Faculty of Science

S. Y. B. Sc.
MICROBIOLOGY
SYLLABUS

From- A.Y. 2014-15

Equivalence of previous syllabus along with revised syllabus from A.Y. 2014-15

S.Y.B.Sc. Microbiology

EQUIVALENCE

SEMI STER	PRESENT COURSE		Revised COURSE From A.Y.2014-15	
	COURSE CODE	**COURSE NAME**	**COURSE CODE**	**COURSE NAME**
I	MB: 211	Microbial Physiology	MB: 211	Bacterial Systematics and Physiology
	MB: 212	Microbial Genetics	MB: 212	Industrial and Soil Microbiology
II	MB: 221	Bacterial Systematics and Analytical Microbiology	MB: 221	Bacterial Genetics
	MB: 222	Applied Microbiology I	MB: 222	Air and Water Microbiology
	MB: 223	Practical Course based on MB:211, MB:212, MB:221, MB:222	MB: 223	Practical Course based on MB:211, MB:212, MB:221, MB:222

Note- Practical Examination will be conducted at the end of the Second Semester.

S. Y. B. SC. MICROBIOLOGY SYLLABUS (SEM I)

MB – 211: BACTERIAL SYSTEMATICS & PHYSIOLOGY		**[48]**
I	**BACTERIAL SYSTEMATICS**	**(15)**
	a. Concept of species	2
	b. Chemotaxonomy	4
	c. Numerical taxonomy	3
	d. Genetic basis of taxonomy i. G + C content ii. DNA hybridization iii. Base sequence similarity (Use of 16s rRNA databanks)	6
II	**BACTERIAL PHYSIOLOGY**	**(20)**
	a. Radioisotopes in the study of metabolic pathways i. Autoradiography ii. Phospher imaging iii. Pulse chase (tracer studies)	3
	b. Definitions of Metabolism, catabolism, anabolism, respiration and fermentation	1
	c. Metabolic pathways (with structures) EMP, HMP, ED, Phosphoketolase, Glyoxylate, TCA (with emphasis on amphibolism), Homofermentative and heterofermentative pathways	12
	d. High Energy Compounds, Electron transport chain, Oxidative phosphorylation and Substrate level phosphorylation , Chemiosmotic hypothesis of ATP formation, Concept of Standard redox potential (Nernst equation)	4
III	**BIOCATALYSTS**	**(13)**
	a. Introduction to Enzymes: Nature of active site, ribozymes, coenzymes, apoenzymes, prosthetic group and cofactors.	3
	b. Nomenclature & classification as per IUB (up to class level).	2
	c. Structure of active site; common amino acids at active site Models for catalysis – i. Lock and key ii. Induced fit iii. Transition state.	4
	d. Specific catalytic groups involved in enzyme catalyzed reactions: Acid-base catalysis, metal ion catalysis, covalent catalysis.	1
	e. Effect of pH & temperature, substrate concentration & enzyme concentration, activators and inhibitors of enzyme	3

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3. Nelson D. L. & Cox M. M. (2005) Lehninger's Principles of Biochemistry, 4th edition, W. H. Freeman & Co. NY (Unit II & III)
4. Voet D. & Voet J. G. (1995) Biochemistry, 2nd Ed.. John Wiley & sons New York. (Unit II & III)
5. Bergey D. H. & Holt J. G. (1994) Bergey's Manual of Determinative Bacteriology. 9th Edition. Lippincott Williams & Wilkins. (Unit I)
6. Garrity G. M. (2005) Bergey's Manual of Systematic Bacteriology. 2nd Edition. (Vols. 1 – 4). Williams & Wilkins. (Unit I)
7. Madigan M. T., Martinko J. M. (2006) Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc. (Unit I, II& III)
8. Prescott L. M., Harley J. P. and Klein D. A. (2005) Microbiology, 6th Edition. MacGraw Hill Companies Inc.(Unit II)
9. Priest F. G. & Brian Austin. (1993) Modern Bacterial Taxonomy. Edn 2, Springer. (Unit I)

	MB – 212: INDUSTRIAL AND SOIL MICROBIOLOGY (48)	
I	**INTRODUCTION TO INDUSTRIAL MICROBIOLOGY**	**(22)**
	a. Strains of industrially important microorganisms: i. Desirable characteristics of industrial strain ii. Principles and methods of primary and secondary screening iii. Master, working and seed culture; development of inoculum	 1 3 2
	b. Equipment: Design of a Fermenter (typical CSTR Continuous stirred Tank Reactor); different parts and their operation.	2
	c. Process Control and Monitoring of different fermentation parameters (temperature, pH, aeration, agitation, foam)	4
	d. Types of fermentations: Batch, continuous, dual fermentations	1
	e. Media for industrial fermentations: Constituents of media ((Carbon source, nitrogen source, amino acids and vitamins, minerals, water, buffers, antifoam agents, precursors, inhibitors and inducers)	8
	f. Contamination: Sources, precautions, and consequences	1
II	**SOIL MICROBIOLOGY**	**(26)**
	a. Soil microorganisms, composition and types of soil.	2
	b. Rhizosphere microflora and its role in the rhizosphere	1
	c. Role of microorganisms in composting and humus formation	2
	d. Biofertilizers: Bacterial, Cyanobacterial ,fungal and their large scale production	3
	e. Biocontrol agents: Bacterial, Viral, Fungal and their large scale production	3
	f. Role of microorganisms in following elemental cycles in nature Carbon, Nitrogen, Sulphur, Phosphorous.	8
	g. Degradation of cellulose, hemicelluloses, lignin and pectin	3
	h**.** Brief account of microbial interactions Symbiosis, Neutralism, Commensalism, Competition, Ammensalism, Synergism, Parasitism, and Predation	4

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2. Ingraham J. L. and Ingraham C.A. (2004) Introduction to Microbiology. 3nd Edition. Thomson Brooks / Cole.
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4. Modi H. A., (2008) Fermentation Technology – Volumes I and II, Pointer Publishers, Jaipur, India
5. Patel A.H. (1985) Industrial Microbiology, Macmillan India Ltd.
6. Peppler H.L. (1979) Microbial Technology, Vol I and II, Academic Press.
7. Prescott S.C. and Dunn C.G. (1983) Industrial Microbiology. Reed G. AVI tech books.
8. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
9. Martin A. Introduction to Soil Microbiology (1961) John Wiley& Sons, New York and London publication
10. Subba Rao N. S. (1977) Soil Microbiology, 4th Ed., Oxford & IBH Publishing Co. Pvt. Ltd.
11. Dubey R.C., and Maheswari, D.K. Textbook of Microbiology, S. Chand & Co.
12. Martin A. (1977) An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
13. Mexander M. (1977) Introduction to soil microbiology, John Wilery NY.
14. Dube H.C. and Bilgrami. K.S.(1976) Text book of modern pathology. Vikas publishing house. New Delhi.
15. Rangaswami G. (1979) Recent advances in biological nitrogen fixation. Oxford and IBH. New Delhi.
16. Stanbury P. F. and Whittaker A. (1984) Principles of Fermentation technology. Pergamon press

S. Y. B. SC. MICROBIOLOGY SYLLABUS (SEM II)

MB – 221: BACTERIAL GENETICS		**[48]**
I	**UNDERSTANDING MOLECULES OF HEREDITY**	**(10)**
	a. RNA world and shift to DNA world with time	1
	b. Discovery of transforming material (hereditary material): Griffith's experiment	1
	c. Evidence for nucleic acid as genetic material i. Avery and MacLeod experiment ii. Gierer and Schramm / Fraenkel-Conrat & Singer experiment (TMV virus) iii. Hershay& Chase experiment	3
	d. Prokaryotic genome organization	1
	e. Concept of Gene, basic structure of B form of DNA, Properties of nucleotides related with DNA stability	3
	f. Comparative account of different forms of DNA	1
II	**DNA REPLICATION AND EXPRESSION**	**(13)**
	a. DNA replication i. Messelson and Stahl's experiment (semiconservative) ii. Mechanisms of DNA replication: Theta model (semi-discontinuous), J Cairn's experiment, rolling circle model (plasmid DNA, λ phage DNA)	 2 5
	b. Gene organization and expression i. Properties of genetic code ii. Basic mechanism of transcription iii. Basic mechanism of translation	 2 2 2
III	**MUTATIONS AND REVERSIONS**	**(18)**
	a. Spontaneous mutations i. Occurrence and Mechanisms ii. Fluctuation test	2
	b. Mechanisms of induced mutations i. Base pair substitution (Transitions, Transversions), Base analogues (2amino purine, 5bromo uracil), HNO2, Alkylating agents (ethyl methyl sulphonate) ii. Frame shift mutations (Insertions and deletions), Intercalating agents (EtBr, acridine orange), Cross linking agents (Psorolin, mitomycin), UV rays, X rays, Biological mutagens (bacteriophage μ, transposomes)	10

	c. Types of mutations: Nonsense, Missense, Silent, Null, Conditional lethal-temperature sensitive, amber, leaky& non leaky	2
	d. Isolation of Mutants: Replica plate technique	1
	e. Reversion: i. True reversion ii. Suppression (intragenic and intergenic)	3
IV	**PLASMID GENETICS**	(7)
	a. Structure and Properties of plasmids	2
	b. Types of plasmids	1
	c. Plasmid replication	1
	d. Plasmid incompatibility	1
	e. Plasmid curing	1
	f. Plasmid amplification	1

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1. Benjamin Lewin (1994) Genes I. Oxford University Press
2. Friefelder D. (1995) Molecular Biology, 2nd Edn. Narosa Publishing House.
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4. Russel Peter. Essential Genetics. 2nd Edn, Blackwell Science Pub.
5. Stanier R.Y. (1985) General Microbiology. 4th and 5th Edn Macmillan Pub. Co. NY
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8. Watson J.D. (1987) Molecular Biology of the Gene, 4th Ed. The Benjamin Cummings Publishing Company Inc.

	MB – 222: AIR AND WATER MICROBIOLOGY (48)	
I	**AIR MICROBIOLOGY**	**(10)**
	a. Air flora i. Transient nature of air flora ii. Droplet, droplet nuclei, and aerosols	1
	b. Air pollution: Chemical pollutants, their sources in air and effects on human health	2
	c. Methods of Air sampling and types of air samplers i. Impaction on solids ii. Impingement in liquid iii. Sedimentation iv. Centrifugation v. Precipitation vi. Thermal Precipitation	4
	d. Air sanitation: Physical and chemical methods	2
	e. Air borne infections	1
II	**WATER MICROBIOLOGY**	**(38)**
	a. Types of water: surface, ground, stored, distilled, mineral and de-mineralized water	2
	b. Water purification methods, Bacteriological standards of potable water Maharashtra pollution control board (MPCB), Central pollution control board (CPCB), Bureau of Indian standards (BIS) World health Organization (WHO)	2
	c. Indicators of faecal pollution; i. *Escherichia coli* ii. *Bifidobacterium* iii. *Streptococcus faecalis* iv. *Clostridium perfringens* v. New indicators: *Campylobacter* and *Pseudomonas*	5
	d. Water borne Infections	3
	e. Bacteriological analysis of water for potability i. Presumptive coliform count ii. Confirmed test iii. Completed test iv. Eijkman test v. Membrane filter technique	6

	f. Sewage and Waste Water 1. Analysis of waste water i. Physic chemical parameters: pH, temperature, total solids, suspended solids, Chemical Oxygen Demand(C.O.D.) ii. Biological parameters: B.O.D., Toxicity (Fish bioassay) iii. Industrial water pollutants, their ecological effects and health hazards (Biomagnification and eutrophication) 2. Methods of effluent treatment – Primary, secondary, tertiary treatment methods 3. Recycling of waste water and sludge 4. Solid waste management i. Raw materials ii. Organisms involved and their activity iii. Biochemical mechanisms of Biomethanation. iv. Types of anaerobic digesters. v. Applications of biogas (Methane)	6 6 2 6

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2. Ingraham J.L. and Ingraham C.A. (2004) Introduction to Microbiology. 3nd Edition. Thomson Brooks / Cole.
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11. Standard Methods for the Examination of Water and Wastewater (2005) 21st edition, Publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF); edited by Andrew D. Eaton, Mary Ann H. Franson.

MB – 223: PRACTICAL COURSE BASED ON MB 211, 212, 221, 222 (27)		
1	Air sampling using an air sampler & calculation of air flora from different locations with the knowledge of respective standards of bacterial & fungal counts.	1
2	**Growth curve:** a. Absorbance measurement for bacterial culture b. Calculation of growth rate, specific growth rate and generation time c. Graph plotting by using computer software	2
3	**Measurements of cell dimension by micrometry using all the objectives**	1
4	**Bacteriological tests of potability of water** a. MPN, confirmed and completed test. b. Membrane filter technique (Demonstration)	 3 1
5	**Determination of B.O.D., total solids and total suspended solids**	2
6	**I. Biochemical characterization of bacteria:** a. Sugar utilization test (minimal medium + sugar) b. Sugar fermentation test c. IMViC d. Enzyme detection – Amylase, Gelatinase, Catalase, Oxidase e. Oxidative-fermentative test **II. Identification of Any Two bacterial isolates at least up to genus level from soil or air. (Preferably spore forming and pigmented bacteria).**	5 6
7	**Air Flora:** a. Diversity determination. b. Simpson index and settling velocity determination	**1**
8	**Primary screening of industrially important organisms:** a. Organic acid producing microorganisms OR b. Antibiotic producing microorganisms (crowded plate technique)	1
9	a. Induction of mutations by using physical mutagen (e.g. UV rays) and chemical mutagen (e.g.HNO_2) b. Isolation of mutants by any suitable method c. Demonstration of UV survival curve	3
10	**Visits to** a. Water purification plant/ b. Sewage treatment plant/Effluent treatment plant/ c. Fermentation industry	1

N.B.

1. Use semilog paper & computers both to plot the growth curve.
2. Visit report in the journal is mandatory.
3. Latest computer should be provided to the microbiology department.
4. 50% teaching of this practical course should be completed in Ist semester.
5. University examination will be held at the end of the IInd semester