



**Avinashilingam Institute for Home Science and Higher Education for Women**  
(Deemed to be University under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956)  
Re-accredited with 'A+' Grade by NAAC. Recognised by UGC Under Section 12B  
Coimbatore - 641 043, Tamil Nadu, India

**Bachelor's Degree Examination –November 2019**  
**III Semester**

**Class: II UG**  
**Major :Zoology**

**Time: 3 Hours**  
**Max. Marks : 100**

**18BZOC07 - CELLBIOLOGY**

**Part –A**

**Choose the correct answer**

**10×1= 10**

- Father of microscopic anatomy
  - Jan Swammerdam
  - Robert hook
  - Malpighi
  - Nehmian grew
- The particles are separated at different speed at different time by
  - Homogenization
  - Centrifugation
  - Dehydration
  - Crystallization
- The process of colouring the cells and tissues are called
  - Staining
  - Fixation
  - Dehydration
  - Embedding
- The cytoplasm contains a network of membrane bound vesicles called
  - Golgi bodies
  - Endoplasmic reticulum
  - Centrosome
  - Ribosome
- Cytoplasmic junctions between the adjacent cells are known as
  - Cell plate
  - Plasmodesmata
  - Pharagmoplast
  - Phragmosomes
- Secondary lysosomes known as
  - Multivesicular body
  - GERL
  - Digestive vacuoles
  - None of the above
- The main function of mitochondria is
  - Energy transduction
  - Extracellular digestion
  - Thermogenesis
  - Both A and C
- Fibrillar zone is known as
  - Perichromatin
  - Nucleolonema
  - Karyolymph
  - Nuclear sap
- Diploid chromosome number in mouse
  - 46
  - 48
  - 40
  - 64
- Which helps to transmit signals from growth factor receptors
  - RAS
  - TGFβ
  - P<sup>53</sup> gene
  - SMAD4

**Part B**

**5 x 6 = 30**

**Answer ALL questions**  
**Each answer should not exceed 400 words or two pages**

11. a) Write an essay on the scope of cytology.  
(OR)  
11. b) Give an account on Light microscope.
12. a) Explain the chemical composition of plasma membrane.  
(OR)  
12. b) Write short notes on endocytosis and exocytosis.
13. a) Explain the structure and functions of Golgi complex.  
(OR)  
13. b) Describe the different types of Lysosomes.
14. a) Discuss about nuclear proteins .  
(OR)  
14. b) Explain the functions of Nucleolus.
15. a) Give an account on oncogenes and its types.  
(OR)  
15. b) Differentiate the normal and cancer cell based on molecular organization.

**Part C**

**5 x 12 = 60**

**Answer ALL questions**  
**Each answer should not exceed 800 words or four pages**

16. a) Give a detailed account on electron microscope.  
(OR)  
16. b) Explain the structure of eukaryotic cell with diagram.
17. a) Describe the specialized structure of plasma membrane.  
(OR)  
17. b) Explain the Plasma membrane Transport mechanism.
18. a) List out the Functions of mitochondria.  
(OR)  
18. b) Write a brief note on biogenesis of ribosomes.
19. a) Discuss about ultra structure of Nucleus.  
(OR)  
19. b) Explain about giant chromosomes with examples.
20. a) Give a detailed note on antioncogenes.  
(OR)  
20. b) Enumerate the origin and causes of cancer.

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Coimbatore -641043  
Bachelor's Degree Examinations – November 2019  
Semester – III**

**Class : UG  
Time : 3 Hours  
Major : Zoology  
Max. Marks: 100**

**18BZOC07 – Cell Biology**

**Scheme of valuation**

**Part –A**

**Choose the  
correct answer                      10×1= 10**

1. c
2. b
3. a
4. b
5. b
6. c
7. d
8. b
9. c
10. a

**Part - B  
5X6=30**

11. a) Cytology helped to understand various complicated activities such as metabolism, growth, differentiation, heredity and evolution at cellular and molecular level. Some of them are cytotaxonomy, cytogenetics, cell physiology, cytochemistry, ultrastructure and molecular biology, cytopathology, and cytoecology.

11.b) Phase –contrast microscope has the resolving power. It enables to see the

structure of living cell. It is discovered by Netherlandder, Zernike in 1955. exaggerates the small difference between the phases. Phase –contrast microscope has eye point, eye piece, Annular phase plate-annular diaphragm-condenser-focal plane-objective lens. It helps in the observation of behavior of chromosomes of living cells during mitosis or meiosis and various other cellular components.

12. a) Membranes are mainly composed of lipoprotein. Ratio of protein and lipid varies from 1:0.8 to 1: 4. In addition polysaccharides, DNA and RNA have also been found in certain cases. Thin film-like pliabe sheet with 75 Å thickness. Three concentric layers.

Lipid: phospholipids, glycolipids and sterols. Amphipathic . hydrophilic and hydrophobic. Important lipids are lecithin, choline, and cephalin. They are made up of glycerol, fatty acids, phosphoric acid and sphingosine. Proteins: structural proteins and functional proteins, carrier proteins. Integral proteins and peripheral proteins. Other constituents: polysaccharides, sialic acid, DNA, RNA, co-enzymes, porphyrins, metal ions.

12.b) Endocytosis : is a type of active transport that moves particles, such as large molecules, parts of cells, and even whole cells, into a cell. the plasma membrane of the cell invaginates, forming a pocket around the target particle. The pocket pinches off, resulting in the particle being

contained in a newly created intracellular vesicle formed from the plasma membrane. Exocytosis: The reverse process of moving material into a cell is the process of exocytosis. Waste material is enveloped in a membrane and fuses with the interior of the plasma membrane. This fusion opens the membranous envelope on the exterior of the cell, and the waste material is expelled into the extracellular space.

13.a)  $\beta$ - oxidation of fats: Oxidation of fatty acids occurs in three stages:

$\beta$ -oxidation of fatty acids resulting in cleavage of two-carbon units ( $\alpha$  and  $\beta$  carbons) from the carboxyl end of fatty acyl-CoA with the formation of acetyl CoA. This reaction keeps occurring till the entire fatty acyl chain is broken down to acetyl CoA molecules. For eg. Palmitoyl CoA (16 carbon chain) on  $\beta$ -oxidation will give eight acetyl CoA molecules. It is further discussed in detail below. The acetyl groups produced from  $\beta$ -oxidation of the fatty acid participate in the Krebs's cycle resulting in the formation of NADH and FADH<sub>2</sub>.

The reduced coenzymes (NADH and FADH<sub>2</sub>) are oxidized by giving up the protons and electrons to oxygen present in the mitochondria to synthesize ATP by oxidative phosphorylation in the Electron Transport System.

13.b) Biogenesis of mitochondria: regarding the origin of the mitochondria, several hypotheses have been postulated which are as follows:

1. "de novo" origin
2. Origin from the endoplasmic reticulum or plasma membrane
3. Origin by division of pre-existing mitochondria.
4. Prokaryotic origin

14. a) Nuclear proteins : the protein part of the nucleus is complex. Two strongly basic and simple protein. Protamines and histones. They are non-histone proteins and nuclear enzymes.

1. Nucleoprotamines
2. Nucleohistones

14.b) some of the important functions of golgi complex are given below:

1. Processing of secretory and membrane proteins
2. Secretion of polysaccharides
3. Formation of plasma membrane
4. Other functions

15.a) Oncogenes and its types: An oncogene is a gene that has the potential to cause cancer. In tumor cells, they are often mutated or expressed at high levels. Most normal cells will undergo a programmed form of rapid cell death (apoptosis) when critical functions are altered and malfunctioning. Activated oncogenes can cause those cells designated for apoptosis to survive and proliferate instead. Most oncogenes began as proto-oncogenes, normal genes involved in cell growth and proliferation or inhibition of apoptosis. If normal genes promoting cellular growth, through mutation, are up-regulated (gain-of-function mutation), they will predispose the cell to cancer and are thus termed oncogenes. Usually multiple oncogenes, along with mutated apoptotic or tumor suppressor genes will all act in concert to cause cancer.

A gene that is a mutated (changed) form of a gene involved in normal cell growth. Oncogenes may cause the growth of cancer cells. Mutations in genes that become oncogenes can be inherited or caused by being exposed to substances in the environment that cause cancer.

Some of the different categories of oncogenes include:

1. Growth factors or mitogens

2. Receptor tyrosine kinases
3. Cytoplasmic tyrosine kinases
4. Cytoplasmic serine/threonine kinases
5. Regulatory GTPases
6. Transcription factors

15.b) Molecular organization of cancer cell and normal cell:

Normal cell: less glycosyltransferase in golgi complex. Normal glycolysis, oxidation, and TCA cycle, aldolase enzyme is B-type. No plasminogen activator. Receptor molecules are not diffused. GM1, GM2 are on the cell membrane. Fibronectin is normal. AFP and CEA are not synthesized.

Cancer cell: more glycosyltransferase in golgi complex, defective glycolysis and TCA cycle, aldolase enzyme is A-type, plasminogen activator is secreted, Receptor molecules are diffused, GM3 type of gangliosides are present. Fibronectin is drastically absent, alpha – fetoprotein was synthesized.

### Part –C

**5×12=60**

16. a) Electron microscope : The electron microscope is a type of microscope that uses electrons to create an image of the target. It has much higher magnification or resolving power than a normal light microscope. Although modern electron microscopes can magnify objects up to two million times, they are still based upon Ruska's prototype and his correlation between wavelength and resolution. Transmission electron microscope (TEM): in TEM the metal filament or cathode emits the electron beam. They are focused by electromagnetic condenser lens. After passed through the object they are collected by electromagnetic coil which is act as an objective lens. The final image can be visualized on florescent screen on photographic plate. TEM has a resolving power of 400 times

that of the light microscope. They are used in the study of ultrastructures of cell and its components.

Scanning electron microscope (SEM): Electron microscopes use electrons for imaging, in a similar way that light microscopes use visible light. SEMs use a specific set of coils to scan the beam in a raster-like pattern and use the electrons that are reflected or knocked off the near-surface region of a sample to form an image. Since the wavelength of electrons is much smaller than the wavelength of light, the resolution of SEMs is superior to that of a light microscope. SEM contains the following parts: scan coils, condenser lens, secondary electron detector, objective lens. They are used to visualize a 3D image of a cell structure.

16.b) Chromatography : they used to separate the molecules of different substances present together in a solution is applied to an insoluble medium.

1. Paper chromatography : simple method . Paper chromatography is one of the types of chromatography procedures which runs on a piece of specialized paper. It is a planar chromatography system wherein a cellulose filter paper acts as a stationary phase on which the separation of compounds occurs. Principle of paper chromatography: The principle involved is partition chromatography wherein the substances are distributed or partitioned between liquid phases. One phase is the water, which is held in the pores of the filter paper used; and other is the mobile phase which moves over the paper. Uses and application : Paper chromatography is specially used for the separation of a mixture having polar and non-polar compounds.

- For separation of amino acids.
- It is used to determine organic compounds, biochemicals in urine, etc.
- In the pharma sector, it is used for the determination of hormones, drugs, etc.

- Sometimes it is used for evaluation of inorganic compounds like salts and complexes.

2. Column chromatography: Column chromatography is a chromatography technique used to separate mixture of chemical substances into its individual compounds. Column chromatography is a widely used method for the purification or separation of chemical compound mixture in lab. Principles of column chromatography: Column Chromatography consists of two phases: one mobile phase and one contiguous stationary phase. The stationary phase is solid and the mobile phase is liquid. The compound mixture moves along with the mobile phase through stationary phase and separates depending on the different degree of adhesion (to the silica) of each component in the sample or the compound mixture. Column Chromatography is used to isolate active ingredients. Column Chromatography Applications:

- It is very helpful in Separating compound mixtures.
- It is used to determine drug estimation from drug formulations

17.b) Oxidation of carbohydrates : the reaction which involve in the oxidation of glucose into  $CO_2$  and water are known to form the metabolic pathways. It includes 2 kinds of reaction anabolic and catabolic. The catabolic reactions are grouped under the following heads:

- Glycolysis or Embden- Meyerhof pathways
- Oxidative decarboxilation
- Kerb's cycle and
- Respiratory chain and oxidative phosphorylation

18.a) Structural variations of mitochondria : The structural variations in the mitochondria takes place usually due to the difference in number, size, shape and arrangement of cristae or crests in the mitochondria which are follows:

1. Variation due to number of crests
2. Variation due to the structure and arrangement of the crests
3. Variation due to the fusion

18.b) Biogenesis of ribosomes : 1. Biogenesis of 70S Ribosomes

2. Biogenesis of 80S Ribosomes- Nucleolar organizer and ribosomal DNA

Molecular structure of nucleolar organizer- spacer DNA and satellite DNA and amplification or redundancy of the DNA.

Biogenesis of 5S RNA , processing of the ribosomal RNA in nucleolus.

Synthesis of ribosomal protein and ribosomal assembly.

- It is used to remove impurities.
- Used to isolation metabolites from biological fluids.(proteins, enzymes).

17.a) Specialized structures of plasma membrane: the cell surface of certain cells performs various activities such as absorption, secretion, transportation etc, to perform such specialized functions certain modifications are inevitable in the plasma membrane of such cells. Most important specialized structures are given below:

1. Microvilli
2. Inner ends
3. Desmosomes or macula adhaerens
4. Hemidesmosomes
5. Septate desmosomes
6. Terminal bars or zonula adhaerens
7. Inter-digitations
8. Tight junctions or zonula occludens.
9. Gap junctions , macula occludens or nexus.

19.a) Ultrastructure of nucleus : The nucleus is composed of the following structure: nuclear membrane or karyotheca, nucleolus, nuclear sap or nucleoplasm, chromatin fibres.

Nuclear membrane: nuclear envelope surrounds the nuclear contents. Nuclear pores the broken or openings are called nuclear pores.

Nucleolus: spherical and acidophilic dense granule as nucleolus. Granular zone, fibrillar zone, amorphous zone, nucleolar –associated chromatin.

Nucleoplasm : the nuclear components such as chromatin threads, nucleoprotein granules, nucleolus were suspended in the nucleoplasm.

chromatin fibres: thread-like, coiled much elongated structure are known as chromatin substance or chromatin fibres.

19.b) Giant chromosomes : cells at certain stages contain large nuclei with giant or large sized chromosomes. They are polytene and lampbrush chromosomes.

Polytene chromosomes: occurs in the tissues of salivary glands, gut, trachea, fat body cells, and malpighian tubules of many insects of the order Diptera. polytene chromosomes are the permanent prophase chromosomes which contain 1000 times more than the somatic chromosomes. Bands and inter-bands of the polytene chromosomes.

Polytene chromosomes and endomitosis. puffs and balbiani rings of the polytene chromosomes.

Lampbrush chromosomes: diplotene stage of meiosis, the yolk rich oocytes of many vertebrates contain large sized chromosomes known as lampbrush chromosomes. They are much larger than the polytene chromosomes. They composed of the main axis and the lateral loops.

B-chromosomes and Holokinetic chromosomes – Most of these chromosomes are seen in plants.

20.a) Antioncogenes : A tumor suppressor gene, or antioncogene, is a gene that protects a cell from one step on the path to cancer. When this gene mutates to cause a loss or reduction in its function, the cell can progress to cancer, usually in combination with other genetic changes. The loss of these genes may be even more important than proto-oncogene/oncogene activation for the formation of many kinds of human cancer cells. Tumor suppressor genes can be grouped into categories including caretaker genes, gatekeeper genes, and landscaper genes; the classification schemes are evolving as medicine advances, learning from fields including molecular biology, genetics, and epigenetics.

Two-hit hypothesis

Functions : Tumor-suppressor genes, or more precisely, the proteins for which they code, either have a damping or repressive effect on the regulation of the cell cycle or promote apoptosis, and sometimes do both. The functions of tumor-suppressor proteins fall into several categories including the following:

Repression of genes that are essential for the continuing of the cell cycle. If these genes are not expressed, the cell cycle does not continue, effectively inhibiting cell division.

Coupling the cell cycle to DNA damage. As long as there is damaged DNA in the cell, it should not divide. If the damage can be repaired, the cell cycle can continue.

If the damage cannot be repaired, the cell should initiate apoptosis (programmed cell death) to remove the threat it poses for the greater good of the organisms produced

Some proteins involved in cell adhesion prevent tumor cells from dispersing, block loss of contact inhibition, and inhibit metastasis. These proteins are known as metastasis suppressors.

DNA repair proteins are usually classified as tumor suppressors as well, as mutations in their genes increase the risk of cancer, for example mutations in HNPCC, MEN1 and BRCA. Furthermore, increased mutation rate from decreased DNA repair leads to increased inactivation of other tumor suppressors and activation of oncogenes.

Examples : The first tumor-suppressor protein discovered was the retinoblastoma protein (pRb) in human retinoblastoma; however, recent evidence has also implicated pRb as a tumor-survival factor.

Other examples of tumor suppressors include pVHL, APC, CD95, ST5, YPEL3, ST7, and ST14.

20.b) Origin and causes of cancer : Cancer refers to any one of a large number of diseases characterized by the development of abnormal cells that divide uncontrollably and have the ability to infiltrate and destroy normal body tissue. Cancer often has the ability to spread throughout your body.

Cancer is the second-leading cause of death in the world. But survival rates are improving for many types of cancer, thanks to improvements in cancer screening and cancer treatment.

Symptoms: Signs and symptoms caused by cancer will vary depending on what part of the body is affected. Some general signs and symptoms associated with, but not specific to, cancer, include:

- Fatigue
- Lump or area of thickening that can be felt under the skin
- Weight changes, including unintended loss or gain
- Skin changes, such as yellowing, darkening or redness of the skin, sores that won't heal, or changes to existing moles
- Changes in bowel or bladder habits
- Persistent cough or trouble breathing
- Difficulty swallowing
- Hoarseness
- Persistent indigestion or discomfort after eating
- Persistent, unexplained muscle or joint pain
- Persistent, unexplained fevers or night sweats
- Unexplained bleeding or bruising

Causes: Allow rapid growth.

Fail to stop uncontrolled cell growth. Make mistakes when repairing DNA errors. Gene mutations you're born with. Gene mutations that occur after birth. Risk factors : age, habit, family history, health condition, environment. Complications: Pain Fatigue. Difficulty breathing. Nausea. Diarrhea or constipation. Weight loss. Chemical changes in your body. Brain and nervous system problems. Unusual immune system reactions to cancer. Prevention: Stop smoking. Avoid excessive sun exposure. Eat a healthy diet Exercise most days of the week. Maintain a healthy weight. Drink alcohol in moderation, if you choose to drink. Schedule cancer screening exams. Immunizations.