



WEST BENGAL STATE UNIVERSITY
B.Sc. Major 6th Semester Examination, 2026

MCBDSC612T-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 and answer any four from the rest

1. Answer any *five* questions from the following: 2×5 = 10
- Mention any two advantages of molasses as a fermentation substrate.
 - What is NCTC related to Industrial microbiology?
 - What is Custer's effect?
 - State the function of a sparger in a fermenter.
 - What is an ale fermentation?
 - Name one microorganism used for citric acid production and one for ethanol production.
 - What are the substrates used for ethanol production?
 - What is whey? Mention one industrial application.

Answer any four questions from the following

10×4 = 40

- What are the differences between the Crabtree effect and the Pasteur effect? 2
 - Why is lactose a preferred carbon source for penicillin production? 2
 - State the significance of the stationary phase of bacterial growth. 2
 - Draw a neat labelled diagram of a fermenter. 4
- Name two organisms involved in Vitamin B₁₂ production. 2
 - Write down the media composition of the industrial production of Vitamin B₁₂. 2
 - Explain the recovery method of Vitamin B₁₂ production. 3
 - Give one industrial application of fed-batch fermentation. 3
- Draw a labelled diagram of a stirred tank bioreactor and describe the functions of its major components. 4
 - What is an air-lift fermenter? 3
 - State three advantages of air-lift fermenters. 3

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- Explain how pH, temperature and dissolved oxygen are monitored and controlled during fermentation. 4
 - Why is aeration important in industrial fermentation? 3
 - What are antifoaming agents? Mention one example. 3
- How is microbial culture concentration maintained in an industrial fermenter for continuous production? 2
 - What is a Solid-State Medium? Write the composition of a solid-state medium. 2+2
 - Discuss the substrate used for Lipase production. 2
 - Briefly describe the production process of Lipase by submerged fermentation. 2
- Describe molasses and corn steep liquor as fermentation substrates. 2
 - What are Chemical immobilization methods? 2
 - Describe the process for immobilization of glucose isomerase. 3
 - Differentiate Encapsulation and Entrapment. 3
- Describe the industrial production of penicillin with a neat flowchart. 4
 - What is the role of phenylacetic acid in penicillin fermentation? 2
 - Mention two uses of penicillin. 2
 - Name one industrially important β -lactam antibiotic other than penicillin. 2
- Discuss enzyme immobilization by adsorption, entrapment and covalent bonding methods. 4
 - Mention four advantages of enzyme immobilization.
 - State one industrial application each of immobilized glucose isomerase and immobilized penicillin acylase.

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Question Number 1 is compulsory and answer any four from the rest

1. Answer any **five** questions from the following: 2×5 = 10
- Define the function of bone marrow stromal cells in hematopoiesis.
 - Briefly explain the terms:
 - Isotypes
 - Idiotypes
 - Name two primary immunodeficiency diseases.
 - What are the components of Freund's complete adjuvant?
 - Elucidate the functions of C3b.
 - What are chimeric antibodies?
 - What role mast cell and basophils play in immunity?
 - What are NKT cells?

Answer any four questions from the following

10×4 = 40

- Mention two contributions of (i) Rodney Porter and (ii) Karl Landsteiner in the field of Immunology. 2+2
 - Define prozone effect. 1
 - Write a short note on Erythroblastosis fetalis. 3
 - Name the Ig molecule lacking hinge region. 2
 - Explain the activation of the complement cascade by the classical pathway. 3
 - What is innocent bystander lysis? 2
 - What is the function of properdin in regulating the complement activation? 1
 - Why does the staple form of IgM capable of activating the classical pathway of complements? 2
 - Mention the biological consequences of complement activation. 2
- The production of inhibitory signals by engagement of CTLA-4 is important in lymphocyte homeostasis. Justify. 3

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- What are homing molecules? 2
 - The T cell is said to be Class I restricted. What does this mean? 2
 - What are Kupffer cells? 1
 - What is CTLA-4? 2
- Indicate which is likely to be immunogenic for the following pair of antigens. Give reasons. 3
 - A protein with a M.W of 30,000
 - BSA in Freund's complete adjuvant ☒ BSA in Freund's incomplete adjuvant
 - Briefly explain the following: 3
 - Decay Accelerating Factor (DAF) *MAB*
 - Membrane Cofactor Protein (MCP) *Factor cofactor*
 - What is the role of HLA-DO in MHC pathway? *MHC II* 2
 - What is Rheumatoid arthritis? 2
- What are TD and TI antigens? 2
 - Define the terms: 4
 - agretope
 - epitope
 - paratope
 - histotope.
 - How are monoclonal antibodies prepared? 3
 - What are M cells? 1
- Distinguish between the peptide-binding process by MHC Class I and MHC Class II molecules. 3
 - How are chaperones involved in antigen presentation? 3
 - What is cross-presentation? 1
 - What do you mean by positive and negative selection tests? 3
- Define the term antibody titre. 1
 - What are SCID mice? 1
 - Mention the principles behind ELISA and Immunofluorescence. 3+2
 - Name any two cytokines required during hematopoiesis. 1
 - Why are IgG called incomplete antibodies? 2
- Define Primary and Secondary Immune responses. 2
 - Explain the CTL-mediated target cell killing.
 - What are superantigens?
 - What do you mean by (i) Co-stimulatory signal in T-cell activation, (ii) Anergy?
 - What is the basis of Immunological tolerance?



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Answer Question Number 1 and any four from the rest

1. Answer any five questions from the following: 2×5 = 10
 - (a) What is the role of DNA Polymerase in PCR?
 - (b) What is the function of terminal deoxynucleotidyl transferase?
 - (c) What is the purpose of an inducible promoter in an expression vector?
 - (d) What is linker and mention its function?
 - (e) What do you mean by "Humulin"?
 - (f) Explain the principle of chromosome walking.
 - (g) What is the difference between cosmid and fosmid?
 - (h) What do you mean by forward and reverse primers of PCR?
2. (a) Explain how complementary DNA (cDNA) differs functionally from genomic DNA. 4+2+2+2
 - (b) What do you mean by cDNA library?
 - (c) Why is *Agrobacterium tumefaciens* called a natural genetic engineer?
 - (d) What is the significance of promoter sequence in expression vectors?
3. (a) Give an example of restriction enzyme producing 5' cos ends. Name the organism from which this enzyme is isolated and write down its recognition site and indicate the cut sites on DNA. (1+1+2½+2½)+3
 - (b) What is Positional Cloning?
4. (a) What is the structural difference between dNTP and ddNTP and how does this difference cause chain termination in Sanger sequencing? (1+2)+(2+2)+3
 - (b) What is the "Star Activity" in restriction endonucleases, and how can it be avoided experimentally?
 - (c) Why are Type-II Restriction enzymes preferred over Type-I and Type-III system in recombinant DNA Technology?
5. (a) Why is DNA treated with alkaline phosphatase before cloning? 2+2+4+2
 - (b) Why is Blue-white selection done for screening of recombinant clones?

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- (c) A Purified DNA is cut with EcoRI and BamHI separately and then with both enzymes together the following are the observation in gel electrophoresis (fragment in bp).

EcoRI	300	500	850
BamHI	100	600	950
EcoRI + BamHI	100	250	300,400,600

Use this information and make a restriction map of the DNA.

- (d) What is electroporation?
6. Write short notes on: 2½ × 4 = 10
 - (a) Dot blot technique
 - (b) Liposome mediated gene delivery
 - (c) YEP Vector
 - (d) In-situ hybridization.
7. (a) Differentiate between RT-PCR and Real-time PCR based on their primary applications. 2+(2+2)+2+2
 - (b) Define C_t (Threshold cycle) value in PCR. What does a lower C_t value indicate about the template concentration?
 - (c) What is the function of a 'Quencher' molecule in a TaqMan Probe assay?
 - (d) What are Short Tandem Repeats (STRs), why are they useful in DNA fingerprinting?
8. (a) Compare and contrast Type-I, II and III restriction modification systems with respect to their structure, co-factor requirements, and cleavage patterns. 4+2+4
 - (b) State two advantages of using T7 promoter-based expression vectors in *E. coli*.
 - (c) How does M13 differ from λ phage vectors in terms of replication and DNA packaging?
9. (a) What is the advantage of using recombinant vaccine over traditional vaccines? 3+3+2+2
 - (b) How does Bt toxins control pests?
 - (c) How does site directed mutagenesis help to validate drug targets in functional genomics studies?
 - (d) In SDS-PAGE proteins move from cathode to anode irrespective of their charge. Justify why.





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MCBDSC615T-MICROBIOLOGY (MAJOR)

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GROUP-A

1. Answer any five questions from the following: 2×5 = 10
- What do you mean by entomopathogenic fungi? Give one example.
 - How does ammonia released from decomposition of proteins in the soil behave?
 - Give an example of non-legume nitrogen fixer association stating the name of both partners.
 - What is molecular farming?
 - What do you mean by biomimicry? Give an example.
 - What is the difference between mineralization and immobilization of nitrogen?
 - How does methane is produced microbiologically?
 - What are the characteristic features of Azotobacter?
 - What is autochthonous soil microflora?
 - How microorganisms can be used as biocontrol agent against plant pathogens? Give one example.

GROUP-B

- Answer any four from the following questions 10×4 = 40
- Define mycorrhizae. How does the mycorrhizae play a role of biofertilizer in agriculture? 1+3
 - What do you mean by symbiotic and non symbiotic interactions between microbes and plants? 3
 - Define phytoremediation with example. 2
 - Why is soil regarded as biologic fire? 1
 - How do you differentiate between phosphate solubilizing biofertilizers and phosphorous mobilizing biofertilizers? 3
 - How is *Bacillus thuringiensis* used as a biocontrol agent? 2
 - How does microbes survive in low temperatures? Explain with proper examples. 2+1
 - Why Azolla is used as biofertilizer? 2

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- Indicate the role of cellulolytic and methanotrophic bacteria in global climate change. 3
- Write down the biochemical pathway behind the Golden rice production. 3
- Give examples of a novel combination of microbes as biofertilizers. 2
- What are non-symbiotic plant growth promoting bacteria? 2
- How does Rhizobium act as biofertilizer? What is nif gene cluster? 2+1
- What are ammonia oxidizing bacteria? 2
- How do you measure mineralization? 2
- How does microbial phosphate solubilisation occur in soil? 3
- Write a comparative role between amensalism and commensalism with proper example. 3
- Differentiate between epiphytes and endophytes with examples. 3
- What are the differences between chemical fertilizers and biofertilizers? 2
- Give examples of two bio weedicides. 2
- Write short notes on the following: 2½×4 = 10
 - Different strategies for insertion of foreign gene into target plant
 - Role of microorganisms in climate change
 - Advantages of liquid biofertilizers
 - Transgenic plants as bioreactors for recombinant proteins.
- What do you mean by phyllosphere microflora? What is rhizospheric effect? 2+1
- Who is known as father / founder of soil microbiology and why? 2
- What are the methodologies to examine the quality of genetically modified crops? 2
- What are the advantages and disadvantages of GM Crops? 3
- What are fourth generation biofuels? 2
- What are the importance of PSM in agriculture? 3
- What is nitrification? Name two bacterial species associated with nitrification.
- What is green manure?



WEST BENGAL STATE UNIVERSITY
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MCBACOR14T-MICROBIOLOGY (CC14)

Time Allotted: 2 Hours

Full Marks: 40

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Answer Question No. 1 and any four from the rest

1. Answer any *four* from the following questions: 2×4 = 8
 - (a) For gene cloning experiment, why the cleaved plasmid DNA often treated with alkaline phosphatase prior to ligation step?
 - (b) What are isoschizomers and neoschizomers? Explain with examples.
 - (c) What is RAPD?
 - (d) Explain the term 'Stringency' in connection with nucleic acid hybridization.
 - (e) What is the function of linker DNA?
 - (f) What is 'Humulin'?
 - (g) What is forward and reverse primer in PCR?
 - (h) What is Acetosyringone?
2. (a) Differentiate between Northern and Southern blotting. 4+2+2
 (b) In SDS-PAGE protein moves from cathode to anode irrespective of their charge. Justify why?
 (c) What is in situ hybridization?
3. (a) Why blue white selection is done for screening of recombinant clones? 3+2+3
 (b) How is mRNA purified from eukaryotic cell?
 (c) Explain how 'contig maps' are generated.
4. (a) Outline the steps in colony hybridization and explain how false positive may occur during the screening process. 3+3+2
 (b) Why is it not possible to study untranslated region (UTRs) and promoter sequences by using cDNA library?
 (c) What will be the consequences of using random primers instead of oligo dT primers during cDNA synthesis?
5. (a) What are the key features of eukaryotic expression vector? 3+3+2
 (b) Describe the baculovirus expression system.
 (c) How can a foreign protein be modified to facilitate its purification?

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6. (a) Why is partial digestion often used for construction of genomic DNA libraries? 3+3+2
 (b) Describe the principal features of pUC cloning system.
 (c) Mention some important characteristics of *E.coli* strains used as host for recombinant DNA technology.
7. Write short notes on: 2×4 = 8
 - (a) Recombinant vaccine
 - (b) Electroporation
 - (c) YE vector
 - (d) Liposome mediated gene delivery.
8. (a) Compare and contrast type I, II and III restriction modification systems with respect to structure, cofactor requirement and cleavage pattern. 3+2+3
 (b) State two advantages of using T7 promoter based expression system in *E. coli*.
 (c) How does M13 differ from λ phage vectors in term of replication and DNA packaging?
9. (a) What are the various methods of in vitro labelling of DNA? 3+2+2+1
 (b) What is the advantage of having MCS in a vector?
 (c) Why are two different antibiotic resistance genes used in pBR322 for screening recombinants?
 (d) What is reporter gene?





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MCBADSE04T-MICROBIOLOGY (DSE3/4)

Time Allotted: 2 Hours

Full Marks: 40

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Answer Question. No. 1 and any four from the rest.

1. Answer any **four** questions: 2×4 = 8
 - (a) What are the advantages for plants in having mycorrhizal association?
 - (b) Mention four microflora of ruminants.
 - (c) What is autochthonous soil microflora? Give one example.
 - (d) How methane is produced microbiologically?
 - (e) What are the characteristic features of *Azotobacter*?
 - (f) What do you mean by biomanure? Give one example.
 - (g) How microorganisms can be used as biocontrol agent against plant pathogens? Give one example.
 - (h) What do you mean by entomopathogenic fungi? Give one example.
2. (a) Write a comparative note between amensalism and commensalism with proper example. 3
 - (b) Differentiate epiphytes and endophytes with proper example. 3
 - (c) Define ecto-mycorrhiza with proper example. 2
3. (a) How *Rhizobium* acts as biofertilizer? What is *nif* gene cluster? 2+1
 - (b) What are ammonia oxidizing bacteria? How microbial phosphate solubilisation occurs in soil? 1+4
4. (a) How biofuel is produced by microorganisms? 3
 - (b) Write a short note on non-symbiotic plant growth promoting bacteria. 3
 - (c) What are the characteristic features of *Bradyrhizobium*? 2
5. (a) What do you mean by phyllosphere microflora? What is rhizospheric effect? 2+1
 - (b) Write briefly on (i) BT cotton (ii) Golden Rice. 2½ + 2½

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6. (a) What is soil texture? What do you mean by soil texture triangle? 1+2
 - (b) '*Trichoderma* sp. is used as a biocontrol agent.' — Explain. 2
 - (c) What are PGPMs? Give suitable example. 2
 - (d) Why is lignin highly resistant to microbial degradation? 1
7. (a) What is compost? Outline the process involved in vermicomposting. 1+3
 - (b) State the role of humus in maintenance of soil health and hence crop productivity. 2
 - (c) How does soil pH control greenhouse gas production by soil microorganisms? 2
8. Write short notes on: (Any **four**) 2×4 = 8
 - (a) Leghaemoglobin
 - (b) Issues with GM crops
 - (c) Soil as Microbial habitat
 - (d) Greenhouse gases
 - (e) Strategies of pesticide remediation.