

2013-2017



Journey to Success



BS BOTANY-III

**CELL BIOLOGY
GENETICS & EVOLUTION
(COURSE CODE: BOT-201)**

YEAR-WISE **U**NIVERSITY

PAST **P**APERS

*Short Questions
With Answers*

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BY: AAMIR ISHAQ

2013**SHORT QUESTIONS (20 MARKS)****Q. No.1. How Plesiomorphy differs from Apomorphy?****(02 Marks)**

| Plesiomorphy | Apomorphy |
|---|---|
| <ol style="list-style-type: none"> 1. An evolved character or trait that is shared by some or all members of a phylogenetic group and their common ancestor but is not unique to that group. 2. Plesiomorphy cannot be used to define particular clade. 3. Plesiomorphic character is not similar throughout the clade. 4. A primitive or Ancestral character. <p>Example: A segmented spinal column is a plesiomorphy of mammals, being present as well in other groups such as fishes, reptiles, amphibians, and birds.</p> | <ol style="list-style-type: none"> 1. Apomorphy refers to a novel evolutionary character, unique to a particular clade and all its descendants. 2. Apomorphy can be used as defining character of a particular clade. 3. An Apomorphous character is similar throughout the clade. 4. A derived or specialized character. <p>Example: As an example, the class Aves is defined by the presence of feathers. The absence of legs in snakes is another example of apomorphy.</p> |

Q.No. 2. What is Pit? Describe its main functions?**(02 Marks)**

ANS: Pits are the characteristic depressions on the cell walls of plant cells. They act as the channels for the transport of water and minerals between adjacent cells. **Pits** of two neighboring cells are usually located opposite to each other and these opposite pits together are called **pit pair**.

Q. No.3. Briefly discuss various protocols regarding Genetic engineering?**(02 Marks)**

ANS: The process of manipulating genes, usually outside the organism's normal reproductive process is called genetic engineering or gene modification or gene splicing.

Protocols: These involve different **methods and applications** of Genetic Engineering which include

- **Isolation of genes** with help of molecular scissors called restriction endonucleases which cut the DNA or chromosome at specific sites.
- **Manipulation** by using molecular vectors mostly plasmids which can self replicate so can increase the quantity of genes.
- **Reintroduction of DNA** into cells or model organism. Therefore proteins are expressed outside the body of organism.

Applications: Genetic engineering is used to

- Make a crop resistant to herbicide.
- Introducing a novel trait
- Producing a new protein or enzyme
- Introduce new characteristics into organisms physiologically or physically.

Examples: Production of human insulin. It is produced by using modified bacteria.

Q.No. 4. Differentiate between the following terms.**(14 Marks)**

| Homology | Homoplasy |
|--|--|
| <ol style="list-style-type: none"> 1. Homology refers to a similar character emerged by the common ancestry. 2. Homology results from divergent evolution. 3. Homologous structures show different functions. 4. These show high degree of genetic similarity. | <ol style="list-style-type: none"> 1. Homoplasy refers to a similar character that does not emerge from a common ancestor. 2. Homoplasy results from convergent evolution. 3. Homoplasious characters show similar functions. 4. These do not show genetic similarity. |

5. It Occurs as a result of evolutionary relationship.
Example: Vertebrate limbs

5. It occurs as a result of adaptation to environmental condition.
Example: Wings of birds, bat and insects.

| Transduction | Transformation |
|---|--|
| 1. The process by which bacterial DNA is moved from one bacterium to another by a virus. 2. It is considered as biological method. 3. Only a small part of the total genetic material of any one bacterial cell is carried by transducing particle. | 1. The genetic recombination in which bacteria absorb naked DNA without the help of virus. 2. It is a non biological method. 3. It is the genetic alteration of a cell resulting from the introduction, uptake and expression of foreign genetic material. |

| Monoploidy | Diploidy |
|---|---|
| 1. The condition in which single basic set of chromosomes is present is called monoploidy. 2. It is some time equal to half number of chromosome but not always. Example: 7 is the monoploid number (x) of hexaploid wheat which is $2n=6x=42$ | 1. The condition showing the presence of two complete sets of chromosomes is called diploidy. 2. It is sometime equal to total number of chromosome if an organism has only 2 sets. Example: 46 is the diploid number of man which is $2n=2x=46$ |

| Tonoplast | Protoplasm |
|--|--|
| A tonoplast is actually the membrane that surrounds the large vacuole in a mature plant cell. | Nucleoplasm and cytoplasm are living contents of the cell which are collectively called as protoplasm. |

| Plasmalemma | Lomasomes |
|---|--|
| The cell membrane (also known as the plasma membrane or cytoplasmic membrane, and historically referred to as the plasmalemma) is a biological membrane that separates the interior of all cells from the outside environment (the extracellular space). It consists of a lipid bilayer with embedded proteins. | Paramural bodies are membranous or vesicular structures located between the cell walls and cell membranes of plant and fungal cells. When these are continuous with the cell wall, they are termed lomasomes , while they are referred to as plasmalemmasomes if associated with the plasmalemma. |

| Test cross | Back cross |
|--|---|
| In test cross, a dominant phenotype is crossed with the homologous recessive genotype in order to discriminate between homologous dominant and heterozygous genotypes. | In backcross, the F1 is crossed with one of the parents or genetically identical individual to the parent to recover an elite genotype from a parent which bears an elite genotype. |

SUBJECTIVE QUESTIONS (30 MARKS)

NOTE: ANSWER THE FOLLOWING QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS.

Q1. Describe in detail the variations in CHROMOSOME structure and arrangement.

Q2. How CROSSING OVER differs from GENETIC LINKAGE? Discuss

Q3. What is CELL WALL? Describe different btypes of cell walls and their functions in the organisms.

Q4. What is CELL CYCLE? Write down the processes of MITOTIC CYCLE.

Q5. Discuss in detail the 2nd LAW OF INDEPENDENT ASSORTMENT. What are the limitations in its applicability?

Q6. Describe any two of the followings.

i. CYTOPLASMIC INHERITANCE

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- ii. GENE MUTATION
iii. MITOCHONDRIA AND ITS FUNCTION

2014

(SUBJECTIVE PART)

SHORT QUESTIONS (20 MARKS)

Q2. Give short answers.

(2x10=20)

i) Differentiate between back cross and test cross.

| Test cross | Back cross |
|--|---|
| In test cross, a dominant phenotype is crossed with the homologous recessive genotype in order to discriminate between homologous dominant and heterozygous genotypes. | In backcross, the F ₁ is crossed with one of the parents or genetically identical individual to the parent to recover an elite genotype from a parent which bears an elite genotype. |

ii) What are enzymes? Give their significance.

ANS: Enzymes are biologically active globular proteins which act as **biocatalysts** to speed up a biochemical reaction without being used themselves. These are specific as these act on specific substances called substrates.

Significance: Enzymes are essential in living systems as in the absence of enzymes, metabolism will take place at very slow speed so life would cease and all chemical reactions would be locked up. Enzymes remove all physiological barriers and lower the energy of activation which is minimum amount of energy required to activate the substrate so it can change into product.

iii) What is allopolyploidy?

ANS: It is one of the types of polyploidy (with more than two sets of chromosomes) in which chromosomes are derived from different species. It occurs by hybridization of two closely related species. In most of the cases, the hybrid cannot produce viable gametes. Thus it becomes sterile.

Example: **Triticale:** it has six chromosome sets. Four are taken from wheat (*Triticum turgidum*) and two are taken from rye (*Secale cereal*)

iv) Differentiate between multiple allele and polygene.

| Multiple Allele | Polygene |
|---|--|
| 1. Multiple alleles are more than two alternative forms of a single gene, which are located at the same loci of homologous chromosomes. | 1. Polygenic traits are determined by group of nonallelic genes. |
| 2. Only two types of alleles among all alternative forms are present in an individual. | 2. All genes of a group are present in an individual. |
| 3. Determination of a trait by co-dominance or complete dominance. | 3. Determination of a trait by co-dominance or incomplete dominance. |
| 4. Environment has no influence. | 4. Environment has a higher influence. |
| 5. Determine qualitative traits. | 5. Determine quantitative traits. |
| Example: ABO blood type of man | Example: Wheat grain colour, human height etc. |

v) What is gene pool?

ANS: A **gene pool** is the collection of different genes within an interbreeding population. The concept of a gene pool usually refers to the sum of all the alleles at all of the loci within the genes of a population of a single species.

Example: Every human being on Earth is able to interbreed with one another as a single species. The human gene pool is therefore made up of every allele variant of the approximated 19,000-20,000 human genes within our DNA.

vi) What are autosomes?

ANS: Autosomes are homologous pair of chromosomes in a somatic cell which are not sex chromosomes. Humans have 22 pairs of autosomes, which transmit all genetic traits and conditions other than those that are sex-linked. Also called euchromosome.

vii) Define crossing over.

ANS: It is the process where homologous chromosomes pair up with each other and exchange different segments of their genetic material (non sister chromatids) to form recombinant chromosomes. It occurs during prophase I of meiosis resulting into gene reshuffling and genetic variations. It may also take place during mitosis which may results in loss of heterozygosity.

viii) Differentiate between Autophagy and Autolysis.

| Autophagy | Autolysis |
|--|--|
| Autophagy usually refers to an ordered and purposeful digestion of cellular components. It's basically the way a cell can deal with unused or poorly folded proteins. This is a normal cellular process. | Autolysis on the other hand occurs when digestive enzymes leak out of lysosomes and start destroying the cell. |

ix) What are different stages of interphase?

Interphase: It is the phase between two consecutive cell divisions during which cell grows and carries out its various metabolic processes. It is divided into following stages.

- **The G₁ (first growth or Gap 1) phase:** It is the early growth phase of the cell.
- **S (DNA synthesis) phase:** During this phase the growth continues. It also involves DNA replication.
- **G₂ (second growth or Gap 2) phase:** This phase prepares the cell for division. It includes replication of the mitochondria and other organelles, synthesis of microtubules and protein which will make up mitotic spindle fibers and chromosome condensation.

x) Define cytolysis. Explain its types shortly.

ANS: Cytolysis is a transport mechanism for the movement of large quantities of molecules into and out of cells.

Types: There are three main types of cytolysis.

- **Endocytosis:** The bulk movement of material into the cell by formation of vesicle is called endocytosis. There are three forms of endocytosis.
 - **Pinocytosis (cell drinking):** The nonspecific uptake of all droplets of extracellular fluid.
 - **Phagocytosis (cell eating):** the uptake of solid particles by invagination.
 - **Receptor-mediated endocytosis:** in this case specific receptors are present on plasma membrane which allow specific molecules to move inside by endocytosis.
- **Exocytosis:** The removal of cell secretions from the cell by out folding is called exocytosis.
- **Transcytosis:** It is through the cell, in and out.

Q3. Answer the following briefly.

(15x2=30)

- 1) Differentiate between translation and transcription. Give a detailed note on translation.
- 2) Describe the law of segregation by strand analysis.

2015

SUBJECTIVE PART

Q2. Short Questions / Answers.

10 X 2 = 20

i) Differentiate between Cytokinesis and Karyokinesis.

| Cytokinesis | Karyokinesis |
|---|--|
| 1. Cytokinesis is the approximately equal | 1. Karyokinesis is the equal distribution of |

distribution of cytoplasm between the two daughter cells.
2. It is the final step in cell division.
3. It is relatively a simple process.

replicated genetic material between two daughter nuclei.
2. It is the initial step in cell division.
3. A sequential process involving complex segregation of genetic material.

ii) Describe the Semi-conservative Replication.

ANS: The generally accepted method of DNA replication, in which the two strands of the DNA helix separate and free nucleotides pair with the exposed bases on the single chains to form two new DNA molecules, each containing one original and one newly synthesized strand of DNA. Thus primary structure means nucleotide sequence of parental duplex is conserved but secondary structure means original duplex is disrupted.

iii) Define Translocation.

ANS: In genetics, a chromosome translocation is a chromosome abnormality caused by rearrangement of parts between nonhomologous chromosomes. A gene fusion may be created when the translocation joins two otherwise-separated genes, it is detected on cytogenetics or a karyotype of affected cells.

iv) Define Fluid Mosaic Model.

ANS: The fluid mosaic model explains various observations regarding the structure of functional cell membranes. It was developed by S. Jonathan Singer and Garth Nicholson. According to this model, there is a bilayer of phospholipids which form a fluid sea in which the protein molecules are embedded. The proteins float in this sea like iceberg. Therefore, the membrane is in a constant state of shifting and changing. The word mosaic is used for many different kinds of proteins which are dispersed in phospholipids bilayer sea.

v) What is Antisense Strand?

ANS: It is the DNA antisense strand which serves as the source for the protein code, because, with bases complementary to the DNA sense strand, it is used as a template for the mRNA. Since transcription results in an RNA product complementary to the DNA template strand, the mRNA is complementary to the DNA antisense strand.

vi) What is Synapsis?

Synapsis (also called syndesis) is the pairing of two homologous chromosomes that occurs during meiosis. It allows matching-up of homologous pairs prior to their segregation, and possible chromosomal crossover between them. Synapsis takes place during prophase I of meiosis.

vii) Differentiate between Allelomorphs and Gynandromorphy.

| Allelomorphs | Gynandromorphy |
|---|---|
| One of a pair or series of genes located at the same locus in homologous chromosomes and controlling the same character, or one of a pair of characters which are governed by allelomorphic genes and are alternative to each other in inheritance. | A gynandromorph is an organism that contains both male and female characteristics. The term gynandromorph, from Greek "gyne" female, "andro" male, and "morphé" form, is mainly used in entomology. |

viii) What is Complete Linkage?

ANS: In genetics, complete linkage is defined as the state in which two loci are so close together that alleles of these loci are virtually never separated by crossing over. The closer the physical location of two genes on the DNA, the less likely they are to be separated by a crossing-over event.

ix) Differentiate between Monohybrid and Dihybrid cross.

| Monohybrid Cross | Dihybrid Cross |
|---|--|
| A cross involving divergent expression of one | Dihybrid cross involves a pair of gene. It means |

trait is transferred to as monohybrid cross. In monohybrid allele one gene is required to cross over.

Example: Crossing of phenotypically yellow homozygous dominant plant color (YY) with phenotypically green homozygous recessive plant colour (yy).

two characteristics are used to cross over.

Example: Cross between a homozygous dominant round yellow plant, genotypically (RRYY), and a homozygous recessive, wrinkled green plant, genotypically (rryy).

x) Describe Homology.

ANS: Homology refers to a similar character emerged by the common ancestry. Homology results from divergent evolution. Homologous structures show different functions. These show high degree of genetic similarity. It Occurs as a result of evolutionary relationship. **Example:** Vertebrate limbs

Q3. Answer the following.

3 X 10 = 30

1. Explain the four Mechanisms of Sex Determination.
2. Explain Prophase-I of Meiosis in detail.
3. Give an account of Euploidy.

2016

SUBJECTIVE PART

Q. 2. Answer short questions. Attempt any 10.

(20)

i) Describe the importance of proteins.

ANS: The name of proteins is derived from Greek word *proteios* means first place. These are most abundant organic compounds of the cell as they make about 50 % of dry matter of the cell. It is very difficult to classify Proteins as they have great structural and functional diversity. Most important functions of proteins are as follows.

- Structural material for animals and plant.
- Energy source
- Defense of body: Example: Antibodies, interferon etc.
- As chemical messenger: Example: Hormones
- Receptors on cell membrane.
- Enzymes to speed up biochemical reactions.
- Reserve food: Examples: Albumin in egg white, Casein in milk
- Muscle contraction: Examples: Actin and Myosin
- Cell division: Examples: Tubulin in spindle fibers

ii) What are dictyosomes?

ANS: Dictyosomes are stacks of flat, membrane-bound cavities (cisternae) that together comprise the Golgi apparatus. Within the dictyosomes, proteins are stored, modified, sorted, and packed into vesicles (which are then closed off as Golgi vesicles) for further transport.

iii) Define cell cycle.

ANS: The cell cycle or cell-division cycle is the series of events that take place in a cell leading to its division and duplication of its DNA (DNA replication) to produce two daughter cells. It is divided into following stages.

- The G₁ (first growth or Gap 1) phase: It is the early growth phase of the cell.
- S (DNA synthesis) phase: During this phase the growth continues. It also involves DNA replication.
- G₂ (second growth or Gap 2) phase: This phase prepares the cell for division. It includes replication of the mitochondria and other organelles, synthesis of microtubules and protein which will make up mitotic spindle fibers and chromosome condensation.
- The M (Mitotic) phase: It involves partitioning of chromosomes and daughter cells.

iv) Differentiate cisternae and cristae.

| Cisternae | Cristae |
|--|--|
| A cisterna (plural cisternae) is a flattened membrane disk of the endoplasmic reticulum and Golgi apparatus. A Golgi stack may contain anywhere from three to twenty cisternae, but most contain about six. Golgi cisternae can be separated into four classes; cis, medial, trans, and TGN (trans-Golgi network). | A crista (plural cristae) is a fold in the inner membrane of a mitochondrion. The name is from the Latin for crest or plume, and it gives the inner membrane its characteristic wrinkled shape, providing a large amount of surface area for chemical reactions to occur on. |

v) Describe Karyotype analysis

ANS: Chromosome analysis or karyotyping is a test that evaluates the number and structure of a person's chromosomes in order to detect abnormalities. Chromosomes are thread-like structures within each cell nucleus and contain the body's genetic blueprint. Three types of techniques are used in karyotype analysis.

1. **Classic Karyotype analysis:** In this technique a dye, Giemsa, is used. It stains bands on the chromosomes. This is called *G-banding*.
2. **Spectral Karyotype (SKY technique):** It is molecular cytogenetic technique. It is used to show all 23 pairs of human chromosomes in different colours and widely used to identify structural chromosome aberrations in cancer cells and other disease conditions.
3. **Formation of Karyogram:** This technique is used to determine the diploid number of chromosomes of an organism.

vi) Differentiate deletion and addition.

| Deletion | Addition |
|---|---|
| In genetics, a deletion (also called gene deletion , deficiency , or deletion mutation) (sign: Δ) is a mutation (a genetic aberration) in which a part of a chromosome or a sequence of DNA is lost during DNA replication. | In genetics, an insertion (also called an insertion mutation) is the addition of one or more nucleotide base pairs into a DNA sequence. This can often happen in Microsatellite regions due to the DNA polymerase slippage. |

vii) Give the importance of crossing over.

ANS: **Crossing over**, or recombination, is the exchange of chromosome segments between nonsister chromatids in meiosis. **Crossing over** creates new combinations of genes in the gametes that are not found in either parent, contributing to genetic diversity.

viii) Differentiate between Aneuploidy and Euploidy.

| Aneuploidy | Euploidy |
|--|---|
| 1. Aneuploidy is the variation in the number of a particular chromosome within the set so it is the condition in which one or fewer chromosomes are added or deleted from the normal number of chromosome number. 2. Diploidy, Triploidy and tetraploidy are variations | 1. Euploidy is the increase of the number of chromosome sets in the genome so it is an exact multiple of a chromosome number. 2. Nullisomy ($2n-2$), Monosomy ($2N-1$), Trisomy ($2N+1$) and tetrasomy ($2n+2$) are variations |

ix) Describe the Law of Independent Assortment.

ANS: The principle, originated by Gregor Mendel, stating that when two or more characteristics are inherited, individual hereditary factors assort **independently** during gamete production, giving different traits an equal opportunity of occurring together. Expand. Also called Mendel's second law.

x) What are three types of RNA and their importance?

ANS: There are three main types of RNA.

1. **Messenger RNA (mRNA):** It brings or carry genetic message from DNA (nucleus) to ribosome for the synthesis of specific protein. The mRNA is about 3 to 4% of total RNA in the cell.
2. **Transfer RNA (tRNA):** The tRNA reads message (code) on mRNA and transfers specific amino acid to the ribosome. It has anticodes. It forms about 10 to 20% of total cellular RNA.
3. **Ribosomal RNA (rRNA):** The rRNA combines with ribosomal proteins and forms ribosome so it provides the machinery and site for protein synthesis. It forms a large part, about 80% of total RNA.

xi) What are Okazaki fragments and where are these found?

ANS: Okazaki fragments are short (about 100 to 200 nucleotides long in eukaryotes and 1000 to 2000 nucleotides in prokaryotes), newly synthesized DNA fragments that are formed on the lagging template strand as the result of discontinuous DNA replication. They are complementary to the lagging template strand, together forming short double-stranded DNA sections.

xii) What is point mutation?

ANS: A point mutation is a genetic mutation where a single nucleotide base is changed, inserted or deleted from a sequence of DNA or RNA. Point mutations have a variety of effects on the downstream protein product—consequences that are moderately predictable based upon the specifics of the mutation.

xiii) Define conjugation.

ANS: Bacterial conjugation is the transfer of genetic material between bacterial cells by direct cell-to-cell contact or by a bridge-like connection between two cells. It is a mechanism of horizontal gene transfer. Bacterial conjugation is often incorrectly regarded as sexual reproduction or mating. It does not involve the fusion of gametes and formation of a zygote. Therefore it is not sexual mating.

xiv) What is the importance of PCR?

ANS: Polymerase chain reaction (PCR) is a technique used in molecular biology to amplify a single copy or a few copies of a segment of DNA across several orders of magnitude, generating thousands to millions of copies of a particular DNA sequence. PCR has a number of advantages.

- It is fairly simple to understand and to use, and produces results rapidly. The technique is highly sensitive with the potential to produce millions to billions of copies of a specific product for sequencing, cloning, and analysis.
- It has its uses to analyze alterations of gene expression levels in tumors, microbes, or other disease states.^[41]
- PCR is a very powerful and practical research tool. The sequencing of unknown etiologies of many diseases are being figured out by the PCR.
- The technique can help identify the sequence of previously unknown viruses related to those already known and thus give us a better understanding of the disease itself. If the procedure can be further simplified and sensitive non radiometric detection systems can be developed, the PCR will assume a prominent place in the clinical laboratory for years to come

xv) Differentiate between population and community.

| Population | Community |
|--|--|
| In biology, a population is all the organisms of the same group or species, which live in a particular geographical area, and have the capability of interbreeding. | In ecology, a community is an assemblage or association of populations of two or more different species interacting and occupying the same geographical area and in a particular time, also known as a biocoenosis. |

Q3. Attempt any (2) two questions.

1. a. What are nucleic acids? What are its types?

(15 + 15)

(5)

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- b. Give the ultra structure of chromosomes. (10)
2. a. Briefly describe cell cycle and its stages. (5)
b. Describe sex linked and sex limited characters with examples. (10)
3. What is the PCR, and how is it carried out to produce multiple copies of a DNA segment? (15)

2017**SUBJECTIVE PART**

Q. 2. Answer short questions. Attempt any 10. (20)

i) Mention functions of Golgi complex.

ANS: Golgi complex performs following functions:

1. Golgi complex are concerned with cell secretions. For example in mammals, the pancreas secretes granules which contain enzymes for digestion.
2. Golgi apparatus transport the proteins or enzymes outside the cell.
3. The most important function of Golgi apparatus is formation of glycoproteins and glycolipids by adding carbohydrates into proteins and lipids.
4. The dictyosomes form a structure called phragmoplast between the dividing plant cells which forms new cell wall between dividing cell.

ii) What is the chemical composition of Ribosomes?

ANS: Ribosomes contain equal amount of proteins and rRNA. So they are also known as ribonucleoprotein. The protein contains a large number of lysine and arginine amino acids. These amino acids contain positive charges. It makes the ribosome strongly negative. There are four rRNAs molecules in eukaryotic ribosomes. 18S rRNA is present in small unit of ribosome, 20S, 2.8S and 18S rRNAs are present in larger subunits. The prokaryotes have only three molecules of rRNAs.

iii) What are Glyoxisomes and what is their function?

ANS: Glyoxisomes are one of the microbodies and cytoplasmic organelles present only in plant cells. These are most abundant in plant seedlings of lipid rich seeds only during germination like castor oil and soybeans.

Functions: Conversion of stored fatty acids in seeds into carbohydrates is one of the primary activities of glyoxisomes. This conversion takes place through a cycle called Glyoxylate Cycle. The enzymes for this cycle are present in Glyoxisomes.

- Glyoxisomes play an important role in both catabolic and anabolic pathways in plants as they break the fatty acids into succinic acid in lipid rich seeds.

iv) What are B-chromosomes?

ANS: B chromosomes are extra chromosomes to the standard complement that occur in many organisms. They can originate in a number of ways including derivation from autosomes and sex chromosomes in intra- and interspecies crosses.

v) What is Cytokinesis?

ANS: 1. Cytokinesis is the approximately equal distribution of cytoplasm between the two daughter cells. It is the final step in cell division. It is relatively a simple process in plant cells during which secretions of Golgi complex form phragmoplast and cell plate in the center of dividing cell which ultimately is changed into new cell wall.

vi) What is the role of Mitosis?

ANS: The role of mitosis is as follows.

- The hereditary material is equally distributed in the daughter cell during mitosis.
- As there is no crossing over or recombination so mitosis ensures the continuity of similar information from parent to daughter cell.
- Asexual reproduction in some organisms takes place by mitosis.
- Regeneration, healing of wounds and replacement of older cells are also gifts of mitosis.
- The development and growth of multicellular organisms depends on the orderly controlled mitosis.
- Tissue culture and cloning also require mitosis.

vii) What is Karyotyping?

ANS: Karyotyping is a test that evaluates the number and structure of a person's chromosomes in order to detect abnormalities. Chromosomes are thread-like structures within each cell nucleus and contain the body's genetic blueprint. Three types of techniques are used in karyotype analysis.

1. **Classic Karyotype analysis:** In this technique a dye, Giemsa, is used. It stains bands on the chromosomes. This is called *G-banding*.
2. **Spectral Karyotype (SKY technique):** It is molecular cytogenetic technique. It is used to show all 23 pairs of human chromosomes in different colours and widely used to identify structural chromosome aberrations in cancer cells and other disease conditions.
3. **Formation of Karyogram:** This technique is used to determine the diploid number of chromosomes of an organism.

viii) Differentiate between Nucleoside and Nucleotide.

| Nucleoside | Nucleotide |
|--|---|
| 1. Nucleoside contains only a nitrogenous base and a pentose sugar either ribose or deoxyribose. | 1. Nucleotide contains a nitrogenous base, pentose sugar and a phosphate group. |
| 2. Nucleoside is the precursor of nucleotide. | 2. Nucleotide is the precursor of both DNA and RNA |

ix) What are Transposons?

ANS: Transposons are segments of DNA that can move around to different positions in the genome of a single cell. In the process, they may

- cause mutations
- increase (or decrease) the amount of DNA in the genome of the cell, and if the cell is the precursor of a gamete, in the genomes of any descendants.

These mobile segments of DNA are sometimes called "jumping genes".

There are two distinct types:

- **Class II transposons.** These consist of DNA that moves directly from place to place.
- **Class I transposons.** These are retrotransposons that
 - first transcribe the DNA into RNA and then
 - use reverse transcriptase to make a DNA copy of the RNA to insert in a new location.

x) What are Alleles?

ANS: An allele is an alternative form of a gene (one member of a pair) that is located at a specific position on a specific chromosome. These DNA codings determine distinct traits that can be passed on from parents to offspring through sexual reproduction.

xi) What is Crossing over?

ANS: It is the process where homologous chromosomes pair up with each other and exchange different segments of their genetic material (non sister chromatids) to form recombinant chromosomes. It occurs during prophase I of meiosis resulting into gene reshuffling and genetic variations. It may also take place during mitosis which may results in loss of heterozygosity.

xii) What is Mutation?

ANS: A mutation is a change that occurs in our DNA sequence, either due to mistakes when the DNA is copied or as the result of environmental factors such as UV light and cigarette smoke etc. Mutations are changes in the genetic sequence. For mutations to affect an organism's descendants, they must: 1) occur in cells that produce the next generation, and 2) affect the hereditary material. Ultimately, the interplay between inherited mutations and environmental pressures generates diversity among species.

xiii) What is the difference between Active and Passive transport?

| Active transport | Passive transport |
|---|---|
| 1. Active transport pumps molecules against the concentration gradient using ATP energy 2. It is an uphill movement. Examples: Endocytosis, exocytosis, active secretions of substances into blood stream, sodium/potassium pump etc are active. | 1. Passive transport allows the molecules to pass the membrane through a concentration gradient, requiring no cellular energy. 2. It is downhill movement. Examples: Diffusion, facilitated, osmosis etc are passive transports. |

xiv) What are plasmids and what is their role in bacteria?

ANS: Plasmids are small, circular, double-stranded DNA molecules that are distinct from a cell's chromosomal DNA. Plasmids naturally exist in bacterial cells, and they also occur in some eukaryotes. Often, the genes carried in plasmids provide bacteria with genetic advantages, such as antibiotic, heavy metal, insect resistance etc.

xv) What is Cell cycle?

ANS: The cell cycle or cell-division cycle is the series of events that take place in a cell leading to its division and duplication of its DNA (DNA replication) to produce two daughter cells. It is divided into following stages.

- **The G₁ (first growth or Gap 1) phase:** It is the early growth phase of the cell.
- **S (DNA synthesis) phase:** During this phase the growth continues. It also involves DNA replication.
- **G₂ (second growth or Gap 2) phase:** This phase prepares the cell for division. It includes replication of the mitochondria and other organelles, synthesis of microtubules and protein which will make up mitotic spindle fibers and chromosome condensation.

The M (Mitotic) phase: It involves partitioning of chromosomes and daughter cells.

Q3. Attempt any (2) two questions.

(15 + 15)

1. a. What is Gene mutation? (7)
b. Describe DNA replication in detail.. (8)
2. a. Explain the structure and function of Plastids. (7)
b. Describe Chromosomal Aberrations in detail. (8)
3. What is the PCR, and how is it used to form multiple copies of a DNA segment? (15)

☺ wish you good luck ☺



| Code | Subject Title | Cr. Hrs | Semester |
|---------|---|---------|----------|
| BOT-201 | Botany-III (Cell Biology, Genetics and Evolution) | 3 | III |
| Year | Discipline | | |
| 2 | Botany, Zoology, Chemistry-I | | |

Syllabus Outline: An Introduction to Morphology and Functioning of Cell, Cellular Organelles and Mechanisms of Cell Division, Study of Genes and their Inheritance Patterns, Concept of Evolution.

Course Outline:

a) Cell Biology:

1. Structures and brief description of Bio-molecules
 - i. Carbohydrates
 - ii. Lipids
 - iii. Proteins
 - iv. Nucleic Acids
2. Cell: Physico-Chemical Nature of Plasma Membrane and Cytoplasm.
3. Ultrastructure of plant cell with a brief Description and Functions of the following Organelles:
 - i. Endoplasmic Reticulum
 - ii. Plastids
 - iii. Mitochondria
 - iv. Ribosomes
 - v. Dictyosomes
 - vi. Vacuole
 - vii. Microbodies (Glyoxysomes and Peroxisomes)
4. Nucleus: Nuclear Membrane, Nucleolus, Ultrastructure and Morphology of Chromosomes, Karyotype Analysis.
5. Reproduction in Somatic and Embryogenic Cell, Mitosis and Meiosis, Cell Cycle.
6. Chromosomal Aberrations; Changes in the Number of Chromosomes Aneuploidy and Euploidy, Changes in the Structure of Chromosomes, Deficiency, Duplication, Inversion and Translocation.