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Based on

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QUESTION PAPER

June – 2023

(Solved)

BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATES)

B.B.Y.C.T.-131

Time: 2 Hours] *[Maximum Marks: 50*

Note: *All questions are compulsory. Marks are indicated against each questions.*

Q. 1. ***(a)*** **State whether the following statements are 'True' or 'False':**

(i) **Louis Pasteur developed the vaccine from an attenuated culture of virulent bacteria.**

(ii) **Heterocysts are present in Volvox.**

(iii) **Equisetum is heterosporous.**

(iv) **Ginkgo seeds have a foul odour.**

Ans. *(i)* True, *(ii)* False, *(iii)* False, *(iv)* True.

(b) **Choose the correct option from given in the parentheses:**

(i) **(Gene therapy/Bacteriophage therapy) is a therapy in which viruses are used to destroy bacterial pathogens.**

(ii) **The (coralloid/aerial) roots are apogeotropic and help in fixing Nitrogen.**

(iii) **In (siphonostele/haplostele) there is no pith in the centre of xylem core.**

(iv) **Secondary mycelia in Basidiomycota are (monokaryotic/dikaryotic).**

Ans. *(i)* Bacteriophage therapy, *(ii)* coralloid, *(iii)* haplostele, *(iv)* dikaryotic.

(c) **Match the items given under Column 'A' with those given under Column 'B':**

Column 'A'	Column 'B'
(A) Cup-like chloroplasts	***(i)*** **Rhizoids**
(B) Fungal cell wall	***(ii)*** **Trabeculae**
(C) Marchantia	***(iii)*** **Chitin**
(D) Selaginella	***(iv)*** **Chlamydomonas**

Ans. (A) *(iv)*, (B) *(iii)*, (C) *(i)*, (D) *(ii)*.

Q. 2. Differentiate between the following pairs of terms:

(i) **Bacterial cell and Archaeal cell**

Ans. The general cell structure of archaea and bacteria are the same but composition and organization of some structures differ in archaea. Similar to bacteria, archaea do not have interior membranes but both have a cell wall and use flagella to swim. The Archaea constitute a domain or kingdom of single-celled microorganisms. These microbes are prokaryotes, meaning that they have no cell nucleus or any other membrane-bound organelles in their cells. Bacteria constitute a large domain of prokaryotic micro-organisms. Typically a few micrometres in length, bacteria have a number of shapes, ranging from spheres to rods and spirals. Archaea differ in the fact that their cell wall does not contain peptidoglycan and cell membrane uses ether linked lipids as opposed to ester linked lipids in bacteria. Archaea flagella evolved from bacterial type IV pili while bacterial flagella evolved from type III secretion system. Bacterial flagellum is like a stalk which is hollow and is assembled by subunits that are free to move up the central pore adding on to tip of flagella while in archaea flagella subunits are added on to the base.

(ii) **Liverworts and Mosses**

Ans. Ref.: See Chapter-13, Page No. 96, Q. No. 5.

(iii) **Transformation and Transduction**

Ans. Ref.: See Chapter-4, Page No. 23, 'Transformation', 'Transduction'.

***(iv)* Petrifaction and Compression**

Ans. Ref.: See Chapter-16, Page No. 117, Q. No. 3.

Q. 3. Using a well-labelled diagram, show how the coralloid root of *Cycas* is structured. Discuss its benefits.

Ans. Ref.: See Chapter-20, Page No. 148, Q. No. 7.

Also Add: The main function of coralloid root is nitrogen fixation and also act as aerating organs.

Q. 4. *(a)* With the help of diagrams, describe the sexual reproduction in Polysiphonia.

Ans. Ref.: See Chapter-7, Page No. 52, Q. No. 7.

***(b)* Write the various uses of Gymnosperms under the following headings: food, medicine, pulp and paper**

Ans. Ref.: See Chapter-22, Page No. 163, 'Wood Timber', 'Non-Timber and Paper – Pulp', Page No. 164, Q. No. 1*(d)*, (Self Assessment Question) and Q. No. 1 (Terminal Question).

Q. 5. *(a)* Why is it thought that gymnosperm seed have remarkable combination of two generations? Explain.

Ans. Ref.: See Chapter-19, Page No. 139, Q. No. 3.

***(b)* Using the labelled diagram, explain the structure of the T4 bacteriophage.**

Ans. Ref.: See Chapter-1, Page No. 5, Q. No. 2.

Q. 6. *(a)* Discuss the characteristics of haplostele and actinostele.

Ans. Ref.: See Chapter-18, Page No. 133, 'Maplostele', 'Actinostele'.

***(b)* Explain homologous theory of alternation of generations in brief.**

Ans. Ref.: See Chapter-12, Page No. 91, 'Alternation of Generations', Page No. 93, Q. No. 2, (Homalogous Theory)'.

Q. 7. Write short notes on any *two* of the following:

***(i)* Bacterial plasmid**

Ans. Ref.: See Chapter-3, Page No. 18, Q. No. 4 (Terminal Questions).

***(ii)* Prokaryotic algal cell**

Ans. Algal cell based on its internal organization, can be divided into two catgories prokaryotic and eukaryotic. *Prokaryotic Algal* cells don't have well differentiated membrane bound organelles e.g. Cyanobacteria or blue green algae. Their cell enclosed by plasma membrane containing non-membrane bound organelles.

Cell Wall and Cell Sheath: The cells are enveloped by peptidoglycan layer outside the cell membrane. The peptidoglycan layer is surrounded by a periplasmic space which is again surrounded by an outer membrane.

Photosynthetic Lamellae: Cyanobacteria have pigmented membranes but no chloroplasts. These pigmented membrane occupy the peripheral region of the cell called chroniatoplasm. In this area photosynthetic pigment chlorophylla and phycobiliproteins are present.

Granular Inclusions of Cytoplasm: In the cytoplasm of cyanobacteria there are several types of granules. Cyanophycin granules (protein like polymers) present as non-membrane bound granules. Common granules present in mostly all algae are rich in phosphate and polyphosphate granules. An unique granule present in cyanobacteria are polyhedral crystalline bodies known as carboxysomes. Cyanobacteria contain 70s ribosomes dispersed in the cytoplasm which are needed for protein synthesis.

Gas Vesicles: Walls of gas vesicles are made up of protein molecules and are permeable to gases but not to water. Gas vesicles are found in many planktonic cyanobacteria.

Nucleoplasm: Nucleoplasm is the central portion of a prokaryotic cell and it contains the genetic material DNA.

Specialised Cells of Cyanobacteria: Filamentous cyanobacteria show two other types of structures – heterocyst and akinetes.

***(iii)* Rhynia**

Ans. Ref.: See Chapter-16, Page No. 115, 'Rhynia'.

***(iv)* Role of bryophytes in soil erosion**

Ans. Ref.: See Chapter-15, Page No. 111, Q. No. 1.

■■

Sample Preview of The Chapter

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Biodiversity (Microbes, Algae, Fungi and Archegoniates)

Viruses : General Account and Economic Importance

INTRODUCTION

Viruses can be defined as small obligate, intracellular particles seen only by electron microscope that can infect and take over the host cell to replicate. We can say, viruses are unique class of infectious agents. They can infect all types of organisms. Viruses are the blur boundary between the living and non-living organisms. Thus, all viruses are a cellular entities and are made up of genetic material inside a protein coat. Viruses are important also as they play a role in making medicines as in vaccine production, cancer therapy, phage therapy, etc.

CHAPTER AT A GLANCE

DISCOVERY

The new science virology was established by Chamberland-Pasteur Filter by Charles Chamberland with Louis Pasteur. This filter was with pore sizes of 0.1-1 micron which can remove all bacteria and other cells from a liquid suspension. Robert Koch formulated germ theory of disease which states that infectious diseases are caused by microorganisms which can be seen only via microscope. At the end of 19th century in Europe tobacco growers were worried because of the presence of mosaic like pattern on tobacco leaves. A German Scientist concluded that the causative agent may be very small bacteria which could not be seen by a microscope. Another microbiologist Martinus Beijerinck repeated the same experiment and believed that TMD was caused by a new form of infectious agent which was smaller and simpler than bacteria. Friedrich Loeffler and Paul Frosch working on Foot and Mouth Disease (FMD). Frederick Tword discovered Bacteriophages, the virus infecting bacterial cells. In 1917 d' Herelle's rediscovered this phenomenon with his first communication on bacteriophage, An Invisible Microbe Antagonistic to Dysentry Bacteria. In 1935, Klendell Stanley for the first time crystallized a virus the Tobacco Mosaic Virus (TMV).

GENERAL ACCOUNT

Viruses are non-cellular life forms and are obligate intracellular parasites. Thus, viruses exist in two phases – extracellular and intracellular.

Viral Size

Viruses are very small size that cannot be seen by naked eyes as well as by light microscope. Their size ranges from 0.02 to 0.3 μ m or 20 to 300 nm.

Structure of Viruses

The viruses are made up of only two components – protein and nucleic acid which together known as the nucleocapsid.

The Capsid

Capsid is a protein coat that protects the viral genome against chemical and physical damage and it also helps the virus to enter into the host cell. Capsid helps in packaging or assembly of the viral genoms during viral replication. The capsid acts as antigen in the host support an antitbody-based immune response which is the first layer of defence of the host from viral infection.

The Virus Symmetry

The building blocks of capsid are capsomeres which are responsible for the three different symmetry groups of viruses. Three symmetry groups of viruses are:

Hellical Symmetry: The helical structure is cylindrical in shape.

***Cubical /Icosahedral Symmetry*:** An icosahedral is a polygon with 20 facets and 12 corners.

***Complex Symmetry*:** These viruses are a combination of cubical and helical symmetry. They do not show purely helical or cubical symmetry.

Viral Envelop

The outer membranes layer that surrounds the nucleocapsid of so many viruses is known as viral envelope and these viruses are called as enveloped viruses. These are animal viruses and some plant and bacterial viruses and viruses which do not have an envelope are called naked viruses or non-enveloped viruses.

The Viral Nucleic Acid

The viral nucleic acid is made up of only one type of nucleic acid i.e. either of DNA (Deoxyribonucleic Acid) or RNA (Ribonucleic Acid). The viral nucleic acid is mostly linear or circular in some cases. It is also exists as segment.

Classification of Viruses on the basis of Nucleic Acid: The viruses are usually classified into two groups on the basis of presence of their nucleic acid i.e. DNA or RNA.

Viruses with DNA are called DNA viruses and viruses with RNA are called RNA viruses. On the basis of DNA and RNA viruses are further sub-grouped as:

- Class I double stranded (ds) DNA viruses.
- Class II single stranded (ss) DNA viruses.
- Class III double stranded (ds) RNA viruses.
- Class IV single stranded (ss) RNA viruses.
- Class V single stranded (ss) RNA genomer with negative sense.
- Class VI single stranded (ss) RNA genome.
- Class VII double stranded (ds) DNA genome with positive sense.

Viral Enzymes and Other Contents

The first viral enzyme to be discovered was Neuraminidase (NA). Neuraminidase is required by the virus so that it can be released from the host cell. Viral transcriptase is another important enzyme present in viruses.

Viral Taxonomy

The number of viruses and their taxonomic categories are continuously expanding. The family name of viruses ends with viridae, sub-family name is virinar, and genus (and species) name is virus.

DNA VIRUS (T-PHAGE)

Viruses with DNA as a genetic material are known as DNA viruses. These can be single stranded DNA or double stranded DNA as genetic material.

T-Phage Virus

T-phages (T1 through T7. T standing for type) are a specific class of large, complex bacteriophages with icosahedral heads, double stranded DNA with a characteristic head and tail structure. T-phages have double stranded DNA and so belong to class-I of viruses.

RNA VIRUSES (TMV)

RNA viruses are with RNA as their genetic material. Among the plant viruses, Tobacco Mosaic Virus (TMV) has been studied most extensively. TMV has a helical symmetry with positive sense (+) single stranded (ss) RNA in the middle.

Tobacco Mosaic Virus (TMV)

TMV is historically important as it was the first virus to be discovered by Dmitri Ivanowsky and the first virus to be crystallized by Wendal Stanley. TMV infects tobacco and other plants like tomato, spinach and pepper and causes considerable damage to plantations. Plant cell walls must be damaged for the virion to enter the cell and cause infection.

OTHER VIRUS LIKE THINGS – SUB VIRAL PARTICLES

These are virus related agents that are capable of causing diseases. So far studied these viruses agents are only of two types – viriods and prions.

Viroids

Viruses may be often referred to as the smallest infectious things. But there are some smaller contenders also. Some of the agents of plant disease lack even a viral coat and are merely small strings of plain, or "naked," RNA. They are believed to be a more primitive version of ordinary viruses. These particles with a small, circular, single stranded RNA that do not contain any protein or capsid are called viroids.

Prions

Prions (Proteinaceous Infectious Particles) are infectious particles that have only proteins and do not have DNA or RNA. Prions are proteins that have the ability to transmit diseases, a finding that has defied scientific expectations.

ECONOMIC IMPORTANCE

It has been believed that viruses are infectious agents and leads to massive economic losses. Though some viruses are important as pathogens and they play a major beneficial role in medicine researches and diagnostics.

Economic Losses due to Viral Disease

Plant Diseases: Plant viruses are much more difficult to control. The economically important food crops are severely affected by viral diseases.

Animal Diseases: Foot and Mouth Diseases (FMD) is a disease caused by virus in India is of annual economic loss.

Human Viral Diseases: Main viral diseases like AIDS, influenza, dengue, polio, diarrhoea, small pox, hepatitis, etc.

Economic Benefits of Viruses

Viruses can be economically beneficial also. As for vaccine production, gene therapy, cancer therapy, bacteriophage therapy, in researches, virus-based diagnosis and viral biopesticides.

SELF-ASSESSMENT QUESTIONS

Q. 1. Which among the following statement are true:

(i) Viruses can be defined as large obligate, intracellular particles seen only by light microscope that have to infect and take over host cell to replicate.

(ii) Bacteriophages infect bacteria.

(iii) First animal virus was discovered by Twort and d'Herelle.

(iv) Wendell Stanley for the first time crystallised virus.

Ans. *(i)* False, *(ii)* True, *(iii)* False, *(iv)* True.

Q. 2. In the following statements choose alternate correct word given in parenthesis.

(i) The therapy in which viruses can be used for destruction of bacterial pathogens is (gene therapy/bacteriophage therapy).

(ii) Rabies is caused by (Rhabdoviruses/Picorna virus).

(iii) Tobacco Mosaic Virus (TMV) is a (DNA virus/RNA virus).

(iv) Enzyme required by the virus so that it can be released from the host cell (Hemagglu-tinin/ Neuraminidase).

(v) Positive (+) sense single stranded RNA virus are classified under (Class V Class IV) Baltimore Classification.

(vi) A layer of protein present between nucleocapsid and envelop is called the (Matrix/Spike).

Ans. *(i)* Bacteriophage therapy, *(ii)* Rhabdo virus, *(iii)* RNA virus, *(iv)* Neuraminidase, *(v)* Class IV, *(vi)* Matrix.

TERMINAL QUESTIONS

Q. 1. Write short notes on:

***(i)* Prions**

Ans. It is a virus like agent that is known as pathogen capable of causing diseases. So prions (proteinaceous infectious particles) are infectious particles that have only proteins. They do not have nucleic acid i.e. DNA or RNA. Prions are proteins that have the ability to transmit diseases. Prions cause serious neurological diseases in animals and humans. Prion is a rogue proteins direct the host to create abnormal proteins. When a prion comes into contact with the normal version of the protein, then normal protein to change shape and becomes a prion. Prions are resistant to a wide range of chemical and physical treatment like heat, ultra-violet radiations, formal-dehyde, etc.

***(ii)* Viriods**

Ans. It is virus like agent that is known as pathogen. Capable of causing infectious diseases viriods have small circular, single stranded RNA that do not contain any proteins or capsid. The RNA molecule does not contain any protein coding gene. It has naked RNA. As RNA molecule without any protective covering viriods are not degraded by enzymes. They have a very tight secondary structure because of extensive internal base pairing and thus look like rods. Viriods cause plant diseases like potato spindle tuber, tomatoes, citrus exocortis and cucumber pale fruit disease. Potato Spindle Tuber Viriod (PSTV) infects both potato and tomato. Viriod is also responsible for hepatitis-d. There can be serious agricultural impact due to diseases caused by viriods.

***(iii)* Virus Classification**

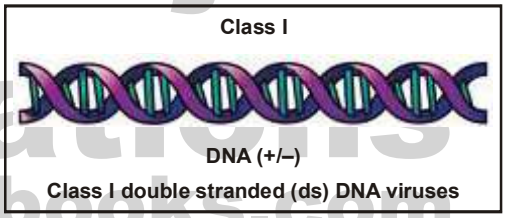
Ans. On the basis of their nucleic acid or genome (DNA or RNA) the viruses are classified into two groups. Afterwards viruses split into separate families based on different characteristics like stand type (double stranded and single stranded).

(i) DNA viruses with DNA as their genetic material, and

(ii) RNA viruses with RNA as their genetic material.

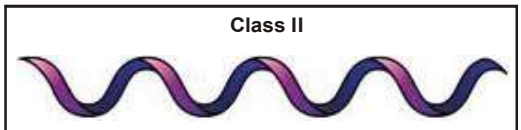
These viruses are further sub-grouped as:

(a) Class I double stranded (ds) DNA viruses. These have double strand of DNA e.g. Adenoviruses, Herpesviruses, Poxviruses, etc.



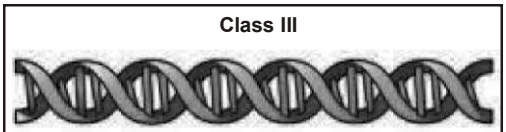
Class I double stranded (ds) DNA viruses

(b) Class II single stranded (ss) DNA viruses. These viruses have single strand of DNA e.g. Parvoviruses.



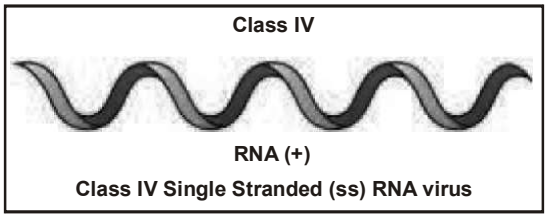
Class II Single Stranded (ss) DNA viruses.

(c) Class III double stranded (ds) RNA. These viruses have double strand of RNA genomes e.g. Reoviruses, Birnaviruses, etc.

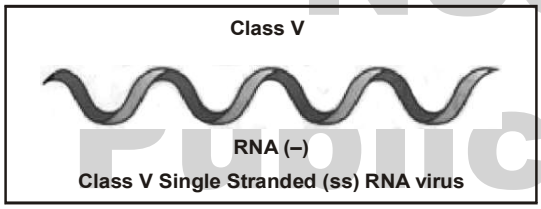


Class III double stranded (ds) RNA virus.

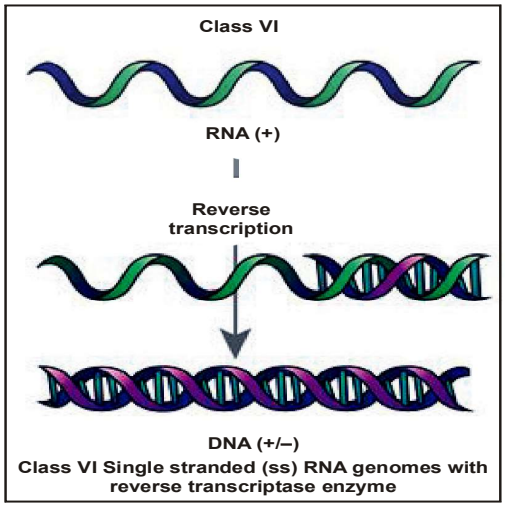
(d) Class IV single stranded (ss) RNA. These viruses have single strand of RNA genomes (Positive (+) sense). In this type of virus, the base sequence of RNA molecule is identical with that of mRNA i.e. in the host cell, viral RNA acts like mRNA and can be directly translated by the host ribosome e.g. Picorna viruses, Togaviruses, etc.



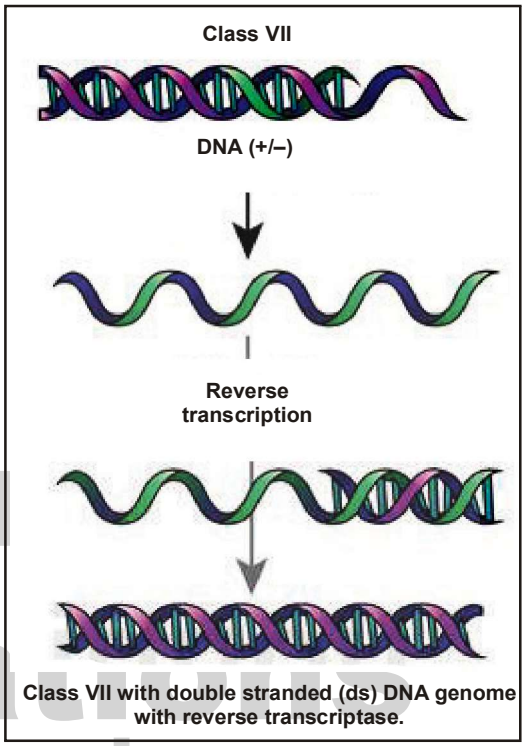
(e) Class V single stranded (ss) RNA genomes. In these viruses RNA genomes which are complementary in base sequence to the mRNA [negative (-ve) sense] e.g. Orthomyxoviruses. Rhabdoviruses, etc. In the host cell, negative sense viral RNA acts as a template for transcription to make complementary mRNA, which is then translated by the host ribosome. Negative sense RNA viruses also carry RNA polymerase needed for transcription of their RNA.



(f) Class VI viruses have single stranded (ss) RNA genomes. These with help of reverse transcriptase enzyme convert to double stranded (ds) DNA and then form mRNA e.g., Retroviruses.



(g) Class VII viruses have double stranded (ds) DNA genome which convert to positive (+) sense single stranded (ss) RNA and then with help of reverse transcriptase form double stranded (ds) DNA and then transcribe to mRNA e.g. Hepadnaviruses.



***(iv)* Viral envelope**

Ans. Outer membrenous layer that surrounds the nucleocapsid of viruses is called viral envelope. These viruses are known as enveloped viruses e.g. some animal viruses and plant viruses and bacterial viruses e.g. animal viruses herpesvirus and togavirus are enveloped icosahedral viruses. This envelope of viruses is made up of carbohydrates, lipids and proteins. These all are acquired by the virus from the host cell during replication. These viruses are of pleomorphic i.e. area of varying shape as this envelope is a flexible membrenous structure. Their nucleocapsid can be helical or icosahedral. Between the nucleocapsid and envelope, a layer of protein is present called the matrix. This matrix protein is responsible for holding the nucleocapsid to the envelope. The viral envelope of animal virus is formed from the cell and nuclear membrane of the host cell while the virus is exiting the cell via budding. On the viral envelope, special glycoproteins are present known as spikes or peplomeres and these envelope proteins are coded by