**Unit 6: Cell division (6 lectures)**

**Phases of cell cycle, Mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases.**

**Phases of cell cycle**

A cell cycle is a series of events that takes place in a cell as it grows and divides. Cell cycle can be defined as the entire sequences of events happening from the end of one nuclear division to the beginning of the next. During the growth of a cell, a state of equilibrium is maintained between the cytoplasm and nucleoplasm. After attaining this equilibrium growing cell divide and as result two daughter cell produced. The growth of cell and its division involves a series of event constituting the life cycle of the cell called cell cycle.

The first idea of cell division was given by Hofmeisterin 1840. Cell division was first described by Hugo von Mohl in 1844.

The cell cycle involves five phases- G0 Phase , G1Phase, S Phase, G2Phase, M Phase, the first 4 phases together constitute **interphase** stage of cell cycle. It is the self preparatory period of cell that remains between two consecutive cell division.

**G1Phase-** It is called as **first gap phase** since no DNA synthesis takes place. **Growth phase-1** consists of all biosynthetic events for general growth of the cell and synthesis of substances essential for DNA synthesis. It involves synthesis of RNA, proteins and membranes which leads to growth of nucleus and cytoplasm of each daughter cell towards their mature size. This pre-DNA synthesis phase is initial growth phase continues for about 10 -12

hours (30-50% of total time).

During G1Phase, chromatin is fully extended and not distinguishable as discrete chromosomes. This is a time of resumption of normal cell metabolism which has slowed down during the previous cell division. Thus, G1Phase involves transcription of three types of RNAs; rRNA synthesis indicated by the appearance of nucleolus in the interphase nucleus. Proteins synthesis during G1Phase (1) regulatory proteins which control various events of mitosis; (2) enzymes (e.g. DNA polymerase) necessary for DNA synthesis of the next stage; and tubilin and others mitotic apparatus proteins.

**S Phase**- G1Phase is followed by **Synthetic Phase**. It is the period of synthesis of DNA, synthesis of histone proteins occur. Histones are required in massive amounts to doubled DNA material with nucleosome for cell division. Thus, at the end of S phase, each chromosome has two DNA molecules and duplicate set of genes. It lasts for 8 hours (35-45% of total time).

**G2Phase**- Synthetic Phase is followed by **second gap phase** or **Growth phase-2**. This post DNA synthesis phase is continues for 5 hours (10-20% of total time). This phase consists of all metabolic activities concerning the duplication of cellular component. During this phase synthesis of RNA and protein continues which is required for cell growth.

**M Phase-** Growth phase-2 is followed by mitotic phase during which the nucleus divides into two daughter nuclei (**karyokinesis**). This phase is lasts for 2 hours.

**G0 Phase-** Mitotic phase is followed by G0Phase or C Phase which is concerned with division of cytoplasm (**cytokinesis**). Terminally differentiated somatic cells (i.e,, end cells such as neurons and striated muscle cells) that no longer divide, are arrested.



Fig: phases of cell cycle

**General events or characteristic features of interphase**

It is the resting or preparation phase between two mitotic cell divisions.

* Important for metabolic reactions both in the nucleus and cytoplasm
* Nucleus and cytoplasm are metabolically very active and cell grows in size
* Chromosome is indistinct and appears in the form of diffused, long and much coiled structure called chromatin reticulum
* DNA material is doubled
* Nuclear membrane and nucleolus are distinct in this phase
* Centrosome is ready to divide into two centrioles
* Nuclear envelope remain intact