CANCER BIOLOGY :

- In a living organism the multiplication of cells is carefully regulated. Occasionally, these controls are lost. Consequently the cell begins to grow and divide erratically resulting in a mass of cells termed as 'tumours'.
- **Tumour is a purposeless growth of tissue that tends to be atypical of the parent, autonomous and** aggressive. Study of tumours is called **oncology.** Tumors are of 2 types. Malignant and Benign.

1. Malignant tumours (cancerous tumours) :

- These are tumours from which cells can detach and migrate to other parts of the body where they give rise to secondary tumours. This phenomenon is called metastasis. Malignant tumours are harmful and lethal.

2. Benign tumours (noncancerous tumours)

- Benign tumours are small, localized with a fibrous outer capsule. They can not exhibit metastasis and tumour cells never migrate to other parts of the body. Such tumours arc harmless and can be removed by simple surgery.

Characters of Malignant tumours or cancers :

- Cancer cells are characterised by
- indefinite growth, transformation, spherical shape (due to less number of microfibrils), abnormal antigens on the surface of the cell, unusual number of chromosomes, ability to invade neighbouring tissues, entire or partially missing **cadherin** (helps in attachment of cells) and metastasis.
- Cancers are most common in fast dividing tissues like epithelium. Their surfaces are with abnormal glycoproteins and glycolipids.
- So they lose contact with other cells in the tissue. This enables the cancer cells to spread to other areas (metastasis).

I. Types of cancers :

- There are more than 200 different kinds of human cancers reported so far. Few cancers are familial (inherited) while many are sporadic (not-inherited).
- Most cells in the human body can develop a cancer. Based on their origin, they are classified as hereunder.

1. Carcinoma :

- Carcinomas are malignant tumours of the epithelial cells. They are solid, originating from the epithelial tissues of skin, linings of the respiratory, digestive, urinary and genital systems or cells from various glands, breast and nervous tissue.
- They are often named after the cell of origin e.g. Adeno carcinoma (cancer of adenoids) of lung, glioblastoma (cancer of nerve tissue -brain tumours), squamous cell carcinoma (skin), renal cell carcinoma (Kidney tubules) etc., 85 % of the cancers diagnosed are carcinomas.

2. Sarcoma :

- Sarcomas are malignant tumours of connective tissue. They are formed of closely packed cells derived from mesoderm or organ that originated from mesoderm.
- E.g. Osteosarcoma of bone, chondrosarcoma of cartilage, angiosarcoma of blood vessels etc. Sarcomas constitute about 2% of the rumours diagnosed.

3. Leukemia :

- They are the malignant tumours of haemopoietic tissues. They are 'liquid tumours'affecting blood cells particularly the white blood cells growing in the bone marrow e.g. chronic myelocytic leukemia, acute T cell leukemia etc., 4% of the reported cancers are leukemias.

4. Lymphoma:

- A malignant tumour of white blood cells present in the spleen and lymph nodes, e.g. Burkett lymphoma. 4% of the reported cancers are lymphomas.

II. Causative agents of cancer :

- There are a number of genes that have the potential of causing tumours. They arc called oncogenes or tumour inducing genes (T genes).
- They normally induce transformation of the cell. They are present both in viruses (viral oncogenes: *V- one*) and in host cells (cellular oncogenes: *C-one).*

1. Viral oncogenes (*V- ONC*) :

- **Viral oncogenes** normally carried by retroviruses, induce tumour formation. Paton **Rous** (1911) demonstrated that sarcoma is a type of tumor which could be induced in chicken by a virus called
- **Avian sarcoma virus.** Since then many Ti-viruses have been identified. They infect various cells and induce uncontrolled cell division leading to tumour formation.

2. Cellular oncogenes *(C-ONC)*

- Genes very much similar to viral Oncogenes are present in host cells. They are called as proto-oncogenes **or cellular Oncogenes.**

- They encode proteins with similar properties that have been identified in genomes of higher organisms including humanbeings.
- Proto-oncogenes are inactive oncogenes. When mutated, they are converted to active **oncogenes** capable of inducing cancer.

Inactivation of tumour suppressor genes :

- Genes that suppress the activity of oncogenes and prevent tumour formation are called **tumour suppressor** genes. E.g. Gene P^{53} codes for a protein that suppresses the tumour formation.
- Generally they are dominant and suppress the expression of oncogenes.
- When tumour suppressor genes mutate or deleted, it results in failure to control activated oncogenes. It can result in cancer formation

4. Chromosomal changes :

- Structural changes in chromosomes rarely contribute to cancer induction.

5. Mutations in DNA repair genes :

- The DNA of any organism is liable to point mutations. These mutations are often rectified by specific DNA repair mechanisms.
- These mechanisms are under the control of cluster of genes. Some times DNA repair genes become nonfunctional due to mutation or deletion of that part of the DNA. Such conditions lead to **DNA repair syndromes** and can result in a variety of cancers.

6. Others :

- Cancers can be induced by different factors like pollution, radiation, occupational exposure to different carcinogens, food additives, tobacco, alcohol, cosmetics, drugs and chemicals like hexachlorophene are carcinogens.
- Exposure to pollutants like dioxins, benzopyrenes, a few heavy metals and occupational pollutants like arsenic, coal-tar etc., cause cancers.
- Environmental factors like X-rays, U.V. rays and radio active radiations are also carcinogenic in nature.