

MODEL QUESTION PAPERS

Mahatma Gandhi University, Kottayam
First Semester M.Sc.Microbiology Examination - 2012
(MODEL QUESTION PAPER)

MB1PG01 -Biochemistry

Time : 3 Hrs

Weightage: 30

I. Write Notes on Any Five

(Wt: 1 each)

1. Heparin
2. Chitin
3. Sunshine Vitamin
4. Flagellin
5. Disulfide linkage
6. Collagen
7. deoxyribose sugar
8. Prostaglandins

II Write Short Essay on Any Five

(Wt: 2 each)

9. Protein sequencing
10. A helix
11. t- RNA
12. Differentiate DNA from RNA
13. Mechanism of action of steroid hormones
14. Peptidoglycan
15. Glycoproteins
16. Physiological buffers

III Answer Any Three in Detail

(Wt: 5 each)

17. Describe in detail the structure of DNA.
18. Give an account of protein structure
19. What are lipids? How are they classified?
20. What are hormones? How are they classified? Describe the different hormones you have studied.
21. What are vitamins? Give an account of the different vitamins you have studied with special reference to their role in the biological system.
22. Describe in detail the evolutionary divergence of organisms and its relationship to protein structure and function.

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MB1PG02 - Biophysics, Bioinstrumentation And Bioinformatics

Time : 3 Hrs

Weightage: 30

- I. Write Notes on Any Five (Wt: 1 each)**
1. Beer- Lambert's law
 2. Resolving power of a microscope
 3. Enthalpy
 4. Phase contrast microscope
 5. MALDI- TOF
 6. Isoelectric focusing
 7. Ultrafiltration
 8. histones
- II Write Short Essay on Any Five (Wt: 2 each)**
9. Ramachandran plot
 10. High energy molecules
 11. Zinc fingers
 12. Differentiate light microscopes from electron microscopes
 13. Biological databases
 14. SDS PAGE
 15. Construction of phylogenetic tree
 16. Laws of thermodynamics
- III Answer Any Three in Detail (Wt: 5 each)**
17. Applications of Bioinformatics in different fields
 18. Comment on DNA- Protein interactions you have studied
 19. Give an account of the different chromatographic techniques used for separation
 20. What is DNA polymorphism?
 21. Describe the different spectroscopic techniques you have studied
 22. Describe in detail principle and working of confocal microscopy.

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MB1PG03- Cell Biology And Genetics

Time : 3 Hrs

Weightage: 30
(Wt: 1 each)

I. Write Notes on Any Five

1. Fluid Mosaic model of membranes
2. Oncogene
3. Tumor suppressor gene
4. Ribosome
5. Histones
6. Monohybrid ratio
7. Down's syndrome
8. Chloroplast

II Write Short Essay on Any Five

(Wt: 2 each)

9. Differentiate apoptosis from necrosis
10. Functions of biological membranes
11. Chromosome mapping
12. Cytoplasmic inheritance
13. Hardy Weinberg principle
14. Multiple alleles
15. Regulation of cell cycle
16. Inherited disorders in metabolism

III Answer Any Three in Detail

(Wt: 5 each)

17. Describe the process of aging. Comment on the different theories of aging.
18. Give a detailed account of the different stages involved in the cell cycle.
19. Describe the importance of medical genetics
20. With the help of a labeled diagram describe a typical cell and its constituents.
21. What are the causes of cancer? Describe the different stages of cancer development.
Add a note on diagnosis and treatment.
22. Mitochondrion: structural features and functions

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MB1PG04 – Physiology And Biostatistics

Time : 3 Hrs

Weightage: 30
(Wt: 1 each)

I. Write Notes on Any Five

1. Auxins
2. Arithmetic mean
3. BMR
4. Autotroph
5. Transpiration
6. Chlorophyll
7. Hormone
8. Photoperiodism

II Write Short Essay on Any Five

(Wt: 2 each)

9. Correlation and regression
10. Bioluminescence
11. Thermophilic bacteria
12. Bacterial chemolithotrophy
13. Tests of significance
14. Adaptive mechanisms in psychrophilic bacteria
15. Neural and chemical regulation of respiration
16. Regulation of acid base balance in humans

III Answer Any Three in Detail

(Wt: 5 each)

17. Describe the different methods used for collection classification and tabulation of data.
18. Give an account of different mechanisms used to transport materials across biological membranes.
19. Describe in detail Bacterial photosynthesis
20. Give the composition and function of blood. How are blood groups determined?
21. Describe the structure and functions of human nervous system.
22. Describe different modes of nutrition in bacteria with special reference to photosynthetic bacteria.

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MB2PG05 –Microbiology

- Time : 3 Hrs** **Weightage: 30**
- I. Write Notes on Any Five** **(Wt: 1 each)**
- 1) Insertion sequences
 - 2) Enrichment media
 - 3) Fermentation
 - 4) Prions
 - 5) Lyophilization
 - 6) Photoreactivational repair
 - 7) Lowenstein – Jensen media
 - 8) Sterilization
- II Write Short Essay on Any Five** **(Wt: 2 each)**
- 9) Conjugation
 - 10) Quorum sensing
 - 11) Transposons
 - 12) Phenol Coefficient Test
 - 13) Adansonian Classification
 - 14) Robertsonian Translocation
 - 15) Explain Flagellar Structure with a note on difference between prokaryotic & eukaryotic flagella.
 - 16) Viral Classification
- III Answer Any Three in Detail** **(Wt: 5 each)**
- 17) Elaborate on the structure of bacterial cell wall with a note on peptidoglycan synthesis.
 - 18) Explain the mechanism of drug resistance in Bacteria
 - 19) Write in detail about aerobic respiration
 - 20) Elaborate on Generalized & Specialized transduction
 - 21) Classify fungi, with a note on economic importance of fungi.
 - 22) What are the Principles of Taxonomy? Describe in detail.

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MBPG06- Immunology

Time : 3 Hrs

Weightage: 30

I. Write Notes on Any Five

(Wt: 1 each)

- 1) Adjuvants
- 2) Abzymes
- 3) Immunofluorescence
- 4) Chimeric antibody
- 5) Superantigens
- 6) Idiotype and Isotype
- 7) Dendritic cells
- 8) SCID Mice

II Write Short Essay on Any Five

(Wt: 2 each)

- 9) Active & Passive Immunization
- 10) Describe the process of Inflammation
- 11) Erythroblastosis foetalis
- 12) T- Cell Receptor Complex
- 13) MHC Molecules
- 14) ABO blood grouping
- 15) Mechanism involved in Graft Rejection
- 16) Mitogens

III Answer Any Three in Detail

(Wt: 5 each)

- 17) Elaborate on the molecular basis of Antibody Diversity. Write a note on class switching.
- 18) Describe the various Antigen- Antibody reactions in detail.
- 19) Describe the different types of Hypersensitivity reactions.
- 20) What is autoimmunity? Describe the various autoimmune diseases.
- 21) What are Complements? How are they involved in the defense mechanism?
- 22) Explain the process of B – cell maturation, activation & differentiation.

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MB2PG07- Molecular Biology and Genetic Engineering

Time : 3 Hrs

Weightage: 30
(Wt: 1 each)

I. Write Notes on Any Five

1. Restriction endonucleases
2. Gene chip
3. palindromic sequences
4. YAC
5. C-value paradox
6. Ribozymes
7. Okazaki fragments
8. Topoisomerase

II Write Short Essay on Any Five

(Wt: 2 each)

9. Post transcriptional modification of eukaryotic mRNA
10. RNA polymerases in prokaryotes and eukaryotes,
11. Wobble hypothesis
12. DNA modifying enzymes.
13. Transgenic plants
14. Gene knockout technique
15. Expression vectors
16. Difference between Southern and Northern blotting Techniques

III Answer Any Three in Detail

(Wt: 5 each)

17. Discuss in detail lac operon system and its regulatory components.
18. Give a brief definition of a gene library. What is the essential difference between a genomic library and a cDNA library? List the major advantages/limitations on the use of each.
19. Write in detail about molecular markers and their importance.
20. Write about primer designing in PCR. Which DNA polymerase is used in PCR?
21. Explain the different stages in transcription. Add a note on regulation of transcription.
22. Describe in detail the role of enzymes in DNA replication.

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MB2PG08 -Metabolism and Enzymology

Time : 3 Hrs

Weightage: 30
(Wt: 1 each)

I. Write Notes on Any Five

1. Chemiosmosis
2. Salvage Pathway
3. Deamination,
4. Allosteric Enzymes
5. Zymogen
6. Purines
7. Oxidative Phosphorylation
8. Amylase

II Write Short Essay on Any Five

(Wt: 2 each)

9. Michaelis -Menten Equation And Km Value
10. Competitive Inhibition Of Enzyme
11. Alkaline Phosphatase And Its Application In Diagnosis
12. Glycolytic Pathway
13. Multienzyme Complexes
14. Alosteric Control Of Enzymes
15. Urea Cycle
16. Transition State Stabilization

III Answer Any Three in Detail

(Wt: 5 each)

17. Enzyme action: specificity, molecular aspects of enzyme action, and examples from different classes of enzyme.
18. Explain the structural and functional properties of ATP synthesis.
19. Describe the steps for the purification of enzyme.
20. Analytical applications: theory and applications of various enzyme electrodes e.g. enzyme sensors, enzyme membranes, biochips/bio-semiconductors etc.
21. Describe in details the degradation of cholesterol.
22. Regulation of enzymatic action: activation of enzymes, covalent modification, allosteric interaction, multienzyme complexes.

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MB3PG09 -Food & Industrial Microbiology

Time : 3 Hrs

Weightage: 30

- I. Write Notes on Any Five (Wt: 1 each)**
1. Sauerkraut
 2. Sparger
 3. Air lift fermentor
 4. Probiotics
 5. Mushroom poisoning
 6. Lagering
 7. Spirulina
 8. Secondary screening
- II Write Short Essay on Any Five (Wt: 2 each)**
9. Microbiological examination of milk
 10. Fermentor Design
 11. Solid state fermentation
 12. Food poisoning
 13. Microbial Transformation
 14. Mycotoxins
 15. Algae as SCP
 16. Down stream processing
- III Answer Any Three in Detail (Wt: 5 each)**
17. Elaborate on role of microbes in production of antibiotics with an example.
 18. Write an essay on Fermented milk products and their nutritional value & safety aspects.
 19. Discuss the methods and applications of Immobilization.
 20. Give a detailed description of SCP production. Explain the advantage and disadvantage SCP.
 21. Describe in detail the Principles and method of food spoilage & preservation.
 22. Describe microbiological aspects of manufacture of alcoholic beverages

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MB3PG10 - Environmental And Agricultural Microbiology

Time : 3 Hrs

Weightage: 30

- I. Write Notes on Any Five (Wt: 1 each)**
1. Microbes used in bioleaching
 2. Chemical agents used for air sanitation
 3. Factors affecting soil microflora
 4. Any two bacterial wilt diseases.
 5. Significance of Biological oxygen demand of water.
 6. Stages of composting process.
 7. Sources of microorganisms in air
 8. Indicator organisms of faecal contamination of water
- II Write Short Essay on Any Five (Wt: 2 each)**
9. Iron corroding bacteria.
 10. Biofilm formation & significance
 11. IPM strategies for control of plant diseases
 12. Microbial indicators of air pollution
 13. Ectomycorrhizal associations
 14. Production of Bacterial biofertilizers
 15. Steps for purification of water
 16. Mechanism of Biogas production by microbes.
- III Answer Any Three in Detail (Wt: 5 each)**
17. Discuss microbe-microbe Interactions
 18. Elaborate on the mechanism & genetics of biological nitrogen fixation. Explain Root nodulation.
 19. Give in details the methods of Bioremediation.
 20. Give an account of Waste water treatment plant.
 21. Explain biogeochemical cycling and significance of Nitrogen and carbon
 22. Give a brief account of air sampling devices used for enumeration of bacteria.

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MB3PGE1- Microbial Diversity And Extremophiles

Time : 3 Hrs

Weightage: 30

I. Write Notes on Any Five

(Wt: 1 each)

1. Archaea
2. Halophile
3. Barophile
4. Acidophile
5. Alkaliphile
6. Methanogen
7. Viking Mission
8. Ecological Niche

II Write Short Essay on Any Five

(Wt: 2 each)

9. Differentiae archaea and eukarya
10. How are archaebacteria classified?
11. Methods used for detection of life in space.
12. Adaptations of halophiles to life in high salt conditions
13. Search for life on Mars
14. How are Methanogens classified?
15. Soda lakes and deserts
16. Commercial aspects of thermophiles

III Answer Any Three in Detail

(Wt: 5 each)

17. What are Extremophiles? What are the applications of extremozymes?
18. Describe the diversity of microorganisms seen in alkaline environment. How are the organisms adapted to life in the alkaline environment?
19. Differentiate acidophiles from alkaliphiles. Describe the adaptations these organisms have to survive in acidic and alkaline environments.
20. Write an essay on microbial diversity. What are barophiles? How are they adapted to life under pressure?
21. What are aims and objectives of space research? Describe the Martian environment and the search for life on Mars.
22. Elaborate on molecular techniques for studying microbial biodiversity.

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MB3PGE2 - Marine Microbiology

Time : 3 Hrs

Weightage: 30

I. Write Notes on Any Five

(Wt: 1 each)

1. Lichen
2. Astaxanthin
3. Biofouling
4. Microbial loop
5. Psychrophile
6. Mycoparasitism
7. Salmonella
8. Hyperthermophiles

II Write Short Essay on Any Five

(Wt: 2 each)

9. Methods used for preservation of sea food
10. Marine foodborne pathogens
11. Biosurfactant
12. Mangroves
13. Adaptive mechanisms of barophilic microorganisms
14. Estuarine microbes
15. Antibiotics derived from marine microorganisms
16. Saltpans

III Answer Any Three in Detail

(Wt: 5 each)

17. What are marine extremophiles? How are they adapted to life in extreme conditions?
Add a note on their biotechnological uses.
18. Describe the production and applications of products derived from marine microbes which are of use in the field of biotechnology.
19. Describe in detail microbial indicators of marine pollution and control
20. Give a brief description of microorganisms in the marine environment
21. Describe in detail the different water borne pathogens you have studied
22. Elaborate on the methods of collection and estimation of marine microbes

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MB3PGE3 -Environmental Science

Time : 3 Hrs

Weightage: 30

- I. Write Notes on Any Five** **(Wt: 1 each)**
1. Thermal stratification of lake
 2. Marine ecosystem
 3. Characteristics of a community
 4. Sources of air pollution
 5. What is ecofeminism?
 6. Control of noise pollution
 7. Ecological succession
 8. Hotspots of biodiversity
- II Write Short Essay on Any Five** **(Wt: 2 each)**
9. Types of ecological pyramids
 10. Characteristics of freshwater habitat
 11. Sources of water pollution
 12. Bioremediation strategies
 13. Microbial indicators of water pollution
 14. Organisms used as bioweapons
 15. Application & construction of biosensors
 16. Current Major environmental issues in India.
- III Answer Any Three in Detail** **(Wt: 5 each)**
17. Give a detailed account of abiotic components of environment.
 18. Methods for conservation of biological diversity
 19. Give a brief account of bacteriological analysis of water quality.
 20. Methods for control of soil pollution
 21. Write an account of different types of Mycotoxins
 22. Discuss global environmental problems & solutions

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MB3PGE4- Molecular Microbiology

Time : 3 Hrs

Weightage: 30

I. Write Notes on Any Five

(Wt: 1 each)

1. VNTR
2. PFGE
3. Quorum sensing
4. Molecular basis of endospore formation
5. Apoptosis
6. Bacterial toxins
7. T-DNA transfer
8. Plant metabolite

II Write Short Essay on Any Five

(Wt: 2 each)

9. Probes used in molecular biology
10. Molecular biology of microbial evolution
11. Unculturable bacteria
12. Microbial genome analysis
13. Genome mining
14. Molecular basis of microbial virulence
15. Microbial polketides
16. Expression vector

III Answer Any Three in Detail

(Wt: 5 each)

17. Elaborate on laboratory controls and standards in molecular diagnostics.
18. Explain the molecular basis of microbial virulence with special reference to bacterial adhesion, invasion toxin production.
19. Describe the molecular adaptation of Halophiles to extreme environment.
20. Explain in details the different molecular typing methods for microbial strain identification used in epidemiological Studies.
21. Explain the different tools used for the comparison of microbial genomes
22. Elaborate on the different steps involved in the microbial production of recombinant proteins citing an example.

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MB3PGE5 -Nanobiotechnology

Time : 3 Hrs

Weightage: 30

I. Write Notes on Any Five (Wt: 1 each)

1. Biogenic nanoparticles
2. Nanobiotechnology
3. Quantum dots
4. SEM
5. Role of fungi in nanoparticle synthesis
6. Nanoalloy
7. Extracellular synthesis of nanoparticles
8. AFM

II Write Short Essay on Any Five (Wt: 2 each)

9. Use of nanoparticles in cancer therapy
10. Nanocomposite
11. Applications of silver nanoparticles
12. Uses of nanoparticles in MRI
13. Applications of Dynamic light scattering technology in nanoscience
14. Green nanotechnology
15. Mechanism of silver nanoparticle biosynthesis
16. Nanowires

III Answer Any Three in Detail (Wt: 5 each)

17. Explain synthesis of nanoparticles by various groups of microorganisms
18. Explain toxicology of nanoparticles
19. Explain methods used for the characterization of nanoparticles
20. Explain methods used for the synthesis of nanoparticles
21. Explain applications of metal nanoparticles
22. Explain process design for industrial scale synthesis of nanoparticles

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MB3PGE6 -Microbial Quality Assurance, Biosafety and Intellectual Property Rights

Time : 3 Hrs

Weightage: 30

I. Write Notes on Any Five

(Wt: 1 each)=

1. GMP
2. WTO
3. Benefits of IPR
4. GHPs are critical for Food Safety
5. Hazardous materials in biotechnology
6. Distinguish between trade secret and trade mark
7. Copyright Infringement
8. Differentiate between genetically modified food and organic food

II Write Short Essay on Any Five

(Wt: 2 each)

9. Give an account of ethical and safety aspects of animal cloning.
10. State 5 examples of geographical indications in India.
11. Elaborate on procedures for risk assessment of GM seeds and plants.
12. Comment on the ethical issues involved in xenotransplantation.
13. Significance of national biosafety boards in ensuring biosafety regulations and guidelines
14. Explain Food Safety Management Systems
15. Explain the procedure for filing a patent
16. Ethical concerns of biotechnological research and innovations

III Answer Any Three in Detail

(Wt: 5 each)

17. Explain the ethical issues associated with the use of animal models.
18. Why is food packaging crucial for safety and quality control? Explain briefly by highlighting the functions and types of packaging you will use to ensure food safety.
19. Illustrate procedure involved in patenting living organisms.
20. Discuss the ethical and safety issues involved in testing of drugs on human volunteers.
21. HACCP is a preventive and cost effective approach to food safety". Comment on the statement, highlighting the benefits of HACCP for the consumer, industry and the Government.
22. Explain the ethical issues related to the Human genome project.

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MBPG11 - Systematic Bacteriology

Time : 3 Hrs

Weightage: 30

I. Write Notes on Any Five

(Wt: 1 each)

1. Biochemical Characteristics of *Streptococcus*
2. Swarming motility
3. Rocky Mountain spotted fever
4. Pigments produced by *Pseudomonas* species.
5. Colony characteristics of *Corynebacterium diphtheriae*.
6. Coagulase test.
7. Selective media for *Salmonella* species
8. X and V Factor of *Haemophilus*

II Write Short Essay on Any Five

9. Biochemical reactions of *Mycobacterium tuberculosis*
10. RAPD
11. Actinomyces
12. Legionella
13. Toxins produced of *Streptococcus pyogenes*
14. Satellitism
15. 16S rRNA
16. Laboratory identification of *Vibrio cholerae*

III Answer Any Three in Detail

(Wt: 5 each)

17. Elaborate on Gram positive cocci
18. Discuss the salient features of family Enterobacteriaceae.
19. Elaborate on recent developments in bacterial systematics
20. Discuss the biological characters of Spirochetes
21. Discuss in detail anaerobic bacilli you have studied
22. Describe the biological characteristics of Neisseriae.

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MBPG12 -Virology, Mycology And Protozoology

Time : 3 Hrs

Weightage: 30

- I. Write Notes on Any Five (Wt: 1 each)**
- 1) Prions
 - 2) Morphology of enveloped viruses with examples.
 - 3) Characteristic features of Class Deuteromycetes
 - 4) Zoonotic Protozoan Disease
 - 5) Media for Fungal culture
 - 6) Characteristic features of *Entamoeba histolytica* cyst.
 - 7) Schuffner's Dots
 - 8) RNA Viruses
- II Write Short Essay on Any Five (Wt: 2 each)**
- 9) Antigenic Variation of Trypanosoma .
 - 10) Sexual Reproduction in Fungi
 - 11) Epstein Barr Virus
 - 12) Ross Cycle
 - 13) Histoplasmosis
 - 14) Mycotoxins
 - 15) Multiplication of RNA Viruses
 - 16) Morphological forms of *Trypanosoma cruzi*
- III Answer Any Three in Detail (Wt: 5 each)**
- 17) Elaborate on the laboratory diagnosis of Rhabdo Virus.
 - 18) Write the differentiating features of Hepatitis Viruses with special emphasis on Hepatitis B.
 - 19) Explain the life cycle of Leishmania with lab diagnosis.
 - 20) Give details on the general methods for lab diagnosis of Viral diseases and prophylactic measures.
 - 21) Discuss the life cycle of malarial parasite. Write a note on laboratory diagnosis.
 - 22) Explain the causative agents of superficial mycosis its symptoms & laboratory diagnosis.

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MB4PGE7- Clinical Microbiology

Time : 3 Hrs

Weightage: 30

I. Write Notes on Any Five (Wt: 1 each)

1. Write an account on general concept of specimen collection and transport?
2. Write briefly on emerging infections?
3. Give an account on laboratory diagnosis of CNS infection?
4. Comment on immunoprophylaxis?
5. Write briefly on laboratory diagnosis of burn infection?
6. Give an account on Infections of sinuses?
7. Explain the methods for the laboratory diagnosis of urinary tract infections.
8. ELISA

II Write Short Essay on Any Five (Wt: 2 each)

9. Explain the laboratory control of antimicrobial therapy?
10. Explain molecular techniques in diagnostic microbiology?
11. Give an account on infections in immunocompromised persons?
12. Explain the infections of bone and bone marrow?
13. Explain the methods for the diagnosis of STD?
14. Comment on Nosocomial infections?
15. Normal flora of Human body.
16. Give an account on microbiology laboratory safety and design?

III Answer Any Three in Detail (Wt: 5 each)

17. Explain the etiology, lab diagnosis and pathogenesis of blood stream infections?
18. Give an account on wound infections?
19. Comment on pyogenic infections?
20. Explain the Pathogenesis of respiratory tract infections?
21. Write briefly on Infections in foetus and neonates?
22. Explain the important Genital tract infections?

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MB4PGE8- Microbial Genetics

Time : 3 Hrs

Weightage: 30

- I. Write Notes on Any Five** **(Wt: 1 each)**
1. Transcription
 2. Phage induced mutation
 3. Reverse transcription
 4. Restriction enzymes
 5. Plasmid
 6. RAPD
 7. Thymine dimer
 8. Sexduction
- II. Write Short Essay on Any Five** **(Wt: 2 each)**
9. Gene therapy
 10. Differentiate between temperate and lytic phage
 11. DNA repair
 12. DNA sequencing
 13. Attenuation
 14. Post transcriptional modifications
 15. PCR
 16. Transduction
- III. Answer Any Three in Detail** **(Wt: 5 each)**
17. Give a detailed account of the structure of DNA with the help of suitable diagrams.
 18. What is meant by cloning? Describe the different types of vectors used for cloning?
 19. Define Mutation. Explain the different types of mutations you have studied.
 20. How does genetic recombination occur in bacteria? Describe in detail with examples.
Give diagrams wherever necessary.
 21. What is translation? How is protein synthesis regulated? Add a note on post translational modifications.
 22. Explain tryptophan operon and its regulation.

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MB4PGE9- Biostatistics and Research Methodology

Time : 3 Hrs

Weightage: 30

I. Write Notes on Any Five (Wt: 1 each)

1. Importance of statistics with reference to biology
2. What is frequency distribution? Illustrate with an example.
3. Diagrammatic representation- illustrate with examples from biological experiments.
4. Distinguish between diagrammatic and graphical distribution- with special reference to biostatistics.
5. Explain goodness of fit of data with special reference to χ^2 - test.
6. Distinguish between regression and correlation. Explain its importance in experimental data analysis.
7. Explain different methods of collection of data.
8. What are measures of central tendency? Explain the best measure of central tendency.

II Write Short Essay on Any Five (Wt: 2 each)

9. Arithmetic mean.
10. Correlation coefficient ' γ '.
11. Regression Coefficient 'b'.
12. Geometric mean.
13. Measures of dispersion and its significance in data analysis.
14. Explain analysis of variance in experiments.
15. Explain test of significance in statistical analysis of data.
16. Explain small sample test- give an illustrative example.

III Answer Any Three in Detail (Wt: 5 each)

17. Explain arithmetic mean (AM), geographic mean (GM), and harmonic mean (HM). Prove that $AM \geq GM \geq HM$.
18. What is ANOVA? What are the assumptions under ANOVA illustrate?
19. Give the formula for 'z' test and 't' test. Under what situation each one is applied.
20. What is rank correlation? How this type of correlation is calculated? Give its formula.
21. Explain the levels of significance. Explain 5% and 1% level of significance. Give illustration of each level.
22. What is normal distribution? Under what condition a normal distribution will be turned to standard normal distribution. Give the formula.