



WEST BENGAL STATE UNIVERSITY
B.Sc. Major 5th Semester Examination, 2025-26

MCBDSC508T-MICROBIOLOGY (MAJOR)

Time Allotted: 2 Hours

Full Marks: 50

*The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.*

Question Number 1 is compulsory. Answer any four questions from the rest

1. Answer any **five** questions from the following: 2×5 = 10
 - (a) What is the frameshift infidelity of DNA polymerase?
 - (b) What is plasmid incompatibility?
 - (c) Differentiate between reversion and suppression.
 - (d) What is meant by intrastrand crosslink damage in DNA?
 - (e) What are mutator genes?
 - (f) What is plasmid curing? Name an agent used for plasmid curing.
 - (g) Mention any two uses of transposons.
 - (h) What is Weigle reactivation?
2. (a) What are the three major Nucleotide Excision Repair (NER) genes in *E.coli*? (3+3)+
Briefly describe their functions. (1+1+1+1)
 - (b) Define:
 - (i) Missense mutation
 - (ii) Non sense mutation
 - (iii) Point mutation
 - (iv) Null mutation
3. (a) What is recombination repair? State the different types of this repair system. (2+3+1)
What is DSGR? +4
 - (b) Explain the results of the experiment performed by Luria and Delbrück.
4. (a) What is a self-transmissible plasmid? Differentiate it from a mobilizable one. (2+2)+2
+(2+2)
 - (b) Why are F⁺ cells unable to pair with another F⁺ cell for conjugation?
 - (c) How F' factors are created? Explain its role in recombination.
5. (a) What are competence factors? 2+4+2+2
 - (b) Regulation of competence generation is a two-component regulatory system. Explain the statement.

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- (c) In a competent culture of naturally transformable bacteria, only a fraction of cells can uptake environmental DNA. State the reason behind it.
- (d) What is the relation between co-transduction frequency and gene distance?
6. (a) What are LFT and HFT lysates? 3+3+4
 - (b) Differentiate between Composite and Non-composite transposons.
 - (c) How can you experimentally prove that one strand of the DNA enters the recipient bacteria during transformation?
7. (a) Explain the formation of Hfr strains and their significance in bacterial gene mapping. 4+4+2
 - (b) How λ dgal and λ pgal are different functionally?
 - (c) "Lysogeny is a better survival strategy for a bacteriophage when MOI is high". Is the statement correct? Justify your answer.
8. (a) Bacterial cells of genotype $\text{pur}^- \text{pro}^+ \text{his}^+$ were transduced with P1 phage grown on bacteria of genotype $\text{pur}^- \text{pro}^- \text{his}^-$. pur^+ transductants were selected and tested for pro and his markers. pur^+ colonies were analysed as $\text{pro}^+ \text{his}^+—102$, $\text{pro}^+ \text{his}^-—25$, $\text{pro}^- \text{his}^+—160$ and $\text{pro}^- \text{his}^-—1$. What is the gene order? Explain your answer. 3+2+2
+ (1+2)
 - (b) What is a merozygote?
 - (c) What are T₁ plasmids?
 - (d) What are Inverted repeats? Why are they common in most bacterial transposons?





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1. Answer any five questions from the following: 2×5 = 10
 - (a) What is the advantage of targeting reverse transcriptase protein over the surface protein for antiviral drug design against retrovirus?
 - (b) How do anaerobic bacteria supposed to intervene with cancer progression?
 - (c) A true lysogenic phage can never be lytic. So how does their progeny get released from the host?
 - (d) Mention one advantage and one disadvantage of using oncolytic virus in cancer treatment.
 - (e) State the differences between viroids and viruses.
 - (f) What is the basis of prion mediated disease?
 - (g) Which particular attribute of virus has only been considered in ICTV classification?
 - (h) Mention one advantage and one disadvantage of segmented genome in virus.
2. (a) What happens if an *E. coli* cell bearing a λ lysogen is irradiated with UV rays? 2
 - (b) How can you experimentally prove that an *E. coli* cell contains λ lysogen? 2½
 - (c) What is cooperative binding? How does it help lambda repressor to establish lysogeny when M.O.I is greater than 1? 1+2
 - (d) Retroregulation plays an important role in establishing lysogeny in lambda phage, while has no effect on the induction of lambda prophage. Explain. 2½
3. (a) What are the advantages of having subunits in virus capsid? 2
 - (b) Why is icosahedral symmetry preferred over other capsid symmetries? 2
 - (c) What is triangulation number? How many numbers of subunits will be there in an icosahedral capsid if the triangulation number is 9? 1+2
 - (d) Name the smallest virus particle. What do you mean by quasi equivalent packing of viral capsid? 1+2

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4. (a) Mention the special feature of the bacteriophage T4 genome that distinguishes it from its host *E. coli* DNA. How is that featured used by the phage for its own protection from digestion? 2+3
 - (b) State the role of 'N' protein in lambda life cycle. 2
 - (c) What do you understand by the term headful packaging of T4 DNA? 3
5. (a) Suppose you want to isolate bacteriophage against *Vibrio cholerae* from sewage water. What would be the experimental procedure? After isolation of the bacteriophage, how can you determine its burst size? 3+3
 - (b) Both Class I and Class VII virus of Baltimore's classification have dsDNA as their genome. In what context are they separated, then? 2
 - (c) What is the difference between ID₅₀ and LD₅₀ value of viral infection in animal cell? 2
6. (a) Why vaccine development against RNA virus are more difficult than DNA virus? 2
 - (b) How does Amantadine works against Influenza virus? 2
 - (c) How AZT and Acyclovir differ in their mode of action? 2+2
 - (d) How does TAT differ from other transcription factors? 2
7. (a) What will happen if Picorna virus infects a protease mutant host cell? 2
 - (b) Wild type mice can never get infected by Polio virus — Explain. 2
 - (c) Mutation in HA protein leads to a noninfectious influenza virus, while the mutation in NA protein leads to down regulated infection — Justify. 2
 - (d) How can you store and maintain a virus suspension after isolation from a natural source? 2
 - (e) Why certain miRNA can be considered as oncogene? 2
8. (a) State the role of penton fibers in Adenovirus assembly. 2
 - (b) What do you mean by non permissive host of a virus? Why oncovirus cause cancer only in their non permissive host? 1+2
 - (c) How do HBV particles maximize their coding capacity?
 - (d) How many different classes of proto-oncogenes are there? Give one example of each of them.





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Answer Question Number 1 and any four questions from the rest

1. Answer any five questions from the following: 2×5 = 10
 - (a) Cite two important functions of lysosome.
 - (b) What are the structural organization of microtubules?
 - (c) What is the role of nuclear lamina?
 - (d) Differentiate between rough ER and smooth ER.
 - (e) What are the importance of cell cycle check points?
 - (f) What are the functions of adaptor proteins?
 - (g) Mention the role of the Golgi apparatus in protein sorting.
 - (h) Define Cancer. Mention one environmental cause.
2. (a) Describe retrograde and anterograde pathway. (2+2)+3+3
 - (b) Discuss each component of COPI and COPII coated vesicles with their respective functions.
 - (c) What is UPR (Unfolded Protein Response)? Describe the process.
3. (a) Demonstrate how G-protein Coupled Receptors (GPCRs) Signalling regulate glycogen metabolism in higher eukaryotes. 3+2+3+2
 - (b) List a few of the functions of the extracellular matrix in animal tissues.
 - (c) Describe the role of SNARE proteins on the metabolism of vesicle docking and fusion with target membranes.
 - (d) Why is glycosylation considered a quality control mechanism in protein folding in ER?
4. (a) Give four distinct mechanisms by which a CDK can be inactivated. 4+(2+1)+3
 - (b) Describe the process autophagy. What is its importance?
 - (c) How will you differentiate between apoptotic and necrotic cells?
 apoptosis: regulated, active, no inflammation
 necrosis: unregulated, passive, inflammation
5. (a) Explain the structure of the nuclear envelope and its role in nuclear transport. 4+(2+2)+2
 - (b) What are the cell surface protrusions? Give example and their significance.
 - (c) What is the relationship between ECM and integrins?

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6. (a) How do GTP-binding proteins regulate microtubule dynamics? 4+3+3
 - (b) What is the role of condensins in chromatin organization during mitosis?
 - (c) Why are matrix metalloproteinases (MMPs) critical for ECM remodelling?
7. (a) How will you quantify the numbers of insulin receptors on the surface of muscle cells? 3+2+3+2
 - (b) Write two important functions of calcium calmodulin complex in cell signalling.
 - (c) Compare between heterologous and homologous desensitization process.
 - (d) What is apoptosis?
8. (a) What is the function of the peroxisome? 2+2+2+2+2
 - (b) What are cyclic GMP pathways, and why are they important?
 - (c) What is the role of dolichol phosphate in intracellular protein trafficking?
 - (d) What are the functions of SCF and APC in mitosis?
 - (e) Define the functions of GAP and GEF in GPCRs Signalling.
9. (a) What are the roles of Karyopherins, Ran-GTP and FG repeat nucleoporins in nucleo cytoplasmic transport? 3+2+2+3
 - (b) Explain how mutations in p53 contribute to the loss of cell cycle control.
 - (c) How lysosomal proteins are modified in Golgi apparatus?
 - (d) What is the role of CDK inhibitors (CKIs) such as p21 and p27 in cell cycle regulation?

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1. Answer any five questions from the following:
 - (a) What is Spliceosome?
 - (b) Distinguish between Class I and Class II Aminoacyl tRNA Synthetase.
 - (c) What is the significance of Shine Dalgarno sequence?
 - (d) How does unidirectional replication differ from bidirectional replication?
 - (e) What is the overall reaction rate of a bacterial RNA polymerase?
 - (f) Why sliding clamp never get dislodged from DNA any time before the completion of replication?
 - (g) A cell contains genotype $I^S P^+ O^+ Z^+ Y^+$, what will be the product in presence and in absence of Lactose in the medium?
 - (h) How does phosphorylation of CTD of eukaryotic RNA polymerase signals for promoter clearance?
2. (a) How does the proofreading activity of aminoacyl tRNA Synthetase increase the fidelity of protein synthesis? 2+2+2½ + 1+2½
 - (b) What is translocation? Define the step.
 - (c) What is the smallest number of molecules of ATP and GTP consumed in the synthesis of a 200 residue protein? Assume that the hydrolysis of PPI is equivalent to the hydrolysis of ATP for this calculations.
 - (d) What is ribozyme?
 - (e) How can you experimentally prove that the 50S subunit of a ribosome has three binding sites for tRNA?
3. (a) How effector molecules and regulatory proteins control lac operon? 2+2+2+(2+2)
 - (b) Why is glucose a catabolic repressor?
 - (c) How does AraC protein act both as activator as well as inhibitor of BAD operon?
 - (d) Suppose you have prepared a mutant *E. coli* having a nonsense mutation in trp E gene (not near the 3' end). State whether the level of tryptophan synthetase will increase/decrease with compare to the wild type strain both in presence and absence of tryptophan in the media. Explain your answer.

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4. (a) What is CpG island? State its significance in gene silencing. (2+2)+3+1+2
 - (b) Schematically represent the EFTu-EFTs cycling.
 - (c) Both RF1 and RF2 binds with STOP codons to terminate protein synthesis but both the factors cannot bind at a time. Which factor makes the selection between RF1 and RF2?
 - (d) Translation is usually initiated at an AUG codon near the 5' end of an mRNA, but mRNAs often have multiple AUG triplets near their 5' ends. How does ribosome find out the first AUG codon for initiation of protein synthesis in eukaryotes?
5. (a) How can you experimentally locate the oriC of a DNA?
 - (b) What is Klenow fragment? What will happen if you add Klenow fragment in a dsDNA having a nick? 3+(1+2)+3+1
 - (c) Suppose that you carry out an experiment by growing a cell in a medium containing N^{14} and then transferred to a medium containing N^{15} . What will be the position of the bands in density gradient centrifugation if replication was (i) Semi-conservative (ii) Conservative (iii) Dispersive?
 - (d) What is the significance of telomerase sequence in eukaryotes?
6. (a) What is self-splicing? 2+2+2+2+2
 - (b) Why splicing is mandatory for transport of mRNA from nucleus to cytosol?
 - (c) What factors are essential for polyadenylation in mRNA?
 - (d) What are the steps of capping eukaryotic mRNA?
 - (e) The T and t antigens of SV40 are the product of a single gene. How does a single gene give rise to two different proteins?
7. (a) A relaxed dsDNA with 1000 base pairs have 20 nucleotides per turn. How much increase in its twist is to be accumulated to get a negative super coiling with value - 5? 3+2+2+(1+2)
 - (b) Why the slope of DNA renaturation curve is steeper than DNA denaturation curve?
 - (c) Why the absorbance of a DNA solution increases upon denaturation?
 - (d) What is DNA blebbing? Inspite of blebbing, why does a dsDNA not completely denature at 37°C?
8. (a) What is the role of IF1 in ribosome dissociation? 2+(1+2)+1+2
 - (b) What is Okazaki fragment? How Okazaki fragments are joined together to complete the lagging strand synthesis? +(1+1)
 - (c) What do you mean by the term passive replication?
 - (d) How does RNA polymerase control the entry of a single base at a time during transcription?
 - (e) What is Sigma Cascade? Name one microbiological incident where such kind of cascade is observed.
9. (a) What is the role of gene A protein in rolling circle mode of DNA replication and where does it take place? 3+(2+2)+ (1½+1½)
 - (b) What are the different components of the initiation complex in prokaryotic protein synthesis? How do they interact with one another?
 - (c) Why the primers used in DNA replication is a RNA instead of DNA? Why the maximum length of an abortive transcript can never be more than 10 bases?