GOA UNIVERSITY
Taleigao Plateau

SYLLABUS FOR GOA UNIVERSITY ADMISSIONS RANKING TEST (GU-ART) IN MICROBIOLOGY

I. Introduction to Microbiology and Biochemistry

Introduction and historical aspects of Microbiology
Types of Microorganisms; Distribution of microorganisms in nature, Development of microbiology as a discipline, golden era of microbiology. Development in microscopy; Discovery of the microbial world; theory of spontaneous generation vs. biogenesis; Germ theory of diseases, aseptic surgery. Contributions of Leeuwenhoek, Pasteur, Koch, Lister, Fleming. Role of microorganisms in various concepts and fields of microbiology. Establishment of fields of medical microbiology and immunology through the work of Ehrlich, Metchnikoff, Jenner.

Microbial associations
Types of associations: mutualism, commensalism, synergism, syntrophism, competition, antagonism, parasitism, predation; symbiosis. Examples of each type of interaction - mycorrhizal, root nodules, ruminant symbiosis, nematophagus fungi, symbiotic, bioluminescent bacteria.

Microbial cytology
Diversity in microbial cytology. Structure of eukaryotes and prokaryotes – composition, comparisons, and differences. Organization and ultrastructure of prokaryotic cell (Bacterial cell). Cell wall: structure and composition in Gram's positive and Gram's negative bacteria, spheroplast, protoplast, L-forms; Flagella and pili; Cell membrane: architecture, structure & function; Slime and capsule: composition, function; Cytoplasmic organelles; Nuclear material: nature and function; Endospore: structure, sporulation and germination.

Eukaryotic cell structure and Functions:
Cell organelles, Signal transduction, Cell signalling, Cellular differentiation, Cell cycle, apoptosis, stem cells, stem cells

General characters and economic importance of Groups of Microorganisms:
Bacteria, Algae, fungi, Protozoa, Viruses.

Introduction to Biochemistry
Carbohydrates: Trioses, tetroses, pentoses, hexoses, optical isomerism, pyranose and furanose forms, alpha/beta forms, reducing sugars, disaccharides, glycosidic bonds, lactose, maltose, sucrose, polysaccharides - storage: glycogen, starch; structural: cellulose. Principles of carbohydrate determination: Qualitative and quantitative tests for carbohydrates, reducing sugar, non-reducing sugars.
Amino acids: L & D forms, zwitterion, amphoteric nature, R groups, naturally occurring

amino acids. Detection of amino acids by Ninhydrin method.
Proteins: peptide bond, primary, secondary, tertiary, quaternary structure. Qualitative and quantitative protein determination: UV absorption, Colorimetrically by Biuret & Folin Lowry method.
Lipids: Quantitative and qualitative tests of lipid determination, Fatty acids & triglycerides: unsaturated fatty acids.
Nucleic acids: purines & pyrimidines, nucleosides & nucleotides; principle of determination of DNA by diphenylamine and RNA by Orcinol methods.

II Techniques in Microbiology

Physico-chemical conditions
pH: acidophiles, alkalophiles, neutrophiles, Temperature: psychrophiles, thermophiles, mesophiles; Oxygen tension: aerobic, microaerophilic, anaerobic; use of pre-reduced media (Thioglycolate, Robertson's cooked meat), Anaerobic jar; Other conditions: osmotic pressure (osmophiles, halophiles), hydrostatic pressure (barophiles).

Cultivation and growth
Nutritional Types: phototrophs, chemotrophs & their subgroups. Autotrophs and heterotrophs. Types of culture media: synthetic, complex, enriched, enrichment, selective, differential, dehydrated solid and liquid. Salt and pH in culture media. Nutritional requirement of bacteria and nutritional categories. Definition of cell growth/population growth; generation time - definition & formulae, Bacterial growth curve, characteristics of growth phases. Batch/Continuous cultures: principles, steady state, chemostat/Turbidostat. Physical methods for microbial control: Heat, low temperature, Filtration; Osmotic pressure Dessication, Chemical methods of microbial control; disinfectant.
Instruments in Microbiology Laboratory. Microbiology Good Laboratory Practice (GLP) and biosafety. Preparation of Laboratory Media: Peptone water, nutrient broth and agar, preparation of slants and butts, Saboraud's broth and agar, MacConkey's broth and agar. Growth curve of *E. coli.* Motility, Staining, Microscopic counts, Dry-weight, wet-weight, Biological methods: SPC (serial dilution, viable counts, colony counts), MPN.

Microscopy and principles of staining
Bright field microscope. Mordants, fixatives and decolorizers, dyes, chromogen, chromophore, auxochrome, Gram staining, monochrome staining, negative staining.

Microorganisms and their habitat including effect of various factors
Structure and function of ecosystem, Terrestrial environment, Aquatic environment, air, animal environment, Bioluminescent bacteria. Extreme habitats. Application of microbes in environment - Solid waste management, Liquid waste management, Determination of BOD and COD, various processes in waste treatment. Microbial bioremediation and water potability.

III Microbial Physiology

Enzymes
Structure of enzyme, Apoenzyme, Coenzyme, Cofactors, Prosthetic group, monomeric, oligomeric and allosteric enzymes. Classification and nomenclature of enzymes with

examples. Apoenzyme, coenzymes, prosthetic groups, cofactors, Structures of enzymes. Specific activity of enzymes, factors affecting enzyme action. Mechanism of action of enzymes : active site, activation energy, transition state complex. Multienzyme complex – pyruvate dehydrogenase, Isozyme – lactate dehydrogenase.

Metabolism:
Concept of aerobic and anaerobic respiration, fermentation, Major pathways in heterotrophs & regulation: EMP, ED pathway, TCA pathway, ETC, Alcohol fermentation, Pasteur effect, Mixed Acid Fermentations - Homo- & Hetero-fermentative pathways, linear and branched fermentative pathway.

Nutrient Transport:
Types of mechanisms of solute transport: passive diffusion, facilitated diffusion, active transport (Primary and secondary active transport), concept of uniport and symport, group translocation.

IV Microbial Genetics

Concept of gene
Chromosome, chromosome/DNA as carrier of gene. DNA, purines, pyrimidines, nucleosides, nucleotides, Watson-Crick model; Prokaryotic DNA (Circular DNA, Supercoiling, Palindromic); Eukaryotic DNA (Repetitive sequences, split genes, nucleosomes), mitochondrial and chloroplast DNA; RNA: mRNA, rRNA, tRNA. Electrophoretic separation of nucleic acids.

Replication of DNA
Modes of replication - Conservative, semi conservative (Meselson- Stahl experiment) and dispersive. Processes and enzymes involved in replication.

Transcription
Transcription in prokaryotes and eukaryotes, post-transcriptional modification - RNA splicing, formation of mRNA, RNAse H activity; Ribozyme, Operon concept

Translation
Concept of genetic code, codon / anticodon, properties, Wobble hypothesis, start and stop codons, nonsense codons; Ribosomes as sites of protein biosynthesis; amino acid activation and specificity; Initiation, Elongation, Termination; post-translational processing & modification, Inhibitors of protein synthesis; differences between prokaryotic and eukaryotic translation process.

SUGGESTED READING (Latest editions – only indicative not comprehensive)

1. Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. Pearson Education
2. Madigan MT, et al. Brock's Biology of Microorganisms. Pearson International Edition
3. Cappucino J and Sherman N. Microbiology: A Laboratory Manual. Pearson Education Limited
4. Wiley JM, et al. Prescott's Microbiology. McGraw Hill International.
5. Atlas RM. Principles of Microbiology. WM.T. Brown Publishers.
6. Pelczar MJ, et al. Microbiology. McGraw Hill Book Company.
7. Stanier RY, et al. General Microbiology. McMillan.

8. Odum E. Fundamentals of Ecology. Belmont CA: Thomson Brooks/Cole.
9. Coyne M. Soil Microbiology. Cengage Learning, Inc.
10. Rao NS Subba. Soil Microorganisms and Plant Growth. Oxford and IBH Publishing Co.
11. Alexander M. Introduction to Soil Microbiology. Krieger Publishing Company.
12. Salle, A.J. Fundamental principles of bacteriology, Tata McGraw Hill Education.
13. Nelson D.L. and Cox, M.M. Lehninger's Principles of Biochemistry. W.H. Freeman & Co.
14. Voet, D. and Voet, J.G. Bichemirty, John Wiley and Sons.
15. Conn E and Stumpf P. Outlines of Biochemistry, John Wiley and Sons.
16. Atlas RM and R. Microbial Ecology: Fundamentals and Applications. Benjamin Cummings Science publishing, USA.
17. Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition
18. Maier RM, et al. Environmental Microbiology. Academic Press.
19. Okafor, N. Environment Microbiology of Aquatic and Waste systems. Springer, NY.
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21. Campbell RE. Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
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23. Lynch JM and Hobbie JE. Microorganisms in Action: Concepts and Application in Microbial Ecology. Blackwell Scientific publication, U.K.
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28. Stanier RY, et al. General Microbiology. McMillan Press.
29. Tymoczko JL, Berg JM and Stryer L. Biochemistry, W.H.Freeman and Company
30. Nelson DL and Cox MM. Lehninger principles of Biochemistry, W.H.Freeman and Company.
31. Good enough U, Genetics, Holt, Rinehart & Winston of Canada Ltd.
32. Gardner EJ, et al. Principles of Genetics. Wiley-India.
33. Maloy SR, et al. Microbial Genetics, Jones and Barlett Publishers.
34. Strickberger M, Microbial genetics, Prentice Hall India Learning private Limited
35. Goldstein Es, Lewin's Genes, Jones and Bartlett Publishers.
36. Wilson K and Walker J. Principles and Techniques of biochemistry and Molecular Biology. Cambridge University Press.
37. Nelson DL and Cox MM. Lehninger principles of Biochemistry, W.H.Freeman & Co.
38. Willey MJ, et al. Prescott, Harley and Klein's Microbiology. McGraw Hill.
39. Karp G. Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons. Inc.
40. De Robertis EDP and De Robertis EMF. Cell and Molecular Biology. Lipincott Williams & Wilkins, Philadelphia.
41. Cooper Gm and Hausman RE. The Cell: A Molecular Approach. ASM Press & Sunderland, Washington D.C.
42. Nigam A and Ayyagari A. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.