Syllabus for the GU-ART (Goa University Admission Ranking Test) for M.Sc. Marine Microbiology
(Approved in BOS held on 22.12.2021)

Introduction and history of Microbiology

Types and distribution of microorganisms, classification schemes, microscopy, theories of evolution and origin of life, Germ theory of diseases, aseptic surgery. Role of and their applications, types of associations: mutualism, commensalism, synergism, syntrophism, competition, antagonism, amensalism, parasitism, predation; symbiosis. Diversity in microbial cytology. Structure of eukaryotes and prokaryotes (Archaebacteria and Eubacteria) 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 organelles: nucleus, endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes, protein sorting and transport, cytoskeleton and cell movement, the plasma membrane. Signal transduction-receptors involved in signal transduction, extracellular matrix and cell interactions. Introduction to cell signalling: Components of various signalling pathways, downstream effects of signalling on cell adhesion, cellular differentiation, cell cycle and apoptosis. Stem cells and their applications.

Introduction to Biochemistry

Biomolecules and metabolic pathways - trioses, tetroses, pentoses, hexoses, optical isomerism, pyranose and furanose forms, alpha/beta forms, reducing sugars, disaccharides, glycosidic bonds, polysaccharides, storage (glycogen, starch), structural - cellulose. Principles of carbohydrate determination, qualitative and quantitative tests for carbohydrates, reducing sugar, non-reducing sugars. Concept of aerobic and anaerobic respiration, fermentation, major pathways in heterotrophs & regulation: EMP, HMP, ED pathway, TCA pathway, ETC, alcohol fermentation, Pasteur effect, mixed acid fermentations, linear and branched fermentative pathway. L & D forms, zwitterion, amphoteric nature, R - groups, naturally occurring amino acids and their detection by Ninhydrin method. Bonds and structures of proteins. Qualitative and quantitative protein determination, UV absorption, Biuret & Folin Lowry method. Fatty acids & triglycerides. Quantitative and qualitative tests of lipid determination, Purines & pyrimidines, nucleosides & nucleotides; principle of determination of DNA by diphenylamine and RNA by Orcinol methods. Enzymes, definition, protein nature, active site, specificity, holoenzyme, apoenzyme, coenzyme, cofactors, prosthetic group, monomeric, oligomeric and allosteric enzymes. Classification and nomenclature of enzymes, structures and specific activity of enzymes, factors affecting enzyme action. Mechanism of action of enzymes, activation energy, transition state, multienzyme complex,- pyruvate dehydrogenase, isozyme - lactate dehydrogenase. Types of mechanisms of solute transport: passive diffusion, facilitated diffusion, active transport, group translocation.

Techniques in Microbiology

Instruments in microbiology, Good Laboratory Practices (GLP) and biosafety, preparation of media (solid, liquid), preparation of slants and butts, Growth curve of *E. coli.*, motility, staining, dry and wet weight, biological methods. SPC (serial dilution, viable counts,

colony counts), MPN. pH (acidophiles, alkalophiles, neutrophils) temperature (psychrophiles, thermophiles, mesophiles) Oxygen (aerobic, micro-aerophilic, anaerobic), use of pre-reduced media (Thioglycolate, Robertson's cooked meat), anaerobic jar; other conditions: osmotic pressure (osmophiles, halophiles), hydrostatic pressure (barophiles). Nutritional types - phototrophs, chemotrophs & their subgroups. Autotrophs and heterotrophs. Types of culture media: synthetic, complex, enriched, enrichment, selective, differential, dehydrated solid and liquid. Buffers & their use in culture media. Definition of cell growth/population growth; generation time - definition & formulae, Bacterial growth curve, characteristics of growth phases; diauxic growth. 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; disinfection. Bright field microscope, mordants, fixatives and decolorizers, dyes, chromogen, chromophore, auxochrome, Gram staining, monochrome staining, negative staining.

Concept of ecosystems and the role of microbes in the environment.
Ecosystems - structure and functions, producers, consumers and decomposers, energy flow, ecological pyramids (numbers, energy, biomass), food chains and webs. Community structure: ecological succession, trophic structure-zonation and stratification. Habitat complexity (forest, grassland, desert, aquatic - ponds, streams, lakes, rivers, oceans, coastal zone, estuaries). 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.

Microbial Genetics
Chromosomes, 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. Types of RNA, electrophoretic separation of nucleic acids. Modes of replication - conservative, semi conservative (Meselson- Stahl experiment) and dispersive. Processes and enzymes involved in replication. Transcription in prokaryotes and eukaryotes, post-transcriptional modification - RNA splicing, formation of mRNA, RNAse H activity; Ribozyme, Operons. 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.

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