subcontinent from the south and the east of the Indus river, Jammu and Kashmir, east Assam, south Mizoram and the whole of the Indian peninsula.
- The peacock is fully protected under the Indian Wildlife (Protection) Act, 1972.

### National Flower

- Lotus (*Nelumbo Nucifera Gaertn*) is the national flower of India.
- It is a sacred flower and occupies a unique position in the art and mythology of ancient India and has been an auspicious symbol of Indian culture since time immemorial.

### National Tree

- Indian fig tree, *Ficus bengalensis*, whose branches root themselves like new trees over a large area.
- The roots then give rise to more trunks and branches.
- Because of this characteristic and its longevity, this tree is considered immortal and is an integral part of the myths and legends of India.
- Even today, the banyan tree is the focal point of village life and the village council meets under the shade of this tree.

### National River

- The Ganga or Ganges is the longest river of India flowing over 2,510 kms of mountains, valleys and plains.
- It originates in the snowfields of the Gangotri Glacier in the Himalayas as the Bhagirathi River.
- It is later joined by other rivers such as the Alaknanda, Yamuna, Son, Sumti, Kosi and Ghagra.
- The Ganga river basin is one of the most fertile and densely populated areas of the world and covers an area of 1,000,000 sq. km.
- There are two dams on the river – one at Haridwar and the other at Farakka.

Compiled by Rex Christopher

## THE CONSTITUTION OF INDIA

- Dolphin is an endangered animal that specifically habitats this rivers.
- The Ganga is revered by Hindus as the most sacred river on earth.
- Key religious ceremonies are held on the banks of the river at cities such as Varanasi, Haridwar and Allahabad.
- The Ganga widens out into the Ganges Delta in the Sunderbans swamp of Bangladesh, before it ends its journey by emptying into the Bay of Bengal.

### National Fruit

- A fleshy fruit of the tree *Mangifera indica*, the mango is one of the important and widely cultivated fruits of the tropical world.
- Mangoes have been cultivated in India from time immemorial.
- The poet Kalidasa sang its praises.
- Alexander savored its taste, as did the Chinese pilgrim Hieun Tsang.
- Mughal emperor Akbar planted 100,000 mango trees in Darbanga, Bihar at a place now known as Lakhi Bagh.

### National Game

- Hockey is the National Game of India.
- Unmatched excellence and incomparable virtuosity brought India a string of Olympic gold medals.
- The Golden Era of hockey in India was the period from 1928 – 1956 when India won 6 consecutive gold medals in the Olympics.
- During the Golden Era, India played 24 Olympic matches, won all 24, scored 178 goals (at an average of 7.43 goals per match) and conceded only 7 goals.
- The two other gold medals for India came in the 1964 Tokyo Olympics and the 1980 Moscow Olympics.

## Framing of the Constitution of India

- The Constitution of India was framed and adopted by the Constituent Assembly of India.
- The Constitution Assembly was set up in November 1946 as per the Cabinet Mission Plan of 1946.
- The demand for the Constitution Assembly to draft the Constitution of India was, for the first time, raised by the Congress in 1935.
- The British Government accepted this demand, for the first time, in the 'August Offer' of 1940.
- The seats were allocated to three communities—Muslims, Sikhs and General—in proportion to their population.
- There were a total of 389 members in the Constituent Assembly of which 296 were elected by the members of the Provincial Assemblies and the rest were nominated by the Princely States.
  - The Mountbatten Plan of June 3, 1947 announced the partition of the country and a separate Constituent Assembly for the proposed State of Pakistan.
  - Consequently the members of the Constituent Assembly representing those areas which were included in Pakistan, East Bengal, North-West Frontier Province (NWFP), West Punjab, Sindh, Baluchistan, and Sylhet district of Assam, were no more members of the Constituent Assembly of India.

## Three Phases of the Constituent Assembly

- i) 1st Phase: As Constituent Assembly under the limitations of Cabinet Mission, Plan from 6th December 1946 to 14th August 1947.
- ii) 2nd Phase: As Constituent Assembly, a Sovereign body + Provisional Parliament from 15th August 1947 to 26th November 1949.
- iii) 3rd Phase: As a Provisional Parliament from 27th November 1949 to March 1952.

## THE CONSTITUTION OF INDIA

- North-West Frontier Province and Sylhet decided through a referendum to remain with Pakistan.
- Therefore, the membership of the Constituent Assembly for India was reduced to 299 after partition.
- Its first meeting was held on 9th December 1946, with Sachidanand Sinha as the interim President.
- On 11th December 1946, Dr. Rajendra Prasad was elected as the President of the Constituent Assembly.
- The historic 'Objective Resolution' was moved in the Constituent Assembly by Pt. Jawahar Lal Nehru on 13th December 1946.
- The first meeting of Constituent Assembly was boycotted by the Muslim League.
- Shri B. N. Rau was appointed as the Legal Advisor of the Constituent Assembly.
- Dr. B.R. Ambedkar is rightly regarded as the 'Father of the Constitution of India'.
- The Constituent Assembly formed 13 important committees for framing the Constitution.
- The Drafting Committee of 7 members were appointed on 29 August 1947, with Dr. B.R. Ambedkar as the Chairman.
- The first draft of the Constitution was prepared in October 1947 and was published in January 1948.
- The Draft Constitution of India prepared by the Drafting Committee was submitted to the President of the Assembly on 21 February 1948.
- As many as 7,635 amendments were proposed and 2473 were actually discussed.
- The clause-by-clause consideration of the Draft Constitution was taken up between 15 November 1948 and 17 October 1949.
- On 26 November 1949, the people of India through the Constituent Assembly adopted, enacted and gave to themselves the Constitution of India.

- The Constitution was finally signed in by the members of the Constituent Assembly on 24 January 1950, which was the last day of the Assembly.
- The Constitution came into full operation with effect from 26 January 1950.
- During this period, the Constituent Assembly acted as a ‘Temporary Parliament’ [15 August 1947 – 26 November 1949]
- The Constitution was approved by the members and was signed in by 284 members of the Constituent Assembly.
- It is considered to be the lengthiest Constitution in the world.
- Originally, it had 22 Parts, 395 Articles and 8 Schedules.
- The Constituent Assembly held 11 sessions.

**Drafting Committee of Constituent Assembly**

**Chairman:** Dr. BR Ambedkar  
**Members**

1. N Gopalaswamy Ayyangar
2. Alladi Krishnaswami Iyer
3. KM Munshi
4. Mohammed Sadullah
5. BL Mittar (replaced by N Madhav Rao)
6. DP Khaitan (who died in 1948 and was replaced by TT Krishnamachari)

- The Draft Constitution was considered for 114 days. The Constituent Assembly took 2 years, 11 months and 18 days to frame the Constitution.
- It cost the exchequer Rs. 6.4 crore.
- The design of the National Flag was adopted by the Constituent Assembly on July 22, 1947.
- The National Anthem was adopted by the Constituent Assembly on January 24, 1950.
- The Constituent Assembly of India was converted into the provisional Parliament of India on November 26, 1949.
- The only State having constitution of its own is Jammu & Kashmir.

**Committees of the Constituent Assembly**

The Constituent Assembly appointed 22 committees to deal with different task of Constitution-making. Out of these, 10 were on procedural affairs and 12 on substantive affairs. The report of these committees formed the basis on which the first draft of the Constitution was prepared. These were as follows:

**Committees on Procedural Affairs**

1. Steering Committee (Chairman: Dr K M Munshi)
2. Rules of Procedure Committee (Chairman: Dr. Rajendra Prashad)
3. House Committee
4. Hindi Translation Committee
5. Urdu Translation Committee
6. Finance and Staff Committee
7. Press Gallery Committee
8. Committee on the effect of Indian Independence Act of 1947.
9. Orders of Business Committee
10. Credential Committee

**Committees of Substantive Affairs**

1. Drafting Committee (Chairman: Dr B R Ambedkar)
2. Committee for Negotiating with States (Chairman: Dr Rajendra Prashad)
3. Committee on Chief Commissioners' Provinces.
4. Union Constitution Committee (Chairman: Jawaharlal Nehru)
5. Provincial Constitution Committee (Chairman: Sardar Patel).
6. Special Committee to Examine the Draft Constitution (Chairman: Sir Alladi Krishnaswamy Iyer)
7. Commission on Linguistic Provinces
8. Expert Committee on Financial Provisions
9. Ad-hoc Committee on National Flag
10. Union Powers Committee (Chairman: Jawaharlal Nehru)
11. Ad. hoc Committee on the Supreme Court

12. Committee on Fundamental Rights and Minorities (Chairman: Sardar Patel)

## Important members of the Constituent Assembly

Jawaharlal Nehru, Rajendra Prasad, Sardar Patel, Maulana Azad, Gopalaswamy Ayyangar, Gobind Ballabh Pant, Abdur Ghaffar Khan, TT Krishnamachari, Alladi Krishnaswami Ayyar, H N Kunzru, H S Gour, K V Shah, Masani, Acharya Kripalani, Dr Ambedkar, Dr Radha Krishnan, Dr Jaykar, Liaquat Ali Khan, Khwaja Nazimuddin, Sir Feroze Khan Noor, Suhrawardy, Sir Zafurullah Khan and Dr Sachchidananda Sinha.

- The first elections to the Parliament were held in 1952.
- The first amendment to the Constitution was effected in 1951.
- According to Article 394, provisions relating to the citizenship, elections, provisional Parliament and temporary and transitional provisions contained in Articles 5, 6, 7, 8, 9, 60, 324, 366, 367, 379, 380, 388, 391, 392 and 393 came into force on the day of adoption (i.e. 26 November 1949) of the Constitution and the remaining provisions of the Constitution came into being on the day of the commencement (i.e. 26 January 1950) of the Constitution.
- According to Article 395, the Government of India Act of 1935 and the Indian Independence Act of 1947 got replaced with the commencement of the Constitution of India.
- January 26 was selected as the date of commencement of the Constitution of India because on this date in 1930, Indian people observed 'Independence day', following the resolution of 'Purna Swaraj' of the Congress session held in the midnight of December 31, 1929 at Lahore.

## THE CONSTITUTION OF INDIA

- Constituent Assembly could not be called a sovereign body. It was established by the British government and could be abolished by it. So its authority was limited, and it worked within the framework of the Cabinet Mission Plan. These limitations were nullified by the passing of the Indian Independence Act of 1947.

## Different sources of our Constitution

- The founding fathers of our Constitution had before them the accumulated experience from the working of all the known constitutions of the world, and were aware of the difficulties faced in the working of those constitutions.
- Hence, besides incorporating some provisions from the other constitutions, a number of provisions were included to avoid some of the difficulties experienced in the working of these constitutions.
- This is an important reason for making our Constitution the lengthiest and the most comprehensive of all written constitutions of the world.
- The most profound influence was exercised by the Government of India Act of 1935. The federal scheme, office of governor, power of federal judiciary, emergency powers etc were drawn from this Act.
- The British practice influenced the lawmaking procedures, rule of law, system of single citizenship besides, of course, the model of a parliamentary form of government.
- The US Constitution inspired details on the independence of judiciary, judicial review, fundamental rights, and the removal of Supreme Court and High Court judges.
- The Irish Constitution was the source of the Directive Principles, method of Presidential elections, and the

- nomination of members of Rajya Sabha • by the President.
- From the Canadian Constitution was taken the idea of a federation with a strong Centre, and placing residuary powers with the Centre.

The Weimar Constitution of Germany was the source of provisions concerning the suspension of fundamental rights during emergency. The idea of a Concurrent List was taken from the Australian Constitution.

## Parts

The individual Articles of the Constitution are grouped together into the following Parts:

<b>Part I – Union and its Territory</b>	<b>Part XII – Finance, Property, Contracts and Suits</b>
<b>Part II – Citizenship.</b>	<b>Part XIII – Trade and Commerce within the territory of India</b>
<b>Part III – Fundamental Rights</b>	<b>Part XIV – Services Under the Union, the States</b>
<b>Part IV – Directive Principles of State Policy</b>	<b>Part XIVA – Tribunals</b>
<b>Part IVA – Fundamental Duties</b>	<b>Part XV – Elections</b>
<b>Part V – The Union</b>	<b>Part XVI – Special Provisions Relating to certain Classes</b>
<b>Part VI – The States</b>	<b>Part XVII – Languages</b>
<b>Part VII – States in the B part of the First schedule (repealed)</b>	<b>Part XVIII – Emergency Provisions</b>
<b>Part VIII – The Union Territories</b>	<b>Part XIX – Miscellaneous</b>
<b>Part IX – The Panchayats</b>	<b>Part XX – Amendment of the Constitution</b>
<b>Part IXA – The Municipalities</b>	<b>Part XXI – Temporary, Transitional and Special Provisions</b>
<b>Part IXB – The Co-operative Societies</b>	<b>Part XXII – Short title, date of commencement, Authoritative text in Hindi and Repeals</b>
<b>Part X – The scheduled and Tribal Areas</b>	
<b>Part XI – Relations between the Union and the States</b>	

## Schedules

Schedules are lists in the Constitution that categorize and tabulate bureaucratic activity and policy of the Government.

**First Schedule** (Articles 1 and 4) - This lists the states and territories of India, lists any changes to their borders and the laws used to make that change.

**Second Schedule** (Articles 59(3), 65(3), 75(6), 97, 125, 148(3), 158(3), 164(5), 186 and 221) – This lists the salaries of officials holding public

office, judges, and Comptroller and Auditor General of India.

**Third Schedule** (Articles 75(4), 99, 124(6), 148(2), 164(3), 188 and 219) – Forms of Oaths – This lists the oaths of offices for elected officials and judges.

**Fourth Schedule** (Articles 4(1) and 80(2)) – This details the allocation of seats in the *Rajya Sabha* (the upper house of Parliament) per State or Union Territory.

## NATRAJ INSTITUTE OF TNPSC

**Fifth Schedule** (Article 244(1)) – This provides for the administration and control of Scheduled Areas<sup>[Note 5]</sup> and Scheduled Tribes<sup>[Note 6]</sup> (areas and tribes needing special protection due to disadvantageous conditions).

**Sixth Schedule** (Articles 244(2) and 275(1)) – Provisions made for the administration of tribal areas in Assam, Meghalaya, Tripura, and Mizoram.

**Seventh Schedule** (Article 246) – The union (central government), state, and concurrent lists of responsibilities.

**Eighth Schedule** (Articles 344(1) and 351) – The official languages.

**Ninth Schedule** (Article 31-B) – Validation of certain Acts and Regulations.<sup>[40]</sup>

**Tenth Schedule** (Articles 102(2) and 191(2)) – "Anti-defection" provisions for Members of Parliament and Members of the State Legislatures.

**Eleventh Schedule** (Article 243-D) – *Panchayat Raj* (rural local government),

**Twelfth Schedule** (Article 243-W) – Municipalities (urban local government).

## THE CONSTITUTION OF INDIA

### PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC and to secure to all its citizens: JUSTICE, social, economic and political; LIBERTY of thought, expression, belief, faith and worship; EQUALITY of status and of opportunity; and to promote among them all FRATERNITY assuring the dignity of the individual and the 2[unity and integrity of the Nation]; IN OUR CONSTITUENT ASSEMBLY this twenty sixth day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

- Derived from "objectives Resolution" passed by J.Nehru in Constituent Assembly.
- Basic Structure of a constitution
- Once amended by 42<sup>nd</sup> constitutional amendment act, 1976 which was inserted "SOCIALIST, SECULAR, INTEGRITY" in preamble.

**PART I****THE UNION AND ITS TERRITORY**

**1.** (1) India, that is Bharat, shall be a Union of States.

(2) The States and the territories thereof shall be as specified in the First Schedule.

(3) The territory of India shall comprise—

(a) the territories of the States;

(b) the Union territories specified in the First Schedule; and

(c) such other territories as may be acquired.

**2.** Parliament may by law admit into the Union, or establish, new States on such terms and conditions as it thinks fit.

**3.** Parliament may by law—

(a) form a new State by separation of territory from any State or by uniting two or more States or parts of States or by uniting any territory to a part of any State;

(b) increase the area of any State;

(c) diminish the area of any State;

(d) alter the boundaries of any State;

(e) alter the name of any State:

4[Provided that no Bill for the purpose shall be introduced in either House of Parliament except on the recommendation of the President]

The Bill has been referred by the President to the Legislature of that State for expressing its views thereon within such period as may be specified in the reference or within such further period as the President may allow and the period so specified or allowed has expired.

**4.** Any law referred to in article 2 or article 3 shall contain such provisions for the amendment of the First Schedule and the Fourth Schedule as may be necessary to give effect to the provisions of the law and may also contain such supplemental, incidental and consequential provisions (including provisions as to representation in Parliament and in the Legislature or Legislatures of the State or States affected by such law) as Parliament may deem necessary.

**THE CONSTITUTION OF INDIA**

(2) No such law as aforesaid shall be deemed to be an amendment of this Constitution for the purposes of article 368.

**PART II**  
**CITIZENSHIP**  
(*Part II.—Citizenship.—Arts. 7—11.*)

- 5.** At the commencement of this Constitution, every person who has his domicile in the territory of India and—  
(a) who was born in the territory of India; or  
(b) either of whose parents was born in the territory of India; or  
(c) who has been ordinarily resident in the territory of India for not less than five years immediately preceding such commencement, shall be a citizen of India.
- 6.** Citizenship at the commencement of the Constitution. Rights of citizenship of certain persons who have migrated to India from Pakistan.
- 7.** Notwithstanding anything in articles 5 and 6, a person who has after the first day of March, 1947, migrated from the territory of India to the territory now included in Pakistan shall not be deemed to be a citizen of India: Provided that nothing in this article shall apply to a person who, after having so migrated to the territory now included in Pakistan, has returned to the territory of India under a permit for resettlement or permanent return issued by or under the authority of any law and every such person shall for the purposes of clause (b) of article 6 be deemed to have migrated to the territory of India after the nineteenth day of July, 1948.

- 8.** Notwithstanding anything in article 5, any person who or either of whose parents or any of whose grandparents was born in India as defined in the Government of India Act, 1935 (as originally enacted), and who is ordinarily residing in any country outside India as so defined shall be deemed to be a citizen of India if he has been registered as a citizen of India by the diplomatic or consular representative of India in the country where he is for the time being residing on an application made by him therefor to such diplomatic or consular representative, whether before or after the commencement of

**THE CONSTITUTION OF INDIA**

this Constitution, in the form and manner prescribed by the Government of the Dominion of India or the Government of India.

**9.** No person shall be a citizen of India by virtue of article 5, or be deemed to be a citizen of India by virtue of article 6 or article 8, if he has voluntarily acquired the citizenship of any foreign State.

**10.** Every person who is or is deemed to be a citizen of India under any of the foregoing provisions of this Part shall, subject to the provisions of any law that may be made by Parliament, continue to be such citizen.

**11.** Nothing in the foregoing provisions of this Part shall derogate from the power of Parliament to make any provision with respect to the acquisition and termination of citizenship and all other matters relating to citizenship.

**Citizenship act 1955** gives how to acquire / how to loss citizenship. It was amended in 1986, 1992, 2003, 2005, 2013, 2015.

**How to acquire:**

1. By birth
2. By descent
3. By registration
4. By naturalization
5. By incorporation of territory

**How to loss:**

1. **Renunciation**
2. Termination
3. Deprivation

**PART III**  
**FUNDAMENTAL RIGHTS**

- Drawn from USA constitution
- Judicially enforceable

*General*

**12.** In this Part, unless the context otherwise requires, the State" includes the Government and Parliament of India and the Government and the Legislature of each of the States and all local or other authorities within the territory of India or under the control of the Government of India.

**13. (1)** All laws in force in the territory of India immediately before the commencement of this Constitution, in so far as they are inconsistent with the provisions of this Part, shall, to the extent of such inconsistency, be void. (2) The State shall not make any law which takes away or abridges the rights conferred by this Part and any law made in contravention of this clause shall, to the extent of the contravention, be void.

*Right to Equality*

**14.** The State shall not deny to any person equality before the law or the equal protection of the laws within the territory of India.

**15.** The State / citizen shall not discriminate against any citizen on grounds only of religion, race, caste, sex, place of birth or any of them.

**16.** There shall be equality of opportunity for all citizens in matters relating to employment or appointment to any office under the State.

**17.** "Untouchability" is abolished and its practice in any form is forbidden. The enforcement of any disability arising out of "Untouchability" shall be an offence punishable in accordance with law.

**18. (1)** No title, not being a military or academic distinction, shall be conferred by the State.  
(2) No citizen of India shall accept any title from any foreign State.

**THE CONSTITUTION OF INDIA***Right to Freedom*

**19.** (1) All citizens shall have the right— (a) to freedom of speech and expression; (b) to assemble peaceably and without arms; (c) to form associations or unions; (d) to move freely throughout the territory of India; (e) to reside and settle in any part of the territory of India; (g) to practise any profession, or to carry on any occupation, trade or business.

**20.** (1) No Ex Post Facto Law - No person shall be convicted of any offence except for violation of a law in force at the time of the commission of the Act charged as an offence, nor be subjected to a penalty greater than that which might have been inflicted under the law in force at the time of the commission of the offence.

(2) No Double Jeopardy - No person shall be prosecuted and punished for the same offence more than once.

(3)No Self Incrimination - No person accused of any offence shall be compelled to be a witness against himself.

**21.** No person shall be deprived of his life or personal liberty except according to procedure established by law.

**21A.** The State shall provide free and compulsory education to all children of the age of six to fourteen years in such manner as the State may, by law, determine

**22.** (1) No person who is arrested shall be detained in custody without being informed, as soon as may be, of the grounds for such arrest nor shall he be denied the right to consult, and to be defended by, a legal practitioner of his choice.

(2) Every person who is arrested and detained in custody shall be produced before the nearest magistrate within a period of twenty-four hours of such arrest excluding the time necessary for the journey from the place of arrest to the court of the magistrate and no such person shall be

detained in custody beyond the said period without the authority of a magistrate.

(3) to any person who is arrested or detained under any law providing for preventive detention.

(4) No law providing for preventive detention shall authorise the detention of a person for a longer period than three months unless—

(a) an Advisory Board consisting of persons who are, or have been, or are qualified to be appointed

### *Right against Exploitation*

**23.** Traffic in human beings and *begar* and other similar forms of forced labor are prohibited and any contravention of this provision shall be an offence punishable in accordance with law.

**24.** No child below the age of fourteen years shall be employed to work in any factory or mine or engaged in any other hazardous employment.

### *Right to Freedom of Religion*

**25.** Freedom of conscience and free profession, practice and propagation of religion.

**26.** the right— (a) to establish and maintain institutions for religious and charitable purposes;

(b) to manage its own affairs in matters of religion;

Prohibition of employment of children in factories, etc.

**27.** No person shall be compelled to pay any taxes, the proceeds of which are specifically appropriated in payment of expenses for the promotion or maintenance of any particular religion or religious denomination.

**28.** (1) No religious instruction shall be provided in any educational institution wholly maintained out of State funds.

### *Cultural and Educational Rights*

**29.** (1) Any section of the citizens residing in the territory of India or any part thereof having a distinct language, script or culture of its own shall have the right to conserve the same.

(2) No citizen shall be denied admission into any educational institution maintained by the State or receiving aid out of State funds on grounds only of religion, race, caste, language or any of them.

**30.** All minorities, whether based on religion or language, shall have the right to establish and administer educational institutions of their choice.

**31.** [Compulsory acquisition of property.] *Repealed by the Constitution (Forty-fourth Amendment) Act, 1978.*

### *Right to Constitutional Remedies*

**32.** (1) The right to move the Supreme Court by appropriate proceedings for the enforcement of the rights conferred by this Part is guaranteed.

(2) The Supreme Court shall have power to issue directions or orders or writs, including writs in the nature of *habeas corpus, mandamus, prohibition, quo warranto* and *certiorari*, whichever may be appropriate, for the enforcement of any of the rights conferred by this Part.

(3) Without prejudice to the powers conferred on the Supreme Court by clauses (1) and (2), Parliament may by law empower any other court to exercise within the local limits of its jurisdiction all or any of the powers exercisable by the Supreme Court under clause (2).

(4) The right guaranteed by this article shall not be suspended except as otherwise provided for by this Constitution.

**33.** Parliament may, by law, determine to what extent any of the rights conferred by this Part shall, in their application to,—

(a) the members of the Armed Forces; or

(b) the members of the Forces charged with the maintenance of public order; or  
(c) persons employed in any bureau or other organization established by the State for purposes of intelligence or counter intelligence;

**34.** Restriction on rights conferred by this Part while martial law is in force in any area.

**35.** Parliament shall have, and the Legislature of a State shall not have, power to make laws—  
Legislation to give effect to the provisions of this Part.

#### **PART IV** **DIRECTIVE PRINCIPLES OF STATE POLICY**

- Drawn from Ireland constitution
- Judicially not enforceable

**36.** In this Part, unless the context otherwise requires, “the State” has the same meaning as in Part III.

**37.** The provisions contained in this Part shall not be enforceable by any court, but the principles therein laid down are nevertheless fundamental in the governance of the country and it shall be the duty of the State to apply these principles in making laws.

#### **Socialistic Principles**

**38.** The State shall strive to promote the welfare of the people by securing and protecting as effectively as it may a social order in which justice, social, economic and political, shall inform all the institutions of the national life.

**39.** The State shall, in particular, direct its policy towards securing—

- (a) that the citizens, men and women equally, have the right to an adequate means of livelihood;
- (b) that the ownership and control of the material resources of the community are so distributed as best to sub serve the common good;

(c) that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment;

(d) that there is equal pay for equal work for both men and women;

(e) that the health and strength of workers, men and women, and the tender age of children are not abused and that citizens are not forced by economic necessity to enter avocations unsuited to their age or strength;

(f) that children are given opportunities and facilities to develop in a healthy manner and in conditions of freedom and dignity and that childhood and youth are protected against exploitation and against moral and material abandonment.

**39A.** The State shall secure that the operation of the legal system promotes justice, on a basis of equal opportunity, and shall, in particular, provide free legal aid, by suitable legislation or schemes or in any other way, to ensure that opportunities for securing justice are not denied to any citizen by reason of economic or other disabilities.

**41.** The State shall, within the limits of its economic capacity and development, make effective provision for securing the right to work, to education and to public assistance in cases of unemployment, old age, sickness and disablement, and in other cases of undeserved want.

**42.** The State shall make provision for securing just and humane conditions of work and for maternity relief.

**43.** The State shall endeavour to secure, by suitable legislation or economic organisation or in any other way, to all workers, agricultural, industrial or otherwise, work, a living wage, conditions of work ensuring a decent standard of life and full enjoyment of leisure and social and cultural opportunities and, in particular, the State shall endeavour to promote cottage

industries on an individual or co-operative basis in rural areas.

**43A.** The State shall take steps, by suitable legislation or in any other way, to secure the participation of workers in the management of undertakings, establishments or other organisations engaged in any industry.

**47.** The State shall regard the raising of the level of nutrition and the standard of living of its people and the improvement of public health as among its primary duties and, in particular,

## Gandhian Principles

**40.** The State shall take steps to organise village panchayats and endow them with such powers and authority as may be necessary to enable them to function as units of self-government.

**43.** To promote cottage industries

**46.** The State shall promote with special care the educational and economic interests of the weaker sections of the people, and, in particular, of the Scheduled Castes and the Scheduled Tribes, and shall protect them from social injustice and all forms of exploitation.

**47.** the State shall endeavour to bring about prohibition of the consumption except for medicinal purposes of intoxicating drinks and of drugs which are injurious to health.

**48.** Prohibition of slaughtering of cows/cattle's.

## Liberal / Intellectual Principles

**44.** The State shall endeavor to secure for the citizens a uniform civil code throughout the territory of India.

**45.** Provision for early childhood care and education to children below the age of six years.—The State shall endeavour to provide early childhood care and education for all

children until they complete the age of six years.”.

**48.** The State shall endeavour to organise agriculture and animal husbandry on modern and scientific lines and shall, in particular, take steps for preserving and improving the breeds, and prohibiting the slaughter, of cows and calves and other milch and draught cattle.

**48A.** Protection and improvement of environment and safeguarding of forests and wild life.

**49.** It shall be the obligation of the State to protect every monument or place or object of artistic or historic interest, to be of national importance, from spoliation, disfigurement, destruction, removal, disposal or export, as the case may be.

**50.** The State shall take steps to separate the judiciary from the executive in the public services of the State.

**51.** The State shall endeavour to—

- (a) promote international peace and security;
- (b) maintain just and honourable relations between nations;
- (c) foster respect for international law and treaty obligations in the dealings of organized peoples with one another; and
- (d) encourage settlement of international disputes by arbitration.

**PART IVA**  
**FUNDAMENTAL DUTIES**

**51A.** It shall be the duty of every citizen of India—

- (a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;
- (b) to cherish and follow the noble ideals which inspired our national struggle for freedom;
- (c) to uphold and protect the sovereignty, unity and integrity of India;
- (d) to defend the country and render national service when called upon to do so;
- (e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;
- (f) to value and preserve the rich heritage of our composite culture;
- (g) to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures;
- (h) to develop the scientific temper, humanism and the spirit of inquiry and reform;
- (i) to safeguard public property and to abjure violence;
- (j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;
- (k) who is a parent or guardian to provide opportunities for education to his child or, as the case may be, ward between the age of six and fourteen years.

- 10 Fundamental duties Inserted on the recommendation of Swaran Singh committee by the Constitution (Forty-second Amendment) Act, 1976.
- 11<sup>th</sup> duty was Inserted by the Constitution (Eighty-sixth Amendment) Act, 2002
- Derived from USSR constitution

**THE CONSTITUTION OF INDIA****PART V - THE UNION****CHAPTER I.—THE EXECUTIVE*****The President***

**52.** There shall be a President of India.

**53.** (1) The executive power of the Union shall be vested in the President and shall be exercised by him either directly or through officers subordinate to him in accordance with this Constitution.

(2) Without prejudice to the generality of the foregoing provision, the supreme command of the Defence Forces of the Union shall be vested in the President and the exercise thereof shall be regulated by law.

**54.** The President shall be elected by the members of an electoral college consisting of— (a) the elected members of both Houses of Parliament; and (b) the elected members of the Legislative Assemblies of the States.

Election shall be determined in the following manner:—

(a) every elected member of the Legislative Assembly of a State shall have as many votes as there are multiples of one thousand in the quotient obtained by dividing the population of the State by the total number of the elected members of the Assembly;

(b) if, after taking the said multiples of one thousand, the remainder is not less than five hundred, then the vote of each member referred to in sub-clause (a) shall be further increased by one;

(c) each elected member of either House of Parliament shall have such number of votes as may be obtained by dividing the total number of votes assigned to the members of the Legislative Assemblies of the States under sub-clauses (a) and (b) by the total number of the elected members of both Houses of Parliament, fractions exceeding one-half being counted as one and other fractions being disregarded.

(3) The election of the President shall be held in accordance with the system of proportional representation by means of the single transferable vote and the voting at such election shall be by secret ballot.

**56.** (1) The President shall hold office for a term of five years from the date on which he enters upon his office:

Provided that—

(a) the President may, by writing under his hand addressed to the Vice-President, resign his office;

**57.** A person who holds, or who has held, office as President shall, subject to the other provisions of this Constitution, be eligible for re-election to that office.

**60.** Every President and every person acting as President or discharging the functions of the President shall, before entering upon his office, make and subscribe in the presence of the Chief Justice of India or, in his absence, the senior-most Judge of the Supreme Court available, an oath or affirmation

**61.** When a President is to be impeached for “violation of the Constitution”, the charge shall be preferred by either House of Parliament.

#### **Procedure for impeachment of the President:**

No such charge shall be preferred unless—

(a) the proposal to prefer such charge is contained in a resolution which has been moved after at least fourteen days' notice in writing signed by not less than one-fourth of the total number of members of the House has been given of their intention to move the resolution, and  
(b) such resolution has been passed by a majority of not less than two-thirds of the total membership of the House.

(c) When a charge has been so preferred by either House of Parliament, the other House shall investigate the charge or cause the charge to be investigated and the President shall have

the right to appear and to be represented at such investigation.

(d) If as a result of the investigation a resolution is passed by a majority of not less than two-thirds of the total membership of the House by which the charge was investigated or caused to be investigated, declaring that the charge preferred against the President has been sustained, such resolution shall have the effect of removing the President from his office as from the date on which the resolution is so passed.

#### **CHAPTER III.—LEGISLATIVE POWERS OF THE PRESIDENT**

**123.** (1) If at any time, except when both Houses of Parliament are in session, the President is satisfied that circumstances exist which render it necessary for him to take immediate action, he may promulgate such Ordinances as the circumstances appear to him to require.

(2) An Ordinance promulgated under this article shall have the same force and effect as an Act of Parliament, but every such Ordinance—

(a) shall be laid before both Houses of Parliament and shall cease to operate at the expiration of six weeks from the reassembly of Parliament, or, if before the expiration of that period resolutions disapproving it are passed by both Houses, upon the passing of the second of those resolutions; and  
(b) may be withdrawn at any time by the President.

**Vice-President**

**63.** There shall be a Vice-President of India.

**64.** The Vice-President shall be *ex officio* Chairman of the Council of States and shall not hold any other office of profit:

Provided that during any period when the Vice-President acts as President or discharges the functions of the President under article 65, he shall not perform the duties of the office of Chairman of the Council of States and shall not be entitled to any salary or allowance payable to the Chairman of the Council of States under article 97.

**65.** (1) In the event of the occurrence of any vacancy in the office of the President by reason of his death, resignation or removal, or otherwise, the Vice-President shall act as President until the date on which a new President elected in accordance with the provisions of this Chapter to fill such vacancy enters upon his office.

**66.** (1) The Vice-President shall be elected by the members of an electoral college consisting of the members of both Houses of Parliament in accordance with the system of proportional representation by means of the single transferable vote and the voting at such election shall be by secret ballot.

(2) The Vice-President shall not be a member of either House of Parliament or of a House of the Legislature of any State, and if a member of either House of Parliament or of a House of the Legislature of any State be elected Vice-President, he shall be deemed to have vacated his seat in that House on the date on which he enters upon his office as Vice-President.

(3) No person shall be eligible for election as Vice-President unless he—

(a) is a citizen of India;

(b) has completed the age of thirty-five years; and (c) is qualified for election as a member of the Council of States.

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(4) A person shall not be eligible for election as Vice-President if he holds any office of profit under the Government of India or the Government of any State or under any local or other authority subject to the control of any of the said Governments.

**67.** The Vice-President shall hold office for a term of five years from the date on which he enters upon his office:

Provided that—

(a) a Vice-President may, by writing under his hand addressed to the President, resign his office;

(b) a Vice-President may be removed from his office by a resolution of the Council of States passed by a majority of all the then members of the Council and agreed to by the House of the People; but no resolution for the purpose of this clause shall be moved unless at least fourteen days' notice has been given of the intention to move the resolution;

(c) a Vice-President shall, notwithstanding the expiration of his term, continue to hold office until his successor enters upon his office.

**General points:**

**71.** All doubts and disputes arising out of or in connection with the election of a President or Vice-President shall be inquired into and decided by the Supreme Court whose decision shall be final.

**72.** The President shall have the power to grant pardons, reprieves, respites or remissions of punishment or to suspend, remit or commute the sentence of any person convicted of any offence—

(a) in all cases where the punishment or sentence is by a Court Martial;

(b) in all cases where the punishment or sentence is for an offence against any law relating to a matter to which the executive power of the Union extends;

(c) in all cases where the sentence is a sentence of death.

(2) Nothing in sub-clause (a) of clause (1) shall affect the power conferred by law on any officer of the Armed Forces of the Union to suspend, remit or commute a sentence passed by a Court Martial.

(3) Nothing in sub-clause (c) of clause (1) shall affect the power to suspend, remit or commute a sentence of death exercisable by the Governor of a State under any law for the time being in force.

### **Council of Ministers**

**74.** There shall be a Council of Ministers with the Prime Minister at the head to aid and advise the President who shall, in the exercise of his functions, act in accordance with such advice

The question whether any, and if so what, advice was tendered by Ministers to the President shall not be inquired into in any court.

**75.** (1) The Prime Minister shall be appointed by the President and the other Ministers shall be appointed by the President on the advice of the Prime Minister.

The total number of Ministers, including the Prime Minister, in the Council of Ministers shall not exceed fifteen per cent. of the total number of members of the House of the People -  
Inserted by the Constitution (Ninety-first Amendment) Act, 2003

(2) The Ministers shall hold office during the pleasure of the President.

(3) The Council of Ministers shall be collectively responsible to the House of the People.

(4) Before a Minister enters upon his office, the President shall administer to him the oaths of office and of secrecy according to the forms set out for the purpose in the Third Schedule.

(5) A Minister who for any period of six consecutive months is not a member of either House of Parliament shall at the expiration of that period cease to be a Minister.

(6) The salaries and allowances of Ministers shall be such as Parliament may from time to time by law determine and, until Parliament so

determines, shall be as specified in the Second Schedule.

### ***The Attorney-General for India***

**76.** (1) The President shall appoint a person who is qualified to be appointed a Judge of the Supreme Court to be Attorney-General for India.

(2) It shall be the duty of the Attorney-General to give advice to the Government of India upon such legal Other provisions as to Ministers. matters, and to perform such other duties of a legal character, as may from time to time be referred or assigned to him by the President, and to discharge the functions conferred on him by or under this Constitution or any other law for the time being in force.

(3) In the performance of his duties the Attorney-General shall have right of audience in all courts in the territory of India.

(4) The Attorney-General shall hold office during the pleasure of the President, and shall receive such remuneration as the President may determine.

### ***Conduct of Government Business***

**77.** (1) All executive action of the Government of India shall be expressed to be taken in the name of the President.

**CHAPTER II.—PARLIAMENT****General**

**79.** There shall be a Parliament for the Union which shall consist of the President and two Houses to be known respectively as the Council of States and the House of the People.

**80.** (1) The Council of States shall consist of—  
(a) twelve members (in the fields of Literature, science, art and social service) to be nominated by the President and (b) not more than two hundred and thirty-eight representatives of the States and of the Union territories.

(2) The allocation of seats in the Council of States to be filled by representatives of the States and of the Union territories shall be in accordance with the provisions in that behalf contained in the Fourth Schedule.

(4) The representatives of each State in the Council of States shall be elected by the elected members of the Legislative Assembly of the State in accordance with the system of proportional representation by means of the single transferable vote.

(5) The representatives of the Union territories in the Council of States shall be chosen in such manner as Parliament may by law prescribe.

The House of the People shall consist of—  
(a) not more than five hundred and thirty members chosen by direct election from territorial constituencies in the States, and  
(b) not more than twenty members to represent the Union territories, chosen in such manner as Parliament may by law provide.

**83.** (1) The Council of States shall not be subject to dissolution, but as nearly as possible one-third of the members thereof shall retire as soon as may be on the expiration of every second year in accordance with the provisions made in that behalf by Parliament by law.

**Qualifications of MPs**

**84.** A person shall not be qualified to be chosen to fill a seat in Parliament unless he— is a citizen of India, and makes and subscribes before some

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person authorised in that behalf by the Election Commission an oath or affirmation according to the form set out for the purpose in the Third Schedule;

(b) is, in the case of a seat in the Council of States, not less than thirty years of age and, in the case of a seat in the House of the People, not less than twenty-five years of age; and

(c) possesses such other qualifications as may be prescribed in that behalf by or under any law made by Parliament.

**85.** The President shall from time to time summon each House of Parliament to meet at such time and place as he thinks fit, but six months shall not intervene between its last sitting in one session and the date appointed for its first sitting in the next session.

(2) The President may from time to time—  
(a) prorogue the Houses or either House;  
(b) dissolve the House of the People.

**President's address in the Parliament**

**87.** (1) At the commencement of the first session after each general election to the House of the People and at the commencement of the first session of each year the President shall address both Houses of Parliament assembled together and inform Parliament of the causes of its summons.

**88.** Every Minister and the Attorney-General of India shall have the right to speak in, and otherwise to take part in the proceedings of, either House, any joint sitting of the Houses, and any committee of Parliament of which he may be named a member, but shall not by virtue of this article be entitled to vote.

**Officers of Parliament**

**89.** (1) The Vice-President of India shall be *ex officio* Chairman of the Council of States.

(2) The Council of States shall, as soon as may be, choose a member of the Council to be Deputy Chairman thereof and, so often as the office of Deputy Chairman becomes vacant, the Council

shall choose another member to be Deputy Chairman thereof.

**93.** The House of the People shall, as soon as may be, choose two members of the House to be respectively Speaker and Deputy Speaker thereof and, so often as the office of Speaker or Deputy Speaker becomes vacant, the House shall choose another member to be Speaker or Deputy Speaker, as the case may be.

**95.** (1) While the office of Speaker is vacant, the duties of the office shall be performed by the Deputy Speaker or, if the office of Deputy Speaker is also vacant, by such member of the House of the People as the President may appoint for the purpose.

(2) During the absence of the Speaker from any sitting of the House of the People the Deputy Speaker or, if he is also absent, such person as may be determined by the rules of procedure of the House, or, if no such person is present, such other person as may be determined by the House, shall act as Speaker.

**97.** There shall be paid to the Chairman and the Deputy Chairman of the Council of States, and to the Speaker and the Deputy Speaker of the House of the People, such salaries and allowances as may be respectively fixed by Parliament by law and, until provision in that behalf is so made, such salaries and allowances as are specified in the Second Schedule.

### **Conduct of Business**

**99.** Every member of either House of Parliament shall, before taking his seat, make and subscribe before the President, or some person appointed in that behalf by him, an oath or affirmation according to the form set out for the purpose in the Third Schedule.

**100.** (1) Save as otherwise provided in this Constitution, all questions at any sitting of either House or joint sitting of the Houses shall be determined by a majority of votes of the members present and voting, other than the

Speaker or person acting as Chairman or Speaker.

The Chairman or Speaker, or person acting as such, shall not vote in the first instance, but shall have and exercise a casting vote in the case of an equality of votes.

**Quorum:** Until Parliament by law otherwise provides, the quorum to constitute a meeting of either House of Parliament shall be one-tenth of the total number of members of the House.

If at any time during a meeting of a House there is no quorum, it shall be the duty of the Chairman or Speaker, or person acting as such, either to adjourn the House or to suspend the meeting until there is a quorum.

### **Disqualifications of Members**

**101.** (1) No person shall be a member of both Houses of Parliament and provision shall be made by Parliament by law for the vacation by a person who is chosen a member of both Houses of his seat in one House or the other.

(2) No person shall be a member both of Parliament and of a House of the Legislature of a State, and if

a person is chosen a member both of Parliament and of a House of the Legislature of 2[a State], then, at the expiration of such period as may be specified in rules made by the President, that person's seat in Parliament shall become vacant, unless he has previously resigned his seat in the Legislature of the State.

(3) If for a period of sixty days a member of either House of Parliament is without permission of the House absent from all meetings thereof, the House may declare his seat vacant: Provided that in computing the said period of sixty days no account shall be taken of any period during which the House is prorogued or is adjourned for more than four consecutive days.

**102.** (1) A person shall be disqualified for being chosen as, and for being, a member of either House of Parliament—

- (a) if he holds any office of profit under the Government of India or the Government of any State, other than an office declared by Parliament by law not to disqualify its holder;
- (b) if he is of unsound mind and stands so declared by a competent court;
- (c) if he is an undischarged insolvent;
- (d) if he is not a citizen of India, or has voluntarily acquired the citizenship of a foreign State, or is under any acknowledgment of allegiance or adherence to a foreign State;
- (e) if he is so disqualified by or under any law made by Parliament.

**Powers, Privileges and Immunities of Parliament and its Members**

- 105.** (1) Subject to the provisions of this Constitution and to the rules and standing orders regulating the procedure of Parliament, there shall be freedom of speech in Parliament.  
(2) No member of Parliament shall be liable to any proceedings in any court in respect of anything said or any vote given by him in Parliament or any committee thereof, and no person shall be so liable in respect of the publication by or under the authority of either House of Parliament of any report, paper, votes or proceedings.  
(3) In other respects, the powers, privileges and immunities of each House of Parliament, and of the members and the committees of each House, shall be such as may from time to time be defined by Parliament by law, and, until so defined, 1[shall be those of that House and of its members and committees immediately before the coming into force of section 15 of the Constitution (Forty-fourth Amendment) Act,

- 106.** Members of either House of Parliament shall be entitled to receive such salaries and allowances as may from time to time be determined by Parliament by law and, until provision in that respect is so made, allowances at such rates and upon such conditions as were immediately before the commencement of this Constitution applicable in the case of members

of the Constituent Assembly of the Dominion of India.

***Legislative Procedure***

- 107.** (1) Subject to the provisions of articles 109 and 117 with respect to Money Bills and other financial Bills, a Bill may originate in either House of Parliament.  
(2) Subject to the provisions of articles 108 and 109, a Bill shall not be deemed to have been passed by the Houses of Parliament unless it has been agreed to by both Houses, either without amendment or with such amendments only as are agreed to by both Houses.  
(3) A Bill pending in Parliament shall not lapse by reason of the prorogation of the Houses.  
(4) A Bill pending in the Council of States which has not been passed by the House of the People shall not lapse on a dissolution of the House of the People.  
(5) A Bill which is pending in the House of the People, or which having been passed by the House of the People is pending in the Council of States, shall, subject to the provisions of article 108, lapse on a dissolution of the House of the People.

***Joint Sitting:***

- 108.** (1) If after a Bill has been passed by one House and transmitted to the other House—  
(a) the Bill is rejected by the other House; or  
(b) the Houses have finally disagreed as to the amendments to be made in the Bill; or Salaries and allowances of members.  
(c) more than six months elapse from the date of the reception of the Bill by the other House without the Bill being passed by it, the President may, unless the Bill has elapsed by reason of a dissolution of the House of the People, notify to the Houses by message if they are sitting or by public notification if they are not sitting, his intention to summon them to meet in a joint sitting for the purpose of deliberating and voting on the Bill: Provided that nothing in this clause shall apply to a Money Bill.  
(2) In reckoning any such period of six months as is referred to in clause (1), no account shall be

taken of any period during which the House referred to in sub-clause (c) of that clause is prorogued or adjourned for more than four consecutive days.

(3) Where the President has under clause (1) notified his intention of summoning the Houses to meet in a joint sitting,

(4) If at the joint sitting of the two Houses the Bill, with such amendments, if any, as are agreed to in joint sitting, is passed by a majority of the total number of members of both Houses present and voting, it shall be deemed for the purposes of this Constitution to have been passed by both Houses:

**109.** (1) A Money Bill shall not be introduced in the Council of States.

(2) After a Money Bill has been passed by the House of the People it shall be transmitted to the Council of States for its recommendations and the Council of States shall within a period of fourteen days from the date of its receipt of the Bill return the Bill to the House of the People with its recommendations and the House of the People may thereupon either accept or reject all or any of the recommendations of the Council of States.

**Money Bill:**

**110.** (1) For the purposes of this Chapter, a Bill shall be deemed to be a Money Bill if it contains only provisions dealing with all or any of the following matters, namely:—

- (a) the imposition, abolition, remission, alteration or regulation of any tax;
- (b) the regulation of the borrowing of money or the giving of any guarantee by the Government of India, or the amendment of the law with respect to any financial obligations undertaken or to be undertaken by the Government of India;
- (c) the custody of the Consolidated Fund or the Contingency Fund of India, the payment of moneys into or the withdrawal of moneys from any such Fund;
- (d) the appropriation of moneys out of the Consolidated Fund of India;
- (e) the declaring of any expenditure to be expenditure charged on the Consolidated Fund

of India or the increasing of the amount of any such expenditure;

(f) the receipt of money on account of the Consolidated Fund of India or the public account of India or the custody or issue of such money or the audit of the accounts of the Union or of a State; or

(g) any matter incidental to any of the matters specified in sub-clauses (a) to (f).

(3) If any question arises whether a Bill is a Money Bill or not, the decision of the Speaker of the House of the People thereon shall be final.

(4) There shall be endorsed on every Money Bill when it is transmitted to the Council of States under article 109, and when it is presented to the President for assent under article 111, the certificate of the Speaker of the House of the People signed by him that it is a Money Bill.

**President's Assent:**

**111.** When a Bill has been passed by the Houses of Parliament, it shall be presented to the President, and the President shall declare either that he assents to the Bill, or that he withholds assent therefrom: Provided that the President may, as soon as possible after the presentation to him of a Bill for assent, return the Bill if it is not a Money Bill to the Houses with a message requesting that they will reconsider the Bill or any specified provisions thereof and, in particular, will consider the desirability of introducing any such amendments as he may recommend in his message, and when a Bill is so returned, the Houses shall reconsider the Bill accordingly, and if the Bill is passed again by the Houses with or without amendment and presented to the President for assent, the President shall not withhold assent therefrom.

**Procedure in Financial Matters****Annual Financial Statement / BUDGET**

**112.** (1) The President shall in respect of every financial year cause to be laid before both the Houses of Parliament a statement of the

estimated receipts and expenditure of the Government of India for that year, in this Part referred to as the "annual financial statement".

(2) The estimates of expenditure embodied in the annual financial statement shall show separately— (a) the sums required to meet expenditure described by this Constitution as expenditure charged upon the Consolidated Fund of India; and Assent to Bills.

(b) the sums required to meet other expenditure proposed to be made from the Consolidated Fund of India, and shall distinguish expenditure on revenue account from other expenditure.

**113.** (1) So much of the estimates as relates to expenditure charged upon the Consolidated Fund of India shall not be submitted to the vote of Parliament, but nothing in this clause shall be construed as preventing the discussion in either House of Parliament of any of those estimates.

(2) So much of the said estimates as relates to other expenditure shall be submitted in the form of demands for grants to the House of the People, and the House of the People shall have power to assent, or to refuse to assent, to any demand, or to assent to any demand subject to a reduction of the amount specified therein.

(3) No demand for a grant shall be made except on the recommendation of the President.

**No money shall be withdrawn from the Consolidated Fund of India except under appropriation made by law passed in accordance with the provisions of this article.**

**116.** (1) Notwithstanding anything in the foregoing provisions of this Chapter, the House of the People shall have power—

(a) to make any grant in advance in respect of the estimated expenditure for a part of any financial Supplementary, additional or excess grants.

**Votes on account, votes of credit and exceptional grants.**

(b) to make a grant for meeting an unexpected demand upon the resources of India when on account of the magnitude or the indefinite

character of the service the demand cannot be stated with the details ordinarily given in an annual financial statement;

(c) to make an exceptional grant which forms no part of the current service of any financial year; and Parliament shall have power to authorise by law the withdrawal of moneys from the Consolidated Fund of India for the purposes for which the said grants are made.

**117.** (1) A Bill or amendment making provision for any of the matters specified in sub-clauses (a) to (f) of clause (1) of article 110 shall not be introduced or moved except on the recommendation of the President and a Bill making such provision shall not be introduced in the Council of States:

It provides for the imposition, abolition, remission, Special provisions as to financial Bills.

#### ***Procedure Generally***

**120.** (1) Notwithstanding anything in Part XVII, but subject to the provisions of article 348, business in Parliament shall be transacted in Hindi or in English: Provided that the Chairman of the Council of States or Speaker of the House of the People, or person acting as such, as the case may be, may permit any member who cannot adequately express himself in Hindi or in English to address the House in his mother-tongue.

**121.** No discussion shall take place in Parliament with respect to the conduct of any Judge of the Supreme Court or of a High Court in the discharge of his duties except upon a motion for presenting an address to the President praying for the removal of the Judge as hereinafter provided.

**CHAPTER IV.—THE UNION JUDICIARY**

**124.** (1) There shall be a Supreme Court of India consisting of a Chief Justice of India and, until Parliament by law prescribes a larger number, of not more than 30 other Judges.

(2) Every Judge of the Supreme Court shall be appointed by the President by warrant under his hand and seal after consultation with such of the Judges of the Supreme Court and of the High Courts in the States as the President may deem necessary for the purpose and shall hold office until he attains the age of sixty-five years:

A Judge may, by writing under his hand addressed to the President, resign his office

**Qualification of Judges:** A person shall not be qualified for appointment as a Judge of the Supreme Court unless

he is a citizen of India and

(a) has been for at least five years a Judge of a High Court or of two or more such Courts in succession; or

(b) has been for at least ten years an advocate of a High Court or of two or more such Courts in succession; or

(c) is, in the opinion of the President, a distinguished jurist.

**Removal of Judges:**

Judge of the Supreme Court shall not be removed from his office except by an order of the President passed after an address by each House of Parliament supported by a majority of the total membership of that House and by a majority of not less than two thirds of the members of that House present and voting has been presented to the President in the same session for such removal on the ground of proved "misbehavior or incapacity"

(6) Every person appointed to be a Judge of the Supreme Court shall, before he enters upon his office, make and subscribe before the President, or some person appointed in that behalf by him, an oath or affirmation according to the form set out for the purpose in the Third Schedule.

(7) No person who has held office as a Judge of the Supreme Court shall plead or act in any court or before any authority within the territory of India.

**125.** There shall be paid to the Judges of the Supreme Court such salaries as may be determined by Parliament by law and, until provision in that behalf is so made, such salaries as are specified in the Second Schedule.

**129.** The Supreme Court shall be a court of record and shall have all the powers of such a court including the power to punish for contempt of itself.

**Seat of Supreme Court:**

**130.** The Supreme Court shall sit in Delhi or in such other place or places, as the Chief Justice of India may, with the approval of the President, from time to time, appoint.

**Jurisdictions:**

**131.** The Supreme Court shall, to the exclusion of any other court, have **original jurisdiction** in any dispute—

(a) between the Government of India and one or more States; or

(b) between the Government of India and any State or States on one side and one or more other States on the other; or

(c) between two or more States,

**132.** An **appeal** shall lie to the Supreme Court from any judgment, decree or final order of a High Court in the territory of India, whether in a civil, criminal or Supreme Court other proceeding, if the High Court certifies under article 134A that the case involves a substantial question of law as to the interpretation of this Constitution.

**133.** An appeal shall lie to the Supreme Court from any judgment, decree or final order in a civil proceeding of a High Court in the territory of India

(a) that the case involves a substantial question of law of general importance; and

(b) that in the opinion of the High Court the said question needs to be decided by the Supreme Court.

**136.** Notwithstanding anything in this Chapter, the Supreme Court may, in its discretion, grant **special leave** to appeal from any judgment, decree, determination, sentence or order in any cause or matter passed or made by any court or tribunal in the territory of India.

**137.** Subject to the provisions of any law made by Parliament or any rules made under article 145, the Supreme Court shall have **power to review** any judgment pronounced or order made by it.

**141.** The law declared by the Supreme Court shall be binding on all courts within the territory of India.

### **Advisory Jurisdiction:**

**143.** If at any time it appears to the President that a question of law or fact has arisen, or is likely to arise, which is of such a nature and of such public importance that it is expedient to obtain the opinion of the Supreme Court upon it, he may refer the question to that Court for consideration and the Court may, after such hearing as it thinks fit, report to the President its opinion thereon.

The President may, notwithstanding anything in the proviso to article 131, refer a dispute of the kind mentioned in the 3[said proviso] to the Supreme Court for opinion and the Supreme Court shall, after such hearing as it thinks fit, report to the President its opinion thereon.

The administrative expenses of the Supreme Court, including all salaries, allowances and pensions payable to or in respect of the officers and servants of the Court, shall be charged upon the Consolidated Fund of India, and any fees or other moneys taken by the Court shall form part of that Fund.

## **CHAPTER V - COMPTROLLER AND AUDITOR-GENERAL OF INDIA (CAG)**

**148.** (1) There shall be a Comptroller and Auditor-General of India who shall be appointed by the President by warrant under his hand and seal and shall only be removed from office in like manner and on the like grounds as a Judge of the Supreme Court.

(2) Every person appointed to be the Comptroller and Auditor-General of India shall, before he enters upon his office, make and subscribe before the President, or some person appointed in that behalf by him, an oath or affirmation according to the form set out for the purpose in the Third Schedule.

(3) The salary and other conditions of service of the Comptroller and Auditor-General shall be such as may be determined by Parliament

(4) The Comptroller and Auditor-General shall not be eligible for further office

The administrative expenses of the office of the Comptroller and Auditor-General, including all salaries, allowances and pensions payable to or in respect of the persons serving in that office, shall be charged upon the Consolidated Fund of India.

**149.** The Comptroller and Auditor-General shall perform such duties and exercise such powers in relation to the accounts of the Union and of the States and of any other authority or body as may be prescribed by or under any law made by Parliament

**151.** The reports of the Comptroller and Auditor-General of India relating to the accounts of the Union shall be submitted to the President, who shall cause them to be laid before each House of Parliament.

(2) The reports of the Comptroller and Auditor-General of India relating to the accounts of a State shall be submitted to the Governor of the State, who shall cause them to be laid before the Legislature of the State.

**PART VI**  
**THE STATES****CHAPTER I.—GENERAL**

**152.** In this Part, unless the context otherwise requires, the expression “State” does not include the State of Jammu and Kashmir

**CHAPTER II.—THE EXECUTIVE*****The Governor***

**153.** There shall be a Governor for each State:

**155.** The Governor of a State shall be appointed by the President by warrant under his hand and seal.

**156.** (1) The Governor shall hold office during the pleasure of the President.

(2) The Governor may, by writing under his hand addressed to the President, resign his office.

(3) Subject to the foregoing provisions of this article, a Governor shall hold office for a term of five years from the date on which he enters upon his office: Provided that a Governor shall, notwithstanding the expiration of his term, continue to hold office until his successor enters upon his office.

**Qualifications:**

**157.** No person shall be eligible for appointment as Governor unless he is a citizen of India and has completed the age of thirty-five years.

**159.** Every Governor and every person discharging the functions of the Governor shall, before entering upon his office, make and subscribe in the presence of the Chief Justice of the High Court exercising jurisdiction in relation to the State, or, in his absence, the senior most Qualifications for appointment as Governor.

**161.** The Governor of a State shall have the power to grant pardons, reprieves, respites or remissions of punishment or to suspend, remit or commute the sentence of any person convicted of any offence against any law relating

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to a matter to which the executive power of the State extends.

***Council of Ministers***

**163.** (1) There shall be a Council of Ministers with the Chief Minister at the head to aid and advise the Governor in the exercise of his functions, except in so far as he is by or under this Constitution required to exercise his functions or any of them in his discretion.

**164.** (1) The Chief Minister shall be appointed by the Governor and the other Ministers shall be appointed by the Governor on the advice of the Chief Minister, and the Ministers shall hold office during the pleasure of the Governor:

(2) The Council of Ministers shall be collectively responsible to the Legislative Assembly of the State.

(3) Before a Minister enters upon his office, the Governor shall administer to him the oaths of office and of secrecy according to the forms set out for the purpose in the Third Schedule.

(4) A Minister who for any period of six consecutive months is not a member of the Legislature of the State shall at the expiration of that period cease to be a Minister.

(5) The salaries and allowances of Ministers shall be such as the Legislature of the State may from time to time by law determine and, until the Legislature of the State so determines, shall be as specified in the Second Schedule.

***The Advocate-General for the State***

**165.** (1) The Governor of each State shall appoint a person who is qualified to be appointed a Judge of a High Court to be Advocate-General for the State.

(2) It shall be the duty of the Advocate-General to give advice to the Government of the State upon such legal matters, and to perform such other duties of a legal character, as may from time to time be referred or assigned to him by the Governor, and to discharge the functions conferred on him by or under this Constitution or any other law for the time being in force.

(3) The Advocate-General shall hold office during the pleasure of the Governor, and shall receive such remuneration as the Governor may determine *Conduct of Government Business*

**CHAPTER III-THE STATE LEGISLATURE  
*General***

**168.** (1) For every State there shall be a Legislature which shall consist of the Governor, and— (a) in the States of Telengana, Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Karnataka, and Uttar Pradesh, two Houses; (b) in other States, one House.

(2) Where there are two Houses of the Legislature of a State, one shall be known as the Legislative Council and the other as the Legislative Assembly, and where there is only one House, it shall be known as the Legislative Assembly.

**169.** (1) Parliament may by law provide for the abolition of the Legislative Council of a State having such a Council for the creation of such a Council in a State having no such Council, if the Legislative Assembly of the State passes a resolution to that effect by a majority of the total membership of the Assembly and by a majority of not less than two-thirds of the members of the Assembly present and voting.

(2) Any law referred to in clause (1) shall contain such provisions for the amendment of this Constitution as may be necessary to give effect to the provisions of the law and may also contain

such supplemental, incidental and consequential provisions as Parliament may deem necessary.

(3) No such law as aforesaid shall be deemed to be an amendment of this Constitution for the purposes of article 368.

(1) Subject to the provisions of article 333, the Legislative Assembly of each State shall consist of not more than five hundred, and not less than sixty, members chosen by direct election from territorial constituencies in the State.

(2) For the purposes of clause (1), each State shall be divided into territorial constituencies in such manner that the ratio between the population of each constituency and the number of seats allotted to it shall, so far as practicable, be the same throughout the State.

**171.** (1) The total number of members in the Legislative Council of a State having such a Council shall not exceed one-third of the total number of members in the Legislative Assembly of that State:

Provided that the total number of members in the Legislative Council of a State shall in no case be less than forty.

(2) Until Parliament by law otherwise provides, the composition of the Legislative Council of a State shall be as provided in clause (3).

(3) Of the total number of members of the Legislative Council of a State—

(a) as nearly as may be, one-third shall be elected by electorates consisting of members of municipalities, district boards and such other local authorities in the State as Parliament may by law specify;

(b) as nearly as may be, one-twelfth shall be elected by electorates consisting of persons residing in the State who have been for at least three years graduates of any university in the territory of India or have been for at least three years in possession of qualifications prescribed by or under any law made by Parliament as equivalent to that of a graduate of any such university;

(c) as nearly as may be, one-twelfth shall be elected by electorates consisting of persons who have been for at least three years engaged in

teaching in such educational institutions within the State, not lower in standard than that of a secondary school, as may be prescribed by or under any law made by Parliament;

(d) as nearly as may be, one-third shall be elected by the members of the Legislative Assembly of the State from amongst persons who are not members of the Assembly;

(e) the remainder shall be nominated by the Governor in accordance with the provisions of clause (5).

(4) The members to be elected under sub-clauses (a), (b) and (c) of clause (3) shall be chosen in such territorial constituencies as may be prescribed by or under any law made by Parliament, and the elections under the said sub-clauses and under sub-clause (d) of the said clause shall be held in accordance with the system of proportional representation by means of the single transferable vote.

(5) The members to be nominated by the Governor under sub-clause (e) of clause (3) shall consist of persons having special knowledge or practical experience in respect of such matters as the following, namely:— Literature, science, art, co-operative movement and social service.

**172.** (1) Every Legislative Assembly of every State, unless sooner dissolved, shall continue for five years from the date appointed for its first meeting and no longer and the expiration of the said period of 1[five years shall operate as a dissolution of the Assembly:

Provided that the said period may, while a proclamation of Emergency is in operation, be extended by Parliament by law for a period not exceeding one year at a time and not extending in any case beyond a period of six months after the Proclamation has ceased to operate.

(2) The Legislative Council of a State shall not be subject to dissolution, but as nearly as possible one-third of the members thereof shall retire as soon as may be on the expiration of every second year in accordance with the provisions made in that behalf by Parliament by law.

**173.** A person shall not be qualified to be chosen to fill a seat in the Legislature of a State unless

he— (a) is a citizen of India, and makes and subscribes before some person authorised in that behalf by the Election Commission an oath or affirmation according to the form set out for the purpose in the Third Schedule;

(b) is, in the case of a seat in the Legislative Assembly, not less than twenty-five years of age and, in the case of a seat in the Legislative Council, not less than thirty years of age; and

(c) possesses such other qualifications as may be prescribed in that behalf by or under any law made by Parliament.

**174.** (1) The Governor shall from time to time summon the House or each House of the Legislature of the State to meet at such time and place as he thinks fit, but six months shall not intervene between its last sitting in one session and the date appointed for its first sitting in the next session.

(2) The Governor may from time to time—  
(a) prorogue the House or either House;  
(b) dissolve the Legislative Assembly.

**200.** When a Bill has been passed by the Legislative Assembly of a State or, in the case of a State having a Legislative Council, has been passed by both Houses of the Legislature of the State, it shall be presented to the Governor and the Governor shall declare either that he assents to the Bill or that he withholds assent therefrom or that he reserves the Bill for the consideration of the President:

Provided that the Governor may, as soon as possible after the presentation to him of the Bill for assent, return the Bill if it is not a Money Bill together with a message requesting that the House or Houses will reconsider the Bill or any specified provisions thereof and, in particular, will consider the desirability of introducing any such amendments as he may recommend in his message and, Assent to Bills.

when a Bill is so returned, the House or Houses shall reconsider the Bill accordingly, and if the Bill is passed again by the House or Houses with or without amendment and presented to the

Governor for assent, the Governor shall not withhold assent there from:

Provided further that the Governor shall not assent to, but shall reserve for the consideration of the President, any Bill which in the opinion of the Governor would, if it became law, so derogate from the powers of the High Court as to endanger the position which that Court is by this Constitution designed to fill.

**201.** When a Bill is reserved by a Governor for the consideration of the President, the President shall declare either that he assents to the Bill or that he withholds assent therefrom:

Provided that, where the Bill is not a Money Bill, the President may direct the Governor to return the Bill to the House or, as the case may be, the Houses of the Legislature of the State together with such a message as is mentioned in the first proviso to article 200 and, when a Bill is so returned, the House or Houses shall reconsider it accordingly within a period of six months from the date of receipt of such message and, if it is again passed by the House or Houses with or without amendment, it shall be presented again to the President for his consideration.

#### ***Procedure in Financial Matters***

**202.** (1) The Governor shall in respect of every financial year cause to be laid before the House or Houses of the Legislature of the State a statement of the estimated receipts and expenditure of the State for that year, in this Part referred to as the "annual financial statement".

(2) The estimates of expenditure embodied in the annual financial statement shall show separately—

(a) the sums required to meet expenditure described by this Constitution as expenditure charged upon the Consolidated Fund of the State; and Bills reserved for consideration.

No demand for a grant shall be made except on the recommendation of the Governor.

#### ***Procedure Generally***

**210.** (1) Notwithstanding anything in Part XVII, but subject to the provisions of article 348, business in the Legislature of a State shall be transacted in the official language or languages of the State or in Hindi or in English:

Provided that the Speaker of the Legislative Assembly or Chairman of the Legislative Council, or person acting as such, as the case may be, may permit any member who cannot adequately express himself in any of the languages aforesaid to address the House in his mother tongue.

**211.** No discussion shall take place in the Legislature of a State with respect to the conduct of any Judge of the Supreme Court or of a High Court in the discharge of his duties.

#### **CHAPTER IV.—LEGISLATIVE POWER OF THE GOVERNOR**

**213.** (1) If at any time, except when the Legislative Assembly of a State is in session, or where there is a Legislative Council in a State, except when both Houses Restriction on discussion in the Legislature.

Courts not to inquire into proceedings of the Legislature.

The Governor is satisfied that circumstances exist which render it necessary for him to take immediate action, he may promulgate such Ordinances as the circumstances appear to him to require:

Provided that the Governor shall not, without instructions from the President, promulgate any such Ordinance if—

(a) a Bill containing the same provisions would under this Constitution have required the previous sanction of the President for the introduction thereof into the Legislature; or  
(b) he would have deemed it necessary to reserve a Bill containing the same provisions for the consideration of the President; or

(c) an Act of the Legislature of the State containing

the same provisions would under this Constitution have been invalid unless, having been reserved for the consideration of the President, it had received the assent of the President.

(2) An Ordinance promulgated under this article shall have the same force and effect as an Act of the Legislature of the State assented to by the Governor, but every such Ordinance—

(a) shall be laid before the Legislative Assembly of the State, or where there is a Legislative Council in the State, before both the Houses, and shall cease to operate at the expiration of six weeks from the reassembly of the Legislature, or if before the expiration of that period a resolution disapproving it is passed by the Legislative Assembly and agreed to by the Legislative Council, if any, upon the passing of the resolution or, as the case may be, on the resolution being agreed to by the Council; and  
(b) may be withdrawn at any time by the Governor.

## **CHAPTER V-THE HIGH COURTS**

**214.** There shall be a High Court for each State.

**216.** Every High Court shall consist of a Chief Justice and such other Judges as the President may from time to time deem it necessary to appoint.

**217.** (1) Every Judge of a High Court shall be appointed by the President by warrant under his hand and seal after consultation with the Chief Justice of India, the Governor of the State, and, in the case of appointment of a Judge other than the Chief Justice, the Chief Justice of the High Court, and shall hold office, in the case of an additional or acting Judge, as provided in article 224, and in any other case, until he attains the age of sixty two years.

Provided that—

(a) a Judge may, by writing under his hand addressed to the President, resign his office;  
(b) a Judge may be removed from his office by the President in the manner provided in clause

(4) of article 124 for the removal of a Judge of the Supreme Court;

(c) the office of a Judge shall be vacated by his being appointed by the President to be a Judge of the Supreme Court or by his being transferred by the President to any other High Court within the territory of India.

### **HC Judge Qualifications:**

(2) A person shall not be qualified for appointment as a Judge of a High Court unless he is a citizen of India and—

(a) has for at least ten years held a judicial office in the territory of India; or  
(b) has for at least ten years been an advocate of a High Court or of two or more such Courts in succession;

**219.** Every person appointed to be a Judge of a High Court shall, before he enters upon his office, make and subscribe before the Governor of the State, or some person appointed in that behalf by him, an oath or affirmation according to the form set out for the purpose in the Third Schedule.

**221.** There shall be paid to the Judges of each High Court such salaries as may be determined by Parliament by law and, until provision in that behalf is so made, such salaries as are specified in the Second Schedule.

**222.** (1) The President may, after consultation with the Chief Justice of India, transfer a Judge from one High Court to any other High Court.

**226.** (1) Notwithstanding anything in article 32 every High Court shall have power, throughout the territories in relation to which it exercises jurisdiction, to issue to any person or authority, including in appropriate cases, any Government, within those territories directions, Jurisdiction of existing High Courts.

Power of High Courts to issue certain writs.  
orders or writs, including 1[writs in the nature of *habeas corpus*, *mandamus*, *prohibition*, *quo warranto* and *certiorari*, or any of them, for the

enforcement of any of the rights conferred by Part III and for any other purpose.

throughout the territories in relation to which it exercises jurisdiction.

**227.** Every High Court shall have superintendence over all courts and tribunals

Court name	Established	Act established	Jurisdiction	Seat	BENCHES
Allahabad High Court <sup>[2]</sup>	11 June 1866	Indian High Courts Act 1861	Uttar Pradesh	Allahabad	Lucknow
Bombay High Court	14 August 1862	Indian High Courts Act 1861	Maharashtra, Goa, Dadra and Nagar Haveli, Daman and Diu	Mumbai	Aurangabad,Nagpur, Panaji
Calcutta High Court	2 July 1862	Indian High Courts Act 1861	West Bengal, Andaman and Nicobar Islands	Kolkata	Port Blair
Chhattisgarh High Court	1 November 2000	Madhya Pradesh Reorganisation Act, 2000	Chhattisgarh	Bilaspur	
Delhi High Court <sup>[3]</sup>	31 October 1966	Delhi High Court Act, 1966	National Capital Territory of Delhi	New Delhi	
Gauhati High Court <sup>[4]</sup>	1 March 1948	Government of India Act, 1935	Arunachal Pradesh, Assam, Nagaland, Mizoram	Guwahati	Aizwal,Itanagar,Kohima
Gujarat High Court	1 May 1960	Bombay Reorganisation Act, 1960	Gujarat	Ahmedabad	
High Court of Judicature at Hyderabad <sup>[5]</sup>	5 July 1954	Andhra State Act, 1953	Andhra Pradesh,Telangana	Hyderabad	
Himachal Pradesh High Court	1971	State of Himachal Pradesh Act, 1970	Himachal Pradesh	Shimla	
Jammu and Kashmir High Court	28 August 1943	Letters Patent issued by then Maharaja of Kashmir	Jammu and Kashmir	Srinagar/Jammu <sup>[6]</sup>	
Jharkhand High Court	15 November 2000	Bihar Reorganisation Act, 2000	Jharkhand	Ranchi	

<b>Karnataka High Court<sup>[7]</sup></b>	1884	Mysore High Court Act, 1884	Karnataka	Bengaluru	Dharwad,Gulbarga
<b>Kerala High Court<sup>[8]</sup></b>	1956	States Reorganisation Act, 1956	Kerala, Lakshadweep	Kochi	
<b>Madhya Pradesh High Court<sup>[9]</sup></b>	2 January 1936	Government of India Act, 1935	Madhya Pradesh	Jabalpur	Gwalior,Indore
<b>Madras High Court</b>	15 August 1862	Indian High Courts Act 1861	Tamil Nadu, Puducherry	Chennai	Madurai
<b>Manipur High Court</b>	25 March 2013	North-Eastern Areas (Reorganisation) and Other Related Laws (Amendment) Act, 2012	Manipur,	Imphal	
<b>Meghalaya High Court</b>	25 March 2013	<u>North-Eastern Areas (Reorganisation) and Other Related Laws (Amendment) Act, 2012</u>	Meghalaya,	Shillong	
<b>Orissa High Court</b>	3 April 1948	Orissa High Court Order, 1948	Odisha	Cuttack	
<b>Patna High Court</b>	2 September 1916	Government of Bihar India Act, 1915	Bihar	Patna	
<b>Punjab and Haryana High Court<sup>[11]</sup></b>	21 March 1919	High Court (Punjab) Order, 1947	Punjab, Haryana,Chandigarh	Chandigarh	
<b>Rajasthan High Court</b>	21 June 1949	Rajasthan High Court Ordinance, 1949	Rajasthan	Jodhpur	Jaipur
<b>Sikkim High Court</b>	16 May 1975	The 36th Amendment to the Indian Constitution	Sikkim	Gangtok	
<b>Tripura</b>	26 March	North-Eastern	Tripura	Agartala	

High Court	2013	Areas (Reorganisation) and Other Related Laws (Amendment) Act, 2012		
Uttarakhand High Court	9 November 2000	Uttar Pradesh Reorganisation Act, 2000	Uttarakhand	Nainital

**CHAPTER VI.—SUBORDINATE COURTS**

**233.** (1) Appointments of persons to be, and the posting and promotion of, district judges in any State shall be made by the Governor of the State in consultation with the High Court exercising jurisdiction in relation to such State.

(2) A person not already in the service of the Union or of the State shall only be eligible to be appointed a district judge if he has been for not less than seven years an advocate or a pleader and is recommended by the High Court for appointment.

**235.** The control over district courts and courts subordinate thereto including the posting and promotion of, and the grant of leave to, persons belonging to the judicial service of a State and holding any post inferior to the post of district judge shall be vested in the High Court, but nothing in this article shall be construed as taking away from any such person any right of appeal which he may have under the law regulating the conditions of his service or as authorizing the High Court to deal with him otherwise than in accordance with the conditions of his service prescribed under such law.

**PART VIII  
THE UNION TERRITORIES**

**239.** (1) Save as otherwise provided by Parliament by law, every Union territory shall be administered by the President acting, to such extent as he thinks fit, through an administrator to be appointed by him with such designation as he may specify.

The President may appoint the Governor of a State as the administrator of an adjoining Union territory, and where a Governor is so appointed, he shall exercise his functions as such administrator independently of his Council of Ministers.

**PART IX**  
**THE PANCHAYATS**

**243.** In this Part, unless the context otherwise requires,—

- (a) “district” means a district in a State;
- (b) “Gram Sabha” means a body consisting of persons registered in the electoral rolls relating to a village comprised within the area of Panchayat at the village level;
- (c) “intermediate level” means a level between the village and district levels specified by the Governor of a State by public notification to be the intermediate level for the purposes of this Part;
- (d) “Panchayat” means an institution (by whatever name called) of self-government constituted under article 243B, for the rural areas;
- (e) “Panchayat area” means the territorial area of a Panchayat;
- (f) “population” means the population as ascertained at the last preceding census of which the relevant figures have been published;
- (g) “village” means a village specified by the Governor by public notification to be a village for the purposes of this Part and includes a group of villages so specified.

**243A.** A Gram Sabha may exercise such powers and perform such functions at the village level as the Legislature of a State may, by law, provide.

**243-I.** (1) The Governor of a State shall, as soon as may be within one year from the commencement of the Constitution (Seventy-third Amendment) Act, 1992, and thereafter at the expiration of every fifth year, constitute a Finance Commission to review the financial position of the Panchayats and to make recommendations Powers to impose taxes by, and Funds of, the Panchayats.

**243K.** (1) The superintendence, direction and control of the preparation of electoral rolls for, and the conduct of, all elections to the

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Panchayats shall be vested in Audit of accounts of Panchayats. Elections to the Panchayats.

**PART IXA**  
**THE MUNICIPALITIES**

**243P.** In this Part, unless the context otherwise requires,—

- (a) “Committee” means a Committee constituted under article 243S;
- (b) “district” means a district in a State;
- (c) “Metropolitan area” means an area having a population of ten lakhs or more, comprised in one or more districts and consisting of two or more Municipalities or Panchayats or other contiguous areas, specified by the Governor by public notification to be a Metropolitan area for the purposes of this Part;
- (d) “Municipal area” means the territorial area of a Municipality as is notified by the Governor;
- (e) “Municipality” means an institution of self government constituted under article 243Q;
- (f) “Panchayat” means a Panchayat constituted under article 243B;
- (g) “population” means the population as ascertained at the last preceding census of which the relevant figures have been published.

**243Q.** (1) There shall be constituted in every State,— (a) a Nagar Panchayat (by whatever name called) for a transitional area, that is to say, an area in transition from a rural area to an urban area; (b) a Municipal Council for a smaller urban area; and (c) a Municipal Corporation for a larger urban area,

**243Y.** (1) The Finance Commission constituted under article 243-I shall also review the financial position of the Municipalities and make recommendations to the Governor.

**243ZA.** (1) The superintendence, direction and control of the preparation of electoral rolls for, and the conduct of, all elections to the Municipalities shall be vested in the State Election Commission referred to in article 243K.

**PART X**  
**THE SCHEDULED AND TRIBAL AREAS**

**244.** (1) The provisions of the Fifth Schedule shall apply to the administration and control of the Scheduled Areas and Scheduled Tribes in any State other than the States of Assam Meghalaya, Tripura and Mizoram.

(2) The provisions of the Sixth Schedule shall apply to the administration of the tribal areas in the States of Assam Meghalaya, Tripura and Mizoram

**PART XI**  
**RELATIONS BETWEEN THE UNION AND THE STATES****CHAPTER I.—LEGISLATIVE RELATIONS*****Distribution of Legislative Powers***

**245.** (1) Subject to the provisions of this Constitution, Parliament may make laws for the whole or any part of the territory of India, and the Legislature of a State may make laws for the whole or any part of the State. (2) No law made by Parliament shall be deemed to be invalid on the ground that it would have extra-territorial operation.

**246.** (1) Notwithstanding anything in clauses (2) and (3), Parliament has exclusive power to make laws with respect to any of the matters enumerated in List I in the Seventh Schedule (in this Constitution referred to as the “Union List”). (2) Notwithstanding anything in clause (3), Parliament, and, subject to clause (1), the Legislature of any State also, have power to make laws with respect to any of the matters enumerated in List III in the Seventh Schedule (in this Constitution referred to as the “Concurrent List”).

(3) Subject to clauses (1) and (2), the Legislature of any State has exclusive power to make laws for such State or any part thereof with respect to any of the matters enumerated in List II in the

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Seventh Schedule (in this Constitution referred to as the “State List”).

(4) Parliament has power to make laws with respect to any matter for any part of the territory of India not included in a State notwithstanding that such matter is a matter enumerated in the State List.

**Parliament Legislation over State Lists:**

**249.** If the Council of States has declared by resolution supported by not less than two thirds of the members present and voting that it is necessary or expedient in the national interest that Parliament should make laws with respect to any matter enumerated in the State List specified in the resolution, it shall be lawful for Parliament to make laws for the whole or any part of the territory of India with respect to that matter while the resolution remains in force.

**250.** While a Proclamation of Emergency is in operation, have power to make laws for the whole or any part of the territory of India with respect to any of the matters enumerated in the State List.

**252.** If it appears to the Legislatures of two or more States to be desirable that any of the matters with respect to which Parliament has no power to make laws for the States except as provided in articles 249 and 250 should be regulated in such States by Parliament by law

**253.** Parliament has power to make any law for the whole or any part of the territory of India for implementing any treaty, agreement or convention with any other country or countries or any decision made at any international conference, association or other body.

**356.** When State emergency is in operation

***Co-ordination between States******I - Disputes relating to Waters***

**262.** (1) Parliament may by law provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-State river or river valley.

(2) Parliament may by law provide that neither the Supreme Court nor any other court shall exercise jurisdiction in respect of any such dispute or complaint as is referred to in clause (1).

***II - Inter State Council:***

**263.** If at any time it appears to the President that the public interests would be served by the establishment of a Council charged with the duty of—

- (a) inquiring into and advising upon disputes which may have arisen between States;
- (b) investigating and discussing subjects in which some or all of the States, or the Union and one or more of the States, have a common interest; or
- (c) making recommendations upon any such subject and, in particular, recommendations for the better co-ordination of policy and action with respect to that subject,

it shall be lawful for the President by order to establish such a Council, and to define the nature of the duties to be performed by it and its organisation and procedure.

**THE CONSTITUTION OF INDIA****PART XII****FINANCE, PROPERTY, CONTRACTS AND SUITS****CHAPTER I.—FINANCE**

**265.** No tax shall be levied or collected except by authority of law.

**Consolidated Fund Of India:**

**266.** (1) Subject to the provisions of article 267 and to the provisions of this Chapter with respect to the assignment of the whole or part of the net proceeds of certain taxes and duties to States, all revenues received by the Government of India, all loans raised by that Government by the issue of treasury bills, loans or ways and means advances and all moneys received by that Government in repayment of loans shall form one consolidated fund to be entitled “the Consolidated Fund of India”, and all revenues received by the Government of a State, all loans raised by that Government by the issue of treasury bills, loans or ways and means advances and all moneys received by that Government in repayment of loans shall form one consolidated fund to be entitled “the Consolidated Fund of the State”.

**Public Account Of India:**

**266.** (2) All other public moneys received by or on behalf of the Government of India or the Government of a State shall be credited to the public account of India or the public account of the State, as the case may be.

(3) No moneys out of the Consolidated Fund of India or the Consolidated Fund of a State shall be appropriated except in accordance with law and for the purposes and in the manner provided in this Constitution.

**Contingency fund of India:**

**267.** (1) Parliament may by law establish a Contingency Fund in the nature of an interest to be entitled “the Contingency Fund of India” into which shall be paid from time to time such sums as may be determined by such law, and the said

Fund shall be placed at the disposal of the President to enable advances to be made by him out of such Fund for the purposes of meeting unforeseen expenditure pending authorization of such expenditure by Parliament by law under article 115 or article 116.

(2) The Legislature of a State may by law establish a Contingency Fund in the nature of an interest to be entitled "the Contingency Fund of the State" into which shall be paid from time to time such sums as may be determined by such law, and the said Fund shall be placed at the disposal of the Governor of the State to enable advances to be made by him out of such Fund for the purposes of meeting unforeseen expenditure pending authorisation of such expenditure by the Legislature of the State by law under article 205 or article 206.

### ***Distribution of Revenues between the Union and the States***

**268.** Duties levied by the Union but collected and appropriated by the States.

(1) Such stamp duties and such duties of excise on medicinal and toilet preparations as are mentioned in the Union List shall be levied by the Government of India but shall be collected—  
(a) in the case where such duties are leviable within any Union territory, by the Government of India, and  
(b) in other cases, by the States within which such duties are respectively leviable.

(2) The proceeds in any financial year of any such duty leviable within any State shall not form part of the Consolidated Fund of India, but shall be assigned to that State.

**268A.** (1) Taxes on services shall be levied by the Government of India and such tax shall be collected and appropriated by the Government of India and the States

**269.** (1) Taxes on the sale or purchase of goods and taxes on the consignment of goods shall be levied and collected by the Government of India but shall be assigned and shall be deemed to

have been assigned to the States on or after the 1st day of April, 1996

**270.** (1) All taxes and duties referred to in the Union List, except the duties and taxes referred to in articles 268 and 269, respectively, surcharge on taxes and duties referred to in article 271 and any cess levied for specific purposes under any law made by Parliament shall be levied and collected by the Government of India and shall be distributed between the Union and the States

**271.** Parliament may at any time increase any of the duties or taxes referred to in those articles by a surcharge for purposes of the Union and the whole proceeds of any such surcharge shall form part of the Consolidated Fund of India.

**272.** *Taxes which are levied and collected by the Union and may be distributed between the Union and the States.*

*Repealed by the Constitution (Eightieth Amendment) Act, 2000*

**273.** There shall be charged on the Consolidated Fund of India in each year as grants-in-aid of the revenues of the States of Assam, Bihar, Orissa and West Bengal, in lieu of assignment of any share of the net proceeds in each year of export duty on jute and jute products to those States, such sums as may be prescribed.

**274.** (1) No Bill or amendment which imposes or varies any tax or duty in which States are interested,

**275.** (1) Such sums as Parliament may by law provide shall be charged on the Consolidated Fund of India in each year as grants-in-aid of the revenues of such States as Parliament may determine to be in need of assistance, and different sums may be fixed for different States.

**Finance Commission**

**280.** (1) The President shall, within two years from the commencement of this Constitution and thereafter at the expiration of every fifth year or at such earlier time as the President considers necessary, by order constitute a Finance Commission which shall consist of a Chairman and four other members to be appointed by the President.

(2) Parliament may by law determine the qualifications which shall be requisite for appointment as members of the Commission and the manner in which they shall be selected.

**Duties:**

(3) It shall be the duty of the Commission to make recommendations to the President as to—  
(a) the distribution between the Union and the States of the net proceeds of taxes which are to be, or may be, divided between them under this Chapter and the allocation between the States of the respective shares of such proceeds;

(b) the principles which should govern the grants in- aid of the revenues of the States out of the Consolidated Fund of India;

(4) The Commission shall determine their procedure and shall have such powers in the performance of their functions as Parliament may by law confer on them.

**281.** The President shall cause every recommendation made by the Finance Commission under the provisions of this Constitution together with an explanatory memorandum as to the action taken thereon to be laid before each House of Parliament.

**Miscellaneous Financial Provisions**

**282.** The Union or a State may make any grants for any public purpose, notwithstanding that the purpose is not one with respect to which Parliament or the Legislature of the State, as the case may be, may make laws.

**CHAPTER IV.—RIGHT TO PROPERTY**

**300A.** No person shall be deprived of his property save by authority of law.

**PART XIII  
TRADE, COMMERCE AND INTERCOURSE  
WITHIN THE TERRITORY OF INDIA****PART XIV  
SERVICES UNDER THE UNION AND THE  
STATES****CHAPTER I.—SERVICES****ALL-INDIA SERVICES.**

**312.** If the Council of States has declared by resolution supported by not less than two-thirds of the members present and voting that it is necessary or expedient in the national interest so to do, Parliament may by law provide for the creation of one or more all India services (including an all-India judicial service) common to the Union and the States, and, subject to the other provisions of this Chapter, regulate the recruitment, and the conditions of service of persons appointed, to any such service.

**CHAPTER II.—PUBLIC SERVICE  
COMMISSIONS**

**315.** (1) Subject to the provisions of this article, there shall be a Public Service Commission for the Union and a Public Service Commission for each State.

(2) Two or more States may agree that there shall be one Public Service Commission for that group of States, and if a resolution to that effect is passed by the House or, where there are two Houses, by each House of the Legislature of each of those States, Parliament may by law provide for the appointment of a Joint State Public Service Commission (referred to in this Chapter as Joint Commission) to serve the needs of those States.

**316.** (1) The Chairman and other members of a Public Service Commission shall be appointed, in the case of the Union Commission or a Joint Commission, by the President, and in the case of

a State Commission, by the Governor of the State.

(2) A member of a Public Service Commission shall hold office for a term of six years from the date on which he enters upon his office or until he attains, in the case of the Union Commission, the age of sixty-five years, and in the case of a State Commission or a Joint Commission, the age of sixty-two years, whichever is earlier:

**320.** (1) It shall be the duty of the Union and the State Public Service Commissions to conduct examinations for appointments to the services of the Union and the services of the State respectively.

**323.** (1) It shall be the duty of the Union Commission to present annually to the President a report as to the work done by the Commission and on receipt of such report the President shall cause a copy thereof together with a memorandum explaining, as respects the cases, if any, where the advice of the Commission was not accepted, the reasons for such non-acceptance to be laid before each House of Parliament.

#### **PART XIVA TRIBUNALS**

**323A.** (1) Parliament may, by law, provide for the adjudication or trial by administrative tribunals of disputes and complaints with respect to recruitment and conditions of service of persons appointed to public services and posts in connection with the affairs of the Union or of any State or of any local or other authority within the territory of India or under the control of the Government of India or of any corporation owned or controlled by the Government.

#### **PART XV ELECTIONS**

##### **Election Commission**

**324.** (1) The superintendence, direction and control of the preparation of the electoral rolls for, and the conduct of, all elections to Parliament and to the Legislature of every State and of elections to the offices of President and Vice-President

(2) The Election Commission shall consist of the Chief Election Commissioner and such number of other Election Commissioners, if any, as the President may from time to time fix and the appointment of the Chief Election Commissioner and other Election Commissioners shall, subject to the provisions of any law made in that behalf by Parliament, be made by the President.

- Subject to the provisions of any law made by Parliament, the conditions of service and tenure of office of the Election Commissioners and the Regional Commissioners shall be such as the President may by rule determine.
- Provided that the Chief Election Commissioner shall not be removed from his office except in like manner and on the like grounds as a Judge of the Supreme Court and the conditions of service of the Chief Election Commissioner shall not be varied to his disadvantage after his appointment.
- Provided further that any other Election Commissioner or a Regional Commissioner shall not be removed from office except on the recommendation of the Chief Election Commissioner.

**PART XVI**  
**SPECIAL PROVISIONS RELATING TO CERTAIN CLASSES**

**338.** There shall be a **Commission for the Scheduled Castes** to be known as the National Commission for the Scheduled Castes.

(2) Subject to the provisions of any law made in this behalf by Parliament, the Commission shall consist of a Chairperson, Vice-Chairperson and three other Members and the conditions of service and tenure of office of the Chairperson, Vice-Chairperson and other Members so appointed shall be such as the President may by rule determine.

**338A.** There shall be a Commission for the Scheduled Tribes to be known as the **National Commission for the Scheduled Tribes**.

(2) Subject to the provisions of any law made in this behalf by Parliament, the Commission shall consist of a Chairperson, Vice-Chairperson and three other Members and the conditions of service and tenure of office of the The words "and Scheduled Tribes" omitted by the Constitution (Eighty-ninth Amendment) Act, 2003.

Chairperson, Vice-Chairperson and other Members shall be appointed by the President by warrant under his hand and seal.

**340.** (1) The President may by order appoint a **Commission** consisting of such persons as he thinks fit to investigate the conditions of socially and educationally **backward classes** within the territory of India and the difficulties under which they labour and to make recommendations as to the steps that should be taken by the Union or any State to remove such difficulties and to improve their condition and as to the grants that should be made for the purpose by the Union or any State and the conditions subject to which such grants should be made, and the order appointing such Commission shall define the procedure

**PART XVII**  
**OFFICIAL LANGUAGE****CHAPTER I.—LANGUAGE OF THE UNION**

**343.** (1) The official language of the Union shall be Hindi in Devanagari script.

**344.** (1) The President shall, at the expiration of five years from the commencement of this Constitution and thereafter at the expiration of ten years from such commencement, by order constitute a Commission which shall consist of a Chairman and such other members representing the different languages specified in the Eighth Schedule as the President may appoint, and the order shall define the procedure to be followed by the Commission.

(2) It shall be the duty of the Commission to make recommendations to the President as to—

- (a) the progressive use of the Hindi language for the official purposes of the Union;
- (b) restrictions on the use of the English language for all or any of the official purposes of the Union;
- (c) the language to be used for all or any of the purposes mentioned in article 348;

**PART XVIII**  
**EMERGENCY PROVISIONS****National Emergency:**

**352.** (1) If the President is satisfied that a grave emergency exists whereby the security of India or of any part of the territory thereof is threatened, whether by war or external aggression or armed rebellion, he may, by Proclamation, make a declaration to that effect in respect of the whole of India or of such part of the territory thereof as may be specified in the Proclamation.

(2) A Proclamation issued under clause (1) may be varied or revoked by a subsequent Proclamation.

(3) The President shall not issue a Proclamation under clause (1) or a Proclamation varying such Proclamation unless the decision of the Union Cabinet that such a Proclamation may be issued has been communicated to him in writing.

(4) Every Proclamation issued under this article shall be laid before each House of Parliament and shall, except where it is a Proclamation revoking a previous Proclamation, cease to operate at the expiration of one month unless before the expiration of that period it has been approved by resolutions of both Houses of Parliament.

(5) The Proclamation shall cease to operate at the expiration of thirty days from the date on which the House of the People first sits after its reconstitution unless before the expiration of the said period of thirty days, a resolution approving the continuance in force of the Proclamation has been also passed by the House of the People.

(6) For the purposes of clauses (4) and (5), a resolution may be passed by either House of Parliament only by a majority of the total membership of that House and by a majority of not less than two-thirds of the Members of that House present and voting.

**THE CONSTITUTION OF INDIA**

Proclamations on different grounds, being war or external aggression or armed rebellion

**353.** While a Proclamation of Emergency is in operation, then— (a) notwithstanding anything in this Constitution, the executive power of the Union shall extend to the giving of directions to any State as to the manner in which the executive power thereof is to be exercised; (b) the power of Parliament to make laws with respect to any matter shall include power to make laws conferring powers and imposing duties, or authorising the conferring of powers and the imposition of duties, upon the Union or officers and authorities of the Union as respects that matter, notwithstanding that it is one which is not enumerated in the Union List:

**355.** It shall be the duty of the Union to protect every State against external aggression and internal disturbance and to ensure that the Government of every State is carried on in accordance with the provisions of this Constitution.

**State Emergency:**

**356.** (1) If the President, on receipt of a report from the Governor of a State or otherwise, is satisfied that a situation has arisen in which the Government of the State cannot be carried on in accordance with the provisions of this Constitution, the President may by Proclamation.

**365.** Where any State has failed to comply with, or to give effect to, any directions given in the exercise of the executive power of the Union under any of the provisions of this Constitution, it shall be lawful for the President to hold that a situation has arisen in which the Government of the State cannot be carried on in accordance with the provisions of this Constitution.

(2) Any such Proclamation may be revoked or varied by a subsequent Proclamation.

(3) Every Proclamation under this article shall be laid before each House of Parliament and shall, except where it is a Proclamation revoking a previous Proclamation, cease to operate at the expiration of two months unless before the expiration of that period it has been approved by resolutions of both Houses of Parliament.

It would otherwise have ceased to operate in 6 months, but no such Proclamation shall in any case remain in force for more than three years.

**358. While a Proclamation of Emergency, article 19 shall restrict** the power of the State as defined in Part III to make any law or to take any executive action which the State would but for the provisions contained in that Part be competent to make or to take, but any law so made shall, to the extent of the incompetency, cease to have effect as soon as the Proclamation ceases to operate, except as respects things done or omitted to be done before the law so ceases to have effect.

**359.** Where a Proclamation of Emergency is in operation, the President may by order declare that the right to move any court for the enforcement of such of the rights conferred by Part III (except articles 20 and 21) as may be mentioned in the order and all proceedings pending in any court for the enforcement of the rights so mentioned shall remain suspended for the period during which the Proclamation is in force or for such shorter period as may be

#### **Financial Emergency:**

**360.** If the President is satisfied that a situation has arisen whereby the financial stability or credit of India or of any part of the territory thereof is threatened, he may by a Proclamation make a declaration to that effect.

- (b) shall be laid before each House of Parliament;
- (c) shall cease to operate at the expiration of two

months, unless before the expiration of that period it has been approved by resolutions of both Houses of Parliament:

Notwithstanding anything in this Constitution—

- (a) any such direction may include—
  - (i) a provision requiring the reduction of salaries and allowances of all or any class of persons serving in connection with the affairs of a State;
  - (ii) a provision requiring all Money Bills or other Bills to which the provisions of article 207 apply to be reserved for the consideration of the President after they are passed by the Legislature of the State;

#### **PART XIX**

#### **MISCELLANEOUS**

**361.** (1) The President, or the Governor or Rajpramukh of a State, shall not be answerable to any court for the exercise and performance of the powers and duties of his office or for any act done or purporting to be done by him in the exercise and performance of those powers and duties

**PART XX**  
**AMENDMENT**

**368.** Parliament may in exercise of its constituent power amend by way of addition, variation or repeal any provision of this Constitution in accordance with the procedure laid down in this article.

**Procedure:**

An amendment of this Constitution may be initiated only by the introduction of a Bill for the purpose in either House of Parliament, and when the Bill is passed in each House by a majority of the total membership of that House and by a majority of not less than two-thirds of the members of that House present and voting, it shall be presented to the President who shall

give his assent to the Bill and thereupon the Constitution shall stand amended in accordance with the terms of the Bill.

Provided that if such amendment seeks to make any change in—

- (a) article 54, article 55, article 73, article 162 or article 241, or
  - (b) Chapter IV of Part V, Chapter V of Part VI, or Chapter I of Part XI, or
  - (c) any of the Lists in the Seventh Schedule, or
  - (d) the representation of States in Parliament, or
  - (e) the provisions of this article,
- the amendment shall also require to be ratified by the Legislatures of not less than one-half of the States by resolutions to that effect passed by those Legislatures

**Amendments to the Indian Constitution**

Here is a list of all amendments to the Indian Constitution.

No.	Year	Objectives
1st amendment	June 18, 1951	To fully secure the constitutional validity of zamindari abolition laws. To place reasonable restriction on freedom of speech. A new constitutional device, called Schedule 9 introduced to protect laws that are contrary to the Constitutionally guaranteed fundamental rights. These laws encroach upon property rights, freedom of speech and equality before law
2nd amendment	May 1, 1953	A technical amendment to fix the size of each parliamentary constituency between 650,000 and 850,000 voters.
3rd amendment	February 22, 1955	Limits maximum no of seats in lok Sabha up to 500 States to be divided into constituencies such that one member of a constituency represents between 500000 and 750000 people
4th amendment	April 27, 1955	Restrictions on property rights and inclusion of related bills in Schedule 9 of the constitution
5th amendment	December 24, 1955	Provides for a consultation mechanism with concerned states in matters relating to the amendments to the territorial matters and in the re-naming of the state
6th amendment	September 11, 1956	Amended the Union and State Lists with respect to raising of taxes

7th amendment	November 1956	1,	Reorganization of states on linguistic lines Abolition of Class A, B, C, D states Introduction of Union Territories
8th amendment	January 5, 1960		Clarify state's power of compulsory acquisition and requisitioning of private property Include Zamindari abolition laws in Schedule 9 of the constitution
9th amendment	December 1960	28,	Minor adjustments to territory of Indian Union consequent to agreement with Pakistan for settlement of disputes by demarcation of border villages, etc.
10th amendment	August 11, 1961		Incorporation of Dadra, Nagar and Haveli as a Union Territory after acquisition from Portugal
11th amendment	December 1961	19,	Election of Vice President by Electoral College consisting of members of both Houses of Parliament, instead of election by a Joint Sitting of Parliament. Indemnify the President and Vice President Election procedure from challenge on grounds of existence of any vacancies in the electoral college
12th amendment	December 1961	20,	Incorporation of Goa, Daman and Diu as a Union Territory, after acquisition from Portugal
13th amendment	December 1963	1,	Formation of State of Nagaland, with special protection under Article 371A
14th amendment	December 1962	28,	Incorporation of Pondicherry into the Union of India Creation of Legislative Assemblies for Himachal Pradesh, Tripura, Manipur and Goa
15th amendment	October 5, 1963		Raise retirement age of judges from 60 to 62 Other minor amendments for rationalizing interpretation of rules regarding judges etc.
16th amendment	October 5, 1963		Make it obligatory for seekers of public office to swear their allegiance to the Indian Republic and prescribe the various obligatory templates
17th amendment	June 20, 1964		To secure the constitutional validity of acquisition of Estates and place land acquisition laws in Schedule 9 of the constitution
18th amendment	August 27, 1966		Technical Amendment to include Union Territories in Article 3 and hence permit reorganisation of Union Territories
19th amendment	December 1966	11,	Abolish Election Tribunals and enable trial of election petitions by regular High Courts

20th amendment	December 1966	22,	Indemnify & validate judgments, decrees, orders and sentences passed by judges. Validate the appointment, posting, promotion and transfer of judges except those not eligible for appointment under article 233. Amendment was needed to overcome the effect of judgement invalidating appointments of certain judges in the state of Uttar Pradesh
21th amendment	April 10, 1967		Included Sindhi as a National Language
22nd amendment	September 1969	25,	Provision to form Autonomous states within the State of Assam
23rd amendment	January 1970	23,	Extend reservation for SC / ST and nomination of Anglo Indian members in Parliament and State Assemblies for another ten years i.e. up to 1980
24th amendment	November 1971	5,	Enable parliament to dilute fundamental rights through amendments to the constitution
25th amendment	April 20, 1972		Restrict property rights and compensation in case the state takes over private property
26th amendment	December 1971	28,	Abolition of privy purse paid to former rulers of princely states which were incorporated into the Indian Republic
27th amendment	February 1972	15,	Reorganization of Mizoram into a Union Territory with a legislature and council of ministers
28th amendment	August 29, 1972		Rationalized Civil Service rules to make it uniform across those appointed prior to Independence and post independence
29th amendment	June 9, 1972		Places land reform acts and amendments to these act under Schedule 9 of the constitution
30th amendment	February 1973	27,	Changes the basis for appeals in Supreme Court of India in case of Civil Suits from value criteria to one involving substantial question of law
31th amendment	October 17, 1973		Increased size of Parliament from 525 to 545 seats. Increased seats went to the new states formed in North East India and minor adjustment consequent to 1971 Delimitation exercise
32nd amendment	July 1, 1974		Protection of regional rights in Telangana and Andhra regions of State of Andhra Pradesh
33rd amendment	May 19, 1974		Prescribes procedure for resignation by members of parliament and state legislatures Prescribes procedure for verification and acceptance of resignation by house speaker
34th amendment	September 1974	7,	Place land reform acts and amendments to these act under Schedule 9 of the constitution
35th amendment	March 1, 1975		Terms and Conditions for the Incorporation of Sikkim into the Union of India
36th	April 26, 1975		Formation of Sikkim as a State within the Indian Union

amendment		
37th amendment	May 3, 1975	Formation of Arunachal Pradesh legislative assembly
38th amendment	August 1, 1975	Enhances the powers of President and Governors to pass ordinances
39th amendment	August 10, 1975	Negated the judgement of Allahabad High Court invalidating Prime Minister Indira Gandhi's election to parliament. Amendment placed restrictions on judicial scrutiny of post of Prime Minister
40th amendment	May 27, 1976	Enable Parliament to make laws with respect to Exclusive Economic Zone and vest the mineral wealth with Union of India. Place land reform & other acts and amendments to these act under Schedule 9 of the constitution
41th amendment	September 1976	Raised Retirement Age Limit of Chairmen and Members of Union and State Public Commissions from sixty to sixty two.
42nd amendment	April 1, 1977	Amendment passed during internal emergency by Indira Gandhi. Provides for curtailment of fundamental rights, imposes fundamental duties and changes to the basic structure of the constitution by making India a "Socialist Secular" Republic
43rd amendment	April 13, 1978	Amendment passed after revocation of internal emergency in the Country. Repeals some of the more 'Anti-Freedom' amendments enacted through Amendment Bill 42
44th amendment	September 1979	Amendment passed after revocation of internal emergency in the Country. Provides for human rights safeguards and mechanisms to prevent abuse of executive and legislative authority. Annuls some Amendments enacted in Amendment Bill 42
45th amendment	January 1980	Extend reservation for SC / ST and nomination of Anglo Indian members in Parliament and State Assemblies for another ten years i.e. up to 1990
46th amendment	February 1983	Amendment to negate judicial pronouncements on scope and applicability on Sales Tax
47th amendment	August 26, 1984	Place land reform acts and amendments to these act under Schedule 9 of the constitution
48th amendment	April 1, 1985	Article 356 amended to permit President's rule up to two years in the state of Punjab
49th amendment	September 1984	Recognize Tripura as a Tribal State and enable the creation of a Tripura Tribal Areas Autonomous District Council
50th amendment	September 1984	Technical Amendment to curtailment of Fundamental Rights as per Part III as prescribed in Article 33 to cover Security Personnel protecting property and communication infrastructure

51st amendment	June 16, 1986	Provide reservation to Scheduled Tribes in Nagaland, Meghalaya, Mizoram and Arunachal Pradesh Legislative Assemblies
52nd amendment	March 1, 1985	Anti Defection Law - Provide disqualification of members from parliament and assembly in case of defection from one party to other
53rd amendment	February 20, 1987	Special provision with respect to the State of Mizoram.
54th amendment	April 1, 1986	Increase the salary of Chief Justice of India & other Judges Provisions for determining future increases without the need for constitutional amendment
55th amendment	February 20, 1987	Special powers to Governor consequent to formation of state of Arunachal Pradesh
56th amendment	May 30, 1987	Transition provision to enable formation of state of Goa
57th amendment	September 21, 1987	Provide reservation to Scheduled Tribes in Nagaland, Meghalaya, Mizoram and Arunachal Pradesh Legislative Assemblies
58th amendment	December 9, 1987	Provision to publish authentic Hindi translation of constitution Provision to publish authentic Hindi translation of future amendments
59th amendment	March 30, 1988	Article 356 amended to permit President's rule up to three years in the state of Punjab Articles 352 and Article 359A amended to permit imposing emergency in state of Punjab or in specific districts of the state of Punjab
60th amendment	December 20, 1988	Professional Tax increased from a maximum of Rs. 250/- to a maximum of Rs. 2500/-
61th amendment	March 28, 1989	Reduce age for voting rights from 21 to 18
62nd amendment	December 20, 1989	Extend reservation for SC / ST and nomination of Anglo Indian members in Parliament and State Assemblies for another ten years i.e. up to 2000
63rd amendment	January 6, 1990	Emergency powers applicable to State of Punjab, accorded in Article 359A as per amendment 59 repealed
64th amendment	April 16, 1990	Article 356 amended to permit President's rule up to three years and six months in the state of Punjab
65th amendment	March 12, 1992	National Commission for Scheduled Castes and Scheduled Tribes formed and its statutory powers specified in The Constitution.
66th amendment	June 7, 1990	Place land reform acts and amendments to these act under Schedule 9 of the constitution
67th amendment	October 4, 1990	Article 356 amended to permit President's rule up to four years in the state of Punjab
68th amendment	March 12, 1991	Article 356 amended to permit President's rule up to five years in the state of Punjab

69th amendment	February 1, 1992	To provide for a legislative assembly and council of ministers for Federal National Capital of Delhi. Delhi continues to be a Union Territory
70th amendment	December 21, 1991	Include National Capital of Delhi and Union Territory of Pondicherry in electoral college for Presidential Election
71th amendment	August 31, 1992	Include Konkani, Manipuri and Nepali as National Languages
72nd amendment	December 5, 1992	Provide reservation to Scheduled Tribes in Tripura State Legislative Assembly
73rd amendment	April 24, 1993	Statutory provisions for Panchayat Raj as third level of administration in villages
74th amendment	June 1, 1993	Statutory provisions for Local Administrative bodies as third level of administration in urban areas such as towns and cities
75th amendment	May 15, 1994	Provisions for setting up Rent Control Tribunals
76th amendment	August 31, 1994	Enable continuance of 69% reservation in Tamil Nadu by including the relevant Tamil Nadu Act under 9th Schedule of the constitution
77th amendment	June 17, 1995	A technical amendment to protect reservation to SC/ST Employees in promotions
78th amendment	August 30, 1995	Place land reform acts and amendments to these act under Schedule 9 of the constitution
79th amendment	January 25, 2000	Extend reservation for SC / ST and nomination of Anglo Indian members in Parliament and State Assemblies for another ten years i.e. up to 2010
80th amendment	June 9, 2000	Implement Tenth Finance Commission recommendation to simplify the tax structures by pooling and sharing all taxes between states and The Centre
81th amendment	June 9, 2000	Protect SC / ST reservation in filling backlog of vacancies
82nd amendment	September 8, 2000	Permit relaxation of qualifying marks and other criteria in reservation in promotion for SC / ST candidates
83rd amendment	September 8, 2000	Exempt Arunachal Pradesh from reservation for Scheduled Castes in Panchayati Raj institutions
84th amendment	February 21, 2002	Extend the usage of 1971 national census population figures for state wise distribution of parliamentary seats
85th amendment	January 4, 2002	A technical amendment to protect seniority in case of promotions of SC/ST Employees
86th amendment	December 12, 2002	Provides Right to Education until the age of fourteen and Early childhood care until the age of six
87th amendment	June 22, 2003	Extend the usage of 1971 national census population figures for state wise distribution of parliamentary seats
88th amendment	January 15, 2004	To extend statutory cover for levy and utilization of Service Tax

89th amendment	September 28, 2003	The National Commission for Scheduled Castes and Scheduled Tribes was bifurcated into The National Commission for Scheduled Castes and The National Commission for Scheduled Tribes
90th amendment	September 28, 2003	Reservation in Assam Assembly relating to Bodoland Territory Area
91st amendment	January 1, 2004	Restrict the size of council of ministers to 15 % of legislative members & to strengthen Anti Defection laws
92nd amendment	January 7, 2004	Enable Levy of Service Tax Include Bodo, Dogri, Santali and Maithili as National Languages
93rd amendment	January 20, 2006	To enable provision of reservation for other backward classes (O.B.C.) in government as well as private educational institutions
94th amendment	June 12, 2006	To provide for a Minister of Tribal Welfare in newly created Jharkhand and Chhattisgarh States
95th amendment	25 January 2010	Extended the reservation of seats in Lok Sabha and State Assemblies for SC and ST from sixty to seventy years
96th amendment	23 September 2011	Substituted "Odia" for "Oriya"
97th amendment	12 January 2012	Added the words "or co-operative societies" in Article 19(l)(c) and inserted article 43B i.e, Promotion of Co-operative Societies and added Part-IXB i.e, THE CO-OPERATIVE SOCIETIES
98th amendment	2012	Insertion of new article 371 J. Special provisions with respect to state of Karnataka

**PART XXI****TEMPORARY, TRANSITIONAL AND SPECIAL PROVISIONS**

**369.** Notwithstanding anything in this Constitution, Parliament shall, during a period of five years from the commencement of this Constitution, have power to make laws with respect to the following matters as if they were enumerated in the Concurrent List,

**Special Status to Jammu and Kashmir:**

**370.** (1) Notwithstanding anything in this Constitution,— (a) the provisions of article 238 shall not apply in relation to the State of Jammu and Kashmir;

(b) the power of Parliament to make laws for the said State shall be limited to—

(i) those matters in the Union List and the Concurrent List which, in consultation with the Government of the State, are declared by the President to correspond to matters specified in the Instrument of Accession governing the accession of the State to the Dominion of India as the matters with respect to which the Dominion Legislature may make laws for that State; and

(ii) such other matters in the said Lists as, with the concurrence of the Government of the State, the President may by order specify.

**PART XXII****SHORT TITLE, COMMENCEMENT  
AUTHORITATIVE TEXT IN HINDI AND  
REPEALS**

## I. Nature Of Economics

### *Economic Growth and Development*

In the words of **Prof. Bell**, “economic thought is a study of heritage left by writers on economic subjects over a period of about 2500 years, and it freely draws upon all phases of human knowledge”.

### *The Hebrew Economic Thought*

- The Hebrews had one of old the ancient civilizations of the world.
- They gave top priority for religion and ethics, and they gave importance to agriculture.
- The Hebrews had definite ideas on subjects such as usury (interest), just price, property rights and monopoly.
- The Hebrew civilization was a rural and agrarian civilization.
- One of their proverbs is: “*He that tilleth the soil shall have plenty of bread*”.
- The **jubilee year** was the 50<sup>th</sup> year. According to Jubilee year, the land sold to someone was to revert to its owner in the 50<sup>th</sup> year.
- **The Sabbath:** was the weekly day of rest, relaxation and good living.

### *Mercantilism*

- The economic ideas and policies which were followed by European governments from the 15<sup>th</sup> century until the second half of the 18<sup>th</sup> century may be described as **mercantilism**.
- The mercantilists thought that the wealth of a nation could be increased by **trade**.
- **Alexander Gray** put it, “*it was thus a primary principle of the typical mercantilist to maximize exports while minimizing imports*”.
- According to mercantilists, trade was the most important occupation. Industry and manufacture were ranked second in importance. And agriculture was considered the least important occupation.

### *The Physiocrats*

- The term '**physiocracy**' means '**Rule of Nature**'.
- Physiocracy was essentially a revolt by the French against mercantilism.
- The physiocrats developed the concept of natural order. According to them, the natural order is an ideal order given by God.
- They advocated *laissez-faire*. It means “*let things alone, let them take their own course*”.

### *The Leading Economists Of The classical school*

- 1.) **Adam Smith** - who is regarded as the Father of Economics was interested in the nature and causes of the wealth of nations. We can call him the first development economist.
- 2.) **David Ricardo** - was interested in the problems of distribution.
- 3.) **J.S. Mill** - believed in individualism as well as socialism. He advocated socialist reforms in distribution as the laws of distribution were different from the laws of production.
- 4.) **Karl Marx (1818-1883)** - was the founder of scientific socialism. He was a great critic of the capitalist system which was exploitative in nature and predicted that capitalism would give way to socialism. According to him, “*all history is a history of class struggle*”.
- 5.) **Alfred Marshall** - who pointed out that economics, was on one side a study of wealth and on the other and more important side a part of the study of man.
- 6.) **J.M. Keynes** - is considered the Father of New Economics. During the 1920s and 1930s, when the capitalist countries were affected by the Great Depression marked by bad trade and mass unemployment, Keynes suggested a greater role for government and a bold fiscal policy to tide over the crisis. The New Deal policy of America was greatly influenced by Keynesian policy.

### *Economic Growth and Development*

- **Economic growth** has been defined by Arthur Lewis as “*the growth of output per head of population*”.
- In other words, economic growth refers to an increase in per capita national income.
- According to Arthur Lewis, economic growth is conditioned by (1) economic activity, (2) increasing knowledge and (3) increasing capital.
- In general terms, we may say if there is decline in poverty, unemployment, and inequality, there is **Economic Development** in the country. Otherwise, even if per capita income doubled, we cannot say there is economic development.

So when we say there is development, there must be improvement in the quality of life. That means;

- People must have higher incomes,
- Better education,
- Better health care and nutrition,
- Less poverty and
- More equality of opportunity.

So according to **Michael P. Todaro** and **Stephen C. Smith**, “development must be conceived of as a multidimensional process involving major changes in social structures, popular

attitudes and national institutions, as well as the acceleration of economic growth, the reduction of inequality, and the eradication of poverty".

### *Rostow's Stages of Economic Growth*

**W.W. Rostow**, American economic historian described the transformation of countries from underdevelopment to development in terms of stages of growth. The following stages are:-

- 1) **The Traditional Society** – It is custom-bound and tradition-oriented, the poor countries are good example.
- 2) **The Transitional Society** - In the transitional society, the force of customs and traditions will become less, there will be economic motivation, and there will be improvements in physical and social infrastructure.
- 3) **The take-off stage** – It refers to a situation where an economy transforms itself from a predominantly agricultural to a predominantly industrial society.
- 4) **The mature stage** - In this stage, the government has to make some basic decisions. As there will be abundant resources and goods, whether it has to use them for strengthening the nation into a strong and powerful state militarily or to use the resources for improving the welfare of the people.
- 5) **The age of high mass consumption** - The final stage is the age of high mass consumption. During this period, people will consume all kinds of goods especially durable goods like cars on a mass scale.

## **2. Population**

### *Meaning of Population*

The term population refers to the whole number of people or inhabitants in a country or region.

### *Factors Determining Population Growth*

The basic factors determining population growth are:-

#### **1. Birth Rate**

Birth rate has a positive influence on growth of population. Higher the birth rate, higher will be the growth of population.

The birth rate depends on the following factors:

- the age of marriage
- the rapidity of child birth
- social customs and beliefs and
- Illiteracy and ignorance of controlling births.

Early marriage, higher child birth, higher the spread of social customs and beliefs (like son preference to do the religious functions) and higher the rate of illiteracy and ignorance of birth controlling measures, higher will be the birth rate and population growth.

Social awareness and spread of education among the

people can help to increase the mean age of marriage, increase the knowledge about family planning methods and family welfare measures to control births, reduce the rapidity of child birth and thereby reduce the birth rate.

#### **2. Death Rate**

Lower the death rate, higher will be the population growth and vice versa. High death rates may be due to hunger, starvation, malnutrition, epidemics, lack of proper medical and sanitary facilities.

On the other hand, low death rates may be the result of better diet, pure drinking water, improved hospital facilities, control of epidemics and contagious diseases and better sanitation.

#### **3. Migration**

Out-migration will reduce population growth while in-migration will increase the population growth.

Migration is not an important factor contributing to the population growth due to the restrictions imposed by different countries. Thus, the two major causes for the variations in population are birth rate and death rate.

### **Population as a stimulant to economic development**

- ❖ In a backward economy, population growth results in increase in supply of labour. This in turn results in the availability of cheap labour in the economy. Therefore, under a given technology with the availability of capital, production can be increased by increasing the labour use.
- ❖ Population growth results in increased demand for products. Increased demand results in increased production, employment and income in the economy. As a result, the economy will develop.
- ❖ Due to population growth, the supply of goods and services increases. Increased supply results in increased production, which in turn results in specialisation. Specialisation will induce technological improvements.
- ❖ Increased demand and increased supply of products result in scarcity of resources, which induce technological improvements.

### *Population Explosion*

Population explosion means the alarming and rapid rate of increase in population.

### *Causes Of Population Explosion*

#### **1. High Birth Rate**

High Birth rate is a major cause responsible for the rapid growth of population. In India, although the birth rate has declined from 45.8 per thousand during the period 1891-1900 to about 25.8 per thousand in 2001, it is still considered to be substantially high. The birth rate has not come down considerably in spite of the increase in the widespread

propaganda of family planning, family welfare programmes and population education campaigns.

## **2. Low Death Rate**

The phenomenal fall in the death rate in recent years is another important factor that has contributed to the rapid increase in population. The death rate in India is about 8.5 per thousand in 2001. Due to advancement in medical science, dreadful and chronic diseases such as small pox, cholera, plague, typhoid are no longer dreaded. Better facilities for sanitation and cleanliness, provision of pre-natal and post-natal care has reduced infant mortality rate.

## **3. Early Marriage**

The practice of early marriage is another important reason for the rapid increase in population in India. The mean age of marriage for girls is about 18 years, which is low, compared to the world countries, which is about 23 to 25 years. This results in a longer span for reproductive activity and the increase in the number of children.

## **4. Social and Religious reasons**

In India, every person has to marry because marriage is a compulsory institution as per social norms. In joint family system, nobody feels individual responsibility and everybody has access to equal level of consumption. Therefore, people do not hesitate to increase the size of the family. Most of the people think that at least one male child should be born in the family. In the expectation of getting a male child, they go on increasing the family size.

## **5. Poverty**

Poverty is another cause which contributes to the increase in population. Children are a source of income of the family. The children at a very young age help their parents in work, instead of going to school and thus prove to be an asset for the family. Every additional child will become an earning member and thus supplement the family income.

## **6. Standard of living**

People whose standard of living is low. Since a majority of the population is uneducated, they are unable to understand the need for family planning. They are unaware that a smaller size of family will help them enjoy a better standard of living.

## **7. Illiteracy**

A major part of the population (about 60%) in India is either illiterate or has the minimum education. This leads them to accept minimal work in which they cannot even support themselves.

Unemployment and under-employment further lead to poverty.

## ***Population Explosion as an obstacle to Economic Development***

The rising population in India affects economic development in the following ways:

### **(1) Food Shortage**

If the population of India goes on rising and there is no proportionate increase in agricultural production, the country will face a serious food problem.

### **(2) Burden of unproductive Consumers**

The greater the increase in population, the greater is the number of children and old persons. Children and old persons consume without making any contribution to output. The increasing number of children and old people increase the burden in terms of more requirements of nutrition, medical care, public health and education that go unattended to a large extent.

### **(3) Reduction in National and Per Capita Income**

The fast growing population reduces the average growth rate of national income and per capita income. This is because whatever is added to the national income is consumed by ever-increasing population.

### **(4) Low savings and investment**

The national income and per capita income in India is very low to leave any margin for the people to save. Further, there will be a fall in effective demand as the people's purchasing power is low. Rapid population growth thus makes it difficult to increase the rate of savings which determines the possibility of achieving higher productivity and incomes in a country.

### **(5) Reduction in Capital Formation**

Capital formation is very essential for the economic development of a country, particularly for a developing country like India. Capital formation depends upon saving and investment. This is not possible when there is a rapid growth of population, which results in more unemployment and underemployment. Thus, the fast-growing population affects the capital formation in the country adversely.

### **(6) Unemployment and Underemployment**

Rising population aggravates the problem of unemployment. The labour force also increases with the increase in population; and this increased labour force is not fully absorbed due to lack of employment opportunities. Therefore, there are more unemployed and underemployed people.

### **(7) Loss of Women's Labour**

Rapid and frequent childbirths make a large number of women unable to take part in productive activity for longer periods. This is a waste of human resource, and it retards economic development.

### **(8) Low Labour efficiency**

The increasing population adversely affects the national income and the per capita income. Due to this, the people have a low standard of living, which makes them less

efficient. This hinders the rapid development of the country.

#### **(9) More Expenditure on Social Welfare Programmes**

A rise in population increases the number of children. This would demand more social expenditure on medical care, public health, family welfare, education and housing, etc.

#### **(10) Agricultural Backwardness**

The increase in population has led to uneconomic holdings through subdivision and fragmentation of land holdings in India. The size of holding is so small that mechanised farming is not possible. Although some successful efforts towards development of agriculture have been made under the Five Year Plans.

#### **(11) Underdeveloped Industries**

The rapid growth of population adversely affects industrial development. This is the reason why neither the cottage and small-scale industries nor large-scale industries could develop adequately in the country. Both big and small industries require adequate capital, whereas the rate of capital formation is low in India. Public investment in India is insufficient for the industrial development of the country.

#### **(12) Financial Burden on Government**

Rapid increase in population is a financial strain to the government. The resources have to be spent on launching poverty alleviation programmes and social welfare schemes, includes drinking water, housing, sanitary, health and medical facilities in order to increase the standard of living of the people. If the population is controlled, then the government can spend on more productive purposes which would increase the national and per capita income and thereby raise the standard of living of the people.

#### **Steps to check rapid growth of population**

##### **(1) Couple Protection Rate (CPR)**

CPR should be increased, which means the percentage of couples using birth control or family planning methods should go up.

##### **(2) Infant Mortality rate (IMR)**

IMR must be reduced further because when infants die in lesser numbers, there is an incentive to adopt small family norm by the people.

##### **(3) Industrialisation of the country**

The burden of population on land must be reduced. Cottage and small scale industries must be developed in villages to provide employment to the maximum number of people. This leads to increase in standard of living which acts as a check on population growth.

##### **(4) Increase in Female Literacy Rate and Education**

The educated people have a better and more responsible outlook towards the size of their families. They can understand the advantages of a small family and adopt family planning methods to reduce the family size. This will help in reducing the birth rate.

##### **(5) Late Marriages**

Late marriages must be encouraged. At the same time, early marriages must be strictly checked. The minimum age of marriage for boys at 21 years and for girls at 18 years should be strictly followed in real life.

#### **(6) Legal Steps**

Strict laws must be made and enforced to check early marriages and polygamy.

#### **(7) Family Planning**

Family Planning means limiting the size of the family. The Family Planning Campaign should be a national movement. Education about family planning must be made common. People must be made aware of the different methods of birth control.

#### **Theories of Population**

##### **1.) Malthusian Theory of Population**

The Malthusian theory of population is the most well-known theory on population in economics. Malthus pointed out that an accelerated increase in population would outweigh the increase in food production. This would have an adverse impact on the development of an economy. This theory is explained in the following propositions:

- First, the rate of growth of population is limited by the availability of the subsistence i.e. food. If the subsistence increases, population also increases.
- Second, population increases at a faster rate than food production. In other words, while population increases in a geometric progression, food production increases in an arithmetic progression.
- Third, the preventive and positive checks are the two measures to keep the population on the level with the available means of subsistence.

**The first proposition**, states that the size of population is determined by the availability of food production. If food production does not increase to match the rate of growth of population, it will lead to poverty. If the food production increases, the people will tend to increase their family size. This will lead to more demand for food, so the availability of food per person will diminish. This will lead to a lower standard of living.

**The second Proposition**, states that population would increase at a geometrical progression i.e. in the ratio of 2, 4, 8, 16, 32, etc., but food production would increase at an arithmetical progression i.e. in the order of 2, 4, 6, 8, 10, etc. The imbalance between the population growth and food supply would lead to a bare subsistence of living, misery and poverty.

**The third proposition**, imbalance is corrected by two checks namely **preventive checks and positive checks**.

1. **Preventive checks** are applied by man to reduce the population. It include late marriage, self-restraint and other similar measures applied by people to limit the family.

2. **Positive checks** affect population growth by increasing death rate. It includes Common diseases, plagues, wars, famines unwholesome occupations, excess labour, exposure to the seasons, extreme poverty, bad nursing of children are a few examples for positive checks.

### 2.) The Theory of Optimum Population

The modern theory of optimum population brings out the relationship between changes in population and the consequent changes in per capita income. Modern economists such as **Sidgwick**, **Cannon**, **Dalton** and **Robbins** have propagated this theory.

**Optimum population** means the ideal population relative to the natural resources, stock of capital equipment and state of technology.

In other words, *optimum population is that level of population at which per capita output is the highest.*

A country is said to be under populated if the population is less than the optimum and overpopulated if the population is more than the optimum.

The following formula measures whether population at a point of time is optimum or not

$$M = \frac{A-O}{O}$$

Where,

M = Maladjustment in level of output

A = Actual population

O = Optimum population

If 'M' is zero, then the total population is equal to optimum population

If 'M' is positive, the total population is more than the optimum population.

If 'M' is negative, the total population is less than the optimum population

### 3. The Theory of Demographic Transition

The demographic transition brings out the relationship between fertility and mortality, i.e. between the birth rate and the death rate.

*Birth rate refers to the number of births occurring per 1000 in a year.*

*Death rate refers to the number of deaths occurring per 1000 in a year.*

This theory explains the changes in these rates as a consequence of economic development. This theory points out that there are three distinct stages of population growth.

#### Stage I: High Birth Rate and Death Rate

In the first stage, the country is backward and less developed.

Agriculture will be the main occupation of the people. The standard of living of the people will be low.

The high death rate is due to poor diets, improper sanitation and lack of proper medical facilities.

Birth rate is high on account of widespread illiteracy, ignorance of family planning techniques, early marriages, social beliefs, customs and attitudes of the people.

In this stage, the rate of growth of population is not high since high birth rate is offset by the high death rate and the population growth stagnates.

#### Stage II: High Birth Rate and Low Death Rate

As a country advances, it might result in increase in industrial activity, creating more employment opportunities.

This will raise the national and per capita income of the people, thereby increasing their standard of living.

The advancement in science and technology will result in the availability of better medical facilities.

The eradication of many epidemics and dangerous diseases and better sanitary conditions reduce the disease and death.

The birth rate still remains high due to the resistance to change, and the long established customs and beliefs.

#### Stage III: Low Birth Rate and Death Rate

Economic development leads to change in the structure of the economy from an agrarian to a partially industrialised.

With the increase in industrialisation, people migrate from rural to urban areas, and there is a change in the attitude of the people.

With the spread of education, people prefer small families in order to increase the standard of living. Thus the birth rate is reduced.

Implementation of better medical facilities, control of disease and public sanitation result in low death rate.

Census

The term ‘Census’ can be defined as the process of collecting, compiling, evaluating, analysing and publishing the demographic economic and social data relating to all persons in a country at a specified time.

The first population census in India was taken in 1872 and in 1881. From then, the census is taken once in 10 years. The latest census was taken in 2011. Census is very important to know (1) the rate of growth of population (2) the changes in the distribution of the population.

Census is useful for economic planning, and for implementing welfare schemes and measures.

**The Use of Population Census**

The details recorded in the population census are as follows:

- Total Population
- Sex Composition
- Rural versus Urban population
- Age Composition
- Density of Population
- Literacy Rate
- Urbanisation
- Occupational Pattern

**Characteristics of Indian Population**

India accounts for about 2.4 % of the total world area but has to support about 16.84 % of the world population.

Thus during one century i.e. 100 years, the population of India has increased by nearly 788.5 million people.

This order of increase is really alarming and threatening to the whole development process in India.

**Population growth in India**

Rate of growth of population is a function of birth rate and death rate. The increase in population in India can be explained by the variations in birth and death rates. The birth rate in India declined from 49.2 per thousand in 1901 to 17.64 in 2001. In the same period, the death rate has fallen from 42.6 per thousand to 8.5 per thousand.

The National Population Policy (NPP)-2000 recently adopted by the Government of India states that “the long term objective is to achieve a stable population by 2045, at a level consistent with the requirements of sustainable development, and environment protection.”

**Population Policy**

India was the first developing country to adopt a population policy and to launch a nationwide family planning programme in 1952.

The main objective of the population policy is to ensure that there is reasonable gap between the fall of death and birth rates.

Population policy refers to the efforts made by any

Government to control and change the population structure.

**National Population Policy 2000**

The National Population Policy (NPP) 2000 has the immediate objective of addressing the unmet needs of contraception, health infrastructure, health personnel and integrating service delivery for basic reproductive and child health care.

The policy's long term objective is to stabilise population by 2045.

A National Commission on population presided over by the Prime Minister, Chief Ministers of all States and other dignitaries as the members has been constituted to oversee and review the policy (NPP-2000) implementation.

Similar to the National Commission, State Level Commissions presided over by the respective State Chief Ministers have also been set up with the same objective of ensuring implementation of the policies.

**Measures to achieve a stable population**

The National Population Policy has listed the following measures to achieve a stable population by 2045.

1. Reduction of infant mortality rate (IMR) below 30 per 1,00,000 live births.
2. Reduction of maternal mortality rate (MMR) to below 100 per 1, 00,000 live births.
3. Universal immunization.
4. To achieve 80 % deliveries in regular dispensaries, hospitals and medical institutions with trained staff.
5. Access to information, containing AIDS, prevention and control of communicable diseases.
6. Incentive to adopt two-child small family norm.
7. Strict enforcement of Child Marriage Restraint Act and Pre-Natal Diagnostic Techniques Act.
8. Rising the age of marriage of girls from 18 to 20.
9. A special reward for women who marry after 21.

**The Action Plan of the programme includes the following:**

- Self-help groups at village Panchayat levels comprising mostly of housewives will interact with health care workers and gram panchayats.
- Elementary education to be made free and compulsory.
- Registration of marriage, pregnancy to be made compulsory along with births and deaths

The Government hopes to achieve the objective of population stabilisation by 2045

## Poverty and Unemployment

### **Definitions of Poverty**

The World Bank (1990) has defined poverty as “**the inability to attain a minimal standard of living**”.

In the words of Dandekar (1981) “**want of adequate income, howsoever defined is poverty**” Thus, lack of adequate income to buy the basic goods for subsistence living is an important element in the definitions of poverty.

### **Types of poverty**

#### **1. Absolute poverty**

When people do not have adequate food, clothing and shelter, we say they are in absolute poverty.

#### **2. Relative poverty**

Relative poverty refers to differences in income among different classes of people or people within the same group or among people of different countries.

#### **3. Temporary or chronic poverty**

In countries like India, when there is poor rainfall, the crops fail and the farmers temporarily enter into a poverty sample. But when they are poor for long, then we call it chronic or structural poverty.

#### **4. Primary Poverty and Secondary Poverty**

Rowntree (1901) made a distinction between primary poverty and secondary poverty.

**Primary poverty** refers to “families whose total earnings are insufficient to obtain the minimum necessities for the maintenance of merely physical efficiency”.

**Secondary poverty** refers to “a condition in which earnings would be sufficient for the maintenance for merely physical efficiency were it not that some portion of it is absorbed by other expenditure, either useful or wasteful such as drink, gambling and inefficient housekeeping.”

Rowntree said that secondary poverty prevented many more people from meeting what he called “human needs standard” than did primary poverty (that is, inadequate incomes).

#### **5. Rural Poverty**

A majority of the people in rural areas are poor because they do not own assets like land and they work as agricultural labourers; their wages are low and they get work only for a few months in a year.

#### **6. Urban Poverty**

The urban poor, on the other hand, work for long hours but they get low incomes. They are employed mostly in the unorganized or informal sector. They are “sub-employed”.

**Sub-employed** are those 1) who work part-time but want full-time work; 2) family heads working full time who do not earn enough to bring their families over the poverty line and 3) discouraged workers who no longer seek work.

### **Poverty Line**

**Poverty Line** refers to the minimum income, consumption, or, more generally *access* to goods and services below which individuals are considered to be poor. The poverty line is the expenditure level at which a minimum calorie intake and indispensable non-food purchases are assured.

It may be noted that even among the poor, there are differences in the degrees of poverty. So the focus of the government policies should be on the poorest of the poor. Nutrition based poverty lines are used in many countries.

### **Poverty in India**

**1. Dandekar and Rath** estimated the value of the diet with 2,250 calories as the desired minimum level of consumption.

While the Planning Commission accepted Rs.20/- per capita per month (i.e. Rs.240/- p.a.),

Dandekar and Rath suggested a lower minimum for rural population (Rs.180/- per capita p.a.) and a higher minimum (Rs.270/- per capita p.a.) for urban population at 1960-61 prices.

On this basis, they estimated that 40 % of the rural population and about 50 % of the urban population were below the poverty line.

**2. According to P.D.Ojha**, the percentage of those below the poverty line in rural sector increased from 52 percent in 1960-61 to 70 percent in 1967-68.

**3. B.S.Minhas** by taking per capita annual consumption expenditure of Rs.240/- as the bare minimum concluded that nearly half of the rural population (50.6 percent) was living below the poverty line in 1968.

**4. P.K.Bardhan's** study concluded that the percentage of rural population below the poverty line increased from 38 percent in 1960-61 to 54 percent in 1968-69.

**5. Montek Singh Ahluwalia's** study of rural poverty (1977) arrived at the conclusion that the rural poverty declined initially from 50% in mid – 1950s to around 40% in 1960-61, but increased to 56.5% in 1967-68.

Whenever agricultural performance was good, rural poverty declined and whenever it was poor, it rose. It may be noted that Ahluwalia used an expenditure level of Rs.15/- in 1960-61 prices for rural areas and Rs.20/- per person per month for urban areas.

Ahluwalia accepted that this level of expenditure represents an extremely low level of living.

**6. The Seventh Finance Commission** used a concept called “the augmented poverty line”.

In it, along with private consumer expenditure per capita, public expenditure on (1) health and family planning; (2) water supply and sanitation; (3) education; (4) administration of police, jails and courts;

(5) roads; and (6) social welfare were taken into account.

According to the estimate of Seventh Finance Commission, 52% of the population was below the poverty line. It also said that this percentage (52%) was applicable to urban as well as rural areas.

**7. The Planning Commission** estimated the poverty line by taking Rs.49.1 and Rs.56.6 per capita monthly expenditure for rural and urban areas respectively.

The World Bank estimated for India that in 1988, 39.6% of the population was below poverty line. The percentage for rural areas was 41.7% and urban areas 39.6%.

#### **Causes of Poverty in India**

The main causes of rural poverty in India are as follows:

1. *Unemployment and underemployment*: Even there are good rains in the year, agricultural labourers do not get work throughout the year.

2. *Population pressures*: there are many dependents per every earning member. And there is the problem of disguised unemployment. On a farm, there may be work for only four persons. But six or seven persons may be there on the farm. The marginal productivity of the extra persons is almost zero.

3. Indian agriculture is marked by low productivity. So majority of those engaged in agriculture are poor.

4. A majority of people in rural areas do not have enough assets, especially land. The main reason for this is the concentration of land in the hands of a few families.

#### **Poverty alleviation programmes**

The problem of poverty eradication is one of providing employment and raising the productivity of low level of employment. The following measures have been taken by the government to remove poverty from the country.

##### **1. Land Reforms**

Land reforms legislation has been passed by the state governments, which aim at improving the economic conditions of agricultural landless labourers.

Every state has passed the necessary legislation fixing ceiling on agricultural holdings by which the maximum amount of land which a person can hold has been fixed by law.

The surplus lands thus acquired were to be distributed to the landless labourers and small peasants.

##### **2. Jawahar Gram Samridhi Yojana (JGSY)**

It was introduced in April 1999 as a successor to Jawahar Rozgar Yojana on a cost sharing basis of 75 : 25 between the Union and States.

##### **3. National Social Assistance Programme (NSAP)**

It was launched on August 15, 1995 to provide social assistance benefits to poor households affected by old age, death of primary bread winner or need for maternity care.

##### **4. Employment Assurance Scheme (EAS)**

It was started on October 2, 1993 in 1778 backward blocks in drought prone, desert, tribal and hill areas. It was expanded to cover all the 5,488 rural blocks of the country. It gave wage employment to the rural poor.

In September 2001, it was merged into new Sampoorna Gramin Rozgar Yojana along with Jawahar Gram Samridhi Yojana.

##### **5. Pradhan Mantri Gramodaya Yojana (PMGY)**

It was introduced in the Budget for 2000-2001 with an allocation of Rs. 5,000 crore. Its focus is on health, primary education, drinking water, housing and rural roads.

Common Property Rights in grazing lands, wastelands, forests and water resources were made available to the rural people in the past.

##### **6. Swarna Jayanti Shahari Rozgar Yojana (SJSRY)**

Urban self-employment and urban wage-employment are the two special schemes under it.

It substituted in December 1997 various programmes operated earlier for urban poverty alleviation.

It is funded on 75: 25 basis between the Union and the States.

##### **7. Integrated Rural Development Programme (IRDP)**

The concept of an Integrated Rural Development Programme was first proposed in the central budget for 1976-77.

This programme was intended to assist rural population to derive economic benefits from the development of assets of each area.

The programme with some modifications was introduced on an expanded scale in 1978-79, beginning with 2,300 blocks, of which 2000 were under common coverage with SFDA, DPAP and CADP, with another 300 blocks added up during 1979-80.

Its coverage was extended to all the blocks of the country since October 2, 1980. Besides the smaller and marginal farmers, this programme was more specific in regard to agricultural workers and landless labourers, and additionally brought within its purview rural artisans also.

The programme emphasised the family rather than the individual approach in the identification of the beneficiaries.

## Unemployment

### **Meaning of Full Employment**

Full employment refers to a situation in which all the workers who are capable of working and willing to work get an employment at reasonable wages. It does not imply that all adults have jobs.

### **Meaning of unemployment**

Unemployment refers to a situation in which the workers who are capable of working and willing to work do not get employment.

### **Unemployment Estimates**

A person working 8 hours a day for 73 days of the year is regarded as employed on a year basis.

The following are the three estimates of unemployment generated in the 27<sup>th</sup> round of NSS (National Sample Survey).

**1. Usual Principal Status unemployment:** It is measured as number of persons who remained unemployed for a major part of the year. This measure is more appropriate to those in search of regular employment e.g., educated and skilled persons who may not accept casual work. This is also referred to as 'open unemployment'.

**2. Weekly Status unemployment:** It refers to the number of persons who did not find even an hour of work during the survey week.

**3. Daily Status unemployment:** It refers to the number of persons who did not find work on a day or some days during the survey week.

### **Causes of Unemployment**

#### **1. High Population growth:**

Due to rapidly increasing population of the country, a dangerous situation has arisen in which the magnitude of unemployment goes on increasing during each plan period.

#### **2. Insufficient Rate of Economic Progress:**

The rate of growth is inadequate to absorb the entire labour force in the country. The opportunities of employment are not sufficient to absorb the additions in the labour force of the country, which are taking place as result of the rapidly increasing population in India.

#### **3. Absence of employment opportunities in activities other than agriculture:**

Agriculture is the principal area of employment in our country. Thus, pressure on land is high, as about 2/3 of the labour force is engaged in agriculture. Land is thus overcrowded and a large part of the work force is underemployed and suffer from disguised unemployment.

#### **4. Seasonal Employment:**

Agriculture in India offers seasonal employment; thus agricultural labour remains idle during the off-season.

#### **5. Joint Family System:**

Existence of joint family system in India promotes

disguised unemployment. Usually the members of a family work on their family farms or do family business. There are more workers on a family farm than what would be needed on them.

#### **6. Increasing turnout of students from Indian Universities:**

During the last decade, educated unemployment has increased due to rapid turnout of graduates by the Indian universities. Moreover, in the Indian educational system, more emphasis is placed on engineering and other Technical subjects rather than on Arts subjects. But there is unemployment amongst technical graduates as well. There is a lack of proper vocational education in the country.

#### **7. Slow Developing of Industries:**

Industrialization is not rapid in our country and industrial labour finds few job opportunities. The agricultural surplus labour force is not absorbed by the industrial sector. This leads to disguised unemployment in agriculture.

### **Measures to Solve Unemployment Problem in India**

A close reading of the Five-Year Plans reveals that in every Five-Years Plan, employment expansion has been emphasised as an objective of development.

The following measures have been suggested for solving the unemployment problem in our country:

#### **1. A Change in the pattern of investment**

The planning process in the initial stages gave importance to an investment-allocation pattern with a high capital-labour ratio. Therefore, a shift in the emphasis to mass consumer goods industries would generate more employment to absorb the unemployed labour force. Moreover, increase in the supply of such goods may help arrest the rising price-level and increase the economic welfare of the people. This is the wage-goods model of development suggested by Vakil and Brahmanand.

#### **2. Encouragement to small enterprises as against big enterprises**

The employment objective and the output objective can be achieved, if greater investment is directed to small enterprises rather than to large enterprises. Now that the Government wants to undertake decentralised development with emphasis on small-scale enterprises, it would be desirable to reorient credit, licensing, raw material allocation and other policies in such a manner that both employment and output are enlarged simultaneously.

#### **3. Problem of Choice of technique**

It would be better to switch over to intermediate technologies till the process of industrialisation gets such a powerful momentum that the new entrants to labour force can be absorbed. During the period of rapid growth in the labour force, it would be advisable to adjust the choice of techniques consistent with the employment objective. Intermediate technology would be more suited to Indian conditions.

#### **4. Encouragement of New Growth Centres in Small**

## Towns and Rural Areas

Experience of planning has revealed that the overcrowded metropolitan centres have received a large share of investment. Therefore, the smaller towns should be developed as new growth centres for the future. The establishment of small industrial complexes can increase employment opportunities and provide flexibility to the economy.

## 5. Subsidies on the Basis of Employment

All schemes of subsidies and incentives to large and small industries have helped output maximisation and greater use of capital resources. The pattern of subsidies should be altered. Creation of more employment should be treated as the basis for the grant of subsidies and incentives. This will shift the entire structure of government support from the large-scale producer to the small-scale producer as this is more consistent with the objective of employment generation and achieving equality and social justice.

## 6. Reorientation of Educational Policy

One great defect of our educational system is that it leads one to take up the professional degree only. The high degree of unemployment among the educated signifies the urgent need to reorient our educational system to greater employment opportunities. Education system should be more diversified. It should have more short term vocational courses that will cater to the local employment needs. Development of quality education is a prerequisite for the development of a nation as it is the remedy for all problems including the problem of unemployment in the country. Hence, a high priority needs to be accorded for education in public expenditure.

## 7. Underemployment in Rural Areas

N.S.S. data have revealed the existence of a high degree of underemployment in India. The total number of underemployed persons available and willing to take up additional work is estimated to be more than two crores. It is necessary to organise the Rural works Programme. Failure of implementation of Rural Works Programme underlines the relatively low importance given to the rural sector to provide additional employment to millions of landless labourers and small and marginal farmers. Urgent action is needed in this direction so that work opportunities grow in the rural areas. This will raise the level of income and employment in rural areas and reduction in poverty levels.

## The Finance Commission of India

**The Finance Commission of India** came into existence in 1951.

It was established under Article 280 of the Indian Constitution by the President of India.

It was formed to define the financial relations between the centre and the state.

The Finance Commission Act of 1951 states the terms of qualification, appointment and disqualification, the term, eligibility and powers of the Finance Commission.

As per the Constitution, the commission is appointed every five years and consists of a chairman and four other members.

### Functions of the Finance Commission

- Distribution of net proceeds of taxes between Centre and the States, to be divided as per their respective contributions to the taxes.
- Determine factors governing Grants-in Aid to the states and the magnitude of the same.
- To make recommendations to president as to the measures needed to augment the Consolidated Fund of a State to supplement the resources of the panchayats and municipalities in the state on the basis of the recommendations made by the Finance Commission of the state.

### *The Finance Commission (Miscellaneous Provisions) Act, 1951*

It lays down rules regarding qualification and disqualification of members of the Commission, their appointment, term, eligibility and powers.

#### I. Qualifications of the members

The Chairman of the Finance Commission is selected among people who have had the experience of public affairs. The **other four other members** are selected from people who:

- Are qualified, as judges of High Court, or
- Have knowledge of Government finances or accounts, or
- Have had experience in administration and financial expertise; or
- Have special knowledge of economics
- 

#### II. Procedure and Powers of the Commission

- Have all powers of the civil court as per the Court of Civil Procedure, 1908.
- Can summon and enforce the attendance of any witness or ask any person to deliver information or produce a document, which it deems relevant.
- Can ask for the production of any public record or document from any court or office.

- Shall be deemed to be a civil court for purposes of Sections 480 and 482 of the Code of Criminal Procedure, 1898

### **III. Disqualification from being a member of the Commission**

A member may be disqualified if:

- He is mentally unsound;
- He is an undischarged insolvent;
- He has been convicted of an immoral offence;
- His financial and other interests are such that it hinders smooth functioning of the Commission.

### **IV. Terms of Office of Members and eligibility for Reappointment**

Every member will be in office for the time period as specified in the order of the president, but is eligible for reappointment provided he has, by means of a letter addressed to the president, resigned his office.

### **V. Salaries and Allowances of the members**

- The members of the Commission shall provide full-time or part-time service to the Commission, as the president specifies in his order.
- The members shall be paid Salaries and Allowances as per the provisions made by the Central Government.

### **The Planning Commission**

After independence, a formal model of planning was adopted, and accordingly the Planning Commission, reporting directly to the Prime Minister of India was established on 15 March 1950, with Prime Minister Jawaharlal Nehru as the chairman.

The Planning Commission does not derive its creation from either the Constitution or statute, but is an arm of the Central/Union Government.

Indian economy is based on the concept of planning. This is carried through by five-year plans, developed, executed and monitored by the Planning Commission.

With the Prime Minister as the Chairman, the commission has a nominated Deputy Chairman, who has rank of a Cabinet Minister.

**Montek Singh Ahluwalia** is currently the Deputy Chairman of the Commission.

Sudha Pillai is current secretary of the commission.

### **The National Development Council (NDC)**

The National Development Council (NDC) or the Rashtriya Vikas Parishad is the apex body for decision making and deliberations on development matters in India, presided over by the Prime Minister.

It was set up on 6 August 1952.

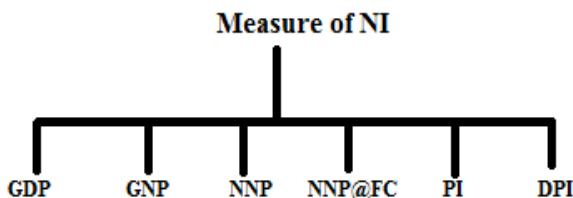
To strengthen and mobilize the effort and resources of the nation in support of the Plan, to promote common economic policies in all vital spheres, and to ensure the balanced and rapid development of all parts of the country.

The Council comprises the Prime Minister, the Union Cabinet Ministers, Chief Ministers of all States or their substitutes, representatives of the Union Territories and the members of the Commissions.

It is an extra-constitutional and non-statutory body. Its status is advisory to Planning Commission but not binding.

### National Income

[NI of a country is the total value of all final goods & services produced in the country in a particular period of time]



#### 1.GDP

The total value of final goods & services produced within the boundary of the country during a given period time. (citizen as well as foreigner)

$$GDP = Q \times P$$

$Q$  – total quantity  $g$  &  $d$  produced in the outers.

$G$  &  $D$  of cities for within boundary.

$P$  – price of  $g$  &  $d$

#### 2.GNP

GNP is the total value of the total output or production of final goods & services produced by the nationals of a country during a given period of time. All resident of non-resident citizens of a country is included. Whereas the income of foreign nationals who reside within the geographical boundary of the country is excluded.

It is calculated from GDP

$$GNP = GDP + [X - M]$$

$X$ (export) = inward remittance of a country in respect of the goods produced and services rendered by national of a country abroad.

In (import): outward remittances of a country from the goods produced and services rendered by foreign national of the country in a domestic area.

$X - M$  is called as Net factor income from abroad.

$$GNP = GDP + \text{net factor income from abroad}$$

#### 3.NNP

NNP is arrived after deducting depreciation from gross national product.

$$NNP = GNP - \text{Depreciation (wear & tear of goods)}$$

NNP is calculated with market price. The market price includes (IT) & excludes subsidies that are made to produce goods & services. This is called NNP at marked price (NNPMP)

#### 4.NNP @ FC

NNP @ FC is calculated national income only on the basis of cost incurred only on the basis of cost incurred to produce the goods & services. The cost is the payment made to the factors of production. The factors of production are land, labour,

capital and entrepreneur. For this, the indirect tax is deducted from (NNP @ MP). Then the subsidies given to produce goods & services are added.

$$NNPFC = NNPMP - \text{Indirect taxes} + \text{subsidy}.$$

### 5. PERSONAL INCOME

1. PI is the sum of all the income received by the entire people of the country in a year.

2. The whole national income is not available to individuals of a country.

3. Some part of national income are not available to individuals of country.

4. At the same time, some monetary payments made to them is not included in national income.

5. So, to calculate PI, parts of National income that are not available to individuals.

$PI = \text{National Income} + [(\text{Transfer payments}) - (\text{Undistributed profits of corporate} + \text{payments of social security provision})]$

$PI = \text{National income} + \text{net transfer payments.}$

➤ Usually the corporates do not distribute the whole profit to shareholders. A portion of profit is kept with them to meet future expenditure and expansion. This is called undistributed profits of the corporates.

Payments for total security provision are payments made by employees towards pension and provident fund.

Transfer payment means the payment that are made not against any productive activity on the part of the receiver. Ex:- pension, unemployment compensation, disaster relief payment, interest paid on public debt, etc.

### 6.DISPOSABLE PERSONAL INCOME (DPI)

DPI means the income that is available to individuals that can be disposed (spent) at their will. All the personal income cannot be spent by individuals.

$$\text{Disposable PI} = PI - \text{Direct Taxes}$$

## The Financial system of India

It refers to the institution of borrowing and lending of funds or demand for the supply of funds of all individuals, institution and companies of the government.

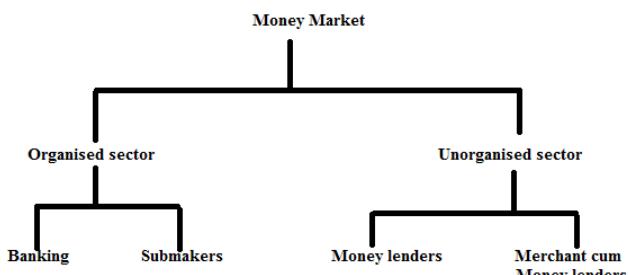
It can be clarified into two broad categories are.

1. Money market
2. Capital market

**1. Money Market** is the market for borrowing and lending of short term funds, say up to 3 yrs.

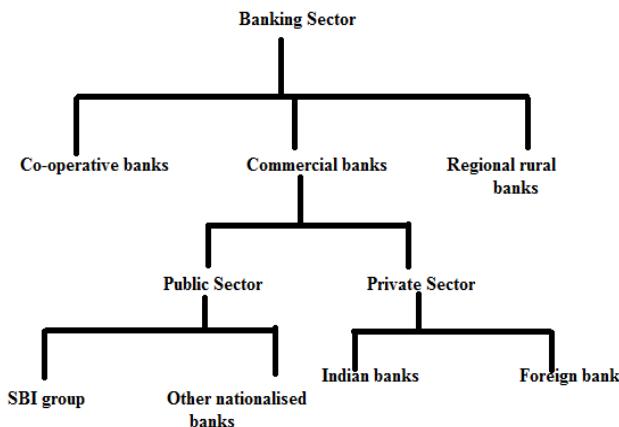
### Composition of money market

Money market of India has participates both from organised & unorganized sector. The organised sectors is characterized by registration, approval and license from market regulators and proper maintenance of accounts. The unorganized sector is devoid of these aspects.



### 1. Banking sector:

It carries out both the deposit taking and lending operations. It consists of commercial banks, regional rural bank & cooperative banks.



**1. Commercial banks:** are run on commercial basis. They accept deposits, give loans and provide other financial services

to earn profit. These are regulated under banking regulation act 1949.

**a. Public sector Banks:** are those banks in which the majority of ownership is with government. The majority of ownership means, shareholding of more than 51%. All PSB were not started by government of India. Some banks which were in the hands of private were nationalised and made public sector banks.

**1. State bank group:** it means SBI & its associates previous name of SBI was imperial bank of India. It was created in 1921, by amalgamating the three presidency banks of Bengal (1806), Bombay (1840) and Madras (1843). Imperial bank of India was nationalised in July 1, 1955 and renamed SBI. In 1959, 8 banks of former princely states were brought under SBI & its associates.

1. SB of Bikaner, SBI of Jaipur
2. SB of Hyderabad
3. State of Indore, Oct 2008
4. SB of Mysore
5. SB of Saurashtra
6. SB of Patiala & Travancore

### 2. Other nationalised banks

The nationalisation was carried out in two stages. 14 large commercial banks which had reserves more than 50 crores were first nationalized on 19<sup>th</sup> July 1969.

Central bank of India, Bank of India, Punjab National Bank, Canara Bank, United Commercial Bank, Syndicate Bank, Bank of Baroda, United Bank of India, Union Bank of India, Dena Bank, Allahabad Bank, Indian Bank, IOB, Bank of Maharashtra

Secondly, 6 banks were nationalized on April 15, 1980 which had reserves more than 200 or [Andhra Bank, Punjab & Sind bank, New bank of India, Vijaya bank, Corporation bank & Oriental Bank of commerce]

In Sep 1993, New bank of India was merged with Punjab National bank.

### b. Private sector Banks:

It consists of both Indian bank as well as Foreign banks.

**1. Indian banks:-** classified as old & new private sector banks. This classification is done by RBI for the convenience of comparing performance of all Indian banks.

**i) Old Banks:** private banks & those Banks which were set up before 1990 are called old banks.

**ii) New Banks:** Banks set up in the private sector after 1990 are called new banks. 12 new banks list.

1. UTI Bank/Axis
2. Indus Ind Bank Ltd
3. ICICI Bank

4. Global Trust Bank/merged with oriental Bank of commerce 2004.
5. HDFC
6. Centurion bank
7. Bank of Punjab
8. Times Bank
9. IDBI Bank Ltd
10. Development Credit Bank
11. Kotak Mahindra Bank
12. Yes Bank Ltd.

in 2004 IDBI Bank Ltd was merged with Parent IDBI, a development financial institute. Centurion bank was merged with Bank of Punjab & named as centurion Bank of Punjab, further centurion Bank of Punjab merged with HDFC in 2006.

## **2. Foreign Banks:-**

After 1991, economic reforms, India opened the door for foreign banks, citi bank, Barc lays & ABN Ambro are ten foreign banks.

### **Indian banks Abroad:-**

Like foreign banks set up in India so that Indian banks set up their branches in Foreign countries both branches in foreign countries both public & private sector banks have branches abroad. Bank of Baroda has the highest number of branches followed by SBI and Bank of India.

## **2. Regional Rural Banks (RRB)**

There were established since 1975, under RRB Act 1979.

RRB were set up in all states except Sikkim & Goa.

Totally 196 banks were set up. Since April 1987, no new RRB has been opened due to the kerkar committers recommendations.

RRB were set up by Public Sector banks. The public sector bank which set up a particular RRB is called sponsor bank of that RRB.

RRB were established to lend to weaker section called target group like landless labour artisan and craftsmen at concessional state.

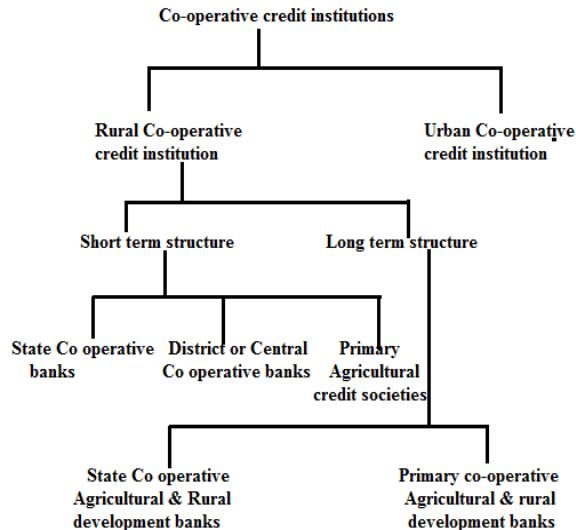
From 1997, RRBs were found to lend outside the target group.

## **3. Co-operative banks:**

- C bar established by state laws.
- CB are established with the aim of funding agriculture and allied sectors and to finance village and cottage industries.
- They operate on the principle 'one person, one vote' in decision making.
- NABARD is the apex body of cooperative sector in India.
  - ⇒ NABARD is also called as the National bank.
  - ⇒ Its Functions are financing of agriculture and refinancing of cooperative banks &

RRB was done by Agriculture Refinance Development Corporation (ARDC) of RBI.  
 ⇒ NABARD was set in July 1982.  
 ⇒ It took over the function of (ARDC)

### The composition of cooperative Banks



#### **1. Short term structure:**

It lend for cultivation acitvities and provide working capital to buy seeds, fertilizers etc.

It has 3 tiered structure

- a) State Co-operative Bank
- b) Central-District Co-operative Bank
- c) Primary Agricultural Credit societies.

#### **a) State co-operative Bank [SCB]**

- ⇒ Each state has its own state co-operative Bank. It is the Apex body for cooperative banks in a particular state
- ⇒ They act as a mediator between RBI and NABARD on one side and central or District co-operative Bank primary Agricultural credit societies on other side.
- ⇒ They get loan from RBI
- ⇒ Now, the intermediation of these banks is abolished by a MOV between RBI and there banks.
- ⇒ Now, RBI has direct dealing with low tier cooperative banks.

#### **b) Central or District co-operative banks:-**

- ⇒ It operates at district level .
- ⇒ Its operational area is limited to one district
- ⇒ There two types of central co-op banks are:-

  1. Co-operative Banking union
  2. Mixed central co-operative bank

#### **1. Co-operative Banking Union:-**

The membership of co-operative banking union is open only to co-operative societies.

2. The membership of mixed central co-operative bank is open both to co-operative societies & individuals.

The central or district co-operative banks get loan from SCB. They grant loans to PAC and individuals. PAC give loan to its members that are individuals.

### C. Primary Agricultural credit Societies:-

- ⇒ These are at village level
- ⇒ They provide short-term loan to agriculture [1-3 years]
- ⇒ Minimum 10 persons can together start a primary Agricultural credit society.

### 2. Long term structure:

- Long term structures lend to meet medium and long term fund requirements, ranges from one and half year to 25 years.
- They lend for land development, construction of wells, purchase of pump sets, redemption of old debts, etc.
- These banks initially were called as mortgage banks. Earlier they were called land development banks. Now they are called co-operative agricultural & rural development banks [CARD Bs]

### 2. Urban Co-operative Credit Institution

The co-operative banks set up in the urban and semi urban areas are called urban co-operative credit institution. They mainly lend to small borrowers and business.

### 2. Sub Markets:

- Sub Markets are markets to generate resources needed for government Financial institution and industries in the short run.
- The sub markets is divided into various segments. They are:-

### 1. Call Money Market:

- It is also know as money at call and short notice market .
- It deals in loans for a period ranging from one to 14 years.
- It is an inter-bank borrowing and lending market
- One bank demand money from another bank to cover its cash reserve requirements with RBI every fortnight and to gain from foreign exchange market.
- It has two segments, there are:
  - a) Call market (or) overnight market is a market for borrowing and lending of money between banks within one day.
  - b) Short notice market is a market for borrowing and lending of money between up to 14 days.

The rate at which funds are borrowed in these markets is called call money rate.

### 2. Bill Market (or) Discount market

In bill market short term funds (90 days) are brought and sold. The bill market consists of two markets. They are:

- a) **Commercial Bill market:** are bills other than treasury bills. They are issued by industries and traders.
  - b) **Treasury Bill Market:** are securities issued by government treasury. They are of short term in nature.
- In this regard, they differ from market loans. They are non-interest bearing (zero interest/zero coupon) these kinds of bonds are called zero coupon bonds. They are issued at discount rates.
- There are two types of treasury Bills, they are:-

#### a) Ad hoc Treasury Bills:-

It is issued for a particular and or case in hand. Till 1991-92 there was only treasury bill of 91 days are called Ad-hoc Treasury bill.

It was discontinued from 1997-98

#### b) Regular Treasury Bill:

These bills are issued regularly to meet budgetary expenditure.

There are number of treasury bills of cliffering maturity

In 1998-99, 182 days treasury bill were introduced . 14 days treasury bills were introduced in 1999-2000

### 3. Certificates of Deposits:- (CD)

These are introduced by commercial Banks and Financial institutions to raise additional Fund. Maturity period rangs from 3m – 1y for banks and 1y – 3y for fina inst.

### 4. Commercial Papers (CP)

It was introduced in 1990. Commercial papers are issued by corporate, primary dealers and the All-Indian financial institutions to raise fund.

### 2. Unorganised Sector:

The unorganised sector banking is not a registered and regulated one. They do not maintain proper account. The interest rate is usually high in unorganised sector. The lending & borrowing operation is less because many procedures followed by banks are not followed in unorganised sector.

It has two types, they are:-

#### 1. Money landers:

The money landers are exclusively engaged in money landing operations. It is their source of livelihood.

#### 2. Merchant cum money landers:

They are engaged in merchandising and money lending. They land to produces of the product in which they merchandise. The produces have to sell their products only to the lander. In this case merchant cum money landers usually purchase products at low price.

### **India – ASEAN FTA**

India had recently concluded FTA with ASEAN (10 countries) in goods. It will become Operative from January 1, 2010.

#### **Features of FTA:**

##### **1. Duty Free Access:**

As many as 4185 items would be opened for duty free access, comprising of processed food, agricultural products, garments, iron & steel & host of other products.

##### **2. Sensitive lists:**

a) 489 articles on which concessional tariffs do not apply.  
b) 590 articles on which tariffs will not be eliminated. They are mostly plantation items.

##### **3. Tariff reduction:**

Tariffs on most commodities shall be reduced b/w 2013 & 2016, while the process of reduction will continue till 2023.

##### **4. Tariff rate:**

The average tariff on most of commodities (4185) in India is 10% while peak rate of duty in ASEAN is 5%, hence India's reduction commitment would be more than ASEAN group.

##### **5. Mutual Recognition Agreements (MRA):**

Under this there will be plenty of opportunities for professionals like architects, doctors, CA's to seek jobs there

#### **Benefits:**

- ❖ Trade between 2 blocks will increase from \$40 bn to \$60 bn
- ❖ ASEAN is India's 4<sup>th</sup> largest trading partner & it will benefit 170 cross of consumers.

#### **Future Prospects:**

When the free trade in services also comes into effect, it.

- ❖ Offers more visas to Indians to work there.
- ❖ India enjoys edge in large number of services.
- ❖ Interests of Indian investors will be protected.
- ❖ Signing of CECA

#### **Concerns:**

- ❖ Indian plantation sector especially Kerala farmers.
- ❖ Rules of Origin | Chinese goods passing through ASEAN markets.
- ❖ Protectionist measures by India | Fear of ASEAN

### **Foreign Trade Policy**

The new FTP is a five year policy from 2009-2014

#### **Aim:**

- ❖ To arrest & reverse the declining trend of exports.
- ❖ Target of \$ 200 bn worth exports for the next fiscal.
- ❖ To double the export of goods & services by 2014.
- ❖ Long term objective : To double India's share in global trade by 2020.

#### **Features of FTP:**

##### **1. Incentives to explore new markets:**

Various sops & incentives for exporters who explore markets in Asia & Africa & to look beyond US & European markets.

26 new markets had been identified for export incentives in Latin America, Asia & Oceania.

##### **2. Gems & Jewellery Sector:**

Boosting exports by allowing duty drawback on exports.

##### **3. Handloom & Handicrafts sector:**

Help under market development scheme.

##### **4. Schemes [Export Promotion]**

- ❖ Continuance of duty refund scheme & DEPB scheme till Dec 2010.
- ❖ Interest subsidy for exporters of 2% for pre-shipment credit.
- ❖ Additional resources provided under MDAS | Market D vt Assistance scheme  
MAIS | Market Access Initiative scheme.

##### **5. Short term Relief:**

Providing dollar credit to exporters overseen by a high level committee comprising Finance secretary, commerce secretary & IBA

##### **6. Estd of (Directorate of Trade Measures)**

Provide help to small & medium scale exporters to export their goods to foreign markets.

##### **7. Income Tax Exemption:**

Extension of IT holiday for EOU for one more years.

##### **8. Brand India:**

Govt to promote 'Brand India' in Made in India shows across the world every year.

##### **9. Govt to make India as diamond trading hub.**

### National Pension Scheme

NPS implemented from May 1 2009 covers all the citizens of India & thus provides social security cover to entire unorganized sector in the country.

#### Features of NPS:

1. Covers every citizen in the age group of 18-55 years.
2. It will be regulated by PFRDA
3. Pension fund managers appointed to manage these funds, which include SBI, LIC, ICICI & UTI asset Mgt company
4. There will be depository participant viz. NSDL to prepare the database of beneficiaries.
5. 23 points of presents have been appointed to collect contributions from beneficiaries willing to join the scheme.
6. Irrespective of one's occupation, open to cobblers, washer man, Rickshaw pullers, etc., & anyone can join the scheme.
7. Minimum contribution is Rs.500/month.
8. Investors will be offered 3 choices to invest their corpus
  - i) Equity (High risk)
  - ii) Corporate bonds / Fixed deposits (Med risk)
  - iii) Govt securities (Low risk)
9. There will be a cap of 50% of total corpus of investor that he can opt to be invested in equity.
10. Switch over option is also available for the investor.
11. The entire corpus can't be withdrawn by beneficiary before the age of 60 yrs.
12. The amount withdrawn at final stage is subjected to taxation.

### G-20 London declaration

G-20 summit held at London in Apr 2009. The meet held on the backdrop of global financial crisis

The meet resolved to ensure inclusive & co-ordinated growth.

#### Declaration

##### 1. Strengthening (global financial markets)

- ❖ Set up a financial stability board at global level
- ❖ Early warning system to predict global economic crisis
- ❖ Against hedge funds, credit rating agencies & tax havens.

##### 2. Strengthening IMF & World Bank:

- ❖ **IMF:** Additional quotas & SDR allocation, revision of quotas for developing countries.
- ❖ **World Bank:** Augment the resources of WB by additional contribution by member countries. (\$ 100 bn)

##### 3. Against Protectionism:

- ❖ Ensure free flow of trade & investment by resisting protectionist measures.

#### 4. Ensure growth, Social Justice & achievement of MDG:

- ❖ Aid for trade & debt relief measures for world's poorest countries.

5. Provide stimulus package for inducing demand in the domestic market.

### GOODS & SERVICES TAX

GST was recommended by Kelkar Task Force on implementation of FRBM Act 2004. It was the ultimate reform in indirect taxation making one country, one indirect tax.

#### Features of GST:

1. Subsume a large no. of state indirect taxes as well as 2 major central indirect taxes into a simplified GST
2. It will be a simplified dual GST with central & state level tax rates.
3. It will be of value added tax in which setoffs would be available in previous transactions, so that it would end up as a final point retail tax with consumer bearing the burden.
4. 12% = 5% to central , 7% to state

#### Merits of GST:

- ❖ Unification of Country's indirect tax structure
- ❖ Integration of Indian economy with global economy since 145 countries has GST at now
- ❖ Revenue surplus for the government in a very short time
- ❖ Lesser burden on consumers leading to increase in consumption & consequent increase in production & GDP
- ❖ Many small entrepreneurs would disclose their incomes & direct taxes go up.
- ❖ Impossible to evade indirect taxes.

#### Problems:

- ❖ Sharing – State's autonomy of revenue b/w centre & states
- ❖ Tax on inter-state transactions
- ❖ Maintaining books & accounts
- ❖ Compensation in initial periods (50,000 cr & 5 yrs)

#### Corporate Governance

Implies running a company on the basis of ethical standards in relation to all those who are directly or indirectly concerned with the company

#### Indian Scenario:

In India, corporate governance is enforced through clause 49 of company Act by SEBI for listed companies. For

other companies, the relevant provisions of company Act have to be followed.

#### **Clause 49 lays down:**

1. Listed companies should inform the stock exchange regarding composition of the board, auditors, various transactions, financial partners, subsidiary companies, etc.
2. Within 15 days of end of every quarter, listed companies should submit a report to stock exchange to conform to guidelines of corporate governance.
3. Appointment of independent directors, who are responsible for enforcing corporate governance.

#### **Problems in India:**

- ❖ Stock exchange fears that if it takes action against any company, then share holders will be affected.
- ❖ India has poorest track record of conviction in the event of corporate fraud. Only 5% of cases are ultimately convicted.

#### **Recommendations:**

##### **1. Vaish Committee, 2005:**

Doing away with petty cases & speedily resolve major cases by setting a serious Fraud investigation office (SFIO)

##### **2. Kania Committee**

Sever monetary penalty for corporate frauds

#### **Need for Corporate governance**

- ❖ Instill confidence in investors / share holders
- ❖ To attract FDI in India
- ❖ Credibility of India

#### **Recent Corporate Fraud:**

Satyam scam, 2008 | Ramalinga Raju shown false profit of Rs. 7500 crore

#### **FDI in Retail**

India permits 100% FDI in wholesale trade & 51% FDI in single brand retailing but kept multiband retailing in negative list.

#### **Reasons:**

- ❖ Adversely affect the livelihood of small neighbourhood stores
- ❖ Large scale unemployment
- ❖ Price rise

#### **Merits in permitting Multiband Retail:**

- ❖ Give big boost to India's food processing industries.
- ❖ Foster greater interdependence b/w agriculture, industry & service sector as food processing industry develops.

- ❖ Generate substantial linkage effects & thereby generate large scale employment in agri, industry & service sector.
- ❖ Give boost to India's export of processed food.
- ❖ Bring about technology transfer from MNCs into domestic industry.
- ❖ Forces Indian entities to enter into organized retail segment thereby creating competition which ultimately benefits consumers.

Based on above reasons, multiband retailing had been recently opened up for FDI in India.

#### **India's response to global credit crisis**

India responded to global credit crisis by resorting to

##### **1. Fiscal Policy**

It refers to government's revenue, expenditure & borrowings.

Government resorted to centra-cyclical fiscal policy in response to global economic crisis. Centra-cyclical fiscal policy refers to borrowing by the government & spending on infrastructure projects that in turn create job & income to the people. Hence demand is created resulting in economic recovery. Thus it is a demand generating fiscal policy.

##### **Indian government spending includes-**

- ❖ Infrastructure projects
- ❖ Public works programmes | NREGS
- ❖ Debt waiver
- ❖ Food & Fertilizer subsidies
- ❖ 6<sup>th</sup> Central pay commission
- ❖ Reduction of certain taxes

##### **2. Monetary Policy:**

India had pursued a loose monetary policy to cope up with economic recession

- ❖ Soft interest rate refime
- ❖ Infusion of liquidity into the economy
- Take care of toxic assets of banks
- ❖ Allocation & diversion of funds to realestate sector infrastructure sector
- ❖ Reduction of short term interest rates
- ❖ Liberalisation of ECB windows
- ❖ Lowering of CRR to improve liquidity in Banks

##### **3. Trade policy:**

Trade policy involved incentives to promote exports.

- ❖ Opening a separate line of credit for EXIM Banks
- ❖ Duty concessions & refunds to labour intensive exports like textile, leather, gems & jewellery etc.
- ❖ Interest relief on pre-shipment & post shipment credits for exporters.

- ❖ Blanket reduction in customs & excise duties.
- ❖ Waiving of counter vailing duty (CVD) for all such imports used by sectors which were most affected.
- ❖ RBI makes available additional funds in commercial banks for lending to exporters.
- ❖ Export incentives in search of new markets in Latin America, Asia, Africa & Oceania

By the above ways, the GDP of first quarter appears 6.1% which shows signs of economic recovery. The first sector to show signs of recovery was real estate followed by manufacturing & infrastructural sector.

### **Reform of International Financial Institutions**

The need for reform of the Brettonwoods twins viz., IMF & world Bank has become much more urgent & inevitable in view of the current global economic crisis.

The proposed reforms are:

#### **1. Monitoring Mechanism:**

Setting up of a monitoring mechanism within IMF for early warning signals in terms of mismanagement of international liquidity.

#### **2. Voting rights enhancement**

Enhancement of voting rights of the emerging in IMF so that they have better say & voice in day to day functioning & policy making of these institutions

#### **3. Augmenting Resources:**

Strengthening & augmenting resources of these institutions so as to enable them to meet the growing requirements of growing economies.

#### **4. Appointment on Merit basis:**

Appointment of the heads of these institutions on the basis of merit & not based on geography.

#### **5. Strengthening SDR:**

Increase in allocation of SDR for developing countries & strengthening SDR as reserve currency by larger representation & weights.

Reduction of SDR allocation for OECD countries as more often they lie idle.

#### **6. Global Financial Stability Board:**

Estd of GFSB which should closely work with IMF to prevent further crisis.

#### **7. Revision of IMF quotas:**

More frequent periodical revision of IMF quotas.

#### **8. World Bank lending:**

World Bank's lending must go to least developed countries whose percapita income is less than \$ 100.

### **Droughts Relief**

- ❖ Ban on export of food items
- ❖ Resorting to import of food grains.
- ❖ Invoking provisions of Essential commodities Act
- ❖ Invoking provisions of ESMA
- ❖ Strengthening PDS
- ❖ NREGS in drought affected districts | supplement income
- ❖ Giving food grains as wages in NREGS
- ❖ Tube wells in drought affected areas
- ❖ Diesel subsidies for pump sets in drought affected areas.
- ❖ Additional power supply to drought affected areas.
- ❖ Strict measures against
  - a) Hoarders b) Speculators c) Black market

### **Oil Sector Reforms**

#### **Reasons:**

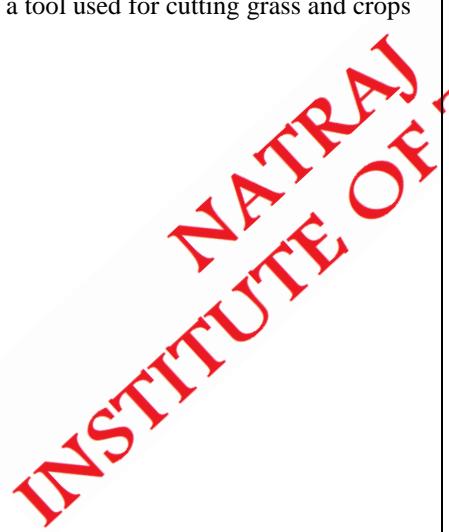
- ❖ To do away with the issue of oil bonds
- ❖ Do away with unproductive subsidies
- ❖ Resorting back to market determined pricing mechanism

#### **Reforms:**

1. Fortnightly / monthly increase in prices of petrol & diesel upto March 2010 so that they get aligned with international prices.
2. To Impose tax on pre-NELP blocks
3. Phasing out of Subsidized LPG supply over next 3 years.
4. Car users in metro to pay higher price for petrol.
5. Cash subsidies in case of agriculture & vulnerable sections of societies.
6. Doing away with administered price mechanism & bringing back market determined price mechanism
7. Doing away with the policy of cross subsidization.

**GENERAL ENGLISH**

cS. No	Poem	Author	<b>Figures of speech observed in the following Poems</b>	<b>Appreciation Questions from Poetry</b>	<b>Important lines from Poems.</b>
1.	Off to outer space tomorrow morning [11 <sup>th</sup> Std.]	Norman Nicholson	<ul style="list-style-type: none"> <li>➤ <i>Count Down</i> – the final moments counted backwards from 10 to 0 before the launch.</li> <li>➤ <i>Daylight will be on the switch</i> – there will be a continuous switching over from day to night,</li> <li>➤ <i>Winter under lock</i> – there will not be any changing seasons.</li> <li>➤ <i>I'll doze when I'm sleepy</i> – as there are no fixed day / night hours, I'll sleep when I feel sleepy.</li> <li>➤ <i>In hail</i> – within earshot; within hearing distance.</li> <li>➤ <i>Solit'ry</i> – alone</li> <li>➤ <i>Gaol</i> – prison</li> <li>➤ <i>Teacups circling round me</i> – teacups circling because of lack of gravitational pull</li> <li>➤ <i>Tracking</i> – following</li> <li>➤ <i>But you needn't think I'll give a damn for you or what you are</i> – don't think I will have time to think about you.</li> <li>➤ <i>Trans-galactic</i> – across galaxies.</li> <li>➤ <i>Blow your top</i> – to explode in anger</li> </ul>	<ul style="list-style-type: none"> <li>➤ What is the place of repetition in this poem? Is it effectively used?</li> <li>➤ What is the overall tone/mood of the poem? a) sadness b) jubilation c) down-to-earth d) humorous e) nonchalance</li> <li>➤ Smile features twice in the poem. Can you find it?</li> <li>➤ Give the rhyme scheme of the poem.</li> </ul>	Nil
2.	Sonnet No: 116 [11 <sup>th</sup> Std.]	William Shakespeare	<ul style="list-style-type: none"> <li>➤ <i>Admit impediments</i> – refers to the Christian marriage service where the priest asks the people gathered if they have any objections to the couple getting married “Impediments” means obstacles 86.</li> <li>➤ <i>Ever-fixed mark</i> – a prominent land or sea-mark which guides ships; true love guides one through the voyage of life.</li> <li>➤ <i>It is the star... height be taken</i> – during Shakespeare’s time people believed that the stars influenced men’s character; in the journey of life, to many a “wandering bark”(a lot boat) the star of genuine love turns out to be the guiding factor, a star’s “height”(attitude) can be measured but the extent to which it controls the fate of man (its “worth”) cannot be determined; similarly, the depth (“worth”) of true love cannot</li> </ul>	<ul style="list-style-type: none"> <li>➤ Give a suitable title to the poem. Give reasons for your choice.</li> <li>➤ Do you like the poem? Why?</li> <li>➤ Alliteration is the repetition of the same consonant sound in several nearby words. Ex: “Let <u>m</u>e not to the true <u>m</u>arriage of true <u>m</u>inds”.</li> <li>➤ What are the other instances of alliterations in this sonnet? Give two examples.</li> </ul>	<p>“ Which alters when it alteration finds, Or bends with the remover to remove”.</p> <p>“It is the star to every wand’ring bark, Whose worth’s unknown, although his height be taken”.</p>

			<p>be measured.</p> <ul style="list-style-type: none"> <li>➤ <i>Love's not...compass come</i> – true love cannot be destroyed by Time; external beauty can be destroyed by Time but not true love; note the destructive power of time (“bending sickle”)</li> <li>➤ <i>Edge of doom</i> – day of the last judgment (on the last day of the world)</li> </ul>		
3.	The Solitary Reaper [11 <sup>th</sup> Std.]	William Wordsworth	<ul style="list-style-type: none"> <li>➤ <i>Yon</i> – yonder, beyond</li> <li>➤ <i>Highland</i> – Scotland</li> <li>➤ <i>Vale</i> – valley</li> <li>➤ <i>Hebrides</i> – a group of islands</li> <li>➤ <i>Plaintive</i> – sad</li> <li>➤ <i>Chaunt</i> – chant</li> <li>➤ <i>Sickle</i> – a tool used for cutting grass and crops</li> </ul>	<ul style="list-style-type: none"> <li>➤ When we make comparisons, we say “this is like .....” (something else) E.g. “This child is gentle as a lamb”. These are called similes. And implied simile is a metaphor.</li> <li>➤ In the poem, what does the poet say about the reaper’s song and about her voice? What does he compare them to?</li> <li>➤ Poets and musicians generally believe that the most thrilling / beautiful songs are the saddest ones. Do you agree? Discuss with your partner.</li> <li>➤ Which stanza of this poem did you like best? Learn it and recite it to your class.</li> <li>➤ Can you think of poems / songs in your mother-tongue that reapers sing? Share your information with your class. Think about festive occasions too.</li> <li>➤ Have you seen reapers harvesting grain? Are they usually alone or in groups? See if you can find any similarities in the reapers you have seen and the one mentioned in this poem. Do they sing or do they work silently?</li> </ul>	 <ul style="list-style-type: none"> <li>✖ “No nightingale did every chaunt More welcome notes to wary bands”. “The Music in my heart I bore Long after it was heard no more”</li> </ul>
4.	Is life, But a	Lewis Carroll	Nil	➤ Nil	✖ Nil

**GENERAL ENGLISH**

	Dream? [11 <sup>th</sup> Std.]				
5.	Be The Best [11 <sup>th</sup> Std.]	Douglas Malloch	<ul style="list-style-type: none"> <li>➤ <i>Scrub</i> – bushes and small trees</li> <li>➤ <i>Bass</i> – an edible fish</li> <li>➤ <i>Rill</i> – a small stream</li> <li>➤ <i>Muskie</i> – a type of rose that smells like musk</li> </ul>	<ul style="list-style-type: none"> <li>➤ Write down the rhyming words in the poem.</li> <li>➤ Which line do you like most?</li> <li>➤ If you can't be ..... then be .....</li> <li>➤ Complete the sentence with suitable ideas.</li> <li>➤ Could you add two more lines to the poem – If you can't be ..... Then just be .....</li> <li>➤ Which structure gets repeated in the poem?</li> <li>➤ How is “repetition” effectively made use of in this poem?</li> <li>➤ Some expressions in the poem bring vivid pictures to our minds. Can you identify some of them?</li> </ul> <p><b>What is the theme observed in the Literary works?</b></p> <ul style="list-style-type: none"> <li>➤</li> </ul>	<p>★ If you can't be..... then just be.....</p>
6.	O Captain My Captain [11 <sup>th</sup> Std.]	Walt Whitman	<ul style="list-style-type: none"> <li>➤ <i>Bleeding drops or red</i> – captain's bleeding wound and the speaker's wounded heart</li> <li>➤ <i>Bells</i> – bells rung in celebration of victory (they also symbolize funeral bells)</li> <li>➤ <i>Weathered</i> – came safely through</li> <li>➤ <i>Dear father</i> – Lincoln's exalted to the position of father of the post-slavery nation.</li> <li>➤ <i>Exult</i> – show jubilation (over victory)</li> <li>➤ <i>Tread</i> – walk softly</li> <li>➤ <i>Trill</i> – produce a quavering or warbling sound</li> </ul>	<ul style="list-style-type: none"> <li>↳ State symbolically the arrangement of syllables, stressed and unstressed in each line.</li> <li>↳ Bring out the significance of the first four long lines and the next four lines short in each stanza.</li> <li>↳ How are emotions expressed in the shorter lines of each stanza?</li> <li>↳ What does a leader leave for his followers?</li> </ul>	Nil
7.	A Psalm of Life [12 <sup>th</sup> Std.]	H W Longfellow	<ul style="list-style-type: none"> <li>➤ <i>Psalm</i> – song or poem</li> <li>➤ <i>Numbers</i> – poetic metres, rhythms</li> <li>➤ <i>Slumbers</i> – sleeps</li> <li>➤ <i>Dust</i> – Refer to Genesis (The Bible) 3:19. “Dust thou art, and unto dust shalt</li> </ul>	<ul style="list-style-type: none"> <li>↳ What does the life of great men teach us?</li> <li>↳ Highlight the significance of the line, “Act in the living present.”</li> </ul>	N “For the soul is dead that slumbers And the grave is not its goal.”

		<p>thou return."</p> <ul style="list-style-type: none"> <li>➤ <i>Destined end</i> – goal</li> <li>➤ 11-12 – There should be progress every day of our lives and tomorrow should be much better than today.</li> <li>➤ <i>Fleeting</i> – passing/brief</li> <li>➤ <i>Stout</i> – strong</li> <li>➤ <i>Muffled</i> – not easy to hear</li> <li>➤ <i>The bivouac of life</i> – simple temporary camp made by soldiers. Here it refers to the temporary stay (sojourn) in this world.</li> <li>➤ <i>Forlorn</i> – lonely and sad</li> </ul>	<ul style="list-style-type: none"> <li>↳ Comment on the last line of the poem: "Learn to labor, not to walk".</li> <li>↳ What is the message of this poem?</li> <li>↳ Mark the rhyme scheme of the poem. The rhyme scheme for the first stanza is as follows: Tell me not, in mournful numbers, a Life is but an empty dream! -b For the soul is dead that slumbers, a And things are not what they seem. B</li> <li>↳ Alliteration: "Alliteration is the repetition of the same consonant sound in several nearby words." Note that in alliteration the sound and sense go together. "For the soul is dead that slumbers And the grave is not its goal." In the first line, /s/ is repeated (soul-slumbers), and in the second line /g/ is repeated (grave-goal). Find out two more instances of</li> </ul>
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				alliteration.	
8.	Women's Rights [12 <sup>th</sup> Std.]	Annie Louisa Walker	<ul style="list-style-type: none"> <li>➤ <i>Cherish</i> – love, hold dear</li> <li>➤ <i>Portray</i> – be a representation of</li> <li>➤ <i>Seclusion</i> – being away from others</li> <li>➤ <i>Strife</i> – conflict</li> <li>➤ <i>Jarring</i> – unpleasant</li> <li>➤ <i>Aloof</i> – distant in feeling or interest</li> <li>➤ <i>Inane</i> – meaningless or stupid</li> <li>➤ <i>Abstraction</i> – being absent-minded; state of not noticing what is happening</li> <li>➤ <i>Hedgerows</i> – rows of bushes or low trees along the side of a road</li> <li>➤ <i>Unobtrusive</i> – not easily seen</li> </ul>	<ul style="list-style-type: none"> <li>↳ Is the suffering of women directly mentioned in the poem?</li> <li>↳ ‘To sleep our life away’ – Comment on this.</li> <li>↳ To a woman, it is always others before self. Find the lines in the poem which suggest this.</li> <li>↳ Who do you think is the poem addressed to?</li> <li>↳ Who do you think is responsible for women being deprived of their rights?</li> <li>↳ How do you relate this poem to the lesson?</li> </ul>	Nil
9.	English Words [12 <sup>th</sup> Std.]	V K Gokak	<ul style="list-style-type: none"> <li>➤ <i>leech craft</i> : ancient medical remedy of using leeches to remove the impure blood</li> <li>➤ <i>bleached</i> : made white, (here) cleaned</li> <li>➤ <i>tempestuous</i> : violent</li> <li>➤ <i>drearier</i> : gloomier</li> <li>➤ <i>devouring</i> : consuming large quantities</li> <li>➤ <i>enmesh</i> : to catch, as if, in a net</li> <li>➤ <i>furrowed</i> : deep and wavy</li> <li>➤ <i>nestle</i> : settle comfortably 205</li> <li>➤ <i>nascent</i> : beginning to develop</li> <li>➤ <i>homing</i> : of the ability to find one's way home</li> <li>➤ <i>aeons</i> : ages, infinitely long periods</li> </ul>	<ul style="list-style-type: none"> <li>↳ Who is the poem addressed to?</li> <li>↳ What does the poet mean by ‘you crossed the furrowed seas’?</li> <li>↳ ‘You pose the cosmic riddle’ – What’s the riddle? Has the riddle been solved?</li> <li>↳ Words have divinity in them – Explain.</li> </ul>	Nil

			<ul style="list-style-type: none"> <li>➤ <i>burthen</i> : burden</li> <li>➤ <i>gospel</i> : good news</li> <li>➤ <i>waneless</i> : not growing smaller</li> <li>➤ <i>fathomless</i> : too deep to be measured or understood</li> <li>➤ <i>Indo-Aryan</i> : referring to the branch of the Aryans who came to India through Iran (English belongs to Germanic, an Indo-Aryan language)</li> </ul>		
10.	Snake 12 <sup>th</sup> Std.	D.H. Lawrence	<ul style="list-style-type: none"> <li>➤ <i>pitcher</i> : large earthenware container for liquids</li> <li>➤ <i>trough</i> : long narrow open container for animals to feed or drink from</li> <li>➤ <i>fissure</i> : a long deep crack in rock or in the earth</li> <li>➤ <i>Etna</i> : a volcanic mountain in Sicily</li> <li>➤ <i>Perversity</i> : unacceptable behaviour</li> <li>➤ <i>convulsed</i> : caused sudden violent, uncontrollable movements</li> <li>➤ <i>paltry</i> : unimportant</li> <li>➤ <i>expiate</i> : accept punishment for a wrong and do something to show one is sorry; make amends for, atone for</li> <li>➤ <i>albatross</i> : a sea-bird common in the Pacific and Southern Oceans. Here, the reference is to Samuel T Coleridge's 'The Rime of the Ancient Mariner'. The mariner shoots the albatross, a traditional symbol of good luck.</li> </ul>	<ul style="list-style-type: none"> <li>↳ What was the poet on his way to do when he first became aware of the snake?</li> <li>↳ What was the snake doing?</li> <li>↳ What did the 'voice of his education' tell the poet he should do?</li> <li>↳ How did he actually feel about the snake when the voices told him to kill it?</li> <li>↳ What caused the poet's horror towards the snake?</li> <li>↳ What did the poet do?</li> <li>↳ What does he feel after having done it?</li> <li>↳ What does the poet mean by "the voices of my accursed education." Why are they accursed?</li> <li>↳ Why does the poet call the snake one of the 'Lords of Life'?</li> <li>↳ Why does the poet call his</li> </ul>	Nil

**GENERAL ENGLISH**

				sin a ‘pettiness’?	
11.	The Man He Killed [12 <sup>th</sup> Std.]	Thomas Hardy	<ul style="list-style-type: none"> <li>➤ <i>nipperkin</i> : a small glass for beer or wine</li> <li>➤ <i>'list</i> : enlist</li> <li>➤ <i>Traps</i> : two-wheeled horse carriage (reference to this is to indicate that there is perhaps no justifiable reason for joining the army)</li> <li>➤ <i>quaint</i> : strange</li> <li>➤ <i>half-a-crown</i> : former British coin. A crown was worth five shillings (twenty five pence)</li> </ul>	N Bring out the use of frequent hyphens in the poem. N What are the emotions expressed in this poem?	Nil
12.			➤	N	

S. No	Essay	Author / Editor	Comprehension Questions from the following Motivational Essays:
1.	Dale Carnegie’s ‘The Road to success’ [11 <sup>th</sup> Std.]	Ed: K.V. Renganathan	<ul style="list-style-type: none"> <li>✖ Is the road to success smooth? What is unique about winners?</li> <li>✖ What is the first step to success?</li> <li>✖ What is a “Goal/Command”?</li> <li>✖ Why should we say ‘no’ generally?</li> <li>✖ How should we treat failure?</li> <li>✖ How can we improve our self-concept?</li> <li>✖ How do successful people manage their time?</li> <li>✖ Why was Mrs. Allred miserable?</li> <li>✖ What is the message of Emerson?</li> <li>✖ Which incident brought a turning-point in the life of Harold Abbott?</li> <li>✖ Why should we be grateful to God?</li> <li>✖ What are our assets?</li> <li>✖ How should we tackle our work?</li> <li>✖ Mention briefly the steps that we must take to achieve success in our lives.</li> <li>✖ How can we increase our happiness according to the author?</li> <li>✖ Which authors and books have been quoted in this essay?</li> <li>✖ What are the three biographical anecdotes mentioned in the essay?</li> <li>✖ What two practical suggestions are made, regarding goals and time management?</li> </ul>
2.	Vision for the Nation [11 <sup>th</sup> Std.]		<ul style="list-style-type: none"> <li>✖ Why are visions necessary for a nation?</li> <li>✖ What does a developed nation mean?</li> </ul>

**GENERAL ENGLISH**

			<ul style="list-style-type: none"> <li>❖ ‘This is not a good sign....’</li> <li>❖ Why does the author make such a remark?</li> <li>❖ What is a nation without vision compared to?</li> <li>❖ What is the key to reaching the status of a developed nation?</li> <li>❖ What type of people can achieve a long term vision?</li> <li>❖ What is xenophobia?</li> <li>❖ What does the author mean by ‘multilateral game’?</li> <li>❖ What was our ‘first vision’?</li> <li>❖ What was the second vision conceived for?</li> <li>❖ What should a nation do to achieve the status of a developed nation?</li> <li>❖ What were the special features of our nation that affected our ability to pursue a vision tenaciously?</li> <li>❖ Why should India evolve its own original economic policy and adopt original strategies?</li> <li>❖ “Those who aim high, have to learn to walk alone too”. – Explain?</li> <li>❖ Where, according to the author do our hopes lie for the realizations of the second vision?</li> </ul>
3.	To the land of Snow [12 <sup>th</sup> Std.]	Ahtushi Deshpande	<p align="right"><i>INSTITUTION OF HIGHER EDUCATION</i></p> <ul style="list-style-type: none"> <li>N What was the purpose of the author’s journey to the ‘Land of Snow’?</li> <li>N Who are the five mythological Pandavas from the writer’s point of view?</li> <li>❖ What are the remains of the deserted village of Milam?</li> <li>N Give reasons as to why it is difficult to keep warm in the Tibetan mountain range.</li> <li>N What is meant by? <ul style="list-style-type: none"> <li>○ ‘The sun plays truant for most of the day’</li> <li>○ ‘You gotta be dead first’</li> <li>○ ‘His confidence is heartening’</li> </ul> </li> <li>N Why does the writer feel that he has trespassed on some hidden or forbidden world of beauty?</li> <li>N ‘Patience is an art well learnt when one is at the mercy of nature’. Why does the author make this observation?</li> <li>❖ Why does the author say Milam has the dubious distinction of being the highest abandoned village in the world?</li> </ul>

## BIOGRAPHY

### ***Walt Whitman***

Walt Whitman was born in Long Island, in the United States of America in 1819. He started his career as an office boy in a law office in Brooklyn at the age of eleven and then became a typesetter's apprentice in a number of print shops. He took to teaching for some time and started his own newspaper, 'the Long Islands'. During 1850-1855 he focused on his own work, 'Leaves of Grass' and continued to write. He died at the age of 72.

### ***William Wordsworth***

William Wordsworth, an eminent poet of nature, was born on 7<sup>th</sup> April, 1770, at Cockermouth, Cumberland, in the Lake District. Though he lost his parents at a very young age, his uncle gave him a god education. His meeting with Samuel Taylor Coleridge in 1795, proved to be a turning point in his life. They, together published, "The Lyrical Ballads" in 1798, Wordsworth succeeded Robert Southey as Poet Laureate in 1843 and remained in office till his death in April 1850.

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### ***Henry Wadsworth Longfellow***

Henry Wadsworth Longfellow (1807-1882), the great American poet, was a professor at Harvard. His great fame began with the publication of his first volume of poems 'Voices of the Night' in 1839, which included "A Psalm of Life," one of nineteenth century's best-loved poems. His other collections include Ballads (1841), Evangeline (1847), Hiawatha (1855), The Courtship of Miles Standish (1858) and Tales of a Wayside Inn (1863). Longfellow was the most popular poet of his age and during his lifetime he became a 'national institution'. "His work was 53 musical, mildly romantic, high-minded, and flavoured with sentimental preachment" (Norton Anthology of American Literature).

### ***Annie Louisa Walker***

Annie Louisa Walker (1836-1907), British-born novelist, children's playwright and poet, was educated in Ontario, where she and her sisters operated a school for ladies. Walker published poetry widely in newspapers on both sides of the border before collecting them in 'Leaves from the Backwoods' in 1861-62. She returned to England to work for her cousin, Margaret Oliphant, a well-known novelist, and edited her 'Autobiography and Letters' in 1899, under her married name, Mrs. Harry Coghill. She collected her poetic output in 'Oak and Maple: English and Canadian Verses.'

### ***David Herbert Lawrence***

David Herbert Lawrence (1885-1930) occupies a unique position among the leading Modernist writers of the generation that came of age before the outbreak of the First World War. D.H. Lawrence was born near Nottingham in the English Midlands. D.H. Lawrence spent several years as a teacher before turning to writing for a livelihood.

## GENERAL ENGLISH

Although D.H. Lawrence is best known for his novels and short stories, he was also a fine poet who wrote free verse. His poetry concentrates on the life-giving force of nature and exalts the physical and instinctual over the purely intellectual.

### ***Thomas Hardy***

Thomas Hardy (1840 - 1928) was both a novelist and a poet. In his novels he depicted people striving against overwhelming odds within a society that was uncaring. However, he sought to improve society. Hardy's poetry marks a bridge between the Victorian Age and the Modernist movement of the twentieth century. Hardy's use of 'non-poetic' language and odd rhymes, coupled with his fatalistic outlook, were both a source and inspiration to numerous twentieth - century writers.

NATRAJ  
INSTITUTE OF TNPSC

## GEOGRAPHY

⇒ India is a peninsula

### Neighbouring countries - Capitals

1. Bangladesh - Dhaka (Share major portion of India)

2. China - Beijing

3. Pakistan - Islamabad

4. Nepal - Katmandu

5. Myanmar - Naibeda

6. Bhutan - Timbu

7. Afghanistan - Kabul

⇒ 28 States & 7 union territories

⇒ Chattisgarh - Raipur (capital)

⇒ Jammu & Kashmir - Srinagar – summer capital

Jammu – winter capital

⇒ India's planned city – Chandigarh

⇒ NCT – National Capital territory – India – Delhi

⇒ Capital of Lakshadweep – Kavarathi

⇒ Smallest bird sanctuary – Pitty Island in Lakshadweep

⇒ Capital of Dadra Nagar Havelli – Silvassa

⇒ Tropic of Cancer

⇒ Passes through Gujarat, Rajasthan, Madhya Pradesh, Chattisgarh, Jharkhand, West Bengal, Tripura, Mizoram

⇒ Divides India into two halves at 23°

### **Mountains**

⇒ Himalayas starts in pamir knot.

⇒ Godwin Austin ( $K_2$ ) is India's largest peak & is located in Karokoram (originated before himalayas) range

⇒ Siyachin Glacier is in Karakoram range

⇒ Ladakh & Sazkar are two ranges in Karakoram range.

⇒ Himadri, Himachal & Shiwalik are 3 ranges in Himalayas (western part)

⇒ Eastern part of Himalayas – Purvachal

⇒ World's largest peak Mt. Everest is in Nepal

⇒ 2<sup>nd</sup> world's largest peak is Kanjanjanha

⇒ Purvachal contains the follows ranges:

i) Batkaibum

ii) Bariel

iii) Manipur hills

iv) Mizor hill

⇒ Gara, khasi, Jaintia are three hills in Meghalaya

⇒ Maysyndrum – India's highest rainfall region is in khasi hills.

- ⇒ Aravalli ranges extends from Gujarat to Rajasthan (Oldest mountain ranges in India)
- ⇒ Delhi is the extension part of Aravalli range.
- ⇒ Andaman & Nicobar is extension part of Himalayas
- ⇒ Vindhya & Satpura ranges.
- ⇒ Gir range is Saurashtra
- ⇒ Gir lion is our national animal before 1970
- ⇒ Rajmahal hill's extension – Gara, khasi, Jaintia
- ⇒ Western Ghats Maharashtra to oddisha
- ⇒ Eastern Ghats
- ⇒ Nilgiri hills is the place where western ghats & Eastern ghats meets.
- ⇒ Mahendragiri (in odissa) is the highest peak in Eastern ghats.,
- ⇒ Anaimudi is the highest peak in western ghats.
- ⇒ Thottabetta is the highest peak in T.N.
- ⇒ It is also in western ghat's
- ⇒ Cardamom (Vif;fha;) hills

### **RIVERS**

#### **i) Brahmaputra**

- ⇒ Manasorover lake – Brahmaputra is originated
- ⇒ Di-Sanghito is the name given to Brahmaputra in China
- ⇒ Dihang is the name given to Brahmaputra in Arunachal Pradesh.
- ⇒ In Assam it is known as Brahmaputra
- ⇒ In Bangladesh it is known as Jamuna
- ⇒ Jamuna & Ganga joins in Bangladesh & it is Solely named as Padma
- ⇒ In delta region it is known as Macna.
- ⇒ Major Tributaries (JizahW)
  - a) Tista (b/w India & Bangladesh)
  - b) Subansri
  - c) Manas
  - d) Dihang – Dibang
- ⇒ Largest riveran island in the world Majuli is in Assam

#### **ii) Indus**

- ⇒ Originates near to Manasorover (in India) lake & drains in Pakistan.
- ⇒ Major Tributaries
  - a) Jhelum b) Chenab c) Ravi d) Beas e) Sutluj

## GEOGRAPHY

- ⇒ India's highest Granite Dam Bhakranangal is in Sutluj
- ⇒ India's Longest canal is Indira Gandhi Sagar Canal is in Thar Desert.

### iii) Ganga

- ⇒ Alaknanda & Bakiratha rivers meet at Haridwar, which is named as Ganga.
- ⇒ Originates in Himalayas
- ⇒ Gangotri, Yamunotri & Glaciers are in Uthrashand
- ⇒ River Yamuna is originated from here.
- ⇒ Yamuna is the tributary river of Ganga & joins in Allahabad.
- ⇒ Haridwar, Ujjain, Allahabad, Nashik (happens Kumbamela in India)
- ⇒ Mahakumbamela occurs once in 144 years (12x12)
- ⇒ Tributaries
  - a) Ramganga b) Gomti c) Sarda d) Rati e) Ghaggar
  - e) Kosi - Sorrow of Bihar, originated in Nepal
- ⇒ Other river Yamuna, Sone
- ⇒ Tributaries of Yamuna: a) Chambal b) Betwa
- b) Kell
- ⇒ Farakka Dam – Hoobly river passes through kolkuttai.
- ⇒ Damadar, Subarnarekha, Mahanadi, Brahmodi are other rivers.

### Godavari

- ⇒ Nashik (in Maharashtra) – Godavari is originated
- ⇒ Rivers Krishna & Godaveri joins & forms a delta known as kolleru lake
- ⇒ Vaiganga, Warda, Penganga, sabari, Manjra are the major tributaries of Godaveri
- ⇒ Thungabathra, Hagari, Sina are the major tributaries of Krishna.
- ⇒ India's largest tiger reserve is Nagarjuna Sahar reserve (in Andhra) in Nagarjuna Sahar lake (near Krishna river)

### Cauvery

- ⇒ Coorg district of Karnataka – Origin place

- ⇒ Kabini & Krishnaraja Sagar – 2 dams in Karnataka
- ⇒ Mettur dam in T.N.
- ⇒ Trichy, Tanjore, Tiruvarur, Nagapattinam – Cauvery Delta District in Tamil Nadu.
- ⇒ Subaravathi, Amaravathi, Arkavathi, Shisha, Noyyal, Bhavani are major tributaries of Cauvery.

### Other Important rivers in Tamil Nadu

- i. ghyhW - Kanchipuram – Vellore, South Arcot – Cuddalore, North Arcot - Vellore
- ii. nghd;dhW – Krishnagiri – T.V. Malai – VPM - PDY
- iii. nts;shW – Nrh;tuhad; Fd;W – fY}h;
- iv. fhtphp
- v. itif – kJiu - ,uhNk];tuk;
- vi. itg;ghW – tpUJefh;> rptfhrp
- vii. jhkpuqudp (tw;whj ejp) – jpUr;nre;J}h;
- ⇒ Stanley reservoir is in Mettur Dam
- ⇒ In T.N. Cauvery is originated from Okkanakal hills.

- ⇒ Vande Matram was first sung in Congress session at 1896.
- ⇒ Morning song of India – National Anthem
- ⇒ In 1911 King Wales visited India
- ⇒ In 1911, first national anthem was sung first

- ⇒ National Aquatic animal – Gangetic Dolphin. It is announced in 2008.
- ⇒ National Heritage animal – Elephant
- ⇒ According to census 2001 our total forest area is 23.28%, but forest coverage area is 20% & the targeted forest area by the govt is 33%
- i) National Forest Policy – 1988
- ii) Social Forestry – 1976
- ⇒ In Arunachal Pradesh more than 90% of area were forests
- ⇒ Areawise – M.P. is the place covered largely by forest
- ⇒ Lowest forest area – Haryana

## GEOGRAPHY

- i) Wild life protection Act – 1972
- ii) Environmental protection Act – 1986
- iii) Project Gir Lion – 1972
- iv) Project Tiger – 1973
- v) Project Crocodile – 1974
- vi) Rhino's conservation - 1987
- vii) Project elephant – 1902
- viii) Project snow leopard – 2002

⇒ In India there are 18 Biosphere  
⇒ India's first national park is Corbett in Uthraghand.  
⇒ India's Largest national park is dessert national park in Rajasthan  
⇒ Kaibul Lamjao national park is in Loltak lake in Manipur. It is the world's only fwating national park  
⇒ Indias first Tiger reserve is Bandipur Tiger reserve in Karnataka  
⇒ India's largest Tiger reserve is Nagarjuna Sahar reserve, Srisailam  
⇒ India's fist Biosphere reserve is Gulf of Mannar

- xvi) Seshachalam (Andhra Pradesh)  
⇒ Velvadar is a national park in Gujarat (Saurashtra region). It is famous for black buck.  
⇒ Largest no. of national park.  
1. Madhya Pradesh 2. Andaman & Nicobar islands.

## Reserves in Tamil Nadu

- ⇒ Pulikat lake is a bird Sanctuary
- ⇒ Guindy national park
- ⇒ Vedanthankal bird sanctuary
- ⇒ Nilgiri biosphere reserves
- ⇒ Mudumalai wild life sanctuary
- ⇒ Point calimere bird sanctuary
- ⇒ Vettangudi bird sanctuary
- ⇒ Gulf of mannar biosphere reserves
- ⇒ Marine national park (both in T.N & Gujarat)

### List of Biospher reserves:

- i) Great Nicobar (India's Southern most part)
- ii) Gulf of Mannar
- iii) Agasthiya malai
- iv) Nilgiri
- v) Pachmarhi (in M.P)
- vi) Achanakumara Amarkantak (in Chattisgarh)
- vii) Simlipal (in oddisha)
- viii) Sunderbans – Sunderban's delta is world's largest delta (it is formed by Ganga & Brahmaputra)  
Sundari trees are found  
It is in W.B.
- ix) Manas (Assam)
- x) Nokrek (Meghalaya)
- xi) Dihan – Dibang (Arunachal pradesh)
- xii) Didru Saikawa (Arunachal Pradesh)
- xiii) Kanjanjanha (Sikkim)
- xiv) Manda devi (Uthragand)
- xv) Rann of Kachch (Gujarat)

### Geology + Minerals:

Fe Ore & Mn → Dharwar System  
Cu, Pb & Zn → Aravalli Series of Dharwars  
Major metallic minerals → Dharwar & Cuddapah  
Limestone, Dolomite, Gypsum,  
 $\text{CaSO}_4$  → Cuddapah & Vindhyan  
Coal → Gondwana system  
Petroleum → Tertiary rocks

### Coal:

Carbon % : Anthracite > Bituminous > Lignite > Peat  
Indian Coal: Bituminous & Non-cooking grade  
Coal → Gondwana (200 My) → 97% reserves,  
Tertiary (55 My) → 3% reserves

### Gondwana Coal:

- 1. Damodar Valley → Jharkhand + West Bengal
- 2. Mahanadi Valley → Chattisgarh + Orissa
- 3. Wardha – Godavari Valley → MP, Maha & AP
- 4. Son valley → MP, Chattisgarh & UP

## GEOGRAPHY

<b>State</b>	<b>Coal Fields</b>
1. Jharkhand	Jharia→ Largest coal field, Giridih, Bokaro, Karanpura , Daltanganj, Ramgarh, Hutar, Auranga
2. Chhattisgarh	Chirimiri – Kurasia, Bisrampur, Jhilmili, Sonhat, Lakhanpur, Sendurgarh. Hardo-Arand, Korba, Mand-Raigarh, Johilla
3. Orissa	Talcher, Rampur – Himgir, Jharsuguda
4. Madhya Pradesh	Singrauli, Sohajpur, Umaria, Pench-Kanhan, Pathkera, Rewa
5. Maharashtra	Chanda-Wardha, Kamptee, Bander, Umred
6. Andhra Pradesh	Singareni, Kothagudam, Tandur
7. West Bengal	Raniganj→ First coalmine in India, Darjeeling [Dalingkot coalfield]
8. Uttar Pradesh	Part of Singrauli coalfield

### **Tertiary Coal:**

- 1. Assam - Makum, Nazira, Mikir Hills, Dilli- Jeypore.
- 2. Meghalaya - Daranggiri, Cherapunji, Laitryngew, Mawlong, Langrin
- 3. Arunachal Pradesh - Namchik – Namphuk
- 4. Jammu Kashmir - Kalakot

### **Lignite:**

- 1. Tamil Nadu - Neyveli→Jayamkondacholapuram
- 2. Gujarat - Umarsar→Kuchchh Dt.
- 3. Jammu Kashmir - Nichahom→Baramulla Dt.
- 4. Rajasthan - Palana → Bikaner Dt.
- 5. Kerala - Varkala

### **Coal Reserves**

- 1. Jharkhand
- 2. Orissa
- 3. Chhattisgarh
- 4. West Bengal
- 5. Madhya Pradesh

Jharia (JK) → Largest Coal Field  
Raniganj (WB) → Oldest Coal Field

### **Petroleum / Mineral Oil:**

First oil field discovered →Makum (Assam)  
First oil drilled →Digboi (Assam)

### **1. North-East Region:**

Assam - Digboi, Moran-Hugrijan, Naharkatiya, Rudrasagar, Galeki.  
Arunachal Pradesh →Nigrum (TirapDt) / Ningru  
Nagaland →Borholla

### **2. Gujarat Region:**

Ankleshwar, Kalol, Nawajam, Kosamba, Kathana, Barkol, Mehsana, Sanand, Lunej (Khambat)

3. Rajasthan :Saraswathi&Rajeswari (BarmerDt)  
Jaisalmer Dt.

### 4. West Coast off-shore oil fields:

- Mumbai High
- Bassein
- Aliabot Is → Gulf of Khambat

### **5. East Coast off-shore oilfields:**

- Krishna – Godavari basin →Rawa field.
- Kaveri basin.

### **6. Tamil Nadu:** Narimanam, Kovilappal

ONGC: Oil and Natural Gas Commission (1956)

### **Oil Pipelines:**

- 1. Naharkatiya – Nunmati – Barauni – Haldia pipeline
- 2. Mumbai High – Mumbai – Ankleshwar – Koyali pipeline.
- 3. Salaya – Koyali – Mathura pipeline.

### **Oil Production**

- 1. Mumbai High
- 2. Gujarat
- 3. Assam
- 4. TN

### **Natural Gas:**

GAIL: Gas Authority of India Limited (1984)

- 1. Gujarat Nanda →Khambat basin Andada
- 2. Tamil Nadu →Adiyakkamangalam
- 3. Assam →Khovaghat
- 4. Andhra Pradesh →Lingla
- 5. Rajasthan Tanot→Jaisalmer basin
- 6. Offshore Fields : K G Basin – Ravva Field Kaveri offshore, Mumbai High, Bassein Field, Kachchh Offshore.

### **Gas Production**

- 1. Mumbai High
- 2. Gujarat
- 3. Andhra Pradesh
- 4. Assam

### **Gas Pipelines:**

- 1. Hazira – Bijaipur – Jagdishpur (HBJ) pipeline:
  - World's longest underground pipeline.
  - India's longest pipeline → 1750 km
- Hazira→Bijaipur→Jagadishpur
  - Supplies gas to 3 power houses.
  - 1. Kawas→Gujarat
  - 2. Anta → Rajasthan
  - 3. Auraiya→ UP

## GEOGRAPHY

- Supplies gas to 6 Fertilizer plants:
  1. Bijaipur→ MP
  2. SawaiMadhopur→ Rajasthan
  3. Jagdishpur→ UP
  4. Shahjahanpur→ UP
  5. Aonla→ UP
  6. PiyalaBabrala→ UP

### **2. Jamnagar – Loni LPG Pipeline**

- Longest LPG pipeline in the world → 1269 km long.
- Connects Jamnagar (Gujarat) to Loni(UP)

### **Power**

#### **HEP :**

HEP Potential → 84, 000 MW @ 60% Load factor

#### **HEP Potential:**

1. Brahmaputra → 42%
2. Indus → 24%
3. Ganga → 13%
4. East Flowing Rivers → 11%
5. West Flowing Rivers → 7%
6. Central Indian Basins → 3%

### **Electricity Installed Capacity: (2002-03)**

Hydro	Thermal	Gas
AP	Maharashtra	Maharashtra
Karnataka	Gujarat	Gujarat
Maharashtra	West Bengal	AP
Punjab	Uttar Pradesh	TN
TN	TN	

### **Total Installed Capacity: (2002-03)**

1. Maharashtra → 13, 180 MW
2. AP → 7, 616 MW
3. Gujarat → 7, 323 MW
4. TN → 7, 146 MW
5. Karnataka → 5, 197 MW

### **Total Electricity Generated**

1. Maharashtra
2. Gujarat
3. AP
4. TN
5. UP

NHPC, NTPC → 1975

### **Wind Energy:**

#### **1. TN:**

- Muppandal – Perungudi
- Kaiyattar

#### **2. Maharashtra→Satara**

#### **3. Gujarat:**

- Lamba→ Largest in Asia
- Mandvi

#### **4. Orissa:**

- Puri

#### **Bio-energy**

Okhla→ Delhi

#### **Geothermal energy:**

- Manikaran→KulluDt, HP
- Tattapani→Chattisgarh

#### **Tidal energy**

	<b>Potential</b>
Gulf of Khambat	→ 7000 MW
Gulf of Kachchh	→ 1000 MW
Sunderbans	→ 100 MW

#### **Wave Energy:**

- Vizhinjam→ Kerala
- Andaman & Nicobar Is

#### **Nuclear Energy:**

Atomic Energy Commission (AEC) → 1948  
 Atomic Energy Institute, Trombay→ 1954  
 Bhabha Atomic Research centre (BARC) → 1967

#### **6 Nuclear Power Stations:**

1. TN → Kalpakkam
2. Karnataka → Kaiga
3. Maharashtra → Tarapur
4. Gujarat → Kakrapara
5. Rajasthan → Rawatbhatta
6. UP → Narora

#### **Minerals**

- i) Metals
- ii) Non-Metals

#### **i) Metals**

#### **ii) Non - metals**

#### **Ferrous**

#### **Non-Ferrous**

Limestone		
Iron ore	Gold	Dolomite
Manganese	Silver	Nitrate
Chromite	Copper	Potash
Pyrites	Lead	Mica
Nickel	Bauxite	Gypsum
Cobalt	Tin	
Tungsten		Magnesium

#### **Iron Ore: [M HLS]**

#### **Ores:**

1. Magnetite → 72% pure Iron
2. Haematite → 60 – 70% pure Iron
3. Limonite → 40 – 60% pure Iron
4. Siderite → 40 – 50% pure Iron

#### **Reserves:**

1. Jharkhand
2. Orissa
3. Karnataka

#### **Production**

1. Karnataka
2. Orissa
3. Chhattisgarh

## GEOGRAPHY

### 1. Karnataka

- Bellary district → Bellary, Hospet, Sandur
- ChikmagalurDt → Baba Budan Hills  
→Kummangudi, Kudremukh
- ShimogaDt
- Chitradurg Dt.
- TumkurDt

### 2. Orissa:

- Mayurbhanj→Gurumahisini, Sulaiat, Badampahar
- Kendujhar→Kiriburu, Meghahataburu
- Sundergarh→Bonai

### 3. Chhattisgarh:

- DurgDt→Dalli, Rajhara
- Dantewada→Bailadila (BastarDt)

### 4. Jharkhand:

- Purbi→Naomundi mines
- PaschmisinghbhumDt→Gua

### 5. Goa:

- Sanquelim
- Sanguem
- Quepem
- Satari
- Ponda
- Bicholim
- Purbi&PaschmiSinghbhumDt→Naomundi&Gua

### 6. Maharashtra:

- Ratnagiri Dt.
- ChandrapurDt
- BhandaraDt

### Orissa:

Barabil-Koira Valley → India's richest haematite ore deposits.

### 7. Andhra Pradesh:

- KarimnagarDt
- Warangal Dt
- Kurnool Dt
- Cuddapah Dt.
- AnantpurDt

### 8. Tamil Nadu:

- Salem →Tirthamalai hills
- Nilgiris→Madapalli, Killimalai

### Manganese:

- Gondite&Kodurite series of Dharwar system

### 1. Orissa:

- Sudergarh Dt.
- KendujargarhDt
- GangpurDt
- KoraputDt

- KalahandiDt
- BolangirDt (Balangir)

### 2. Madhya Pradesh:

- Balaghat – Chhindwara – NimarMandla
- JhabuaDt

### 3. Maharashtra:

- Nagpur – Bhandara Dt.
- Ratnagiri

### 4. Karnataka

- Dharwad, North Kanara Dt.
- Belgaum
- Shimoga – Chitradrug – Bellary – TumkurDt
- ChikmagalurDt

### 5. Andhra Pradesh:

- VijayanagaramDt
- AdilabadDt

### 6. Rajasthan:

- BanswaraDt
- Udaipur Dt

### Chromite:

#### 1. Orissa:

- Cuttack Dt – Sukinda
- KendujharDt
- DharkanalDt

#### 2. TN → Salem

- 3. Andhra →Kammam
- 4. Maharashtra →ChandrapurDt
- 5. Karnataka→ Hassan Dt

### Copper:

- 1. Jharkhand →SinghbhumDt, HazaribaghDt
- 2. Madhya Pradesh:
  - BalaghatDt→Malanjkhand cu mines

### 3. Rajasthan:

- AlwarDt→Kho-Dariba
- JhunjhunaDt→Khetri–Singhana
- Udaipur Dt→Delwara–Kirovli
- BhilwaraDt

#### 4. TN → SouthArcotDt

### Bauxite: (Al)

- Associated with laterite rocks.
- Ore of Aluminium

### 1. Orissa: (Largest Produces)

- Kalahandi Dt.
- SambalpurDt
- BolangirDt (Balangir)

## GEOGRAPHY

- KoraputDt→Damanjodi→Panchpatmali Mines
- SundergarhDt
- 2. Jharkhand:**
  - GumlaDt
  - LohardagaDt
  - PalamurDt
- 3. Gujarat**
  - Bhavnagar Dt
  - Jamnagar Dt
  - JunagadhDt
  - KachchhDt
  - AmreliDt
- 4. MP:**
  - Shahdol, Mandla, Satna, Balaghat Dt.
  - Jabalpur →Katni

- 5. Maharashtra:**
- Kolaba, Thane, Ratnagiri
  - Satara, Pune, Kolhapur

- 6. Chhattisgarh:**
- Durg + BilaspurDt→Maikala Hill
  - Amarkantak Pl →Surguja, Raigarh, Bilaspur

- 7. Tamil Nadu:**
- Salem Dt.
  - NilgiriDt

Galena (pbs) → Lead ore  
Sphalerite (Zns) → Zinc Ore

**Zinc & Lead:**  
Galena: Ore of lead (cubic sulphide)

- Zinc deposits:**
1. Udaipur Dt, Rajasthan →Zawar [99% of Zn in India]
  2. UdhampurDt, JK
  3. South ArcotDt, TN

- Lead deposits:**
1. Rajasthan → Udaipur (Zawar, Debari), Dungarpur, Banswara, Alwar.

**Gold**  
occurs→ Quartz veins in Dharwarschists (Lode deposit)  
→ Placer deposits → River sands

- 3 Gold Fields:**
1. Kolar Gold Field →Kolar Dt.
  2. Hutti Gold Field →Raichur Dt.  
Karnataka
  3. Ramagiri Gold Field →AnantpurDt→ Andhra Pradesh

**Jharkhand:**  
➤ Placer deposits → Subarnarekha river

- Sonanadi→Singhbhum Dt.

### Silver:

#### Ores:

1. Argentine
2. Stephanite
3. Pyrargyrite
4. Prousite

Found mixed with Cu, Au, Zn &Pb

Al – Aluminium

Au – Gold

Ag – Silver

Pb – Lead

Zn – Zinc

Sn – Tin

Mn – Manganese

Fe- Iron

### Production:

1. Rajasthan →Zawar (Udaipur Dt)
- Zawar (Udaipur) → Zinc (Zn), Lead (Pb), Silver (Ag)

### Mica:

3 Types → Muscovite, Phlogopite, Biotite

### 1. AP:

- Nellore Dt.

### 2. Rajasthan

- Jaipur - Bhilwara - Ajmer -
- Udaipur
- Tonk - Sikar
- Dungarpur
- 3. Jharkhand →Hazaribagh, Kodarma
- 4. Bihar → Gaya, Hunger
- 5. TN → CBE, MDU, TRY
- 6. Kerala →Alleppey
- 7. WB →Puralia, Bankura  
Purana→Cuddapah, Vindhyan

### Limestone:

- Cuddapah&Vindhyan, cretaceous formations.
- $\text{CaCO}_3$ → Limestone
- Dolomite → Limestone with > 10% Mg
- 1. MP →Satna, Jabalpur, Katni, Rewa, Damoh, Mandsaur, Morena
- 2. Chhattisgarh → Raipur, Mahasamund, Durg, Bilaspur, Jangir
- 3. AP →Cuddapah, Nalgonda, Adilabad, Karimnagar, Guntur
- 4. Rajasthan →Chittaurgash, Ajmer, Siroli, Udaipur, Kota.
- 5. Gujarat →Junagadh, Amreli, Jamnagar
- 6. TN →Trichy
- 7. Karnataka → Gulbarga
- 8. Maharashtra →Chandrapur

## GEOGRAPHY

### Dolomite:

1. Orissa → Sundergarh
2. MP → Jhabua, Balaghat, Jabodpur
3. Chhattisgarh → Bilaspur, Jangir, Durg
4. AP → Khammam
5. Jharkhand → Palaman
6. Gujarat → Vadodara
7. UP → Mirzapur
8. Maha → Nagpur

### Phosphate:

1. Rajasthan → Udaipur
2. Uttarkhand → Dehradun
3. MP → Jhabua, Chhatarpur
4. UP → Lalitpur

### Apatite:

1. AP → VizajDt
2. WB → PuruliaDt

### Magnesite:

- TN → Leading producer
- Salem Dt.

### Diamonds:

1. Panna → MP
2. Golconda, Wajrakarurkimberlite (Anantpur) → AP

### Atomic Minerals:

#### Uranium:

- Singhbhum, Hazaribagh → Jharkhand
- Gaya → Bihar
- Saharanpur → UP
- Singhbhum → Jaduguda → Baghjanta Mines
- Meghalaya → Domiasat
- Udaipur cumines → Rajasthan

### Thorium:

Th Ores → Monazite sands, Ilmenite sands

### Monazite sands:

1. Kerala → Palghat, Kollam Dt.
2. AP → Vizag
3. Orissa → Mahanadi delta

### Beryllium oxide:

Moderator in Nuclear reactor

### Salt:

1. Gujarat coast
2. Rajasthan → Sambhar lake
3. TN coast
4. Maharashtra coast
5. HP → Mandi produces Rock salt

### Uranium

1. Jharkhand → Banduguranj Project (singhbhumDt), Muhaldih

2. Andhra → Lambarpur → Pedagatta Project (NalcondaDt) → Puliventula Project / TumlaPalli Project (CudappahDt)

### Cotton Textile Industry

KawasjiDhaber: First cotton textile millin Mumbai in 1854

### Cotton Industry

1. Organised sector (Mills)
2. Decentralised sector → i) Power looms -59% cloth  
ii) Handlooms – 19% cloth  
1782 Mills → Public sector 192 mills, Co-op sector 151 mills,  
Private sector 1439 mills

### Important centres

1. Mumbai
2. Coimbatore
3. Ahmedabad
4. Kanpur

Tamil Nadu: Largest no. of mills (439 mills)  
Leading cotton textile producing states:

1. Maharashtra
2. Gujarat
3. Tamil Nadu

### Sugar Industry:

- India → Largest producer of sugarcane &canesugar.
- 8% of world sugar production.
- sugar industry → seasonal industry
- sugar factories → 506
- weight losing crop:  
sugar to sugarcane → 9 to 12%

### Leading sugar producers:

1. Maharashtra → 33%
2. UP
3. Tamil Nadu

### UP Factories:

**1. Ganga-Yamuna doab:** Saharanpur, Muzaffarnagar, Meerut, Ghaziabad, Baghpat&Bulandshahr.

**2. Tarai Region:** Lakhimpur, Basti, Gonda, Deoria, Gorakhpur, Bhraich, sitapur, Faizabad.

### Maharashtra Factories:

Pune, Kolhapur, Sangli, Ahmednagar, Solapur, Manmad.

### TN:

CBE, Vellore, Tiruvannamalai, Villupuram&Trichy.

### Petrochemicals Industry:

**Mumbai:** Hub of Petrochemicals

## GEOGRAPHY

### Cracker Units:

Auraiya → UP  
 Jamnagar, Gandhar, Hazira → Gujarat  
 Nagothane, Ratnagiri → Maharashtra  
 Haldia → WB  
 vizaj → AP

### Organisations

1. IPCL → Indian Petrochemical Corp Ltd.
2. PCL → Petrofils Co-op Ltd.
3. CIPET → Central Inst of Plastics Engg& Tech

PCL Units (Gujarat) → Vadodara, Naldhara

### Plastic Materials Prodn:

Mumbai, Barauni, Mettur, Pimpri&Rishra

### Nylon + Polyester Yarns:

Kota, Pimpri, Mumbai, Modinagar, Pune,  
 Ujjain, Nagpur &Udhna.

### Acrylic staple fibre:

Kota, Vadodhara

## Transport & Communication

### Road Transport:

- Total road length → 33.1 lakh km
- Nagpur plan → 1943
- 20 year road plan → 1961

### Roads

National Highways (NH) → Central Govt.

Stage Highways (SH)

Major District Roads State Govt.

Rural roads

NHAI: National Highways Authority of India → 1995

NHDP: National Highways Dvt project by NHAI

### 1. Golden Quadrilateral:

- 4/6 lanes
- 5846 km long

### 2. N-S & E-W corridors:

N-S corridor: 4076 Km long  
 Srinagar(JK) -----

Kaniyakumari (TN)

E-W corridor: 3640 Km long  
 Porbandar (Gujarat) -----  
 Sikkim (Assam)

3	Major District Roads	4, 70, 000	14
4	Rural Roads	26, 50, 000	80
	Total	33, 13, 769	100

### NH:

Only 2% of total road length but carry 40% of the road traffic.

**Other Roads** → Border Roads, International Highways.

### BRO: Border Road Organisation (1960)

- Constructed road connecting Chandigarh with Manali (HP) &Leh (JK)

### Road Density:

- Length of roads / 100 Km<sup>2</sup> → Road Density
- Highest → Kerala → 387.24 km
- Lowest → JK → 10.48 km
- National Average → 75.42 km

### National Highways:

**NH1** → Delhi – Ambala – Ludhiana – Jalandhar – Amritsar

**NH2** → Delhi – Agra – Kanpur – Allahabad – Varanasi – Mohana – Aurangabad – Bashi – Dhambad – Bardhaman – Kolkata.

**NH3** → Agra – Gwalior – Shivpuri – Biaora – Indore – Dhule – Nashik – Thane – Mumbai

**NH4** → Thane – Panvel – Pune – Satara – Kolhapur – Belgaum – Hubli – Chitradurg – Tumkur – Bangalore – Krishnagiri – Vellore – Chennai

**NH5** → Chennai – Nellore – Ongole – Guntur – Vijaywada – Eluru – Vizaj – Srikakulam – Chhatrapur – Bhubaneshwar – Cuttack – Baleshwar – Baharajora (Jharkhand)

**NH6** → Kolkata – Baharagora – Sambalpur – Raipur – Nagpur – Amravati – Jalgaon–Dhule

**NH7** → Kaniyakumari – Tirunelveli – MDU – Dindigul – Karur – Salem – Krishnagiri – Bangalore – Anantpur – Kurnool – Hyderabad – Nizamabad – Adilabad – Nagpur – Jabalpur – Katni – Mangawan – Varanasi

**NH8** → Delhi – Jaipur – Ajmer – Beawar – Udaipur – Ahmedabad – Vadodara – Surat – Mumbai

**NH9** → Pune – Solapur – Hyderabad – Vijayawada – Machlipatnam

**NH10** → Delhi – Rohtak – Hisar – Fazilka

**NH15** → Pathankot – Amritsar – Bathinda – Ganga nagar – Bikaner – Pokhran – Jaisalmer – Barmer – Radhanpur

**NH17** → Panvel – Ratnagiri – Panaji – Mangalore – Kannur – Kozhikode – Thrissur.

**NH47** → Kaniyakumari – Trivandrum – Kollam – Kochi – Ernakulam – Thrissur – Palakkad – CBE – Salem

**NH45** → Chennai – Villupuram – Trichy – Dindigul

s.no.	Roads	Length(Km)	% of total road length
1	NH	65, 769	2
2	SH	1, 28, 000	4

## GEOGRAPHY

**NH48** → Bangalore – Hassan – Mangalore  
**NH49** → Kochi – Ernakulam – Madurai – Ramnad

### North - South Corridor:

Srinagar – Jammu – Pathankot – Jalandhar – Ludhiana – Aunbala – Delhi – Agra – Gwalior – Jhansi – Sagar – Narshimpur – Nagpur – Adilabad – Nizamabad – Hyderabad – Kurnool – Anantpur – Bangalore – Krishnagiri – Salem – Dindigul – Madurai – Kanyakumari

### East-West Corridor:

Porbandar – Rajkot – Radhanpur – Sirohi – Udaipur – Chittaurgarh – Shivpuri – Jhansi – Kanpur – Lucknow – Faizabad – Gorakhpur – Muzzaffarpur – Purnia – Siliguri – Bongaigaon – Guwahati – Silchar.

N-S & E-W meet @ Jhansi

### N-S & GQ share:

1. Agra – Delhi route
2. Krishnagiri – Bangalore route

### Longest NH:

NH7 → 2, 369 km (Kanyakumari → Varanasi)

NH6 → 1, 949 km (Dhule - Kolkata)

### Shortest NH:

NH 47 A → Ernakulam → Wellington Is (Kochi)

### Descending order:

NH7 > NH6 > NH5 > NH15 > NH2 > NH8 > NH17 > NH 4 > NH3

### Rail Transport:-

1853 : First train from Mumbai to Thane for 34 km.  
Length : 63, 221 km

### Ganges

- i) Broad gauge → 1.676 m, 46,807 km, 74.14%
  - ii) Metre gauge → 1.000 m, 13, 290 km, 21.02%
  - iii) Narrow gauge → 0.762 – 0.610 m, 3, 124 km, 4.94%
- Indian railway route → 41% electrified

### Konkan Railway (1998):

- Connects Mangalore, Karnataka with roha, Maharashtra
- 760 km long

### Freight: (H → L)

1. coal
2. cement
3. food grains
4. Raw material for steel plants

### 16 Railway zones:

1. Central- Mumbai CST

2. North central – Allahabad
3. East central – Hajipur
4. South central – Secunderabad
5. West central – Jabalpur
6. South East Central – Bilaspur
7. Northern – New Delhi
8. Eastern – Kolkata
9. Southern – Chennai
10. Western – Mumbai church gate
11. North Eastern – Gorakhpur
12. North East Frontier – Maligaon (Guwahati)
13. South Eastern – Kolkata
14. South Western – Hubli
15. East Coast – Bhubaneshwar
16. North western – Jaipur

### Rail Factories:

1. Chittaranjan Locomotive works → Chittaranjan, WB
2. Diesel Locomotive works → Varanasi, UP
3. Integral coach Factory → Perambur, Chennai
4. Rail Coach Factory → Kapurthala, Punjab/ Lalganj, UP
5. Wheel and Axle Factory → Bangalore, Karnataka
6. Diesel component works → Patiala, Punjab

### Water Transport:

- i) Inland waterways.
- ii) Oceanic waterways

### Inland waterways:

Navigable waterways → 14, 500 km (1%)

Rivers: Navigable → 3700 km

Used → 2000 km

Canals : Navigable → 4300 km

Navigable by Mech vessels → 900 km

Inland Waterways Authority → 1986

### National Waterways of India:

**NW1** → Allahabad – Haldia → 1620 km

**NW2** → Sadiya – Dhubri → 891 km

**NW3** → Kottapuram – Kollam → 205 km

along with Udyogmandal and champakkar canals

### Oceanic Waterways:

coastline → 7, 517 km

Ports → 12 Major ports (6 on each coast), 185

Minor ports (state Govt)

### Foreign Trade:

- 70% by value
- 95% by volume

ocean routes

Capacity of Indian ports (cargo) → 500 million tonnes.

### Major Ports:

## GEOGRAPHY

West Coast	East Coast
1. Kandla	7. Tuticorin
2. Mumbai (Natural harbour, Chennai [oldest but Biggest Port])	8. artificial
3. Nhavasheva (Jawaharlal Nehru) → Largest container port & Modern Port	9. Ennore
4. Marmagao (Natural harbour @ Deepest land zuari estuary)	10. Vizag
5. New Mangalore	11. Paradwip
6. Kochi → Natural harbour, Queen Haldia of Arabian sea	12. Kolkata - (Tidal ports)

### Air Transport:

**1911:** 10 km travel b/w Allahabad & Naini  
**1953:** Air transport was nationalised & 2 corp set up Air India, Indian (Indian Airlines)  
**1992:** Open sky policy for cargo.

**Airports** → 12 International Airports, 112 Domestic Airports.

### International Airports:

- |                  |                   |              |               |
|------------------|-------------------|--------------|---------------|
| 1. New Delhi     | 2. Mumbai         | 3. Chennai   | 4. Kolkata    |
| 5. Bangalore     | 6. Hyderabad      | 7. Kochi     | 8. Trivandrum |
| 9. Amritsar      | 10. Ahmedabad     | 11. Guwahati |               |
| 12. Panaji (Goa) | 13. Srinagar (JK) |              |               |

### Pawan Hans Ltd:

- Helicopter service operating in hilly areas & tourism in North – Eastern sector.
- Heli service to petroleum sector & tourism

### Rural Settlements

#### 4 types:

1. Clustered, Agglomerated/Nucleated settlements
2. Semi-clustered/ Fragmented settlements
3. Hamleted settlements
4. Dispersed settlements / Isolated settlements

#### 1. Clustered settlements:

- Highly productive alluvial plains, valleys of shivaliks & in NE states.
- Security reasons → Bundelkhand region, Nagaland.
- Maximum utilisation of available resources → Rajasthan

#### 2. Semi-clustered settlements:

- Due to agglomerated tendency in a restricted area of dispersed settlement or consolidated territorial base.

- Also due to segregation / fragmentation of large compact village.
- Ex: Gujarat Plains

#### 3. Hamleted settlements:

- Fragmented into several units physically separated from each other bearing a common name → para, pali, nagla, dhani
- Motivated by social & ethnic factors.
- Ex.: Middle & lower Ganga plain, Chhattisgarh, lower valleys of Himalayas.

#### 4. Dispersed settlements:

- Isolated huts/hamlets of few huts in remote jungles or on small hills with farms or pastures on slopes.
- Due to fragmented nature of land resource base.
- Ex.: Meghalaya, Uttarkhand, HP

### Patterns:

Most common Pattern → Rectangular / Square

#### 1. Linear/String:

- Along road, river, canal
- Ex.: Coastal Kerala, Dun Valley (Doiwala, Lachiwala, Kanwarwala)

#### 2. Radial:

- Roads coverage @ a nodal position

#### 3. Star shaped:

- Inter-road space filled up in radial pattern.

#### 4. Spider web:

- Inter-connecting roads b/w the radial roads filled up.

#### 5. Checkerboard / Rectangular:

- Junction / crossing of 2 important highways.
- Ex. Northern plains of India.

#### 6. Triangular / Arrowhead:

- B/w 2 rivers @ their junction / confluence of 2 roads.

#### 7. Fanshaped:

- At fan head / delta head
- Ex: MP → Asland, Garahakota
- TN → Kanyakumari

#### 8. Circular pattern:

- Around lake / hill

#### 9. Semi-circular:

- Encircle partly
- Ex: UP → Bhimtal
- Rajasthan → siwan

### Towns

**Census Towns:** (All criteria should be satisfied)

- i) Minimum population of 5000 persons.
- ii) Atleast 75% male working population in non-agri pursuits.
- iii) Atleast poplu density of 400 persons / Km<sup>2</sup>

## GEOGRAPHY

### Statutory Towns:

- Places which have municipal / corporation / cantonment board / notified town area committee.

**city :** poph > 1 lakh

**Town:** poph < 1 lakh

### Power Projects

Rosa → UP

ParoHydel → Arunachal Pradesh

Sasan UMPP → MP

Darliparli → Orissa

Udangudi → TN

Nathpa – JhakriHydel → HP

Birbhum Coal Project → WB

### ALCO:

NALCO – Koraput (Orissa)

BALCO – Korba, Ratnagiri (Maha)

HINDALCO – Renukoot (UP)

INDAL – Muri (Jhar), Alupuram (Kerala), Belur (Kar), Hirakud (Orissa)

⇒ India is a peninsula

### Neighbouring countries - Capitals

1. Bangladesh - Dhaka (Share major portion of India)
2. China - Beijing
3. Pakistan - Islamabad
4. Nepal - Katmandu
5. Myanmar - Naibeda
6. Bhutan - Timbu
7. Afghanistan - Kabul
  - ⇒ 28 States & 7 union territories
  - ⇒ Chattisgarh - Raipur (capital)
  - ⇒ Jammu & Kashmir - Srinagar - summer capital  
Jammu - winter capital
  - ⇒ India's planned city - Chandigarh
  - ⇒ NCT - National Capital territory - India - Delhi
  - ⇒ Capital of Lakshadweep - Kavarathi
  - ⇒ Smallest bird sanctuary - Pitty Island in Lakshadweep
  - ⇒ Capital of Dadra Nagar Havelli - Silvassa
  - ⇒ Tropic of Cancer
  - ⇒ Passes through Gujarat, Rajasthan, Madhya Pradesh, Chattisgarh, Jhargand, West Bengal, Tripura, Mizoram
  - ⇒ Divides India into two halves at  $23^{\circ}$

### Mountains

⇒ Himalayas starts in pamir knot.

- ⇒ Godwin Austin ( $K_2$ ) is India's largest peak & is located in Karokkoram (originated before himalayas) range
- ⇒ Siyachin Glacier is in Karakkoram range
- ⇒ Ladakh & Sazkar are two ranges in Karakkoram range.
- ⇒ Himadri, Himachal & Shiwalik are 3 ranges in Himalayas (western part)
- ⇒ Eastern part of Himalayas – Purvachal
- ⇒ World's largest peak Mt. Everest is in Nepal
- ⇒ 2<sup>nd</sup> world's largest peak is Kanjanjanha
- ⇒ Purvachal contains the following ranges:
  - v) Batkaibum
  - vi) Bariel
  - vii) Manipur hills
  - viii) Mizor hill
- ⇒ Gara, khasi, Jaintia are three hills in Meghalaya
- ⇒ Maysyndrum - India's highest rainfall region is in khasi hills.
- ⇒ Aravalli ranges extends from Gujarat to Rajasthan (Oldest mountain ranges in India)
- ⇒ Delhi is the extension part of Aravalli range.
- ⇒ Andaman & Nicobar is extension part of Himalayas
- ⇒ Vindhya & Satpura ranges.
- ⇒ Gir range is Saurashtra
- ⇒ Gir lion is our national animal before 1970
- ⇒ Rajmahal hill's extension - Gara, khasi, Jaintia
- ⇒ Western Ghats Maharashtra to Odisha
- ⇒ Eastern Ghats
- ⇒ Nilgiri hills is the place where western ghats & Eastern ghats meet.
- ⇒ Mahendragiri (in Odisha) is the highest peak in Eastern ghats.
- ⇒ Anaimudi is the highest peak in western ghats.
- ⇒ Thottabetta is the highest peak in TN.
- ⇒ It is also in western ghat's
- ⇒ Cardamom (Vyt;fha;) hills

### RIVERS

#### i) Brahmaputra

- ⇒ Manasorrer lake - Brahmaputra is originated
- ⇒ Di-Sanghito is the name given to Brahmaputra in China

## GEOGRAPHY

- ⇒ Dihang is the name given to Brahmaputra in Arunachal Pradesh.
- ⇒ In Assam it is known as Brahmaputra
- ⇒ In Bangladesh it is known as Jamuna
- ⇒ Jamuna & Ganga joins in Bangladesh & it is Solely named as Padma
- ⇒ In delta region it is known as Macna.
- ⇒ Major Tributaries (JizahW)
  - f) Tista (b/w India & Bangladesh)
  - g) Subansri
  - h) Manas
  - i) Dihang – Dibang
- ⇒ Largest riveran island in the world Majuli is in Assam

### ii) Indus

- ⇒ Originates near to Manasarover (in India) lake & drains in Pakistan.
- ⇒ Major Tributaries
  - b) Jhelum b) Chenab c) Ravi d) Beas e) Sutluj
- ⇒ India's highest Granity Dam Bhakranangal is in Sutluj
- ⇒ India's Longest canal is Indira Gandhi Sagar Canal is in Thar Desert.

### iii) Ganga

- ⇒ Alaknanda & Bakiratharivers meet at Haridwar, which is named as Ganga.
- ⇒ Originates in Himalayas
- ⇒ Gangotri, Yamunotri & Glaciers are in Uthraghland
- ⇒ River Yamuna is originated from here.
- ⇒ Yamuna is the tributary river of Gangas & joins in Allahabad.
- ⇒ Haridwar, Ujjain, Allahabad, Nashik (happens Kumbamela in India)
- ⇒ Mahakumbamela occurs once is 144 years (12x12)
- ⇒ Tributaries
  - c) Ramganga b) Gomti c) Sarda d) Rati e) Ghaggara
  - j) Kosi - Sorrow of Bihar , originated in Nepal
- ⇒ Other river Yamuna, Sone
- ⇒ Tributaries of Yamuna: a) Chambal b) Betwa
- d) Kell

- ⇒ Farakka Dam – Hooblyriver passes through kolkuttai.
- ⇒ Damadar, Subarnarekha, Mahanadi, Brahmedi are other rivers.

### Godavari

- ⇒ Nashik (in Maharastra) – Godavari is originated
- ⇒ Rivers Krishna & Godaveri joins & forms a delta known as kollerilake
- ⇒ Vaiganga, Warda, Penganga, sabari, Manjra are the major tributaries of Godaveri
- ⇒ Thungabathra, Hagari, Sina are the major tributaries of Krishna.
- ⇒ India's largest tiger reserve is NagarjunaSahar reserve (in Andhra) in NagarjunaSahar lake (near Krishna river)

### Cauvery

- ⇒ Coorg district of Karnataka – Origin place
- ⇒ Kabini&krishnarajasagar – 2 dams in Karnataka
- ⇒ Mettur dam in T.N.
- ⇒ Trichy, Tanjore, Tiruvarur, Nagapattinam – Cauvery Delta District in Tamil Nadu.
- ⇒ Subaravathi, Amaravathi, Arkkavathi, Shisha, Noyyal, Bhavani are major tributaries of cauvery.

### Other Important rivers in Tamil Nadu

- viii. ghyhW - Kanchipuram – Vellore, South Arcot – Cuddalore, North Arcot - Vellore
- ix. nghd;dhW-Krishnagiri – T.V. Malai – VPM - PDY
- x. nts;shW-Nrh;tuhad; Fd;W-fLY}h;
- xi. fhtphp
- xii. itif–kJiu - ,uhNk];tuk;
- xiii. itg;ghW-tpUJefh;>rptfhrp
- xiv. jhkpuqudp (tw;whjejp) –jpUr;nre;J}h;
- ⇒ Stanelyreservoir is in mettur dam
- ⇒ In T.N. cauvery is originated from Okkanakal hills.
- ⇒ Vandematram was first sung in congress session at 1896.
- ⇒ Morning song of India – National Anthem
- ⇒ In 1911 king wales visited India
- ⇒ In 1911, first national anthem was sung first
- ⇒ National Aquatic animal – Gangetic Dolphin. It is announced in 2008.
- ⇒ National Heritage animal – ElephanT

## GEOGRAPHY

- ⇒ Acc to census 2001 our total forest area is 23.28%, but forest coverage area is 20% & the targeted forest area by the govt is 33%
- iii) National forest policy – 1988  
iv) Social forestry – 1976
- ⇒ In Arunachal Pradesh more than 90% of area were forests
- ⇒ Areawise – M.P. is the place covered largely by forest
- ⇒ Lowest forest area – Haryana
- ix) Wild life protection Act – 1972  
x) Environmental protection Act – 1986  
xi) Project Gir Lion – 1972  
xii) Project Tiger – 1973  
xiii) Project Crocodile – 1974  
xiv) Rhino's conservation - 1987  
xv) Project elephant – 1902  
xvi) Project snow leopard – 2002
- ⇒ In India there are 18 Biosphere  
⇒ India's first national park is Corbett in Uthraghand.  
⇒ India's Largest national park is dessert national park in Rajasthan  
⇒ KaibulLamjao national park is in Loottaklake in Manipur. It is the world's only fwating national park  
⇒ Indias first Tiger reserve is Bandipur Tiger reserve in Karnataka  
⇒ India's largest Tiger reserve is NagarjunaSahar reserve, Srisailam  
⇒ India's fist Biosphere reserve is Gulf of Mannar
- ⇒ **List of Biospher reserves:**
- xvii) Great Nicobar (India's Southern most part)  
xviii) Gulf of Mannar  
xix) Agasthiyamalai  
xx) Nilgiri  
xxi) Pachmarhi (in M.P)  
xxii) AchanakumaraAmarkantak (in Chattisgarh)  
xxiii) Simlipal (in oddisha)  
xxiv) Sunderbans – Sunderban's delta is world's largest delta (it is formed by Ganga & Brahmaputra)  
Sundari trees are found  
It is in W.B.  
xxv) Manas (Assam)  
xxvi) Nokrek (Meghalaya)  
xxvii) Dihan – Dibang (Arunachal pradesh)
- xxviii) DidruSaikawa (Arunachal Pradesh)  
xxix) Kanjanjanha (Sikkim)  
xxx) Mandadevi (Uthragand)  
xxxi) Rann of Kachch (Gujarat)  
xxxii) Seshachalam (Andhra Pradesh)
- ⇒ Velvadar is a national park in Gujarat (Saurashtra region). It is famous for black buck.
- ⇒ Largest no. of national park.  
2. Madhya Pradesh 2. Andaman & Nicobar islands.

## Reserves in Tamil Nadu

- ⇒ Pulikat lake is a bird Sanctuary  
⇒ Guindy national park  
⇒ Vedanthankal bird sanctuary  
⇒ Nilgiri biosphere reserves  
⇒ Mudumalai wild life sanctuary  
⇒ Point calimere bird sanctuary  
⇒ Vettangudi bird sanctuary  
⇒ Gulf of mammar biosphere reserves  
⇒ Marine national park (both in T.N & Gujarat)

## Transport

- ⇒ Cheapest mode of transport is shipping  
⇒ NHAI (found in 1995)  
⇒ BRO – Border Road Orgn (1960)  
⇒ Total NH – 220  
⇒ Major NH:
  - ❖ NH1 – Delhi to Amristar
  - ❖ NH2 – Delhi to Kolkatta
  - ❖ NH3 – Agra to Mumbai
  - ❖ NH4 - Mumbai to Chennai
  - ❖ NH5 –Chennai to Kolcutta (3<sup>rd</sup> longest)
  - ❖ NH6 – Kolcutta to Mumbai (2<sup>nd</sup> longest)
  - ❖ NH7 – India's longest NH (2369 km) Kanyakumari to Varanasi
  - ❖ NH8 – Delhi to Mumbai (Via Rajasthan, Gujarat)  
(Jaipur, Ahmadabad)
  - ❖ NH15 – Amristar to Radhanpur (in Gujarat)  
Passes through desert
  - ❖ NH17 – Panvel (Maharashtra) to Ernakulam Through Western Coast
  - ❖ NH45 – Chennai to Dindugal
  - ❖ NH47 – Salem to Kanyakumari (via Kerala)
  - ❖ NH7A – Tirunelveli to Tuticorin
  - ❖ NH39 – connects India & Myanmar  
Border that connects India & Myanmar is morieu.

## GEOGRAPHY

- ❖ NH31A – Connects China via Sikkim
- ⇒ Golden Quadrilateral Highway – NH2 – NH4 – NH5- NH 8  
Length – 5846 km
- ⇒ North – south corridor highway – Srinagar to Kanyakumari  
It connects NH7+NH1+NH1A +NH4 – (Jalandhar to Srinagar) Length – 4076 km
- ⇒ East – west corridor highway – Borbandhar to silchar (Assam) length – 3640km
- ⇒ NH28 – 5<sup>th</sup> longest NH
- ⇒ Greatest Road density – Kerala
- ⇒ Lowest road density – J & K
- ⇒ Shortest highway – NH47A (Ernakulam to wellington Highway cochin)

- ⇒ Central – Mumbai
- ⇒ North Central – Allahabad (U.P)
- ⇒ East Central – Hajipur (Bihar)
- ⇒ S.E. Central – Bilaspur (Chattisgarh)
- ⇒ West Central – Jabalpur (M.P.)
- ⇒ South Central – Secundarabad
- ⇒ East Coast railway – Bhuvaneshwar
- ⇒ Konkan railway (west coast) – Navy Mumbai (Belapur)
- ⇒ Maximum route length – Northern railway
- ⇒ Southern railway – part of Andhra, T.N. , pdy, kerala

## WATER TRANSPORT

- ⇒ Inland waterway authority was established in 1986. Its H.Q. is in Noida (V.P.)
- ⇒ National waterway (NW)  
NW1 – Allahabad to Haldia (Ganga river) – 1620 km  
NW2 – Sadiya to Dubri (Brahmaputra) Assam – 891 km  
NW3 – Thotthapuram to Kollam (Kerala) – 205 km  
NW4 – Kakinada to Marakkanam (T.N)  
Bakkingham Canal  
NW5 – Talcher to Dhumra  
In Brahmani river (in odhisha)  
Talcherriver is famous for Lignite

## Major Harbours

- i) Kandla (Gujarat) ii) Mumbai iii) Goa iv)  
Mangalore v) Cochin vi) Tuticorin vii) Chennai viii)  
Ennore ix) Visakapatnam x) Paradwip (odissa) xi)  
Kolcutta

- ⇒ India's longest coast line – Gujarat
- ⇒ 2<sup>nd</sup> longest coast line – Andhra Pradesh

## Railway

- ⇒ First railway line 1853 – Mumbai to Thane
- ⇒ In T.N. Chennai to Arakkonam

## 17 Railway zones

- ⇒ Northern – Delhi, Southern – Chennai,  
Western – Mumbai, Eastern – Kolcutta
- ⇒ N.E. – Gorakpur (Bihar)
- ⇒ N.E. (Frontier) – Maligan (Gauhati)
- ⇒ N.W. – Jaipur
- ⇒ SE – Kolcutta
- ⇒ SW – Hubli (Karnataka)

NAINARAJ INSTITUTE OF TNPSC

## Gravitation

GF – the force which pulls us towards the earth.

- GF hold all planets in its orbit.

## Newton's law of Gravitation

- every particle in the universe attracts every other particle with a force that is  $F = G \cdot \frac{Mm}{r^2}$  (is directly proportional to the product of their masses and inversely proportional to the square of the distance b/w them)

## Centripetal force:

- force directed towards the centre.
- may be GF, frictional force etc.

## Centrifugal force

- acts outwards equal & opposite to centripetal force
- @ poles – weight increase, @ equator – weight decreases
  - 1. earth shape 2. rotation causes – centrifugal force
  - causes – centrifugal force @ poles – 0, @ equ – max.
- If rotation stops – weight increase
- If rotation increases – weight decreases

## Mass

- measure of quantity of matter contained in it.
- mass of a body – constant quantity.
- whereas weight varies from p-p
- surface of the moon =  $g = \frac{r}{6}$  th of that of an earth  $g = 9.8 \text{ m/s}^2$
- ex. lift – accelerate – upward downward cable cut.
- $W = mg$     W – weight; mg – mass accel. due to gravity

## Centre of gravity:

- In a spaceship – state of weightlessness.
- Centre of gravity of a body is the point where the whole weight of the body can be considered to act.
- If the vertical through the cg passes through the base of an object then it is stable.
- racing cars, river in a boat, person bend in uphill & downhill.

## Artificial satellites

- principle the stone with such tremendous speed that radius of its path become a little

greater than the radius of the earth, the stone would never fall on the earth & would keep revolving around it.

- centripetal force = GF.
- $\frac{mv^2}{r} = \frac{GMm}{r^2} = r = \sqrt{\frac{Gm}{r}}$
- $\frac{mv^2}{r} = mg ; v = \sqrt{rg}$
- speed of the satellites does not depend on its mass or at a particular distance from the earth, all objects would have the same speed of revolution.
- If gaseous molecules have escape velocity < 11.2 km/sec they cannot escape from the earth's field.
- satellite launches @ equator & in eastward direction.
- Total energy of a satellite negative – then only it may follow circular /elliptical orbit.
- Escape velocity – the min. velocity to escape away from Earth's gravitational field is 11.21 km/s

## Kepler laws

1. All planets move around the sun in elliptical orbits having sun @ one focus.
2. The area speed of planet around the sun's constant.
3. The square of the period of revolution  $\alpha$  the cube of its mean distance from the sun  $T^2 \propto r^3$

Geo-stationary satellites – 36,000 km – 24 hrs – time period

polar satellites – 700 – 900 km = 102 mh

Uses of satellites – commun., weathering, remote sensing, Navigation

## Indian space prog:

- 1960 started with extant, of Thumbaeverstorial (rocket launching)
- Father of Indian space – prog – Dr. Vikram Sarabhai
- Ist by DAFF (Atomic Energy)
- now carried out by Do. Space since 1972
- Ist state – Aryabhata – 1975 (April)
- Baskara, Rohini

## PHYSICS

### TEMPERATURE

heat & temp lift 61<sup>st</sup> ex. hot spoon with warm water.

#### **Internal energy (it)**

- Iron rail with hammer
- water fall below.

#### **Heat**

- form of energy unit – cal/joule (J)
- It transferred from the body to another due to temp. difference. 1 cal = 4.18 joule

#### **Temp:**

- the measurement of hotness / coldness of a body.
- heat always flows from a body @ higher temp to lower temp. body.
- To measure – Thermometer.

Scales of temp.measurement:

	Centigrade	Fahrenheit	Reavmur	Kelvin scales
Upper point	100°C	212°F	80°R	373 k
Lower point	0°C	32°F	0°R	273 k

#### **Relation b/w diff. scales.**

$$\frac{C}{5} = \frac{F-32}{9} = \frac{R}{4} = \frac{k}{5}$$

1. -40° - the temp @ which Celsius & Fahrenheit scales read same.
2. 0 – the temp @ which Celsius & Reaumur scale read same
3. @ farenheit& kelvin = +574.25
4. @ Farenheit @ Revenue = -25.6
5. normal temp. of a body 37°C / 98.4°F
6. clinical thermometer reads 96°F to 110°F  
35°C to 43°C (or)

Triple points of water – A substance is found to exist in 3 states. (solid, liquid, Gas) is 273.16 K

#### **Y mercury in thermometers**

1. does not stick to glass & does not vapourise much.
2. good conductor of heat
3. opaque& shining.

#### **Meters**

- Bolometer – measures heat radiation.
- Calorimeter – measures quantity of heat.
- Beckmann thermometer – measures small changes in temp (as small as 0.01)
- cyrometer – measure low temp
- pyrometer – measures very high temp. [> 800°C]

- measures temp. by measuring the radiation emitted by the body.

**Thermostat** – regulates the temp @ a particular point (ex. ovens) refrigerators)

- Freezing point & mercury is - 39°C ; hence to measure temp below this freezing point of alcohol is - 11°C

**Specific heat:** - The amount of heat required to raise the temp of a unit mass of the substance of 1°C unit – J/kg° -C

- specific heat of water is maximum mercury – has low SH
- gold – 130 J/kg° C
- specific heat increase with rise in temp. but specific heat decrease with rise in temp from 0°C to ≈ 40°C after which it increase with temp.

**Latent heat** – The amount of heat absorbed / given mt by a unit mass of a substance to change its state without change in temp.

- unit = J/ kg L =  $\frac{Q}{m}$  Q = amount of heat; m = mass of substance.
- ex. hot water, burns are less severe than steam water (has high LH)
- Latent heat of fusion of ice 80 cals.
- Latent heat of vapourisation of water its 536 cals.
- Melting point decreases on adding impurity

#### **Boiling point**

- increase on adding impurity
- increase on increase pressure – ex cooker, ice, cast iron.

#### **Super cooling**

- cooling a liquid below freezing point without turning it to a solid. ex. water can be supercooled to temp as low as -12°C

#### **Super heating**

- Heating a liquid above its boiling point without converting it vapour state ex. water can be heated upto 137°C w/o boiling.

#### **Heating curve of a solid**

#### **Thermal expansion**

- increase in size on heating A solid can indigo 3 types.

i) Linear expansion (in length)

ii) superficial expansion (in area)

iii) cubical expansion (in volume)

**ex.** 1. pendulum runs faster in winter, slower in summer b'coz its length increase in summer.

## PHYSICS

2. Bridge rail track  
hence @  $4^{\circ}$  C, water has its min. volume & max. density.  
Almost every liquid expands with the increase in temp bt. when temp of water is increased from  $0^{\circ}$  to  $4^{\circ}$  C. it volume decrease (After this volume increase)

### **Transmission of heat:**

#### **1. conduction**

- heat transferred w/o bodily movt. of the particles.
- medium required.
- In solid mercury also
- particles do not leave their mean position.
- slow process
- Irregular

#### **2. convection**

- by the bodily movt due to difference in densities of diff. parts of medium.
- medium required
- In all liquid & gases erupt mercury. ex. ventilators, chimneys land, sea breezes.
- particles leave their positions.
- slow
- irregular

#### **3. Radiation**

- quick way of transmission of heat
- no medium
- ex. heat from the sun reaches the earth
- no particles involved.
- In this, heat transferred at the speed of light.
- straight line.

### **Perfectly black body:**

- Body which neither reflects nor transmits the radiation falling on it.
- absorbs all radiations falling on it.

### **Kirchhoff's law**

- Signifies that good absorbers are good emitter.

### **Newton's law of cooling**

- The rate of loss of heat by a body  $\propto$  The difference in temp b/w the body & the surrounding.

### **Stefan's law**

- $E \propto T^4$ ;  $E = \propto T^4$
- The radiant Energy emitted by a black body per unit area per unit time  $\propto$   $4^{\text{th}}$  power of its absolute temp.

- All metals are good conductors of heat silver – best conductor.
- good conductors of heat are good conductors of electricity eruption silica – good conductor of heat, bad conductor of electricity.
- Bad conductors of heat – ex.; Air, wood, ebonite, rubber.
- In winter wooden chair appears hot, than metal chair.
- highly polished surfaces are bad absorbers emitters but they are good reflectors.
- cooling utensils are made of aluminium, Brass & steel.
- These have low SH & high conductivity.
- In deserts, sand that very low SH. day-hot night-cold
- Ice in tumbler, hotter in cloudy night in woollen blanket.
- human breath is visible in winter – air is cold from nose WV – condense & making it visible

## PHYSICS

### Wave Motion (WM)

- Light & sound – propagated in the form of waves WM – the transfer of energy without the net transfer.  
Ex.string tied @ one end of free @ the other end. In then case wave motion of the particles - perpendicular to wave motion. (transverse waves)

$$\text{Wave frequency} = \frac{\text{vibration}}{\text{sec}} \text{ Hertz (Hz)}$$

**Longitudinal waves** - parallel to the wave motion.

- but – in pond with stone complex waves – both transverse & longit. waves characteristics.

### Waves

#### Mechanical waves

1. waves require medium for their propagation (solid, liquid, gas)
2. Types : Longitudinal, Transverse.  
Longitudinal – If the particles of the medium vibrate in this direction of propagation of a wave, that wave is longitudinal ex. sound waves in air waves on springs.

**Amplitude** – Max.displacement of a vibrating particle of medium from its mean position.

Velocity of wave- Freq x wavelength

#### Electromagnetic waves: (EM)

- These are produced by accelerating charges.
- do not require medium
- wavelength range  $10^{-4}$ m to  $10^4$  m
- as transverse wave in nature.
- travel in vaccum @ a speed of  $3 \times 10^8$ m/s

#### Hertz experiment in 1888

- An oscillating electric charge radiates EM waves.
- The energy of these waves is due to the kinetic energy of oscillating charge.

#### EM spectrum

- The orderly distance of EM waves according to their wavelength / freq.
- All EM waves travel with the velocity of light.

Name	Source	Wavelength(m)	Freq (Hz)	Uses
$\gamma$ rays	Nuclear reactions	$10^{-14} - 10^{-10}$	$3 \times 10^{22} - 3 \times 10^{18}$	Inform of nuclear structure & treatment of cancer.
x-rays	High energy	$1 \times 10^{-10} - 3 \times 10^{-8}$	$3 \times 10^{18} - 1 \times 10^{16}$	Diagnostic tool in medicine Study the crystal structure in solids
UV	Atoms & molecule s in an electrical discharge	$6 \times 10^{-10} - 4 \times 10^{-7}$	$5 \times 10^{17} - 8 \times 10^{14}$	To destroy bacteria & sterilize surgical instruments detection of forged documents finger prints in forensic lab
Visible light	Incandescent solids fluorescent lamps	$4 \times 10^{-7} - 8 \times 10^{-7}$	$8 \times 10^{14} - 4 \times 10^{14}$	Provides information along the world
micro	Electronic device	$10^{-3} - 0.3$	$3 \times 10^{11} - 1 \times 10^9$	In radar commn. system ovens
Radio	Charges accelerated through conducting wires	$10 - 10^4$	$3 \times 10^7 - 1 \times 10^4$	Radio & trcommn. systems AM band – 530 khz – 1710 khz TV waves – 54 Mhz – 80 mhz FM – band - 88 mhz-108 mhz
Infrared	Molecules of hot bodies	$8 \times 10^{-7} - 3 \times 10^{-5}$	$4 \times 10^{14} - 1 \times 10^{13}$	Cellular phones – ultra high freq. (UHF) band. In physiotherapy infrared

## PHYSICS

			<p>lamps used. In weather forecasting infrared photos - infrared radiations are not absorbed by air, fog, mist etc they are used to take photograph of long distance objects. To study molecular structure</p>
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HIWI – detected disease drunker drive through / Radiation device.

### Energy $\propto$ frequency

VIBGYOR – max. freq, max. energy.  
low freq, low energy

AM – Amplitude modulation.

Radio broadcasting stations use sound crystals of quartz that vibrate hundreds of thousands of times each second ensuring a constant radio frequency.

### Radio & TV transmission

- ionosphere – reflects radio waves from stations.
- TV signals weaker b'coz of earth's curvature & unit geostationary satellites used.

DTH – digital – quality in picture & stereo sound tech.

Prog. Sources (channels) → broadcast centre → true satellite – dish → receives.

- improvement of vision in low-light environment.

**Night Vision** – uses in night driving / flying, night security & surveillance, wildlife observation, sleep lab monitoring, search & rescue etc. infrared used.

RADAR – Radio detection & ranging

- high frequency radio waves for detecting objects like ship & planes.

- The time interval b/w transmission & reception of pulses helps determine the distance (rotating and sends pulses)
- Oven- Microwaves are generated in the oven @ the frequency of 2450 MHz. by means of magnetron.
- Microwave Utensils are made up of glass. not metals block mt. micro wves glass & papers do not absorb microwaves & do not heat up.

**Computed tomography** – Used in diagnostic studies of internal body structures.

**Work** – when a body is displaced by applying a force on it, then work is said to be done.  $W = F \cdot S - F \cdot s \cdot \cos\theta$

F- Force s – distance. Unit – Joule  
Positive Work done – Force is parallel to displacement ie horse pulls a cart on level road.  
Negative work done – Force is opposite to displacement ie body slide over rough surface.  
Zero work done – If either the force/displacement is zero or help of string body in circular path.

**Energy:** capacity of doing work / unit – joule  
loss of PE – gain of KE

Mechanical Energy – potential –  $mgh$  – work – done on the system PE – increase ex. string compression stretching attract.  
work done by the system PE – decrease stretching attract.

**Kinetic:** energy possessed by a body by virtue of its motion  $KE = \frac{1}{2}mv^2$

momentum –  $P = mv$   $P^2 \propto KE^4$

- KE of air is used to run wind on its of running water to run water mills.
- bullet fired from a gun.

### Transformation of Energy

E- energy m – mass c- velocity of light  
 $Einstein E = mc^2$

Power =  $\frac{work}{Time}$  i.e. time rate of doing work

unit = watt & also measured in horse power.

1 W = 1 J/S

1 KW =  $10^3$  W

1 MW =  $10^6$  W

1 HP = 746 W

1 Watt second (w-s) = 1 J

1 Watt hour (W-h) = 3600 J

1 Kilowatt hour (KW-h) =  $3.6 \times 10^6$  Js

## PHYSICS

### SOUND

- ❖ Longitudinal & Mechanical waves.
- ❖ Requires medium, comparatively air is relatively poor conductor of sound.
- ❖ Audible – 20 Hz to 20,000 Hz.
- ❖ Sensitive to human ear
- ❖ Intrasonic  $< 20$  Hz  $\nabla$  elephants, whales
- ❖ Ultrasonic  $> 20,000$  Hz  $\nabla$  dog, cat, bat (80,000 Hz), mosquito can detect.
- ❖ Dolphins produce 1 lakh Hz : which enable them to locate each other under water.
- ❖ Ultrasonic Used For:
  1. Sending signals.
  2. Measuring sea depth
  3. Cleaning clothes & machinery parts of clocks
  4. Revamping lamb shoot from chimney of factories.
  5. Ultrasonography
  6. Detecting flaws in the interiors of solids
  7. Destroying micro organisms
  8. Mapping underground structures for oil & mineral deposits.
- ❖ Loudness  $\nabla$  Related to the energy of the waves & depends on amplitude.
  - Loudness Measured in decibels (db)
  - Noise level  $> 85$  db  $\nabla$  can impair / damage hearing
  - Increasing loudness by Increase mass of air
  - Instruments have sound boxes. when the box vibrates it moves a large amount of air & increase loudness.

Ex. Whisper – 20 db  
 Ordinary speech - 30 db  
 Traffic – 70 db  
 Thunder – 100 db  
 Amplified music – 120  
 Jet (30 m away) – 140 db

### Speed of Sound

- ❖ In dry air, @  $0^\circ$ , the speed of sound is about 331 m/s(780 miles /h)
- ❖ Speed of sound  $\propto$  humidity & sound  $\propto$  temp
- ❖ Speed @ temp  $V_t = V_0 + 0.61 t$
- ❖ Increase 0.61 m/s for every  $1^\circ$  C
- ❖ Speed of sound 1) depends on the medium more is solids & least in gases 2) depends upon elasticity & density of medium
- ❖ Speed remains unchanged by  $\uparrow$  or  $\downarrow$  of pressure
- ❖ Speed of sound  $<$  speed of light ( $3 \times 10^8$  m/s)

Medium	Speed
Air	331 m/s
Water	1450 m/s
Steel	5000 m/s

Ex. Thunder is heard much after the flash of lightning.

### Echo

- ❖ When a sound wave is reflected by a distant obstacle (wall/cliff) – echo is produced.
- ❖ Echo to be heard separately from the original sound, it must arrive 0.1 sec after the original sound is made.
- ❖ minimum distance required to be heard – 17 m
- ❖ If it is  $< 17$  m, echo can't be distinguished more than one echo heard – **Reverberation** i.e. series of echoes due to more than one reflecting surfaces.
- ❖ In ultrasonics, echo used.

### Refraction of sound:

When successive layers of air have diff. temp, the ability of sound to travel faster in warm air than in cold air causes bending of sound. This bending – Refraction.

### Resonance:

Any vibrating object has a natural frequency, which depends on factors (electricity & shape of the object)

Whenever an object/system is set in oscillation at its natural frequency, as a result of impulses received from some other system vibrating with this same frequency, resonance said to have occurred .

**Ex.** Diver jumping on diving board, Suspension bridge – soldiers.

### Doppler - Effect:

The change in frequency of a wave (sound/light) due to the motion of the source / observer

When the distance b/w the source & observer decreases the apparent frequency increases & vice-versa.

**Ex.** Train whistle.

- ❖ By this effect
  - i) Price used to measure speed of vehicles.

## PHYSICS

- ii) In an astronomy
- 1. To find out star approaching US receding away from us.
- 2. Expanding universe.

### LIGHT

- ❖ The form of energy which causes the sensation of vision  
Some are – self Luminous bodies – ex. Sun  
Some are – Reflecting bodies – ex: planets
- ❖ **Ray** – The direction of the path taken by light  
Represented by a line with an arrow on it
- ❖ **Umbra** – If a light from a small hole, the shadows obtained in a region of total darkness
- ❖ **Penumbra** – If an extended source of light is used the umbra is surrounded by a region of partial darkness.  
Ex: during Shadows, eclipses.
- ❖ The formation of shadows with sharp edges demonstrate the rectilinear propagation of light (i.e) the fact that light travels in straight lines.

### Reflection:

- ❖ When a light in incident upon a surface part of its reflected.
- ❖ It certain surfaces (mirrors & polished metals) reflects almost all the light incident upon them.

### Image formations characteristics

1. Virtual
  2. Laterally inverted
  3. Image is the same size of the object
  4. It is as far behind the mirror as the object is in front of it.
- ❖ U do not see an images in walls like mirror – b'coz roughness & wall surface.
  - ❖ In rough surface – reflected rays or scattered in all directions.

### Diffuse reflection

Inclined mirror object is placed b/w 2 inclined mirrors, several images of the object – formed.

$$\text{No. of images} = \frac{360}{\text{angle } \frac{b}{w} \text{ - mirrors}} - 1$$

1. @  $90^\circ$  - 3 images produced.

2. Parallel mirrors – infinite no. of images.

**Kaleidoscope** – in which multiple images are formed by 2 strips of plane mirrors place @ an angle of  $60^\circ$

-Operates on the principle of multiple reflection

### Curved mirrors

- i) Concave
- ii) Convex

These mirrors made by **depositing vaporized aluminum on a glass surface** which would form a part of sphere.

Deposits outside – concave; Deposits inside – convex

**Concave:** It can be used as a burning glass. Used in

1. Solar coolers
2. Telescopes

Another type of concave – Parabolic mirror

When small bulb in at F, it reflects a parallel beam of intensity.

Ex. Headlamps of cars & search light

**Convex:** Produces virtual images (are erect & smaller than the objects)

Ex. Rear view mirrors in vehicles – creates wide view

But in plane mirror – narrow view

**Refraction:** light bends when it passes obliquely from one medium to another.

Ex. From air to water / glass.

If light enters the same medium does not bend refractive index of a medium =  $\frac{\text{light speed in vacum}}{\text{light speed in medium}}$

**Ex:**

- Stone in pond
- Shortening of person's body
- Seeing sun horizon
- Twinkling of stars.

**MIRAGE** – effects of atmospheric refraction

Associated with hot deserts when an angle of incidence exceeds the critical angle and therefore total internal reflecting takes place.

### Total Internal reflection

If the angle of incidence of light in the denser medium is greater than a particular angle

## PHYSICS

known as the critical angle for that medium. The light is not at all refracted into the rarer medium but it is totally reflected.

### Optical fibre

Covers long distance in remote sensing as sensors.

- Ex. - In endoscopy used tiny optical fibers to see the inside patient stomach
- mirage in deserts.

### Dispersion:

- ❖ White light consists 7 colors (spectrum of white light - VIBGYOR)
- ❖ In vacuum—All these have same speed between in transparent medium – speed varies.
- ❖ Violet – slowest speed in glass but red faster due to different speed, colors refracted through different angles white light passes through a glass prism.

Ex. **Rainbow**- formation due to Total internal reflection & refraction by dispersion of light.

- seen opposite to the sun
- After a shower of rain
- Due to dispersion of sunlight by water droplets suspended in air after rain.
- In each droplet, these on dispersion & total internal reflection.

### Mixing coloured light

- ❖ White  $\Leftrightarrow$  Red + Green + Blue
- ❖ RGB  $\Leftrightarrow$  Primary colors.
- ❖ 2 colors which put white when put together we called **complementary colors**.

$$\begin{array}{lll} G + M = \text{White} & R + G = \text{Yellow} & C + Y = \\ \text{Green} & & \\ B + Y = \text{White} & R + B = \text{Magenta} & \\ C + M = \text{Blue} & & \\ R + C = \text{White} & G + B = \text{Cyan} & M + Y \\ = \text{Red} & & \end{array}$$

### CRT – [Cathode Ray Tube]

consume lot of power, not good quality

### LCD (Liquid Crystal Display)

Advantages – Lightweight construction, portability large screen size than CRT TVs low power consumption, battery powered electronic equipment.

### Plasma Display Panel (PDP)

- Gas tubes
- Power consumes as much power as CRT TV
- Image very bright, wide view angle.

### LENSES

- ❖ used in all optical instruments that produce images cameras, projectors, telescopes, microscopes)
- ❖ Used in spectacles to correct defects.
- ❖ Made mostly of common glass.
- ❖ Convex – (converging) ex. Microscope , forms a real image
- ❖ Concave – (diverging) image – erect, diminished Modern models @ a speed of 24 frames / sec.

### Defects of vision

- ❖ Normal – about 25 cm
- ❖ Long sight (hypermetropia) – cannot see near object.
  - Use converging lens (Convex lens)
- ❖ Short sight (Myopia) – cannot see long distance object.
  - Use diverging lenses (concave lens)

### Power of lens

Power of length reciprocal of its focal length in meters

$$P = \frac{1}{f} \text{ Unit - Dioptr(D)}$$

### Lens Camera

- ❖ in front – lens
- ❖ more converging lens used to minimize the defects of the image
- ❖ shutter b/w lens & the film

### Compound microscope

- ❖ for magnifying minute objects
- ❖ consists of 2 short focal length converging lens - objective , eye lens.
- ❖ Produces real & enlarged image & inverted magnification of distant object.
- ❖ In an astronomical telescope  
Objective lens (convex lens) - large focal length  
Eye lens(convex lens) - short focal length
- ❖ In an Galilean telescope

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Eye-piece - concave lens of short focal length.  
Objective lens -convex lens of large focal length.

**Scattering of light** – Red light scattered the more

**Interface of light** – The super position of 2/more waves of the same kind that pass the same point in space @ the same time.

Ex. Colors in soap bubbles &Oil films on water.

**Diffraction of light** – A failure of light to travel in a straight line.

Ex. CD is viewed in sunlight.

- ❖ Plastic disc, surface is coated with mirror like aluminum or gold film which has another protective over coating of clear plastic.
- ❖ Audio, video system / a computer reads the CD using a laser beam.
- ❖ Data stored in this form of bits arranged in a spiral - due to reflection & diffraction it appears rainbow colors.

## MAGNETS

- ❖ The material which can attract the magnetic substances (cobalt, iron, nickel) – **magnet**
- ❖ The property of attracting the magnetic substances by a magnet – **magnetism**

### Permanent magnets

- ❖ The magnets which do not lose their magnetism with normal treatment.
- ❖ made of certain alloys of nickel, cobalt, iron with some carbon.
- ❖ made in various shapes – bar, rod, disc, ring etc.

### Hard magnetic material

- ❖ The material which retain their magnetism for a long time.
- ❖ When a magnet is freely suspended it aligns itself in the geographical N-S direction.
- ❖ Similar poles repel each other & dissimilar poles attract each other.

### Magnetic field

- ❖ The area surrounding the magnet in which another magnet experience a force on it.
- Unit – newton / ampere - metre (or) weber/m<sup>2</sup> / testa

On the basis of magnetic properties materials classified into

- ❖ **Diamagnetic** – These substances are those in which the individual atoms/ions/molecules do not possess any net magnetic moment as their own.  
Ex. Bismuth, zinc, copper, silver, gold, diamond, water, mercury, etc.
- ❖ **Paramagnetic** – These substances are those in which each individual ions/molecules has a net non-zero magnetic moment on its own.  
Ex. Aluminum, platinum, Manganese, sodium, oxygen
- ❖ **Ferromagnetic** each individual /ions/molecules has a non-zero magnetic moment on its own.  
Ex. Iron, cobalt, nickel, torric chloride
- ❖ **Curie temperature:** As temp ↑ , the magnetic property of ferromagnetic substance decreases &

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above a certain temperature the substance changes into paramagnetic substances.

For soft iron curie temp is 1000K

### **Transformer**

- ❖ A device which converts low voltage AC into high voltage AC & vice versa
- ❖ It is based on electro-magnetic induction and microphone also converts sound energy into electrical energy & vice versa.
- ❖ Electromagnets, cores of transformers, telephone diaphragm armatures of dynamos & motors are made of soft iron, mu-metal & stalloy.

### **MRI [Magnetic Resonance Imaging]**

- ❖ A non-invasive medical test
- ❖ helps physician diagnose & treat diseases
- ❖ does not use X-rays
- ❖ Uses a powerful magnetic field, radio freq. pulses & a computer to produce detailed pictures of organs (heart given leading) bones, soft tissues & other internal body structures.

## ELECTRICITY

Electricity produced by friction b/w 2 dissimilar objects.

- i) one acquire positive charge
- ii) the other an equal negative charge

### **Electrical Charge**

- ❖ A body attaches when it loses/gains the electrons.
- ❖ Sign for electric charge by Benjamin , Franklin.  
Ex.
- ❖ If a glass rod (negative charge) is rubbed with silk (acquire positive charge)
- ❖ If an ebonite rod (negative charge) is rubbed with flannel (positive charge)
- ❖ Like charges repel & unlike charges attract

### **Lightening Conductor (LC)**

- ❖ A gigantic electric discharge occurring between 2 charged clouds between a charged cloud & the earth.
- ❖ (LC) - used to protect fall buildings from lightening damage
- ❖ LC is a thick copper strip fixed to an outside wall of building.
- ❖ Upper end in the several sharp spikes lower end connected to a copper plate buried in the earth.

### **Conductors**

- ❖ Those substances which allow passage of charge & here very low electrical resistance.  
Ex. 1. All metals silver – best  
2. human body & earth.
- ❖ **Super conductors** -At temp near absolute zero metals have almost zero resistance & become superconductor.  
i.e. The resistance of metals to flow of electricity reduces with decreasing temp under research – super conductivity at high temperature.
- ❖ **Semi-conductors**- Ex. Silicon & Germanium  
These have electrical resistivity intermediate b/w those of conductors & insulators. In their crystalline form – good insulators adding impurities – conductivity increases
- ❖ **Insulators** – are those substances which do not allow passage of charge.  
Ex. Rubber, wood, Mica, glass, ebonite.

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- ❖ **n-type & p-type semiconductors** - After the addition of impurities semiconductors become n-type & p-type.

In transistor  $\Leftrightarrow$  made by both type composition used in radios, TV, computer

- ❖ **Integrated Circuits (IC)** - An arrangement of multifunction semiconductor devices.

Consists of a single crystal-chip & SI nearly 1.5 mm<sup>2</sup> in cross section.

### **Coulomb's law:**

The force of attraction / the force of repulsion acting b/w the 2 point charges is proportional to the product of the magnitudes of the 2 charges & inversely proportional to the square of the distance b/w them.

**Electric field** – The region in which electric effect experienced.

**Electric potential** – measured by amount of work done @ any point of the electric field.

Unit – volt

**Potentiometer** – used to measure the exact potential diff. b/w 2 points of electrical circuit / to measure the emf of a cell.

$$\text{Electric current} = \frac{\text{amount of flowing charge}}{\text{sec}}$$

Unit – ampere

### **Ohm's law -**

If there is number charge in the physical state of conductor, then the ratio of potential difference across its ends & the current flowing through it is constant.

$$\frac{v}{i} = R \text{ (Resistance of the circuit)}$$

**Resistance** of a conductor is directly proportional to its length (l) & inversely proportional to its cross section area (A)

$$R \propto \frac{l}{A}$$

1. In metal = temp  $\uparrow \propto R \uparrow$
2. In semiconductor = temp  $\propto \frac{1}{R}$
3. In electrolytes = temp  $\propto \frac{1}{R}$

**Specific Resistance / Resistivity** - Depends only on the material of conductor & its temperature.

1. Increases with temp.
2. Change with impurity

- Ex:**
- Electric bulb filament is made of tungsten.
  - Tungsten has a high melting point (3400°C) & can be heated to a high temp to emit light.
  - Electric bulb makes a bang when if its broken – b'coz inside valves rushing air produce noise.

**Electric power** = 
$$\frac{\text{The electric work done}}{\text{Unit time}}$$

$$P = \frac{w}{t} \text{ Unit – watt}$$

**Kilowatt hour (KWH)** – The unit of energy & is equal to the energy consumed in the rate of 1 kw (1000 J/s) for 1 hour.

$$1 \text{ kw} = 3.6 \times 10^6 \text{ Joule.}$$

### **Ammeter**

- ❖ a device – to measure electric current in circuit.
- ❖ connected in series in the circuit
- ❖ Resistance is zero

### **Voltmeter**

- ❖ to measure the potential diff b/w 2 points in a circuit.
- ❖ connected in parallel in circuit.
- ❖ Resistance is infinite

### **Galvanometer**

- ❖ Used to detect & measure electric current in a circuit
- ❖ can measure current up to  $10^{-6}$
- ❖ Galvanometer can be converted into a voltmeter by connecting a very high resistance in its series.

**Electrical Fuse** – A small conducting wire of alloy of copper, tin & lead having low melting point.

- Protective device used in series.

### **CELL**

Electrochemical cell is a device which converts chemical energy into electrical energy.

### **Types**

# PHYSICS

**1. Primary Cell** - It gets its electrical energy obtained from its irreversible chemical reaction taking place inside the cell.

After completing discharge, the primary cells become unserviceable.

Ex. Voltaic, Leclanche, Daniel, Dry cell.

**Electrolyte** – mixture of ammonium chloride & zinc chloride.

**2. Lead cells** - Secondary cells

- Storage cells / accumulators
- Low internal resistance & giving large currents
- can be recharged

**Secondary cells (Alkaline Batteries)** – Used in emergency lights.

**Car Battery** – combination of lead – acid secondary cells, each of voltage 2.04 v electrodes – lead plates / grids

Electrodes – lead plates / grids

Electrolyte – Sulphuric acid.

- to provide a large current for a short time.

## Effects of Electric current

**1. Electromagnets** used in

1. Industry for lifting & transporting steel plates, girders etc.

2. Electric bells & telephone receivers.

**2. Electrolysis:** An electric current passed through a solution results in the decomposition of the solution –ve & +ve ions.

-ve ions collect @ the +ve electron (anode)

+ve ions collect @ the –ve electron (cathode)

1. Used in electroplating (coating of a base metal with a layer of more expensive metal).

2. Electroplating with gold & silver – common.

3. Important role in metallurgy.

4. Heating Effect – In room heater, oven etc.

These have coils of nichrome (alloy of nickel & chromium) which are heated when current is passed.

5. Motor effect – If a current carrying rectangular coil is placed in a magnetic field, a couple acts on the coil & it starts rotating.

6. Generator – much energy into electrical energy.

7. Inverter – converts DC to AC

## Fluorescent Tubes

❖ It contains mercury vapors @ low pressure, when the tube is switched on mercury vapors emits visible ultraviolet rays.

❖ These rays fall on the fluorescent coating on the inside of the tube & emit VC.

## CFC [Compact Fluorescent Lamps]

4-6 times more efficient than bulbs.

## Cost of Electricity

Consumption – measured in KWh.

Ex. 100 w lamp will consume one unit of electricity in 10 hrs.

750 W electric iron consumes 3 units in 4 hrs.

In TV remote – 1 R signal used

Cordless phone – 100 m distance covered

-46-48 MHz bands.

## UNITS OF MEASUREMENT

QUANTITY	UNIT (SI)
Length	Metre, mil
Time	Second
Mass	Kilogram/tonne
Area	Square metre
Volume	Cubic metre
Velocity	Metre/second
Acceleration	Metre/second square
Density	Kilogram metre/cube
Momentum	Kg m/sec
Work	Joule
Energy	Joule
Force	Newton
Pressure	Pascal or Newton / sq.mtr
Frequency	Hertz
Power	Watt
Weight	Newton or Kilogram
Impulse	Newton-second
Angular Velocity	Radian/second
Viscosity	Poise
Surface tension	Newton/square metre
Heat	Joule
Temperature	Kelvin
Absolute temperature	Kelvin
Resistance	Ohm
Electric current	Ampere
Electromotive force	Volt
Electrical conductivity	Ohm/metre

## PHYSICS

Electric energy	Kilo watt hour	Eudiometer	A glass tube for measuring volume changes in chemical reactions between gases.
Electric power	Kilo watt or watt	Actinometer	measures intensity of electromagnetic radiation.
Magnetic intensity	Orsted	Altazimuth	measures altitude & azimuth of celestial bodies.
Charge	Coulomb	Cryometer	measures low temp.
Magnetic induction	Gauss	Pyrometer	measures very high temp.
Luminous flux	Candela	Daisy meter	determines density of gas
Intensity of sound	Decibel	plato meter	measures changes in volume of substances
Power of lens	Dioptrē	Geiger Muller counter	counter – detection of radioactive radiations.
Depth of sea	Fathom	Fathometer	It measures the depth of the ocean
Luminous velocity	candela	Galvanometer	It measures the electric current of low magnitude.
Loudness	Phon	Hydrometer	It measures the specific gravity of liquids.
Volume / Capacity	Gallon	Hygrometer	it measures humidity in air.
Electric charge	Coloumb	Hypsometer	measures boiling point of liquids.
horse power	747.7 watts	Hydrophone	It measures sound under water.
Parsec	Astronomical unit of distance	Kymograph	It graphically records physiological movements (Blood pressure & heart beat)

## IMPORTANT SCIENTIFIC INSTRUMENTS

Instrument	Use		
Altimeter	It measure altitude and is used in aircrafts		
Ammeter	It measures strength of electric current (in amperes)		
Anemometer	It measures force and velocity of wind		
Audiometer	It measures intensity of sound.		
Audiophone	It is used for improving imperfect sense of hearing		
Barograph	It is used for continuous recording of atmospheric pressure.		
Barometer	It measures atmospheric pressure.		
Binocular	It is used to view distant objects		
Bolometer	It measures heat radiation		
Calorimeter	It measures quantity of heat.		
Carburettor	It is used in an internal combustion engine for charging air with petrol vapour.		
Cardiogram	It traces movements of the heart, recorded on a cardiograph.		
Chronometer	it determines longitude of a place kept onboard ship.		
Cinematography	It is an instrument used in cinema making to throw on screen and enlarged image of photograph.		
Crescograph	It measures the growth in plants.		
Cyclotron	A charged particle accelerator which can accelerate charged particles to high energies.		
Dynamo	converts mechanical energy into electrical energy		
Dynamometer	It measures electrical power.		
Electrometer	It measures electricity		
Electroscope	It detects presence of an electric charge.		
Endoscope	It examines internal parts of the body.		
		Eudiometer	A glass tube for measuring volume changes in chemical reactions between gases.
		Actinometer	measures intensity of electromagnetic radiation.
		Altazimuth	measures altitude & azimuth of celestial bodies.
		Cryometer	measures low temp.
		Pyrometer	measures very high temp.
		Daisy meter	determines density of gas
		plato meter	measures changes in volume of substances
		Geiger Muller counter	counter – detection of radioactive radiations.
		Fathometer	It measures the depth of the ocean
		Galvanometer	It measures the electric current of low magnitude.
		Hydrometer	It measures the specific gravity of liquids.
		Hygrometer	it measures humidity in air.
		Hypsometer	measures boiling point of liquids.
		Hydrophone	It measures sound under water.
		Kymograph	It graphically records physiological movements (Blood pressure & heart beat)
		Lactometer	It determines the purity of milk.
		Manometer	It measures the pressure of gases.
		Mariner's compass	It is an instrument used by the sailors to determine the direction.
		Microphone	It converts the sound waves into electrical vibrations and to magnify the sound.
		Microscope	it is used to obtain magnified view of small objects.
		Odometer	An instrument by which the distance covered by wheeled vehicles is measured
		Ohmmeter	measures electrical resistance.
		Phonograph	An instrument for producing sound.
		Photometer	The instrument compares the luminous intensity of the source of light.
		Periscope	It is used to view objects above sea level (used in sub-marines)
		Potentiometer	It is used for comparing electromotive force of cells.
		Pyrometer	It measures very high temperature.
		Radar	It is used for detecting the direction and range of an approaching plane by means of radio microwaves.
		Rain Gauge	An apparatus for recording rainfall at a particular place.
		Radiometer	It measures the emission of radiant energy

## PHYSICS

Refractometer	It measures refractive index.
Saccharimeter	measures the amount of sugar in solution.
Seismograph	measures the intensity of earthquake shocks.
Salinometer	It determines salinity of solution.
Sextant	This is used by navigators to find the latitude of a place by measuring the elevation above the horizon of the sun or another star.
Spectrometer	It is instrument for measuring the energy distribution of a particular type of radiation.
Speedometer	to record its speed.
Sphygmomanometer	It measures blood pressure.
Spherometer	It measures the curvatures of surfaces
Stereoscope	It is used to view two dimensional pictures.
Stethoscope	An instrument which is used by the doctors to hear and analyse heart and lung sounds.
Straboscope	it is used to view rapidly moving objects.
Tachometer	An instrument used in measuring speeds of aeroplanes and motor boats.
Teleprinter	This instrument receives and sends typed messages from one place to another.
Telescope	It views distant objects in space.
Theodolite	It measures horizontal and vertical angles.
Thermometer	This instrument is used for the measurement
Thermostat	It regulates the temperature at a particular point.
Viscometer	It measures the viscosity of liquids.
venturimeter	It measures rate of flow of fluids.
Voltmeter	It measures the electric potential difference between two points.
Wattmeter	it measures the power of an electrical circuit.
Nephelometer	measures the scattering of light by particles suspended in a liquid.
Rectifier	device for converting AC into DC
Thermopile	for detecting & measuring heat radiations
Electro dynamometer	– measures current, voltage / power in both DC & AC circuit.
Beckmann thermometer	– measures small changes in temp.(small as 0.01)

## Scientific Explanations of Common Phenomena

- Carbon monoxide is poisonous.
- The filament of an electric bulb is made of tungsten.
- A wick in a stove keeps burning continuously capillary action.
- The sky appears blue because the light of the Sun is spread or scattered by the dust particles in the air.
- Food cooks faster at high temperature.
- A man weighs more at the poles than at the equator because the polar radius of the Earth is less than the equatorial radius. Hence the gravitational pull is more at the poles than at the equator.
- The boiling point of sea water will be more than the boiling point of pure water.
- Soft iron is used as an electromagnet because it remains a magnet only while the current passes through the coil around it.
- An electric bulb makes a bang when it is broken because there is a vacuum inside the electric bulb.
- The rushing of air produces a noise generally referred to as the 'bang'.
- The launching of Earth satellite should be from a place near the equator to take the fullest advantage of the Earth's movements. The regions of the Earth closer to the equator are moving faster through space as compared to regions elsewhere.
- In deserts, day temperatures are very high and night temperatures are extremely low because the specific heat of sand is very low.
- The air escaping from a punctured tyre feels cold because the air escaping from a punctured tyre enters a region of low pressure and thus suffers a fall in temperature.
- It is hotter on a cloudy night than on a clear night because clouds prevent the heat radiated by the Earth from escaping into the sky.
- Ice wrapped in a blanket does not melt away quickly because woollen blanket is a bad conductor of heat.
- Steam causes more severe burns than boiling water because steam at the same temperature has more latent heat.
- We experience difficulty in breathing on mountains because the pressure of the air outside is less as compared to the pressure of air inside the lungs.
- When a gun is fired at a visible distance, the sound is heard a little after the smoke is seen because the velocity of light is much higher than that of sound.

## PHYSICS

Invention	Year	Inventor	Country
Acetylene gas	1862	Berthelot	France
Adding machine	1642	Pascal	France
Adhesive tape, (Scotch)	1930	Richard Drew	U.S.A.
Aeroplane	1903	Orville & Wilbur Wright	U.S.A.
Air conditioning	1902	Carrier	U.S.A.
Airplane, (Jet engine)	1939	Ohain	Germany
Airship (Non-rigid)	1852	Henri Giffard	France
Aerosol spray	1926	Erik Rotheim	Norway
Artificial heart	1957	Willem Kolff	Netherlands
Atomic bomb	1945	J. Robert Oppenheimer	U.S.A.
Atomic numbers	1913	Moseley	Britain
Atomic theory	1803	Dalton	Britain
Automatic rifle	1918	John Browning	U.S.A.
Bakelite	1907	Leo H. Baekeland	Belgium
Ballistic missile	1944	Wernher von Braun	Germany
Balloon	1783	Jacques & Joseph Montgolfier	France
Ball-point pen	1888	John J Loud	U.S.A.
Barometer	1644	Evangelista Torricelli	Italy
Battery (electric)	1800	Alessandro Volta	Italy
Bicycle	1839-40	Kirkpatrick Macmillan	Britain
Bicycle tyres (Pneumatic)	1888	John Boyd Dunlop	Britain
Bifocal lens	1780	Benjamin Franklin	U.S.A.
Bleaching powder	1798	Tennant	Britain
Bunsen burner	1855	R. Willhelm von Bunsen	Germany
Burglar alarm	1858	Edwin T. Homes	U.S.A.
Calculus	1670	Newton	Britain
Camera (Kodak)	1888	Walker Eastman	U.S.A.
Canned food	1804	Appert	France
Car (steam)	1769	Nicolas Cugnot	France
Car (petrol)	1888	Karl Benz	Germany
Carburetor	1876	Gottlieb Daimler	Germany
Cassette, (Audio)	1963	Philips Co	Holland
Cassette (Videotape)	1969	Sony	Japan
Celluloid	1861	Alexander Parkes	Britain
Cement (Portland)	1824	Joseph Aspdin	Britain
Chemotherapy	1909	Ehrlich	Germany
Chronometer	1735	John Harrison	Britain
Cinema	1895	Nicolas & Jean Lumiere	France
Clock (Mechanical)	1725	I-Hsing& Liang Ling - Tsan	China
Clock (Pendulum)	1656	Christian Huygens	Netherlands
Cloning, (DNA)	1973	Boyer, Cohen	U.S.A.
Cloning (Mammal)	1996	Wilmut, et al	U.K.
Compact disc	1972	RCA	U.S.A.
Compact disc player	1979	Sony, Philips	Japan, Netherlands

Computer, (Laptop)	1987	Sinclair	Britain
Computer (Mini)	1960	Digital Corp.	U.S.A.
Crossword puzzle	1913	Arthur Wynne	U.S.A.
CT scan	1973	Hounsfield	Britain
Diesel Engine	1895	Rudolf Diesel	Germany
Disc broke	1902	Dr. F. Lanchester	Britain
Disc, (Video)	1972	Philips Co.	Holland
DNA, (Structure)	1951	Crick-UK, Watson -US, Wilkins- UK	U.K. / U.S.
Dynamo	1832	Hypolite Pixli	France
Electric flat iron	1882	H. W. Seeley	U.S.A.
Electric lamp	1879	Thomas Alva Edison	U.S.A.
Electric motor (DC)	1873	Zenobe Gramme	Belgium
Electric motor (AC)	1888	Nikola Tesla	U.S.A.
Electric iron	1882	Henry W. Seely	U.S.A.
Electric washing machine	1906	Alva J Fisher	U.S.A.
Electro-magnet	1824	William Sturgeon	Britain
Electron	1897	Thomson J	Britain
Electroplating	1805	Luigi Brugnatelli	Italy
Electronic computer	1824	Dr. Alan M Turing	Britain
Facsimile machine	1843	Alexander Bain	Britain
Fibre optics	1955	Kepany	Britain
Film (Moving outlines)	1885	Louis Prince	France
Film (Talking)	1922	J. Engl, J. Mussolle& H. Vogt	Germany
Film (Musical sound)	1923	Dr Le de Forest	U.S.A.
Floppy disk	1970	IBM	U.S.A.
Frequency Modulation (FM)	1933	E.H. Armstrong	U.S.A.
Frisbee	1948	Fred Morrison	U.S.A.
Fountain pen	1884	Lewis E. Waterman	U.S.A.
Galvanometer	1834	Andre-Marie Ampere	France
Glider	1853	Sir George Cayley	Britain
Gramophone	1878	Thomas Alva Edison	U.S.A.
Helicopter	1924	Etienne Oehmichen	France
HIV	1984	Martagnier	French
Holography	1947	Denis Gason	Britain
Hydrogen bomb	1952	Edward Teller	U.S.A.
Intelligence testing	1905	Simon Binet	French
Jet Engine	1937	Sir Frank Whittle	Britain
Laser	1960	Theodore Maiman	U.S.A.
Lauderette	1934	J.F. Cantrell	U.S.A.
Lift (Mechanical)	1852	Elisha G. Otis	U.S.A.
Lighting conductor	1752	Benjamin Franklin	U.S.A.
Locomotive	1804	Richard Trevithick	Britain
Logarithms	1614	Napier	Britain
Loom, (power)	1785	E. Cartwright	Britain
Loudspeaker	1900	Horace Short	Britain

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Machine gun	1718	Richard Gatling	Britain
Magnetic recording tape	1928	Fritz Pfleumer	Germany
Match, (safety)	1826	John Walker	Britain
Microphone	1876	Alexander Graham Bell	U.S.A.
Microprocessor	1971	Robert Noyce & Gordon Moore	U.S.A.
Microscope (Comp)	1590	Z. Janssen	Netherlands
Microscope (Elect)	1931	Ruska knoll	Germany
Microwave oven	1947	Percy LeBaron Spencer	U.S.A.
Motor cycle	1885	G. Daimler	Germany
Movie projector	1893	Thomas Edison	U.S.A.
MRI	1971	Damadian	U.S.A.
Neon lamp	1910	Georges Claude	France
Neutron	1932	Chadwick	Britain
Neutron bomb	1958	Samuel Cohen	U.S.A.
Nylon	1937	Dr. Wallace H. Carothers	U.S.A.
Optical fibre	1955	Narinder Kapany	Germany
Paper	A.D.1 05		China
Pacemaker	1952	Zoll	U.S.A.
Pasteurization	1867	Louis Pasteur	France
Pencil	1792	Lacques-Nicolas Conte	France
Periodic table	1869	Mendeleyev	Russia
Photocopier	1938	Carlson	U.S.A.
Photoelectric cell	1893	Julius Elster, Hans F Geitel	Germany
Photo film, (celluloid)	1893	Reichenbach	U.S.A.
Photo film, (Transparent)	1884	Goodwin Eastman	U.S.A.
Photography (On metal)	1826	J.N. Niepce	France
Photography (On paper)	1835	W.H. Fox Talbot	Britain
Photography (On film)	1888	John Carbutt	U.S.A.
Piano	1709	Cristofori	Italy
Pistol, revolver	1836	Colt	U.S.A.
Plutonium fission	1940	Kennedy, Whal, Seaborg, Segre	U.S.A.
Pop-up toaster	1927	Charles Strite	U.S.A.
Printing Press	1455	Johann Gutenberg	Germany
Printing (Rotary)	1846	Richard Hoe	U.S.A.
Printing (Web)	1865	William Bullock	U.S.A.
Proton	1919	Rutherford	N. Zealand
Quantum theory	1900	Plank	Germany
Radar	1922	A.H. Taylor & Leo C. Young	U.S.A.
Radiocarbon dating	1947	Libby	U.S.A.
Radio telegraphy	1864	Dr. Mohlon Loomis	U.S.A.
Radio telegraphy (Trans Atlantic Rayon)	1901 1883	G. Marconi Sir Joseph Swan	Italy Britain
Razor (Electric)	1931	Col. Jacob Schick	U.S.A.
Razor (Safety)	1895	King C. Gillette	U.S.A.

Refrigerator	1850	James Harrison, Alexander Catlin	U.S.A.
Relativity theory	1905	Einstein	Germany
Rubber (Latex foam)	1928	Dunlop Rubber Co	Britain
Rubber (Tyres)	1846	Thomas Hancock	Britain
Rubber (Vulcanised)	1841	Charles Goodyear	U.S.A.
Rubber (Waterproof)	1823	Charles Macintosh	Britain
Safety pin	1849	Walter Hunt	U.S.A.
Safety razor	1903	King Camp Gillette	U.S.A.
Seat belt	1959	Volvo	Sweden
Self-starter	1911	Charles F. Kettering	U.S.A.
Ship (Steam)	1775	I.C. Perier	France
Ship (Turbine)	1894	Hon Sir S. Parsons	Britain
Silk manufacture	50 B.C.		China
Skyscraper	1882	W. Le Baron Jenny	U.S.A.
Slide rule	1621	William Oughtred	Britain
Spinning frame	1769	Sir Richard Arkwright	Britain
Spinning jenny	1764	James Hargreaves	Britain
Spinning mule	1779	Samuel Crompton	Britain
Steam Engine	1698	Thomas Savery	Britain
Steam engine (Piston)	1712	Thomas Newcomen	Britain
Steam engine (Condenser)	1765	James Watt	Britain
Steel (stainless)	1913	Harry Brearley	Britain
Stethoscope	1819	Laennec	French
Submarine	1776	David Bushnell	U.S.A.
Super computer	1976	J.H. Van Tassel	U.S.A.
Synthesiser	1964	Moog	U.S.A.
Tank	1914	Sir Ernest D. Swington	Britain
Tape recorder	1899	Fessenden Poulsen	Denmark
Telegraph	1787	M. Lammond	France
Telegraph code	1837	Samuel F.B. Morse	U.S.A.
Telephone, (Cellular)	1947	Bell Labs	U.S.A.
Telephone (Imperfect)	1849	Antonio Meucci	Italy
Telephone (Perfected)	1876	Alexander Graham Bell	U.S.A.
Telescope	1608	Hans Lippershey	Netherlands
Television (Mechanical)	1926	John Logie Baird	Britain
Television (Electronic)	1927	P.T. Farnsworth	U.S.A.
Television (Colour)	1928	John Logie Baird	Britain
Transformer	1831	Michael Faraday	Britain
Transistor	1948	Bardeen, Shockley & Brattain	U.S.A.
Transistor radio	1955	Sony	Japan
Uranium Fission,	1942	Szilard Fermi	U.S.A.

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(Atomic reactor)			
Vacuum Cleaner (Elec)	1907	Spangler	U.S.A.
Video tape	1956	Charles Ginsberg	U.S.A.
Velcro (Hook and loop fastener)	1948	Georges de Mestral	Switzerland
Washing machine (Elec)	1907	Hurley Machine Co	U.S.A.
Watch	1462	Bartholomew Manfredi	Italy
Welder (Electric)	1877	Elisha Thomson	U.S.A.
Windmill	600	Persian Corn grinding	
Wireless (telegraphy)	1896	G. Marconi	Italy
X-ray	1895	W.K. Roentgen	Germany
Zip fastener	1891	W.L. Judson	U.S.A.

### பேரண்டம் - Universe

- ❖ அண்டம் - (includes) விண்மீன், சூரியன், சந்திரன், கோள்கள், எளிமீன்கள் உள்ளடக்கியவை.
- ❖ மில்லியன் அண்டவெளிகள் உருமண்டலம் (Galaxies) உள்ளன.
- ❖ ஒருபிரபஞ்சவருடம் (cosmic year) - அண்டவெளியைச் (galaxy) சுற்றிவர சூரியன் எடுத்துக்கொள்ளும் காலம் (25 கோடி ஆண்டுகள் )
- ❖ Geocentric concept - Ptolemy – (பூமியேபேரண்டத்தின் சமயம்)
- ❖ Heliocentric concept – copernicus
- ❖ Keplar - சூரியன் பேரண்டத்தின் மையல்ல சூரியகுழும்பத்தின் மையம்.
- ❖ Herschell - சூரியக்குடும்பத்தைத் தாண்டிப்பாலாருமண்டலங்கள் உண்டு.
- ❖ E. Hubble – first demonstrated existence & galaxies beyond milkyway.
- ❖ our gateways (உருமண்டலம்) – பால் வீதிஆழகாயகங்கை
- Spiral (சுருள்வடிவங்களுமண்டலம்)
- our nearest Galaxy – Andromeda
- ❖ அண்டவெளியில் உள்ள அனைத்தும் ஈர்ப்புவிசையினால் இணைந்துள்ளன.
- ❖ everything in the universe emerged from a part singularity
- ❖ பெருவெடிப்புக் கொள்கைப்படி (Bilog Bang theory) 15 bn years ago. take place 13.7 bn years ago.
- ❖ sun → 5 bn years ago.
- ❖ earth → 4 bbn years ago.
- ❖ pulsating (oscillating) theory – after explosion from primordial body, then contracts back & explodes again over immensely long cycles ad infinitum.

### measurement units of space (வானியல் தொலைவிற்கான அலகு)

1. Light year (ஓளிஆழன்டு) – ஒரு ஆண்டுகாலத்தில் ஓளிக்கத்திரி வெற்றிடத்தில் ஏற்கக்குறைய 3 x 10<sup>10</sup> மீட்டர் வினாடிவேகத்தில் செல்லக்கூடியதொலைவு ஒரு ஓளிஆழன்டு

$$1 \text{ LY} = 9.46 \times 10^{12} \text{ km}$$

2. Astronomical Unit (வானியல் அலகு) = பூமியிலிருந்து சூரியனின் தொலைவு.  $1 \text{ AU} = 1.496 \times 10^8 \text{ km}$ .

- சூரியனிலிருந்து பூமியைவந்தடையெடுத்துக்கொள் எனும் காலம் 8mm 20 sec.
- சூரியனுக்கு அடுத்து அருகாமையில் உள்ளstar.
- சூரியனுக்கு அடுத்து அருகாமையில் உள்ள Brightest star – sirivs (Dog star)
- ஈர்ப்புவிசையினால் பினைக்கப்பட்டதுளிரும் வாயிக்களைக் கொண்ட ஒரு மிகப்பெரியவந்து போன்றது
- pronimacentauri (4.2 LY)
- Alpha Centauri (4.3 LY)
- Barnard's star (5.9 LY)
- ஒரு star-y; 98% பங்கு – self luminars bodies 2% பங்கு – Interstellar / gallaztic gas & dust henuated term
- star forming clouds – 1000 times denser than the normal intersteller gas.
- star forming matter in richer than hydrogen & helium
- star's colour based on the temp of the surface Blue color – max. temp they comes yellow & Red etc.

### Formation composition of galache gas & dust

- generates heat (Hydrogen converted into helium by nuclear fusion) emitting large amount of heat & light.

**Black hole:** stars having mass > 3 times that of sun. b'coz of their great gravitational power.

- contract & develop – super density of 10<sup>16</sup> grams / cm<sup>3</sup>
- It dense that nothing not even light can escape from its gravity.
- சூரியக் குடும்பம் - ஆரம்  $5.6 \times 10^9 \text{ km}$

### கோள்கள் (Planets):

- தாமேனிராது, சூரியதூளியைப் பெற்றுபிரதிபலிக்கக் கூடியவை.

### துணைக்கோள்கள் (Moons)

- கோளின் கார்ப்புவிசையால் அக்கோளைச் சுற்றிவரும் விண்பொருள்.

### குறுங்கோள்கள் (Esteroids)

- செவ்வாய் & வியாழன் இடையில் நீள்வட்டப்பாதையில் பல ஆழிரக்கணக்கான விண்கற்கள் (They r different size)

### ளிந்தசத்திரங்கள்

## PHYSICS

விண்வீழ்க்கூல் - விண்வெளியிலிருந்துபூமியின் மேற்பரப்பைவளிமண்டலத்தில் வழியாகஅடையும் பொருள். எனிட்சத்திரம் / எரிகற்கள் (meters) – விண்கற்கள் பூமியின் வளிமண்டலத்திற்குகுள்ளோசுகிவேகத்தில் நடைமுயம் கோடுபோன்றுளியிடன் வாழ்கின்றன. இவற்றில் சிலளிந்துகாற்றில் கலந்துவிடுகின்றன. (Meteoroids) – விழுகற்கள் - சிலபாதிளிந்தநிலையில் பூமியில் விழுகின்றன.

Meteorites: Asteroids மூலம்

Asteroids → Inner planets

Comets → from outer planets (Altu Jupiter)

Pluto – குள்ளக்கோள் (Dwarf Planets)

- 2006 ஆம் ஆண்டு
- கோள்கள் சுற்றுவப்பட்பாதையில் மற்றொருகோள் பங்குபெற்றமையால்

குரியன் ஆயன் - 10 bn. yrs - 5bn yrs. over

படிப்பு – Heliology

core – (மையப்படுத்து/உள்ளகம்)

வெப்பநிலை/ 15 mm. kelvin/ 1, 50, 00, 000° C

Photosphere (ஒளிக்கோலம்)

- வெப்பநிலை – 5760 k
- குரியனின் காணப்படும் கருமைவரிகள்,கரும்புள்ளிகள்
- குரியன் - உலகின் ஆற்றல்மூலம்
- வெப்பநிலையை Stephenson நான்மடிவிதி மூலம் கணக்கிடலாம்.
- குரியனின் ஈர்ப்புவிசைபூமியினதைவிட 28 மடங்குஅதிகம்
- பூமியைவிட 109 மடங்குபெரியது.
- பூமி - குரியன் distance – 150 mm km
- பிரான்ஹோர் வரிகள் (Fraunhofer)
- குரியபுள்ளிகள் → வெப்பநிலை குரியனைவிட்குறைவு

Sunspots (கரும்புள்ளிகள்) – cooler – temp - 1500° c

- periodically of 11 yrs.

கோள்கள் (planets)

பானற்கோள்கள்/உபகோள்கள் → இரும்புமற்றும் பாறைகளால் ஆனது.

பெருங்கோள்கள் / வெளிகோள்கள் (gaseous planets)-

Hydrogen, He & CH<sub>4</sub>. வாயுக்களால் ஆனது.

புதன் (mercury)

- மிகச்சிறியகோள்
- மிகவேகமாக (குரியனைச் சுற்றிவரும்) வலம் வரும் கோள் (revolution 88 days)
- வளிமண்டலமும் துணைக்கோள்கள் → இல்லை.

வெள்ளி (venus) – (பூமியின் இரட்டை)

- ஓளிமிக்ககோள் / hottest

## PHYSICS

- வேறுபெயர்கள் காலைநட்சத்திரம் /மாலைநட்சத்திரம் /குட்டி இடையனின் விளக்கு
- ஒருநாள் > ஒருவருடம் (Rotation period > Revolution period)
- atmosphere contains → CO<sub>2</sub> → 90 – 95%
- like Uranus rotates E → W

**Mars (சிவப்புக் கோள்) செவ்வாய்**

- Nitrogen + argon, லேசானவளிமண்டலம்
- satellites phobos, deimos
- highest Mt. Nix Olympia

**வியாழன் (Jupiter) (Lord of the heavens)**

- மிகப்பெரியது
- வேகமாகசமலும் கோள் (9.8 hrs)
- Atmosphere contains Hydrogen, He, CH<sub>4</sub>, Ammonia
- களிமிட் (Ganymede) – largest satellite

**சனி (saturn)**

- நீரில் மிதக்கும் (b'cozநீரைவிட்குறைந்தஅடர்த்தி)
- மிகலேசானது
- satellite Titan – has nitrogen in its atmosphere.
- system of rings – well defined.
- There are separate particles that move indep. in circular orbits.
- space probe cassini.

**Uranus (பச்சைக்கோள்)**

- identical by William Herchel.
- Rotation – rolling – b'coz 98° inclined at an angle.
- satellites – Ariel, Miranda.

**Neptune:**

- Satellite Triton
- Coldest

All planets rotates W → E except Venus & Uranus  
Comet Shoemaker Levy – 9 – Jupiter (1994)

**சந்திரன் (Moon)**

- நிலவைப்பற்றியபடிப்பு (selenology)
- சுற்றுளவுcircm – 11,000 km.
- விட்டம் diameter – 3475 km
- ஈர்ப்புவிசை 1/6<sup>th</sup> of the earth elliptical
- avg. distance 3, 82, 800 km
- moon in 1/4<sup>th</sup> size of this earth
- one revolution → 27 days 7 hrs. 43 min
- one rotation → 27.3
- so we see only one side of the moon (59% of its surface)
- moon has no atmosphere
- light takes 1.3 sec to reach earth.

## PHYSICS

- பிரதிபலிப்பு – low  
(albedo) only 7% but earth has 30% venus 70%
- July 2, 1969 → Apollo XI – foot on moon  
(அமைதிக்கடல்) spot – sea of tranquillity.
- shackleton crate (Moon impact probe)
- M3 – நிலவில் மூலக்கூறு உள்ளது.
- moon's size – 1/3 of the earth
- Mass – 1/8 th
- Gravitation – 1/6<sup>th</sup>
- density – ½ nd
- mineral (கணிமம்) → Titanium – move
- highest mts → 35,000 ft  
(Lielonitzmts) லீபிஸிட்ஸ் மலைகார்.

Asteroids – very small planets / fragments

- not only b/w mars & Jup. (Asteroid belt)
- occur in everywhere but Jupiter வரைக்கும்
- no atmosphere b'coz small size
- alter Jupiter comets வால் நட்சத்திரம்
- Icy gas – ஆல் ஆனது
- வால் சூரியனுக்கு எதிர்த்திசையில் அமையும்
- Asteroids – Meteorites
- Meteors – remains & comets
- 1. Hailey's comet → 76  
வருடத்திற்கு ஒருமுறைவரும் கடைசியாக 1986-ல்
- 2. comet smith tuttle – 2116-ல் பூமிக்கு வரும்  
damage 1.6 Mn times of hydrogen bombs.

**கோள்களுக்கு - புது விளக்கம் (in 2006)**

(Inter Astronomical Union)

சூரியச் சூழ்மபத்தில் கோள் என்பது

1. சூரியனைவைலம் வருவதாகவும்

2.

போதுமானநிறை& ஒருண்டையான அமைப்புடையதாகவும்  
(hydrostatic equilibrium)

3. அதன் வெலம் வரும் பாதையில் வேறு ஒரவினர்  
இருக்கக்கூடாததாகவும்.

i) மட்டும் நிறைவேற்றினால் small solar System body.

i) & ii) மட்டும் நிறைவேற்றினால் Dwarf planet

(குள்ளக்கோள்/ குற்றளைக்கோள்)

கோள்	சூரியனுக் குழும்ளை தாலைவு	விட்டம்	துடை ணக்கோள்	சமவூத ஸ்	வெலம் வருதல்
புதன்	5.79	4878	0	58.65 days	88 days
வெள்ளி	10.82	12102	0	257 days	225 days
Earth(புவி)	14.96	12755	1	23 hrs 56 min 41 sec	365 d 5hr 48 min
செவ்வாய்	22.79	6787	2	Almos t 24 hrs	687 d
வியாழ	77.83	142800	63	9.8 hrs	12 yrs

ஞனி	142.70	120500	61	10.3 hrs	29 yrs
யுரேனஸ்	287.96	51400	27	10.8 days	84 yrs
neptune	497.06	48600	13	15.7 days	165 yrs

### பூமி

சுற்றுளவு – 40, 232 மா

Area – 510 mm km

distance from sun – 149 mm km

Perihelion(குறைந்தபட்ச தூரம் – 147 mm km)

Aphelim (அதிகப்பட்ச தூரம்) – 152 mm km

பூமியின் சமூல் அச்சுபூமி சூரியனைச் சுற்றிவரும்

தளத்தின் நேர்க்கூத்திற்கு 23 1/2 சாய்ந்துள்ளது.

நிலநடுக்கோட்டுசுற்றுளவு – 40, 067 km

கருவப்பகுதிசுற்றுளவு – 40,000 km

### பூமியின் நகர்வகள்

சமவூதல் (daily movt.)

W → E 23 hrs 56 min 41 sec

velocity 1667 km/hr @ equator @ poles - zero

வினைவகள் - பகல் இரவு

1 hr 15° அப்பால்

காற்றின் திசையைமாற்றும் நீரோட்டத்தின்

பேரலைகளின் உயர்வு/தாழ்வு

Equator day & nights – almost equal

longest day (NH) – June 21

Shortest day (NH) – Dec 22

Vice versa in SH

### சமநிலைநாள் (Equators)

- day & night equal

- sun directly over equ.

- mar 21 – vernal equinox

- sep 21 – Autumnal equinox

### Solstice – ஒருவருடத்தில்

பகலுக்கானநேரத்திற்கும் இரவுக்கானநேரத்திற்கும்  
உள்ளவித்தியாசம் அதிகமாக இருக்கும் நேரம்.

சூரியன் - Tropics – ல் இருக்கும் போதுநிகழம்

Jun 21 – summer solstice

Dec 22 – winter solstice

### Annual movt. (வெலம் வருதல்)

365 days 5hr 48 mm

29 km/sec

### வினைவகள்

- பருவகாலமாற்றும்

- பகல் இரவுநேரமாற்றும்

- காற்றுப்பட்டைகளைநகர்த்தும்

### பருவகாலங்கள்

## PHYSICS

spring – march 21

- sun - @ equ
- spring in NH

summer – Jun 21

- sun @ cancer
- NH – summer

**Autumn – sep 23**

- sun return to equator
- NH – autumn

**Winter – Dec 22**

- sun @ T.O. Capricorn
- NH – winter

**ஆர்டிக் வட்டம்,அண்டார்டிக் வட்டம்**

(நூளிரவு சூரியன்) பகல் 6 மாதம் இரவு 6 மாதம் due to tilted angle  $23{1/2}^{\circ}$  North pole – 21<sup>st</sup> March to 23<sup>rd</sup> Sep.

South pole – 23<sup>rd</sup> sep to 21<sup>st</sup> march

**இருகோடுகள் - பூமியின் கோள் அளவு  $360^{\circ}$  திரைப்பட்டமாகவரையப்படுவது – Latitudes அடச்சக்கோடுகள்**

செங்குத்தாகவரையப்படுவது - Longitudes தீர்க்கக்கோடுகள்

$0^{\circ}$  latitude – பூமத்தியரேகை – நிலஞ்சோடு பூமியைவட்ட&தென் அரைக்கோடாக  
 $23{1/2}^{\circ}$ N - கடகரேகை(cancer)  
 $23{1/2}^{\circ}$ S – மகரரேகை  
 $63{1/2}^{\circ}$  N – ஆர்டிக் வளையம்  
 $63{1/2}^{\circ}$  S – அண்டார்டிக் வளையம்

அடச்சக்கோடுகள்  $1^{\circ}$  - 11.1 km

தீர்க்கக்கோடுகள்  $1^{\circ}$  - 4 min

$0^{\circ}$  longitude – முதன்மைதீர்க்கரேகை (GMT) (Greenwich காசரினேரம்)

$13T$  –  $82\frac{1}{2}^{\circ}$  - அலகாபாத் வழியே

5.30 hrs difference

$90^{\circ}$  N & S – point not a line

181 Latitudes – including equator

எல்லாம் வட்டமாக இருக்குஆனால் ஒருஅளவில் இல்லை.

இருலதிக்கிடைப்பது. தூரம் சமம்

- longitude semicircles.
- distance between 2 meridian not equal.
- $180^{\circ}$  தீர்க்கக்கோடுச்சுவேசநாள்கோடு
- Earth divided into  $24^{\circ}$  longitudinal zones – each being  $15^{\circ}$  / 1 hr apart.
- **longitude & time** Russia – 11 time zones  
 USA & Canada – 5 time zones

**சர்வதேசநாள்கோடு**

4 இடத்தில் வளைவு – Aleutian தீவுகள், Fiji, Samoa, gilbert Islands

**சூரியகிரகணம் (ஒளிமறைவு)**

பாதியாகவும்/ முழுமையாகவும் இருக்கும் only in அமாவாசை(New Moon day)

Moons inclination னால் அமாவாசைஅன்றும் கிரகணம் வருவதில்லை.

**சந்திரகிரகணம்**

- occurs only in full moon (பெள்ளையி)
- 1 hr 40 min வரைநிகழும்
- பூமியின் உள்ளமைப்பு – crust – SIAL mantle (கவசம்)
- core (கருவம்/மையப்பகுதி)
- Normal gain rate – every 32 m/ic

**Endogenic – உள் இயக்கசக்தி**

- Tectonic movt/ கண்டநார்வுகள்
- மெதுவாகவும்,திதேரனவும் ஏற்படும்
- இது இருவேறுசுக்திகளால் ஏற்படும்.

**Epienogenic**

- கண்டாக்கநகர்வு,மலையாக்கநகர்வு

**Orogenicmovt** – மடிப்புமலைகள் (fold mts)

focus – நிலநடுக்கமைடம்  
epicentre – புள்ளிவெளிமையம்