

S. Y. B. Sc. MICROBIOLOGY

MB – 211: MICROBIAL PHYSIOLOGY		
I.	Principles of instruments used in study of microbial physiology	
	Centrifugation techniques – Angular velocity, RPM Vs ‘g’ relations and ultracentrifugation and applications	3
	Chromatography techniques – Partition, adsorption, ion exchange, exclusion and affinity chromatography with applications	5
	Spectrophotometric techniques – UV and visible	3
	Electrophoretic techniques – agarose and polyacrylamide gel	3
	Radiobiological techniques – characters of radioisotopes, Autoradiography, radioisotope dilution technique and pulse chase experiments	2
	Manometric techniques – Warburg’s respirometer	2
II.	Bacterial Physiology	
	a. Metabolism, catabolism, anabolism, respiration, fermentation	2
	b. Glucose degrading pathways – Glycolysis, HMP, ED pathway, phosphoketolase pathway.	5
	c. Pyruvate oxidizing pathway – TCA (with emphasis on amphibolism	2
	d. Interconnectivity of pathways – carbohydrates, proteins, lipids, nucleic acids	2
	e. Concept of central and peripheral energy yielding pathways	1
	f. Oxidative phosphorylation and substrate level phosphorylation , chemiosmotic hypothesis of ATP formation	4
	g. Pathways for fermentation of ethanol and lactic acid - homofermentative and heterofermentative	2
III.	Enzymes	
	a. Enzymes, coenzymes, apoenzymes, prosthetic group and cofactors.	4
	b. Nomenclature & classification as per IUB (only class and sub-class).	2
	c. Properties – structure of active site: common amino acids at active site Models for catalysis – <ul style="list-style-type: none"> • Lock and key • Induced fit • Transition state. 	4
	d. Effect of pH & temperature, activators and inhibitors on enzyme	2

1. Conn E, Stumpf PK., Bruening G, Doi RH. (1987) *Outlines of Biochemistry* 5th Ed , John Wiley and Sons, New Delhi.
2. Moat AG. & Foster JW. (1988) *Microbial Physiology* 2nd Ed. John Wiley and Sons New York.
3. Nelson DL & Cox MM. (2005) *Lehninger’s Principles of Biochemistry*, 4th edition, W. H. Freeman & Co. NY
4. Prescott SC and Dunn CG, (1983). *Industrial Microbiology*, Reed G. AVI tech books.
5. Segel IH. (1997) *Biochemical Calculations* 2nd Ed., John Wiley and Sons, New York.
6. Voet D & Voet JG. (1995) *Biochemistry*, 2nd Ed.. John Wiley & sons New York.
7. Wilson K and Walker JM. (2005) *Principles and Techniques of Biochemistry and Molecular Biology*. 6th Edition. Cambridge University Press.

MB – 212: MICROBIAL GENETICS		
I.	DNA Structure	12
	a. Evidence for DNA as genetic material – Griffith’s experiment and Avery and MacLeod experiment, J. Cairn’s experiment	
	b. Structure of prokaryotic genome – bacterial nucleoid	
	c. Structure of B form, A form and Z form of DNA	
	d. Comparative account of different forms of DNA	
	e. Super coiling of DNA – Linking number, DNA topoisomerases and gyrases	
	Gene expression: Concept of gene and its expression(central dogma, concept of transcription and translation), Concept of genetic code	10
II.	DNA replication and mutations	
	a. Modes of DNA replication (Conservative, semiconservative and dispersive), Messelson and Stahl’s experiment	4
	b. Different mechanisms of DNA replication – semi-discontinuous, rolling circle, D-loop	6
	c. Mutation & natural selection – Spontaneous mutation, Mutations and reversions, Periodic selection, Fluctuation test, Replica plate technique	6
	d. Mutagenic agents and their action - Physical (U.V. rays), Chemical (Base analogues, HNO ₂ , Alkylating agents, Intercalating agents - acridine orange); Types of mutations by these mutagenic agents – base pair substitution, insertions, deletions, frame shift mutations	8

References:

1. Benjamin Lewin. (1994). Genes II. Oxford University Press
2. Benjamin Lewin. (2004) Genes VIII Pearson Education Inc. NJ
3. Friefelder D. (1995). Molecular Biology, 2nd Edn. Narosa Publishing House.
4. Gardner EJ, Simmons MJ and Snustad DP. (1991). Principles of Genetics. 8th Ed. John Wiley & Sons Inc.
5. Hayes William (1984). The Genetics of Bacteria and their Viruses, CBS pub, New Delhi.
6. Russel Peter. Essential Genetics. 2nd Edn, Blackwell Science Pub.
7. Stanier RY. (1985). General Microbiology. 4th and 5th Edn Macmillan Pub. Co. NY
8. Stent SG & Calender R. (1986). Molecular Genetics: An Introductory Narrative, 2nd Edition, CBS Publishers and Distributors, India.
9. Stricberger MW. (1985). Genetics. 3rd Edition Macmillan Pub. Co. NY.
10. Watson JD. (1987) Molecular Biology of the Gene, 4th Ed. The Benjamin Cummings Publishing Company Inc.

MB – 221: BACTERIAL SYSTEMATICS AND ANALYTICAL MICROBIOLOGY		
I.	a. Introduction to Bergey’s Manual of Determinative and Systematic Bacteriology b. Chemotaxonomy c. Numerical taxonomy d. Genetic basis of taxonomy <ul style="list-style-type: none"> i. G + C content ii. DNA homology iii. DNA hybridization iv. Base sequence similarity v. Use of 16s rRNA in classification 	16
II.	Mathematics for biologists <ul style="list-style-type: none"> a. Scales and variables(Continuous and discontinuous), circular scales, ratio scales and relative scatter b. Graphs and equations(– linear, logarithmic) , simple algebraic and differential equations and corresponding graphs, fitting equations to graphs c. Introduction to simple differentiations and integrations. 	12
III.	Biostatistics: (No descriptive questions to be asked in examination; only appropriate problems should be asked in the examination.) <ul style="list-style-type: none"> a. Introduction to concepts and applications b. Sources and collection of data – Experiments, Surveys, Records; Types of data – qualitative and quantitative c. Data sampling – simple random samples, systematic sampling, stratified data sampling, Multistage sampling, Multiphase sampling d. Data Tabulation - Frequency tables e. Diagrammatic presentation – Histograms, Frequency polygons, Line charts, Cumulative frequency charts, Scatter diagrams, Bar diagrams, Pie charts f. Measures of Central tendency: Mean, median, mode, percentile g. Measures of variability-range, standard deviation h. Concept of probability: probability of simultaneous and exclude events. i. Distribution – binomial and Poisson, j. Testing for mean, equality of mean, proportions, equality of proportions, Confidence interval 	20

1. Arya JA and Lardner RW. (1979) Mathematics for Biological Sciences. Prentice Hall Inc.
2. Bergey DH, Holt JG. (1994). Bergey's Manual of Determinative Bacteriology. 9th Edition. Lippincott Williams & Wilkins.
3. Garrity GM (2005). Bergey’s Manual of Systematic Bacteriology. 2nd Edition. (Vols. 1 – 4). Williams & Wilkins.
4. Glover T and Mitchell K. 2002. An introduction to Biostatistics. McGraw-Hill , N.Y.
5. Goon, Gupta and Dasgupta- Fundamentals of statistics. World Press, Kolkata.
6. Khan IA and Khanum A. Fundamentals of Biostatistics. 2nd Ed. Ukaaz Publications, Hyderabad.
7. Madigan MT, Martinko JM. (2006). Brock’s Biology of Microorganisms. 11th Edition. Pearson Education Inc.
8. Prescott LM, Harley JP, and Klein DA. (2005). Microbiology, 6th Edition. MacGraw Hill Companies Inc.
9. Priest FG & Brian Austin. (1993). Modern Bacterial Taxonomy. Edn 2, Springer.
10. Tortora GJ, Funke BR, Case CL. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc.

MB – 222: APPLIED MICROBIOLOGY – I		
I.	Air Microbiology	10
	a. Air flora - Concept of transient air flora, droplet, droplet nuclei, and aerosols	2
	b. Monitoring and control of air flora of i. Hospitals ii. Aseptic filling areas iii. Research laboratories iv. Industries – Food and Pharmaceutical	3
	c. Air pollution: Chemical pollutants and their sources in air	1
	c. Methods of Air sampling	2
	d. Air sanitation	1
	e. Air borne infections	1
	II.	Water Microbiology
a. Types of water: surface, ground, stored, distilled, mineral and de-mineralized water	1	
b. Water purification methods, Bacteriological standards of potable water (BSI & WHO)	2	
c. Indicators of faecal pollution; 1. <i>Escherichia coli</i> 2. <i>Bifidobacterium</i> 3. <i>Streptococcus faecalis</i> 4. <i>Clostridium perfringens</i> 5. New indicators: <i>Campylobacter</i> and <i>Pseudomonas</i>	2	
d. Bacteriological analysis of water for potability 1. Presumptive coliform count 2. Confirmed test 3. Completed test 4. Eijkman test 5. Membrane filter technique	5	
e. Sewage and Waste Water :		
1. Analysis of waste water : a. Physic chemical parameters: pH, temperature, total solids, suspended solids, Chemical Oxygen Demand(C.O.D.) b. Biological parameters: B.O.D., Toxicity (Fish bioassay)	3	
2. Methods of effluent treatment – Primary, secondary, tertiary treatment methods	2	
3. Recycling of waste water and sludge	1	
4. Industrial water pollutants, their ecological effects and health hazards (biomagnification and eutrophication)	2	
III.	Introduction to Industrial Microbiology	24
1. Strains of industrially important microorganisms: a. Desirable characteristics of industrial strain b. Principles and methods of primary and secondary screening c. Master, working and seed culture; development of inoculum	1 2 2	
2. Equipment: a. Design of a Fermenter (typical CSTR Continuous stirred Tank Reactor); different parts and their operation.	2	
3. Types of fermentations: Batch, continuous, fed-batch, dual fermentations	2	
4. Media for industrial fermentations: a. Constituents of media (laboratory and production scale) b. Sources and nutritional aspects. (Carbon source, nitrogen source,	2 8	

	amino acids and vitamins, minerals, water, buffers, antifoam agents, precursors, inhibitors and inducers	
5.	Sterilization of media and air:	
	a. Contamination : Sources, precautions, and consequences	1
	b. Sterilization of media- batch and continuous sterilization	1
	c. Sterilization by filtration (feed, air and heat labile supplements)	1
6.	Process Control and Monitoring of different fermentation parameters (temperature, pH, aeration, agitation, foam)	2

References:

1. Casida LE. (1984). Industrial Microbiology. Wiley Easterbs, New Delhi
2. Ingraham JL and Ingraham CA. (2004). Introduction to Microbiology. 3nd Edition. Thomson Brooks / Cole.
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5. Patel AH. (1985). Industrial Microbiology, Macmillan India Ltd.
6. Peppler HL (1979). Microbial Technology, Vol I and II, Academic Press.
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8. Salle AJ. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
9. Stanbury PF and Whittaker A. (1984) Principles of Fermentation technology. Pergamon press
10. Stanier RY. (1985). General Microbiology. 4th and 5th Edn Macmillan Pub. Co. NY

MB – 223: PRACTICAL COURSE BASED ON MB 211, 212, 221, 222	
1.	Growth curve Use absorbance measurement for bacterial culture and (Calculation of growth rate, specific growth rate and generation time)
2	Effect of salt, pH, temperature, heavy metals on bacterial growth
3	Determination of Decimal Reduction Time of a bacterial culture
4	Measurements of cell dimension by micrometry using all the objectives
5	Bacteriological tests of potability of water a. MPN , confirmed and completed test. b. Membrane filter technique for large volume samples.
6	Determination of B.O.D., total solids and total suspended solids
7	A)Biochemical characterization of bacteria a. Sugar utilization test (minimal medium + sugar) b. Sugar fermentation test c. IMViC d. Enzyme detection – Amylase, Gelatinase, Catalase, and Oxidase e. Oxidative-fermentative test B) Identification of Any Two bacterial isolates at least up to genus level.
8	Air Flora (Air sampling) Diversity calculations Simpson index, settling velocity determination
9	Preparation and printing of manuscript using MS-WORD and EXCEL
10	Compulsory visits to i. Water purification plant. ii. Sewage treatment plant/Effluent treatment plant iii. Fermentation industry
	N.B. 1. Visit report in the journal is mandatory. 2. Latest computer should be provided to the microbiology department. 3. 50% teaching of this practical course should be completed in Ist semester. 4. University examination will be held at the end of the IInd semester