**M.Sc. Examination, 2019**
**Semester-II**
**Biotechnology**
**Course : VI**
**(Microbiology)**

302

**Time : 3 Hours** **Full Marks : 40**

**Questions are of value as indicated in the margin.**

Answer **any four** of the following

1. Describe the structure of Cell Wall and chemical compositions of Gram-Positive and Gram-negative bacteria. Point out the similarities and differences. 8+2=10

2. What are the typical characteristics of Archaea? How do they differ from eubacteria? Give salient features of different groups of Archaea. 2+2+6=10

3. a) Give an account of the structural changes and *nif* gene arrangements in the cells of cyanobacteria when a vegetative cell transforms to a heterocyst ensuring nitrogen fixation.

   b) Describe the economic importance of Actinomycetes. 5+5=10

4. Describe the method used for metagenomics study of microorganisms in environmental samples. How the molecular phylogeny of microorganisms can be determined through 16S rRNA sequencing? 5+5=10

5. a) Give a brief account of nutrition of bacteria.

   b) What are photosynthetic bacteria? Illustrate the photosynthetic ETS of any one group of photosynthetic bacteria. 5+5=10

6. Short notes on **any four** of the following : 2.5×4=10
   a) Different methods for determination of growth of microorganisms
   b) Endo and Exo-toxins
   c) Disease Reservoirs
   d) Different antibiotics based on structure and mode of action
   e) Antifungal drugs
   f) Common microorganisms those colonize different parts of human body with examples.

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**M.Sc. Examination, 2019**
**Semester-II**
**Biotechnology**
**Course : VII**
**(Immunology)**

**Time : 3 Hours** **Full Marks : 40**

**Questions are of value as indicated in the margin.**

Answer **any four** of the following

1. What are secondary lymphoid organs and tissues? Describe the structural organization and immune micro-environment of spleen with proper diagram. How is central tolerance achieved for T cells? 2+6+2=10

2. a) What is multivalency of antibodies? How is this property helpful to develop various immunoassays?

   b) What are antigenic determinants? A protein antigen has distinct amino acid sequences for hydrophobic peptides and hydrophilic peptides. To develop a vaccine, how might these peptides be used as vaccine candidates to induce different kinds of immune responses? (1+3)+(1+5)=10

3. Compare hormones and cytokines by their general structural and functional properties. Explain the general working principle of the cytokine receptors with proper diagram. 5+5=10

4. Mention the modes of attainment of functional diversity during somatic recombination in lymphocytes. Describe any two of them with proper diagrams. Explain the role of Activation-induced cytidine deaminase (AID) in antibody class switching. 2+6+2=10

5. a)What is Anaphylaxis? How does it differ from Delayed type hypersensitivity?

   b) Explain the granzyme-perforin pathway of CTL effector mechanism. (1+5)+4=10

6. Short notes on **any four** of the following : 2.5×4=10
   a) MALT
   b) General structure of TLR
   c) Interferon
   d) Membrane Attack Complex
   e) MHC haplotype
   f) Recombinant vaccine

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305

**M.Sc. Examination, 2019**
**Semester-II**
**Biotechnology**
**Course : VIII**
**(Virology)**

**Time : 3 Hours** **Full Marks : 40**

**Questions are of value as indicated in the margin.**

Answer Question No.**1** and **any three** from the rest.

1. Answer **any five** questions : 2×5=10
   i) Give the structure and function of a pro-drug.
   ii) Show with example the structural symmetry of viruses.
   iii) Describe Lassa Virus.
   iv) Plant viral disease transmission
   v) How does a viral growth differ from bacterial growth?
   vi) Which one of the infection roots is most often involved in the neonatal transmission of hepatitis B virus?
   vii) Why do retroviruses convert their genome to DNA (using reverse transcriptase) and then transcribe it back into viral RNA (and translate that into viral proteins).
   viii) What causes the viral plaques that appear on a bacterial lawn to stop growing larger?
2. Compare Plant virus life cycle with animal virus life cycle. What are the classical symptoms of plant virus? 6+4=10
3. How do viruses cause disease? Explain acute and persistent infection with example. Define and explain latency with suitable example. 2+4+4=10
4. Name and describe the major shapes of nucleocapsids of viruses. For each one, describe a specific virus that is an example. What are advantages, if any, of each shape? Include discussion of viral envelopes. 2+3+3+2=10
5. Classify Myxoviruses with examples. What is the genomic nature of Influenza virus? Describe the basic structure of Influenza virus. Write down the roles of Hemagglutinin and Neuraminidase. 2+2+3+3=10
6. Short notes on **any four** of the following : 2.5×4=10
   i)Blue tongue virus
   ii) Viroids
   iii) Prions
   iv) Nuclear entry to virus
   v) Baltimore classification
   vi) Infectious monoleusis

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M.Sc. Examination, 2019
Semester-II
Biotechnology
Course : IX
Computer Application and Biostatistics

302

Time : 3 Hours

Full Marks : 40

**Questions are of value as indicated in the margin.**

## Group - A

Answer **any two** questions

1. What do you mean by escape sequence in C-Programming? Write down the differences between While and Do-While loop in C-Programming with suitable example. What is array? 2+6+2=10

2. Write down the differences between Structure and Union with suitable example. Write down the meaning of strcpy(), strlen(), strcmp() functions in C. Write a programme to swap two numbers without using third variable. 4+3+3=10

3. What is DBMS? Give examples of three aggregate functions in SQL. Write down the INSERT command and DELETE command of SWK. What is PERL and CGI? 2+3+2+3=10

## Group – B

Answer **any two** questions

1. What do you mean by data? How do primary data differ from secondary data? Give proper example. What is descriptive statistics? Mention the different statistical parameters of descriptive statistics. How does SE differ from SD? 1+1+1+1+4+2=10

2. What is "R" language? What are its advantages over "Excel"? How are correlations related to regression? What is the significance of SS? Diagrammatically plot the relationship between two variables when they are (i) Positively correlated (ii) Negatively correlated (iii) No Correlation. 1+2+2+2+3=10

3. What is the purpose of chi-square test? In a typical Mendelian experiment a Tall pea plant with Red flower was crossed with a Dwarf plant with White flower. The F1 plants generated were all Tall plants with Red flower. The F1 plants were crossed with the parental plant (Dwarf with Red flower). The generated progeny showed a population of 35 Tall plants with Red flower, 39 Tall plants with white flower, 29 dwarf plants with white flower and 30 dwarf plants with white flower. Comment on the inheritance pattern of genes associated with plant height and flower colour. Comment on the inheritance pattern of genes associated with plant height and flower. (chi-square Table value at p = 0.05 is 7.82 for df. 2+8=10

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# MSc. Semester-II Examination - 2019
## Biotechnology
## Paper X - (Practical)
## (Microbiology, Immunology, Virology, Biostatistics)

**Full Marks: 80** **Time: 6 h + 6 h (2 days)**

1. Perform sandwich ELISA with the test samples (S1, S2, S3), and measure in an ELISA reader. Prepare a standard curve with the given standards, and determine the concentration of the samples. Write down the principle of the assay.

20+5=25

2. Human herpes viruses, like EBV infects the B cell and epithelial cell followed by integration of viral genome into host chromosome, a state called latency. Design a detail protocol to detect viral gene in the latent state. Explain why two types of agar used in the phase assay. What is PFU? Why it is called a 'unit'? Experimentally Determine PFU from the given sample. Calculate what will be the PFU of 1 ml phage stock.

5+2+ 2+1+7+3=20

4. Calculate mean, mode and median of leaf length and breadth from the two supplied twig (S-1 and S-2).

   Find out whether any relationship is present between the leaf length and breadth of the supplied twigs (S-1 and S-2) using R programme.

Or,

Find out whether the leaf length of S-1 is really differ from S-2 or not. Establish your results with proper statistical test.

Or,

Find out whether the leaf breadth of S-1 is really differ from S-2 or not. Establish your results with proper statistical test.

Or,

Find out whether the leaf length of S-1 is really differ 3.5 or not. Establish your results with proper statistical test.

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5. Submit the lab note books (4 nos.) 10

6. Viva-voce 10

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M.Sc. Semester II Examination (2022)
Biotechnology
Course/Paper – VI (Microbiology)

**Time: 3 Hours** **Full Marks: 40**

*Questions are of value as indicated in the margin*

Answer **any four** questions

1. a) What are the main features of the subclass, Basidiomycota? What are the economic importances of these groups of organisms?
   b) Describe some of the unique features of *Dictyostelium* spp. (2+3) +5 = 10

2. What are the basic differences between purple sulfur bacteria and purple non-sulphur bacteria? How do purple bacteria differ from green bacteria? What are the basic differences between bacterial photosynthesis and photosynthesis in a higher group of plants? Give a brief account of photosynthetic prokaryotes with special reference to photosynthetic machineries and pigment systems. Briefly describe the role of Nif and Nod factors in symbiotic nitrogen fixation of Bacterial system. 2+2+1+2+3=10

3. a) What are the main types of archaebacteria? Why one particular type is high salt tolerant while the other type is heat tolerant?
   b) What is pathogenesis? Briefly discuss the parasitic strategies for transmission and establishment with suitable examples 1.5+2+ (1.5+5) =10

4. Discus the different Methods of measuring bacterial growth in a batch culture. Describe the Helmstetter-Cummings method for obtaining synchronous culture of bacteria for a long time. What is diauxic growth? 4+4+2=10

5. a) Why Carl Woese used 16S rRNA gene as "Chronometer" for classifying the three domains of living system?
   b) What is Bergey's manual?
   c) State two important differences between Archaea and Bacteria.
   d) State the three purposes of fixation before staining of microbial cells.
   e) State in bulleted form two advantages and uses of ribotyping method.
   2+1.5+1+1.5+ (2+2) =10

6. Write short notes on any four of the following: 2.5 X 4=10
   a) ATP synthesis in anaerobic condition by Halobacterium sp.
   b) Mode of action of sulfa-drugs as antibacterial agents.
   c) Antifungal antibiotic
   d) Exotoxins
   e) Endemic, Epidemic and Pandemic
   f) Antibiotic grouping by mechanism

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**M.Sc. Semester II Examination (2022)**
**Biotechnology**
**Course/Paper – VII (Immunology)**

**Time: 3 Hours** **Full Marks: 40**

*Questions are of value as indicated in the margin*

Answer **any four** questions

1. With proper diagram describe the ultra-structure of any secondary lymphoid organ/tissue. Mention the functional significance of different internal zones of the organ/tissue you described. What is Common lymphoid progenitor?

5+4+1=10

2. a) What was the immunological 'puzzle' solved by Tonegawa and his coworkers based on their classic experimental results published in 1976? Schematically explain how they solved it.

b) Explain Receptor editing mechanism.

(2+4)+4=10

3. a) Why are the complements named so? Explain Jules Bordet's experimental strategy and findings to discover the complements.

b) TLR function bridges between innate and adaptive immunity – Justify.

(1+4)+5=10

4. a) Distinguish with example between recombinant- and DNA vaccination strategies. What is toxoid?

b) How are the antigens processed in the cytosolic pathway? What are the roles of CD4 and CD8 costimulatory molecules?

(4+1)+(3+2)=10

5. Elucidate the general properties of cytokines. With appropriate diagram and example explain the classification scheme of chemokines. What is lymphocyte homing?

5+4+1=10

6. Write Short note on *any four* of the followings.

2½×4=10

a) Opsonization
b) 12/23 rule
c) Thymic selection
d) Structure of Class-I MHC
e) PAMP
f) Ig domain

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**M.Sc. Semester II Examination (2022)**
**Biotechnology**
**Course/Paper – VIII (Virology)**

**Time: 3 Hours** **Full Marks: 40**

*Questions are of value as indicated in the margin.*

Answer question no. **1** and ***any three*** from the rest.

1. Answer any five questions: 5X2=10
   a) Show with example the structural symmetry of viruses.
   b) Would a person who has never been in contact with the varicella-zoster virus be at risk of developing chickenpox or shingles if they come in close contact with a person with shingles? Explain your reasoning.
   c) A 44-year-old CMV antibody negative man is given a lung transplant from a CMV antibody positive donor. Comment on it with explanation.
   d) Describe Zika Virus.
   e) Plant viral disease transmission.
   f) It was observed that the radius of an approximately circular plaque of infected cells grew to 1.45 mm in just 3 days. They measured the distance between adjacent cells to be 0.037 mm to obtain the apparent time for the lytic cycle (from infection to lysis). They compared this time to the actual rate at which new virions are formed: 5 to 6 hours. Predict the radius of infection if the infection process involved a sequence of entry, replication, lysis, and infection of an adjacent cell.
   g) Which step in the replication cycle of viruses do you think is most critical for the virus to infect cells? Explain why
   h) All DNA viruses must replicate in the nucleus and all RNA virus must replicate in cytoplasm. Explain whether the statement is true or false.

2. Explain with Justification (any four): 2.5×4=10
   a) Interferon acts as an anti-viral drug.
   b) Fluorouracil is a pro-drug.
   c) Antiviral not work during latency
   d) EBV can cause different disease depending on condition
   e) Acyclovir is a broad-spectrum antiviral but Cidofovir not
   f) HAART - Highly active antiretroviral therapy

3. Define and classify Human herpesvirus. Describe the properties of human herpes viruses Compare different human herpes virus with example. 3+2+5=10

4. a) Explain Acute and Persistent infection with example.
   b) Describe the basic structure of Influenza virus? Define the role of Haemagglutinin and Neuraminidase. Define antigenic shift and Antigenic drift with example?
   c) Compare between the different viruses which directly causes Hepatic infections
   2+(1+1+2) + 4 = 10

5. What are the classical symptoms of plant viral infections? Describe life cycle of a typical plant virus with proper diagram. Describe viral penetration and intracellular migration in plant viral invasion. 2+4+4=10

6. Short Notes (any four): 2.5×2=10
   a) Baltimore classification
   b) Zoonosis
   c) Viroids
   d) Nuclear Entry to virus
   e) Prions
   f) Blue tongue virus

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**M.Sc. Semester II Examination (2022)**
**Biotechnology**
**Course/Paper – IX (Computer Application and Biostatistics)**

**Time: 3 Hours** **Full Marks: 40**

Questions are of value as indicated in the margin

## Group–A

**Answer any two questions**

1. A) Write a C Program to convert Celsius to Fahrenheit.
   B) What is an array ? 8+2=10

2. A) Write a C Program to check a given integer is Prime Number or not.
   B) What are the basic data types associated with C ? 7+3=10

3. A) Create your homepage using HTML. It should contain link to favourite sites and image of the owner of the homepage (Assume image is available in the same directory.).
   B) Create a table using HTML containing two rows and two columns. 7+3=10

4. A) Write a JavaScript to find the maximum of three given integers.
   B) Write a C-program to find the variance of a given set of numbers. 4+6=10

## Group–B

**Answer any two questions**

1. A) What do you mean by statistical hypothesis testing? Define null and alternate hypothesis.
   B) Mention the aim and utility of ANOVA test. Define 2-way-ANOVA.
   C) How correlation differs from regression? Which statistical expression is indicatedby $R^2$ value in regression analysis?
   3+4+3=10

2. A) What is "paired t test"? What is the parameter by which one can decide whether the t test will "paired t test" or "non-paired t test"?
   B) What is the utility of "one sample Z test"? Define the phenomenon "5% level of probability" for rejection of a null hypothesis in "Z test"
   5+5=10

3. A) Define "sum rule" and "product rule" in probability. How can you apply both the rules at the same time in a Mendelian dihybrid cross?
   B) What will be the probability of different kinds of gametes produced by the $F_1$ plants generated from a cross between a pure strain of tall pea plant with a pure strain of dwarf pea plant?
   8+2=10

4. A) What is the utility of Chi square test?

   B) In a typical Mendelian experiment, a Tall pea plant with Red flower was crossed with a Dwarf pea plant with White flower.The $F_1$ plants generated were all Tall plants with Red flower. The $F_1$ plants were crossed with the parental plant (Dwarf with white flower). The generated progeny showed a population of 35 Tall plants with Red flower, 39 Tall plants with white flower, 29 dwarf plants with red flower and 30 dwarf plants with white flower. Comment on the inheritance pattern of the genes associated with plant height and flower colour. (chi square value at 5% level for df 3 is 7.82)
   2+8=10

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**M.Sc. Semester-II Examination - 2022**
**Biotechnology**
**Paper X - (Practical)**
**(Microbiology, Immunology, Virology, Biostatistics)**

**Time: 6 h + 6 h (2 days)** **Full Marks: 80**

1. Solve the following problems with proper computer programme.

a) In supplied plant sample (S-I), there are two different types of leaf. One set of leaf was collected before application of insecticide and another set of leaf is collected after application. Is there any significant difference in leaf length between the two leaf samples. Justify your answer with proper statistical test and briefly describe your remark.

b) In supplied plant sample (S-II), there are two different types of leaf from two different plants. Is there any significant difference in leaf length between these two leaf samples. Justify your answer with proper statistical test and briefly describe your remark.

c) In supplied plant sample (S-III), there are three different types of leaf. Are there significant amount of variation present in the studied sample. Justify your answer with proper statistical test and briefly describe your remark.

5+5+5=15

2. Dissect the supplied sample (S-IV) and identify the cyanobacterial sample present. Draw rough diagram, describe and identify the cyanobacterial species.

3+3+1½ =7½

3.a) You are being provided with a bacterial culture. Using Gram's staining, identify the culture as Gram positive or Gram negative. Mention the identifier of the culture provided to you.

b) What is the basis of this protocol?

5+2½=7½

4. Write the working principle of plaque assay. Prepare a hard agar plate. Prepare the soft agar and perform the phage assay from the given sample. Count the colonies from the phage plate. Comment on your result.

3+3+5+3+1=15

5. Estimate the specific protein concentration (IL-10) from the given sample (any one out of C1, C2, C3, C4 & C5) by performing sandwich ELISA. Show the calculation of the serial dilution of the standards, plot the standard curve with your readings and write down the estimation procedure.

8+4+3=15

6. Viva-voce. 10

7. Submit your laboratory note books. 10

6/9/22 6/9/2022 6/9/2022

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**M.Sc. Examination 2023**
**Semester II**
**Biotechnology**
**Paper VI: Microbiology**

**Time: 3 hrs** **Full Marks: 40**

**Questions are of value as indicated in the margin.**

Answer *any four* of the following questions

1. (a) Draw the structure of any algal cell and label its important organelles.
   (b) Assume you have isolated a single-celled organism that has a cell wall. How would you determine that it is a fungus and not a bacterium?

   5+5=10

2. (a) Write different methods of measuring microbial growth.
   (a) The population of bacteria grows according to the function $f(t) = 200\ e^{0.2t}$. How many bacteria are present in the population after 300 min of incubation in the same environment? When will the population reach $10^5$ numbers?

   5+(3+2)=10

3. (a) Define selective and differential media with an example of each.
   (b) Write the method of DGGE.

   (2.5+2.5)+5=10

4. (a) Explain the structured growth model of a microorganism.
   (b) Explain the principle of anoxygenic photosynthesis process.

   5+5=10

5. (a) What do you understand by microbial strain improvement? What are the basic methodologies used by scientists to improve different strains?
   (b) The following data correspond to the exponential phase of growth of three bacterial species using glucose as a carbon source:

| Specie A | | Specie B | | Specie C | |
|---|---|---|---|---|---|
| Time (h) | Log N | Time (h) | Log N | Time (h) | Log N |
| 4 | 4.64 | 3 | 5.30 | 5 | 6.22 |
| 5 | 4.81 | 4 | 5.44 | 6 | 6.37 |
| 6 | 4.98 | 5 | 5.58 | 7 | 6.52 |
| 7 | 5.15 | 6 | 5.72 | 8 | 6.67 |
| 8 | 5.32 | 7 | 5.86 | 9 | 6.82 |

Indicate which of these species grows faster. Explain your answer.

(1+4)+5=10

6. (a) What are infectious diseases? Describe the major modes of transmission.
   (b) What are kinetoplastid parasites? What are the symptoms of three different types of Leishmaniasis?

(1+4)+(2+3)=10

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**M.Sc. Examination 2023**
**Semester II**
**Biotechnology**
**Paper VII: Immunology**

**Time: 3 hrs** **Full Marks: 40**

**Questions are of value as indicated in the margin.**

Answer *any four* of the following questions

1. What do you mean by immunodiagnostic techniques? Distinguish between ELISA and Dot ELISA. "Western blotting followed by immunodetection is more informative diagnostic tool than ELISA" – Why?

2+6+2=10

2. Explain the experimental strategy of Tonegawa to reveal the immunoglobulin gene recombination. What are the salient differences in Ig Heavy chain and Light chain recombination?

5+5=10

3. Why are the Professional Antigen Presenting Cells called so? Illustrate the role of different chaperone proteins in endogenous and exogenous antigen processing. What is the role of TAP1/TAP2?

2+6+2=10

4. What are TLRs? How did they derive their names? TLRs are the functional bridges between innate and adaptive immune responses – Explain with suitable schematic diagram.

1+2+7=10

5. What are the functions of co-stimulatory molecules? "CD4 and CD8 molecules determine the functional distinctions of the T cells" – Justify.

5+5=10

6. Write short note on *any four* of the following:

2½×4=10

a) Anaphylatoxin
b) $C1qr_2s_2$ complex
c) Structure of TCR
d) NK cells
e) Ig superfamily
f) Sandwich ELISA

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**M.Sc. Examination 2023**
**Semester II**
**Biotechnology**
**Paper VIII: Virology**

**Time: Three Hours** **Full Marks: 40**

Questions are of value as indicated in the margin.

Answer question number 1 and any **three** from the rest.

1. Answer *any five* of the following: 5×2=10

(a) Compare the lytic and lysogenic reproductive cycles of viruses. Provide reasoning to make a case for which cycle has the potential to produce the most virions.

(b) Protection against influenza A virus in a non-immune individual can be achieved through the administration of a drug that interferes with Viral adsorption and penetration. State whether it is true or false with explanation.

(c) Viruses can be separated into capsid proteins and nucleic acid. When placed back together, these two parts will self-assemble into new infectious virus particles. You purify the NUCLEIC ACID FROM TOMATO mosaic virus and the PROTEIN FROM BEAN mosaic virus. Then you combine these two parts, and they self- assemble into infectious viruses. What happen when these newly assembled (hybrid) viruses are rubbed (with an abrasive) onto BEAN LEAVES?

(d) What is the difference between reproduction of ssDNA and dsDNA viruses?

(e) Influenza A viral replication, as a process is regulated by either positive or negative feedback. Justify

(e) How did the development of a porcelain filter, called the Chamberland-Pasteur filter, help scientists discover viruses?

(f) Why do retroviruses convert their RNA genome to DNA (using reverse transcriptase) and then transcribe it back to viral RNA (and translate that into viral proteins)?

(g) Since viral infection leads to more viral particles, explain why the "growth curve" for viruses is stepped rather than smooth (as encountered in bacterial growth).

2. Describe the unclassified biological agents in animal virology. Define viroid. Describe the replication process of viroid. Compare viroid with plant virus. Compare modes of transmission of viruses in plants and animals.

3+1+2+2+2=10

3. What should be the key characteristics of antiviral drugs? Classify the antiviral drugs with examples. Describe HAART. Antivirals target at every phase of viral infection cycle--describe the statement with justification. 2+3+2+3=10

4. Define a plant virus. What are the classical symptoms of plant viral infections? Describe life cycle of TMV with proper diagram. Describe viral penetration and intracellular migration during plant viral invasion. 1+2+3+4=10

5. Why are virus particles formed? Explain self-assembly. Give examples and describe the major shapes of nucleocapsids and viruses. What are the advantages, if any, of each shape? What is the importance of viral envelopes? Explain with diagram the strategies of viral replication in host cells with example. How does virus exit cell?

1+1+2+1+1+3+1=10

6. Short Notes (**any four**) 2.5×4=10

(a) Blue tongue virus

(b) Viral diagnostics

(c) Valacyclovir

(d) Zika Virus

(e) Zoonosis

(f) Latency of Herpes virus

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**M.Sc. Examination 2023**
**Semester-II**
**Biotechnology**
**Paper IX: Computer Applications and Biostatistics**

**Time: 3 hours** **Full Marks: 40**

**Questions are of values as indicated in the margin**

## Group-A
### Answer any two questions

1. a) Design a HTML page to show your 'CV'. The CV should contain name, address, Phone no, email address, academic records in tabular format etc.
b) Write a JavaScript program to find the HCF of any two positive integers given at runtime.

5+5=10

2. a) Write a C program to find the maximum and mean of a set of integers given at runtime.
b) Write a JavaScript program to print Fibonacci series. [Formula: Fn = F n-1 + F n-2, Where F0=0 and F1=1]

5+5=10

3. a) How many heading tags are there in HTML?
b) Which HTML tag is used to separate sections of text?
c) Write a C for addition and multiplication of two complex numbers.

2+2+6=10

## Group–B
### Answer any two questions

1. a) What is the exact utility of Null hypothesis in Statistical hypothesis testing?
b) What are MSB and MSW in ANOVA test? Define with an example.
c) What parameter (s) determine whether an ANOVA will be one way or two way? Define with example.
d) Which statistical expression is indicated by $R^2$ in regression analysis?

2+3+3+2=10

2.a) What is "one sample Z test"? What is the utility of this test? What are the parameters by which one can decide whether a t test will be "pair t test" or "unpair t test"?
b) What is degree of freedom (df)? Define the two types of df considered for ANOVA?
c) What is the concept of "0.05 level of significance" in statistical analysis?

(1.5+1.5+2)+(1+2)+2=10

3. a) In Mendelian monohybrid experiment both the "sum rule" and "product rule" of probability are equally contributed. Define the phenomenon with proper diagrammatic presentation.
b) What is the utility of Chi square test?
c) In a typical Mendelian experiment, a tall pea plant was crossed with a dwarf pea plant and all the $F_1$ plants generated were tall. The $F_1$ plants were self-crossed which generate 63 Tall and 67 dwarf plants. Comment on the inheritance pattern of the trait with proper line drawing. (Table value of $x^2$ at 5% level for df 1 is 3.84)

4+2+4=10

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**M.Sc. Semester-II Examination-2023**

**Biotechnology**

**Paper-X (Practical)**

**Time: 6h + 6h (2 days)** **Full marks: 80**

1. Prepare a blood film on a glass slide, stain it appropriately, identify and show any two immunocytes under light microscope after focussing it properly. Write down the staining method. Draw the immunocytes you identified. Write down the identifying characters of those two immunocytes.

7+2+2+4=15

2. Draw the following growth curves for microorganism X, starting with 100 cells with a generation time of 30 min at 35°C, 60 min at 20°C and 3hrs at 5°C.

a. The cells are incubated for 5 hrs at 35°C 3

b. After 5 hrs the temperature changed to 20°C for 2 hrs 3

c. After 5 hrs at 35°C, the temperature is changed to 5°C for 2 hrs. followed by 35 °C for 5 hrs.

2+2=4

3. Identify the Cyanobacteria present in the supplied sample (CB-1). Describe, draw and identify the cyanobacteria present in the supplied sample. 2+2+1 = 5

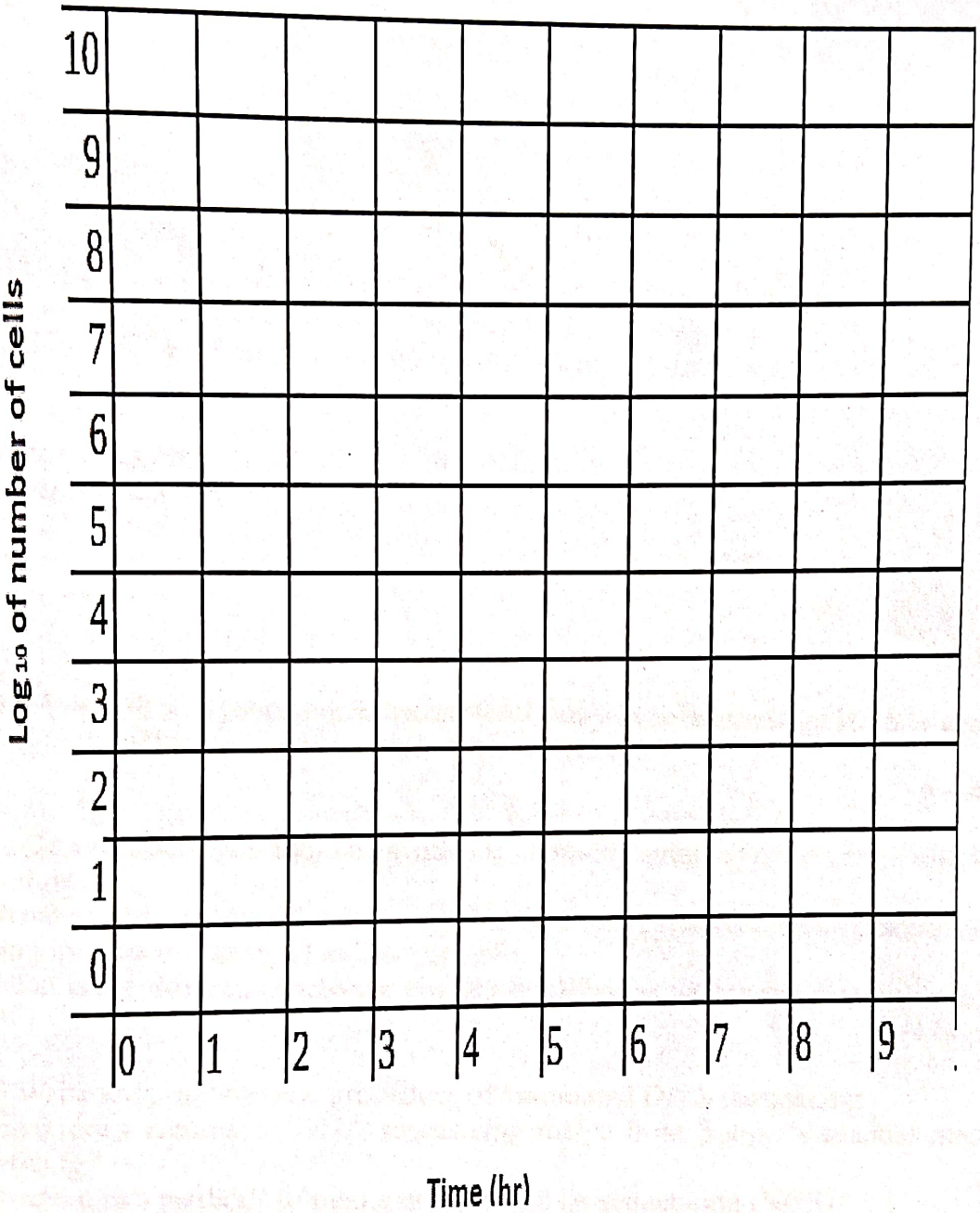
4. Measure the leaf dimension (LL & LB) from the supplied plant sample (PT-1). Is there any relationship between LL & LB. Also test whether LL statistically differed from LB or not using proper statistical test. 2+8=10

5. Measure the seed length (SL) of three different sets of seed mixed within the supplied tube (PT-2). Statistically test whether SL of 3 seeds really differ from each other or not. Also test which pair of seed set show maximum difference for SL based on proper statistical software.

6+4=10

6. Viva-Vove 20

7. Submit your laboratory note books 10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Time (hr)

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**M. Sc. Examination 2024**

**Biotechnology**

**Semester – II**

**Paper – VI (Microbiology)**

Time: 3 hours Full Marks 40

Answer *any four* questions.

1. (a) Compare Archaea with bacteria and eukaryotes

(b) Elaborate the application of Archaea as extremophiles.

**[6+4=10]**

2 (a) Describe different phases of microbial growth in a batch culture. Explain how growth yield and growth rate can be determined. How do environmental factors like temperature and pH influence microbial growth?

(b) Differentiate between synchronous and continuous culture. What is the significance of culture collections? Discuss the methods employed for the preservation of microbial cultures. **[(1.5+1.5+2)+(2+1+2)=10]**

3. (a) Discuss the significance of Bergey's Manual in microbial classification. How was the concept of microbial taxonomy evolved from classical to modern methods? Briefly explain the role of 16S rRNA gene sequencing in this evolution.

(b) Explain the principle of Ribotyping and its application in microbial identification. How does DGGE aid in the analysis of microbial diversity in environmental samples?

**[5+( 3+2) =10]**

4. (a) Compare and contrast the photosynthetic pigments bacteriochlorophylls and plant chlorophylls. Explain the roles of carotenoids and phycobillins in photosynthesis. How do these pigments contribute to the diversity of photosynthetic prokaryotes?

(b) Describe the process of nitrogen fixation in prokaryotes. What is the significance of *nif* genes in this process? **[(1.5+1.5+2)+(2+3)=10]**

5. (a) Describe the streak plate method of obtaining a pure culture. How does a pour plate method differ from the streak plate method?

(b) A chemostat is inoculated with a pure culture of Escherichia coli. The inlet nutrient concentration (S0) is 20 g/L, the flow rate (F) is 1 L/h, and the reactor volume (V) is 2 L. The maximum specific growth rate (μmax) of E. coli is 1.2 $h^{-1}$, and the substrate saturation constant (Ks) is 0.5 g/L.

Complicating factors:

* The system operates in a dynamic state with varying inlet nutrient concentrations due to an upstream process. The inlet nutrient concentration can be described by the following function:

* $S0(t) = 20 + 5\sin(\pi t/12)$ g/L, where t is time in hours.

* The microbial growth is inhibited by a toxic byproduct, acetate, produced during growth. The specific growth rate is reduced according to the following equation:

* $\mu = \mu max * S / (Ks + S) * (1 - P/Ki)$, where P is the acetate concentration (g/L) and Ki is the inhibition constant equal to 2 g/L.

* Acetate is produced with a yield coefficient of $Yp/x = 0.1$ g acetate/g biomass.

Develop a mathematical model describing the dynamics of substrate, biomass, and acetate concentrations in the chemostat.

**[(3+2)+5=10]**

6. Define Epidemic, Pandemic and Endemic with examples. Distinguish between Infectivity and Virulence of a pathogen. Describe the general steps of TLR mediated immune responses against bacteria and viruses.

**[3+2+5=10]**

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**M.Sc. Sem II Examination – 2024**
**Biotechnology**
**Paper VII**
**(Immunology)**

**Time: 3 hours** **FM: 40**

Answer *any four* of the followings

1. Explain Tiselius and Kabat's experiment that established Immunoglobulins as antibodies. What are Primary and Secondary immune response? Describe the internal structure and function of lymph nodes.

4+2+4=10

2. How are the natural antibodies important in innate immune mechanism? Classify PRRs with example. What are DAMPs?

3+6+1=10

3. What do you mean by lymphocyte maturation and activation? How is T-cell maturation significant for central tolerance? Explain deletional and inversional joining with schematic diagram during somatic recombination. What is receptor editing?

2+2+4+2=10

4. (a) Compare Classical and MBL pathways of complement activation.
(b) Mention the general properties of cytokines. What is cytokine storm?

3+(5+2)=10

5. Elucidate the salient features of MHC genes. Compare Class-I and Class-II MHC proteins. What is self MHC restriction?

4+4+2=10

6. Write short notes on any four of the following:

2.5×4=10

a) Immunoglobulin superfamily
b) Superantigen
c) Sandwich ELISA
d) Endocytic pathway of antigen presentation
e) Anaphylatoxin
f) Delayed Type Hypersensitivity

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**M.Sc. Examination 2024**

**Biotechnology**

**Semester II**

**Paper -VIII**

**Virology**

**Time: Three Hours** **Full Marks: 40**

Questions are of value as indicated in the margin.

Answer question number 1 and any **three** from the rest.

1. Answer *any five* of the following: 5×2=10

(a) It was observed that the radius of an approximately circular plaque of infected cells grew to 1.45 mm in just 3 days. They measured the distance between adjacent cells to be 0.037 mm to obtain the apparent time for the lytic cycle (from infection to lysis). They compared this time to the actual rate at which new virions are formed: 5 to 6 hours. Predict the radius of infection if the infection process involved a sequence of entry, replication, lysis, and infection of an adjacent cell.

b) Would a person who has never been in contact with the varicella-zoster virus be at risk of developing chickenpox or shingles if they come in close contact with a person with shingles? Explain your reasoning.

c) A 44-year-old CMV antibody negative man is given a lung transplant from a CMV antibody positive donor. Comment on it with explanation.

(d) Viruses can be separated into capsid proteins and nucleic acid. When placed back together, these two parts will self-assemble into new infectious virus particles. Purify the NUCLEIC ACID FROM TOMATO mosaic virus and the PROTEIN FROM BEAN mosaic virus. Then combine these two parts, and they self- assemble into infectious viruses. What happens when these newly assembled (hybrid) viruses are rubbed (with an abrasive) onto BEAN LEAVES.

e) Which step in the replication cycle of viruses do you think is most critical for the virus to infect cells? Explain why.

f) How do ssDNA and dsDNA viruses replicate?

(g) The promoters for mRNA encoding early proteins in viruses like T4 have a different sequence than the promoters for mRNA encoding late proteins in the same virus. Explain how does this benefit the virus.

2. Explain with Justification (*any four*): 2.5×4=10

a) Interferon acts as an anti-viral drug.

b) Dogs and cats are not infected by human colds.

c) Antiviral does not work during latency.

d) EBV can cause different disease depending on condition.

e) Ribavirin is a pro-drug.

f) HAART Highly active antiretroviral therapy.

g) Viral Envelope is essential for infection.

3. Define and classify Human herpesvirus. Describe the properties of human herpes viruses Compare different human herpes virus with example. 3+2+5=10

4. a) Describe Acute and Persistent infection with example.

b) Elucidate the basic structure of Influenza virus. Define the role of Haemagglutinin and Neuraminidase. Define antigenic shift and Antigenic drift with example.

c) Compare different viruses and unclassified agents which directly cause hepatic infections

2+(1+1+2) + 4= 10

5. What are the classical symptoms of plant viral infections? Describe life cycle of a typical plant virus with proper diagram. Describe viral penetration and intracellular migration in plant viral invasion. 2+4+4=10

6. Write Short Notes on *any four*: 2.5×4=10

(a) Blue tongue virus

(b) Rinderpest

(c) PPR

(d) Viroid

(e) Ebola virus

(f) Baltimore Classification of Virus

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**M.Sc. Examination 2024**

**Semester-II**

**Biotechnology**

**Paper-IX**

**Computer Applications and Biostatistics**

**Time: 3 hours** **Full Marks: 40**

**Questions are of values as indicated in the margin**

## Group-A

**Answer any two questions**

1. a) Explain the relationship between HTML, CSS, and JavaScript in web development.
   b) Describe the different methods of linking CSS and JavaScript files to an HTML document.
   c) Write a code snippet that includes a form with input fields for username and password, along with a submit button.

   2+3+5=10

2. a) Write a C program to find the sum of an AP series.
   b) Write a JavaScript to find factorial of a number.
   c) What is the use of <br> tag in HTML?

   4+5+1=10

3. a) Explain alert(), confirm() and prompt() method of JavaScript window object.
   b) Write a C program for multiplication of two complex numbers (Complex numbers are numbers of the form "a+ib" where a is the real part and b is imaginary part of the complex number and $i=\sqrt{-1}$). Also, print the multiplied output.

   5+5=10

## Group–B

**Answer any two questions**

1. Provide a description on purpose (with supporting examples) for the following statistical tests: 2.5X4 =10

a. Descriptive statistics
b. Paired t-test
c. Non-parametric test
d. Chi-square test

2 (a) What is the purpose of two sample Z test? How do you determine whether a one-sample or two-sample Z test has to be performed based on the structure of the data? Discuss with an arbitrary sample data.

2+3=5

(b) What are the conditions of the events for applying the sum rule and product rule in probability? Based on the concept of probability find out the following:
Probability of different types of gametes from a $F_2$ hybrid of Mendelian dihybrid pea plants.
Probability of different genotypes and phenotypes generated from Mendelian Monohybrid and Dihybrid crosses.

2+1+2=5

3(a) What is the purpose of ANOVA and regression? What are the additional advantages of 2-way ANOVA over 1-way ANOVA?

3+2=5

(b) What is the correlation coefficient? How is regression related to correlation? What are the different statistical parameters expressed by multiple R and regression line in regression analysis?

1+1+3=5

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M.Sc. Examination 2024
Semester-II
Biotechnology

paper-X

Full marks-80 Time-6 hrs.

**Laboratory – II (Microbiology, Immunology, Virology and Biostatistics)**

1. Perform Gram staining of the supplied sample, observe under the microscope, write the procedure and comment on the microbes observed by you 6+5+4=15

2. a) Prepare a slide blood film, fix and stain it appropriately, show and identify any two immunocytes under microscope. Draw the microscopic field to show the position where those immunocytes were located. Draw enlarged representative diagrams (BnW pencil sketch) of the immunocytes you identified and label them. Write down the identifying characters of those cells.

b) Calculate the specific antibody titer of 4 different hypothetical serum samples (S1, S2, S3, S4) from their OD values found after performing an indirect ELISA, as mentioned in the table provided additionally. Draw appropriate graph to calculate the titer, show the detailed calculation, and comment on your results.
(5+1+2+2) +5=15

3. Write down the principle and procedure of the Plaque Assay experiment. Perform the experiment with the given samples (V1-V12). Calculate the CFU from this experiment by counting the plaques appropriately.
5+5+5=15

4. Solve the following statistical problem with two computer programs (Excel and R) and write your comment based on statistical analysis. Mention the output of both the analyses in exam copy 5+5+5=15

Distribution of questions with samples:

Q.4(a)/Sample-I ------- Roll No. Biot 01, Biot 04, Biot 10
Q.4(b)/Sample-II -------Roll No. Biot 02, Biot 05, Biot 08
Q.4(c)/Sample-III -------Roll No. Biot 03, Biot 06, Biot 09
Q.4(d)/Sample-IV -------Roll No. Biot 07, Biot 11

4(a). In the supplied plant sample (S-I), there are two different types of leaves. One set (L-1) of leaf was collected before application of plant growth hormone and the second set (L-2) was collected after application. Is there any significant difference in leaf length between the two leaf samples? Justify your answer with a proper statistical test and briefly describe your remark.

4(b). In the supplied plant sample (S-II), there are two different types of leaf from two different plants. Is there any significant difference in leaf length between these two leaf samples? Justify your answer with a proper statistical test and briefly describe your remark.

4(c). In the supplied plant sample (S-III), there are three different types of leaves. Is there a significant amount of variation for leaf dimension available in the studied sample? Justify your answer with a proper statistical test and briefly describe your remark.

4(d). In the supplied plant sample (S-IV), there are 30 leaves. Find out the descriptive statistics of leaf dimensions. Comment on the relationship between leaf length and breadth. Justify your answer with proper statistical test and briefly describe your remark.

5. Viva voce (15)

6. Practical records (5)