T.Y.B.Sc. Microbiology Syllabus

Submitted on 13/4/2010

University of Pune

Equivalences for the old Courses with New courses in Microbiology

T. Y. B. Sc. Microbiology

Semester III				Semester IV			
New Course		Old Course		New Course		Old course	
Paper	**Course Title**	**Paper**	**Course Title**	**Paper**	**Course Title**	**Paper**	**Course Title**
MB 331	Medical Microbiology - I	MB 331	Medical Microbiology - I	MB 341	Medical Microbiology - II	MB 341	Medical Microbiology - II
MB 332	Genetics & Molecular Biology - I	MB 332	Genetics & Molecular Biology - I	MB 342	Genetics & Molecular Biology - II	MB 342	Genetics & Molecular Biology - II
MB 333	Enzymology	MB 333	Enzymology	MB 343	Metabolism	MB 343	Metabolism
MB 334	Immunology -I	MB 334	Immunology -I	MB 344	Immunology -II	MB 344	Immunology -II
MB 335	Fermentation Technology - I	MB 335	Fermentation Technology - I	MB 345	Fermentation Technology - II	MB 345	Fermentation Technology - II
MB 336	Food & Dairy Microbiology	MB 336	Food & Dairy Microbiology	MB 346	Soil & Agricultural Microbiology	MB 346	Soil & Agricultural Microbiology

Practical Courses

New Course		Old Course	
Paper	Course title	Paper	Course title
MB 347	Practical course – I Applied Microbiology	MB 347	Practical course – I Applied Microbiology
MB 348	Practical course – II Biochemistry & Genetics	MB 348	Practical course – II Biochemistry & Genetics
MB 349	Practical course – III Diagnostic Microbiology & Immunology	MB 349	Practical course – III Diagnostic Microbiology & Immunology

ATKT Rules-As earlier

Syllabus for T. Y. B. Sc. Microbiology

Course Structure: T. Y. B. Sc. MICROBIOLOGY Course includes 12 theory papers and 3 practical courses. Six theory papers will be taught in Semester III and the remaining six in Semester IV. The examination will be held semester-wise for theory paper whereas the examination for three practical courses will be held at the end of the Semester IV.

T. Y. B. Sc. Microbiology

Semester III				Semester IV			
Paper	**Course Title**	**Internal Marks**	**University Exam**	**Paper**	**Course Title**	**Internal Marks**	**University Exam**
MB 331	Medical Microbiology - I	10	40	MB 341	Medical Microbiology - II	10	40
MB 332	Genetics & Molecular Biology - I	10	40	MB 342	Genetics & Molecular Biology - II	10	40
MB 333	Enzymology	10	40	MB 343	Metabolism	10	40
MB 334	Immunology -I	10	40	MB 344	Immunology -II	10	40
MB 335	Fermentation Technology - I	10	40	MB 345	Fermentation Technology - II	10	40
MB 336	Food & Dairy Microbiology	10	40	MB 346	Soil & Agricultural Microbiology	10	40

Practical Courses

Paper	Course title	Internal Marks	University Examination
MB 347	Practical course – I Applied Microbiology	20	80
MB 348	Practical course – II Biochemistry & Genetics	20	80
MB 349	Practical course – III Diagnostic Microbiology & Immunology	20	80

For theory papers, External examination – 40 marks

MB – 331: MEDICAL MICROBIOLOGY - I		
I.	Introduction to infectious diseases of following systems : (common diseases, pathogens and symptoms, defence mechanisms) 1. Respiratory system 2. Gastrointestinal system 3. Kidney and Liver 4. Genital system 5. Central nervous system	10
II.	Study of following groups of bacterial pathogens (with respect to - Classification and biochemical characters, Antigenic structure, Viability characteristics, Pathogenecity, Pathogenesis, Laboratory diagnosis, Epidemiology, Prophylaxis and Chemotherapy): 1. Enteric pathogens (*E. coli*, *Shigella*, *Salmonella*, *Campylobacters*, *Vibrio*) 2. Pneumococci and *Neiserria* *3.* Pyogenic organisms – *Staphylococcus*, *Streptococcus*, *Pseudomonas* *4.* Spirochetes – *Treponema*, *Leptospira* *5. Clostridium tetani* and *Clostridium perfringens* *6. Bacillus anthracis* *7. Mycobacterium tuberculosis and Mycobacterium leprae* 8. Rickettsia	 8 6 4 4 2 2 2 2
III.	Epidemiology 1. Definition, scope and applications 2. Concepts of mortality and morbidity rates, incidence and prevalence 3. Disease distribution based on time, place and person 4. Case control and cohort studies – study design and application 5. Principle and methods – Clinical trials of drugs and vaccines (Randomized control trials Concurrent parallels and cross-over trials) 6. Epidemiology of infectious diseases – 1. Sources and reservoirs of infection 2. Modes of transmission of infections 3. Disease prevention and control measures	8

MB – 341: MEDICAL MICROBIOLOGY - II		
I.	Study of following groups of parasites (with respect to – Morphological characteristic, life cycle and classification, Viability characteristics, Pathogenecity, Pathogenesis, Symptoms, Laboratory diagnosis (serological diagnosis wherever applicable), Epidemiology, Prophylaxis and Chemotherapy): *1. Plasmodium* *2. Entamoeba* Study of following groups of fungal pathogens (with respect to – Morphological and cultural characteristics, Classification, Pathogenecity, Pathogenesis, Symptoms, Laboratory diagnosis, Epidemiology,	 2 2

	Prophylaxis and Chemotherapy): Systemic and topical fungal pathogens: *Candida, Aspergillus, Cryptococcocus, Microsporum* Study of following groups of viral pathogens (with respect to – Virion characteristics, Viability characteristics, Pathogenecity, Pathogenesis, Symptoms, Laboratory diagnosis (including serological diagnosis), Epidemiology, Prophylaxis and Chemotherapy): 1. HIV 2. Polio virus 3. Dengue virus 4. Hepatitis A and Hepatitis B viruses 5. Influenza virus 6. FMD virus 7. Rinderpest virus	4 2 2 2 2 2 2 2
II.	Chemotherapy	
	A. Introduction to chemotherapy: B. Desirable parameters of good chemotherapeutic agent (Selective toxicity, Bioavailibility of Drug, MIC, MBC, LD-50 value, Routes of drug administration	2 4
	C. Mode of action of antimicrobiol agents on a. Bacteria: i) Cell well (Beta lactams, cycloserine, bacitracin) ii) Cell membrane (Polymyxin, Monensin) iii) Protein synthesis (Streptomycin, Tetracyclin) iv) Nucleic Acids (Nalidixic Acid, Actinomycin D, rifamycin, Quinolines) v) Enzyme inhibitors (Trimethopreim, Sulfa drugs) b. Fungi (Griseofulvin, Nystatin) c. Viruses (acyclovir, zidovudine) d. Protozoa (metronidazole, mepacrine)	16
III.	Mechanism of drug resistance	4

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1. Tortora, G.J., Funke B.R., Case C.L, 1992. Microbiology: An introduction5th Edition, Benjamin Pub.Co. NY
2. Davis B.D. ,Debacco, 1990 Microbiology 4th edition, J.B. Lippincott Co. NY
3. Zinsser, W, 1976, Microbiology Edition, W.K Jklik, NY (for topic II)
4. Dey, N.C and Dey, TK. 1988, Medical Bacteriology, 14th Edition Allied agency.
5. Ananthnarayana, R. and C.E, Jayaram Panakar,1996 Text book of microbiology, 5th ition, Orient Longman.
6. Park and Park, Preventive and Social medicine.
7. David Greenwood, Antimicrobial Chemotherapy
8. Franklin, T.J and Snow, G,A. Biochemistry of Antimicrobial Action.
9. Mukherjee, K.L 1988 Medical Laboratory Technology,Vol III, 10th Edition, Tata Mc. Graw-Hill Pub Co
10. Roitt, P.I: Mims, C.J.,Medical Microbiology
11. Chakraborty,P.,2003 A textbook of Microbiology, 2nd Edition New Central Book Agency, India.

MB – 332: GENETICS AND MOLECULAR BIOLOGY		
I.	DNA Replication	
	C. DNA replication- Single replicon. Bidirectional movement of replication fork. Ori C, Prepriming, Priming reaction • DNA polymerases, DNA synthesis of leading, lagging strand • Okazaki fragments. • Termination- Ter sequence, Tus protein	5
II.	Prokaryotic Transcription and Operons	
	a. 1) Transciption of Bacterial DNA • Structure of a typical bacterial Promotor • Structure and role of RNA polymerase • Initiation, elongation and termination – Rho dependent and independent 2) Salient differences between prokaryotic and eukaryotic transcription.	8
	b. Concept of operon, Positive and negative control of operon c. Lac operon. Different mutants of Lac operon d. Arabinose operon e. Catabolite repression f. Tryptophan operon- attenuation control	8
III.	Prokaryotic translation Structure of m-RNA, t-RNA, Ribosomes and their role in translation Initiation, elongation, translocation and termination of protein synthesis	8
IV.	Genetics of Bacteriophages a. One step growth curve b. Doerman's experiment to understand intracellular development of phages in lytic cycle c. Lytic and Lysogenic cycle – detailed mechanism of switch over (in lambda) d. Bacteriophage mutants Plaque morphology, host range, conditional lethal (Ts and Am)	8
V.	Repair mechanisms a. Photoreactivation b. Excision repair c. Recombination repair d. Mismatch repair	5
VI.	Genetics of Fungi: Revision of - Mendelian laws, Eukaryotic cell cycle, Mitosis and Meiosis, Concept of Polyploidy a. Lifecycle of *N. crassa* mapping by tetrad analysis b. Parasexual cycle in *Aspergillus* and its significance	6

MB – 342: GENETICS AND MOLECULAR BIOLOGY		
I.	Gene transfer, Recombination and Mapping Techniques	
	A. Transformation • Discovery of transformation – Griffith's experiment • Role of com genes in development of competence in *S. pneumoniae* • Detailed Process of transformation in Gram positive (*S. pneumoniae*) and Gram negative bacteria (*H. influenzae*) • Factors affecting transformation process a. Competence b. Molecular weight of DNA c. Concentration of DNA	6
	B. Transduction i. Discovery of transduction – Lederberg and Tatum's experiment ii. Generalized transduction (mediated by P22phage) iii. Specialized transduction of (mediated by lambda phage – lambda d gal, lambda p bio, helper phage, double lysogen)	6
	C. Conjugation: i. Discovery of conjugation ii. Properties of F plasmid, "tra" operon iii. F^+, F^- conjugation process iv. Formation of Hfr stains v. Cross between Hfr, F^- cells ii. Formation of F' strains i. Cross between F', F^- cells	6
	D. Recombination i. Definition of recombination ii. Types of recombination iii. Homologous recombination (Holliday model) iv. Single strand assimilation in bacteria, role of Rec A, Rec BCD, Ruv system in homologous recombination v. Site specific recombination (Lambda phage) – role of Int, IHF, Xis vi. Models of recombination with examples a. Breakage and reunion b. Breakage and copying c. Copy choice	6
	E. Recombination mapping: i. Principals of mapping, recombination frequency, map unit. ii. Mapping of chromosome by- a. Co-transformation b. Co-transduction c. Conjugation (Interrupted mating experiment) d. Four on four test for *Streptomyces*	6
II.	Genetic Complementation a. Cis-trans test of genetic function b. Intercistronic (Tryptophan synthatase of *E.coli*) and Intracistronic complementation (rII locus of T4 phage)	2
III.	Bacterial Plasmids a. Structure and properties of plasmids b. Types of Plasmids	4

	c. Plasmid replication and incompatibility d. Amplification and Curing of Plasmid	
IV.	Genetic Engineering a. Concept of Genetic Engineering b. Restriction Enzymes c. Vectors used: Plasmids, Viral DNA, cosmid, phagmid, PACs, BACs, YACs, Expression vectors d. Recombinant DNA technology i. Cutting of DNA • 5' extension • 3' extension • Blunt ends ii. Joining of DNA by T4 and Lambda DNA ligase iii. Homopolymer tailing, Linkers, Adaptors.	8
V.	Basic Molecular Biology Techniques a. Isolation of plasmid DNA (Alkali lysis method) b. Agarose gel Electrophoresis c. Southern blot d. Northern blot e. PCR Technique	4

References:

1. Stricberger, M.W., 1985 Genetics, 3rd Edition Macmillan Pub. Co. NY.
2. Stanier, R. Y., 1985, General Microbiology, 4th Edition, and 5th Edn Macmillan Pub. Co.Ny
3. Hayes, William, 1984, The Genetics of Bacterial and their Viruses, CBS pub, New Delhi.
4. Russel, Peter, Essential Genetics, 2nd Edn, Blackwell Science Pub.
5. Primrose, S. B and Old. Principles of Gene Manipulation
6. Lewin Bengamin, 1994, Genes II, VII and VIII Oxford University Press
7. Stent. S.G.,m Calender, R, 1986, Molecular Genetics: An Introducctory Narrative, 2nd Edition, CBS Publishers and Distributors, India.
8. Friefelder, D., Molecular Biology, 2nd Edn 1995, Narosa Publishing House.
9. Watson. J.D, Molecular Biology of Gene.

MB – 333: ENZYMOLOGY		
I.	Enzymes	
	A. Structure of enzymes Methods to determine amino acid residues at active site Determination of the primary structure of enzyme	5
	B. Role of cofactors in metabolism Occurrence, Structure and biochemical functions of the following: • Nicotinic Acid (Niacin) and the pyrimidine nucleotides. • Riboflavin (Vit B2) and the flavin nucleotides • Thiamine (Vit B1) and Thiamine Pyrophosphate • Lipoic acid • Biotin and Biocytin • Pantothenic acid and coenzyme A Vit B6 group and its coenzymes • Folic acid and it's coenzyme forms • Metal ions	6
II.	C. Enzyme assays a. Principles of enzyme assays: Sampling methods and continuous assay. b.Suitable examples of assays: i. Spectrophotometric methods ii. Spectroflurometric methods iii. Luminescence methods iv. Electrode method v. Manometric methods vi. Radioisotope assay	4
III.	. Principles and Methods of Enzyme purification a. Methods of cell fractionation b. Principles of enzyme purification c. Methods of purification i. Based on molecular size ii. Based on solubility differences iii. Based on electric charge iv. Based on specific binding property and selective adsorption d. Criteria for purity-SDS-PAGE	8
IV	Immobilization of enzymes and whole cells Concept, methods of immobilization and applications	2
V	Characterization of enzyme: Determination of Molecular weight based on following methods: Ultracentrifugation, SDS-PAGE, gel filtration	4
VI	Enzyme Kinetics A. The concept and use of initial velocity B. The Michaelis Menton equation for the initial velocity of single substrate enzyme catalyzed reaction. Brigg's Haldane modification of Michaelis Menton equation. Michaelis Menton plot. Definition with significance of Km, Ks, Vmax.	10

	C. Transformation of the Michaelis Menton equation for plotting kinetic data. i. The Lineweaver and Burk plot ii. The Eadie Hofstee plot iii. The Hanes plot iv. The Eisenthal and Cornish Bowden plot D Enzyme Inhibitions: Kinetics of Inhibition	
VII	Metabolic Regulations i. Enzyme compartmentation at cellular level ii. Allosteric enzymes iii. Feedback mechanisms . iv. Covalently modified regulatory enzymes (e.g. Glycogen phosphorylase) v. Proteolytic activation of zymogens. vi. Isozymes concept and examples vii. Multienzyme complex e.g. Pyruvate dehydrogenase complex(PDH)	9

MB – 343: METABOLISM		
I.	Membrane transport mechanisms i. Passive transport-Diffusion, Osmosis, Facilitated transport ii. Active transport-Active transport systems in bacteria iii. Group translocation of sugars in bacteria iv. Ionophores : Mechanism and examples	6
II.	Bioenergetics i. Laws of thermodynamics ii. Concepts of free energy, entropy, high energy compounds ii. ATP structure and formation (substrate level and oxidative phosphorylation). Hypotheses of ATP formation, with special emphasis on chemiosmotic coupling. iii. Energetics of mitochondrial electron transfer chain	16
III.	Biosynthesis and Degradation A. Chemistry, concept of polymerization of macromolecules-Polysaccharides. (Starch, glycogen, peptidoglycan); Proteins, Lipids (fatty acids, triglycerides and phospholipids) and Nucleic acids. B. Degradation of macromolecules-polysaccharides (starch, glycogen),, fatty acids oxidation and proteins-urea cycle.	18
IV.	Bacterial Photosynthesis: i. Habitat and examples of photosynthetic bacteria ii. Oxygenic and Anoxygenic mechanisms iii. Photosynthetic apparatus iv. Cyclic and non-cyclic photophosphorylation, Calvin cycle	8

References:

1. Lehninger. A.L Principles of Biochemistrry 2nd edition 1993, CBS Publicatiopns

2. Cohn and Stumph. Outline od Biochemistry, 4th Edition 1976, Wiley Easterb, New Delhi.
3. Stainer. R.Y General Microbiology, 4th Edn, 1976 Macmillan Pub London
4. Stryer. L. Biochemistry, 4th Edn 1995, W.H. Freeman &Co. NY
5. William Foster, Enzymology
6. William & Wilson, Techniques in Biochemistry.
7. Hall & Rao- Photosynthesis
8. Practical Biochemistry- Principles & Techniques 4th Edn Editor Keith Wilson & John Walker.
9. Voet D and Voet J. Biochemistry 3rd edition 2004.John Wiley and Sons.
10. Doelle. Microbial metabolism.
11. Moat& Moat. Microbial Physiology.

MB – 334: IMMUNOLOGY – I		
I.	Classification of Immunity , Lines of Defense, Cells and Organs of Immune System	4
	1. Formation of blood cells	1
	2. Cells: Granulocytes structure and function - phagocytosis, mast cells, reticular and endothelial cells, macrophage function, dendritic cells, Lymphocytes – formation, subsets	5
	3. Organs: Primary lymphoid organs – a. Thymus – structure, thymic education, b. Bursa - function Secondary lymphoid organs – structure and function of spleen and lymph node, mucous associated lymphoid tissue; response of secondary lymphoid organs to antigen, lymphatic system and lymph circulation	 2 3
II.	Mediators of Immune System 1. Complement system: classical, lectin and alternate pathway, biological functions of complement activation 2. Inflammation, role of mediators in generation of cardinal signs and significance, role of complement system, kinin system and coagulation system in inflammation, Histamines as mediator of immune inflammation	 3 4
IV.	Antigens 1. Factors affecting immunogenecity 2. Antigenic determinants and haptens 3. Carriers, Adjuvants and biological response modifiers (Microbial and plant origin) 4. Thymus-dependent and thymus-independent antigens, Synthetic antigens, Soluble and particulate antigens, autoantigens, isoantigens	6
V.	Immunoglobulins 1. Structure of basic unit, chemical and biological properties 2. Characteristic of domain structure, functions of light and heavy chain domains 3. Antigenic nature of immunoglobulin molecules 4. Molecular basis of antibody diversity, immunoglobulin class switch over	 2 2 2 2
VI.	Hybridoma Technology and Monoclonal Antibodies 1. Preparation, screening and propogation of hybridomas secreting monoclonal antibodies 2. Applications of monoclonal antibodies	 2 1
VII.	Antigen- Antibody Interactions a. Antibody affinity and avidity b. Cross reactivity 1. Precipitation reactions: in fluid and in gel, immunoelectrophoresis Agglutination reactions: hemagglutination, bacterial agglutination, passive agglutination and agglutination-inhibition 2. Immunofluorescence techniques: direct and indirect, FACS 3. ELISA, biotin-avidin system 4. RIA 5. Western blot technique, Jerne's hemolytic plaque assay	9

MB – 344: IMMUNOLOGY – II		
I.	Major Histocompatibility Complex 1. Structure of MHC in man and mouse 2. Structure and functions of MHC class – I and class – II molecules 3. Polymorphism of MHC molecules 4. MHC antigen typing (microcytoxicity and mixed lymphocyte reaction)	5
II.	Cytokines (Interferons, Interleukins and TNFs) – Types and role in immune activation	3
III.	Generation of Humoral Response 1. Primary and secondary response kinetics, significance in vaccination programs 2. Antigen processing and presentation (MHC class I and class II restriction pathways), cell-cell interactions and adhesion molecules, response to super-antigens, role of cytokines in activation and differentiation of B-cells	 4 8
II.	Cell Mediated Immunity 1. Activation and differentiation of T cells 2. Mechanism of CTL mediated cytotoxicity, ADCC 3. Types of Grafts, Allograft rejection mechanisms – first set and second set rejection 4. Significance of CMI	8
III.	Immunohematology 1. Blood group antigen classification systems 2. Biochemistry of blood group substance of ABO system 3. ABO and Rh system, inheritance, Bombay blood group 4. Laboratory methods of blood group typing, Coomb's test 5. Medico-legal applications of blood groups 6. Blood banking practices, transfusion reactions	10
IV.	Public health immunology 1. Types of vaccines and antisera 2. Immunization schedules: principles and schedules in developing and developed countries	6
V.	Hypersensitivity 1. Immediate and delayed type hypersensitivity 2. Gell and Coomb's classification of hypersensitivity – outline of the mechanisms with examples	 2 2

Reference:

1) Anantnarayan R: 1996 Textbook of Microbiology, 5th Edition. Orient Longman
2) Roitt, I, M,: 1977: Essential Immunology, 8th Edn. Backwell science
3) Roitt I.M. 1977: immunology, 3rd Edn. Blackwell science.
4) Stities, Fudenberg, : 1984 Basic and immunology, 5ht Edn. Lange Medical Publication. USA.
5) Weir, D.M.:1983, Immunology, 5th Edn. Longman Singapore Pub.
6) Bowry, T.R...,:1984, Immunology Simplified, ELBS.

7) Janis Kuby: Immunology, W.H. Freeman & company, N. Y. 2nd Edn 1992 onwards.
8) P. M. Lydyard. A. Whelan and M. W. Fanger. 2000 Instant notes in Immunology. Viva Books Pvt. Ltd New Delhi.
9) Shiro Miwa. 1998 Atlas of Blood Cells. Bnykoto Co. Ltd Tokyo, Japan
10) A.V. Hoffbrand, J. E. Pettit, P.A.H Moss. 2001, Essential Hematology, 4th Edn, Blackwell Sceince Ltd London

MB – 335: FERMENTATION TECHNOLOGY – I		
I.	Strain Improvement: a. Objective of strain improvement b. Methods for strain improvement (selection of different types of mutants e.g. mutants with altered permeability, auxotrophic mutants, analogue resistant mutants with reference to primary and secondary metabolites	8
II	Media optimization: A) Classical approach (Full factorial search) B) Placket & Burman design C) Response Surface Methodology (RSM)	5
III.	Probes for process monitoring and control of fermentation parameters (temperature, pH, dissolved oxygen, agitation, foam, cell mass, CO_2, NH_3)	4
IV.	Scale-up and Scale-down a. Objectives of scale-up b. Levels of fermentation (laboratory, pilot-plant and production levels). c. Criteria of scale-up for critical parameters (aeration, agitation, broth rheology and sterilization) d. Scale-down	4
V.	Principles and operation of downstream processing: a. Cell disruption b. Filtration c. Centrifugation d. Liquid-liquid extraction e. Solvent extraction (distillation) f. Preparative ion exchange chromatography g. Drying	9
VI.	Quantitation of fermentation products Physicochemical, biological and enzymatic methods	5
VII.	Quality Control (QC) in fermentation processes: Principles of validation for pharmaceutical industry	3
VIII.	Tests used for quality assurance (QA) of finished product i. Sterility testing ii. Pyrogen testing iii. Ames test and modified Ames test iv. Toxicity testing v. Shelf life testing	5
IX.	Process economics Fermentation economics, Market potential Recurring and non recurring expenditure	3
	Introduction to Intellectual Property Rights (IPR)	2

MB – 345: FERMENTATION TECHNOLOGY – II		
I.	Concept of Good Manufacturing Practices (GMP), Good Laboratory Practices (GLP) and Standard Operating Practices (SOP)	2
II.	Large scale production of: (using submerged and solid substrate fermentation processes)	
	A. Extracellular metabolites	
	i. Ethanol and alcoholic Beverages (Beer and Wines)	6
	ii. Vitamins (B12 and Riboflavin)	4
	iii. Antibiotics (Penicillin and Streptomycin)	6
	iv. Amino acid - Glutamic acid	2
	v. Organic acids (Citric acid, Vinegar and Lactic acid)	6
	B. Enzymes (Amylase, Lipases, Esterases and Restriction enzymes)	6
	C. Vaccines (Polio, Tetanus and Rabies) and Immune sera	6
	D. Biomass based products i. Biopesticides (Thuricide and *Trichoderma*) ii. Yeast: SCP, Baker's and Distiller's yeast	 3 2
	E. Milk products: Cheese and Yogurt	3
	F. Microbial transformation products: Steroids	2

Reference Books:

1. Casida, L. E., 1984, Industrial Microbiology, Wiley Easterbs, New Delhi
2. Peppler, H. L 1979, Microbial Technology, Vol I and II, Academic Press.
3. Stanbury, P. F. and Whittaker, A. (1984) Prionciples of Fermentation technology, Pergamon press
4. Prescott. S.C and Dunn, C. G., 1983 Industrial Microbiology, Reed G. AVI tech books.
5. A. H. Patel. (1985), Industrial Microbiologu, Macmillan India Ltd.
6. Indian Pharmacopia and British Pharmacopia (Latest Edn).

MB – 336: APPLIED MICROBIOLOGY – II (FOOD AND DAIRY)		
I.	Dairy Microbiology	
	A. Milk: Definition, Composition and Types of Milk (skimmed, toned and homogenized. Concept of clean milk (as per National Dairy development Board (NDDB) norms.	2
	B. Microbial analysis of milk i. Microflora of raw milk. ii. Dye reduction test (using methylene blue and resazurin) iii. Total bacterial count. iv. Brucella ring test and tests for mastitis. v. Somatic cell count	5
	C. Spoilage of milk i. Succession of microorganisms in milk, leading to spoilage. ii. Color and flavor defects iii. Sweet curdling iv. Stormy fermentation v. Ropiness	5
	D. Pasteurization of milk i. Methods of Pasteurization – LTH, HTST, UHT ii. Phosphatase test for determination of efficiency of Pasteurization	5
II.	Food Microbiology	
	A. Food spoilage i. Chemical and physical properties of food affecting microbial growth (intrinsic and extrinsic factors) ii. Sources of spoilage causing micro-organisms iii. Spoilage of a. Meat and Poultry products b. Bread c. Fruits and Vegetables d. Eggs e. Canned fruits	3 3
	B. Food preservation i. Principles of food preservation ii. Use of chemicals and antibiotics in food preservation iii. Canning iv. Dehydration v. Thermal destruction of bacteria - Use of low temperature and high temperature. vi. Determination of TDP, TDT, D, F, and Z values. vii. Use of radiations Principles of Hazard Analysis and Critical Control Points (HACCP - ***Hazard Analysis and Critical Control Points) – transfered from Fermentation Technology course*** Introduction to Tetrapack technology	7
	C. Microbial food poisoning and food infection Food poisoning with reference to sources and prevention of the following: a. *Staphylococcus aureus*	9

	b. *Campylobacter* c. *Clostridium botulinum* d. *Aspergillus flavus*	
	D. Organisms causing food infection with reference to their sources and prevention of the following: i. *Salmonella* ii. *Vibrio parahemolyticus*	3
	E. Fermented foods i. Significance of fermented foods (increase in shelf life and probiotic) ii. Starter cultures for curd preparation and fermentation of idli batter	6

MB – 346: APPLIED MICROBIOLOGY – II (SOIL AND AGRICULTURE)		
I.	Soil Microbiology	
	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	1
	1. Carbon, Nitrogen, Phosphorus and Sulfur cycles in soil 2. Degradation of cellulose, hemicelluloses, lignin and pectin	12
II.	Plant Pathology	
	A. Classification of disease based on symptoms (with one example of each disease): canker, powdery mildew, downy mildew, rust. smut, wilt, spots, mosaic galls and rots	3
	B. Epidemiology of plant diseases	2
	C. Methods of plant disease control i. Eradication ii. Chemical control iii. Biological control (employing bacterial and fungal cultures) iv. Integrated pest management	5
III.	Bioinoculants	
	A. Biochemistry of symbiotic and non- symbiotic nitrogen fixation	2
	B. Phosphate solubilization and Potassium mobilization	2
	C. Methods of application (liquid and carrier based)	2
	D. Comparison of bioinoculants with chemical fertilizers	1
	E. Methods of preparation – liquid and carrier based	2
IV.	Anaerobic digesters (only UASB) i. Raw materials ii. Organisms involved and their activity iii. Cultivation of Methanogens iv. Biochemical mechanisms of gas production (Biomethanation) v. Applications of biogas (Methane)	8
V.	Microbial leaching of copper and iron from low grade ores	2
VI.	Bioremediation and bioagumentation of pesticides polluted sites	3

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1) De.S:1993. Dairy Bacteriology, Oxford University press, New Delhi.
2) Sukumar. De 1980. Qutlines of Dairy Technology Oxford University Press Delhi.
3) Ecles, C.H & Macy , combes, 1973, Milk and milk products, 4th Edn, TMH.
4) Frazier, W.C. and Westhoff, D.C. 1988 . Food Microbiology, 3rd Edn TMH.
5) Jay, James M. 1978. Modern food microbiology,'D' van. Nostrne. NY.
6) Banwari G. J. 1987 Basic Food microbiology, CBS Publisher and distributors, New Delhi.
7) Mexander .M. 1977 Introduction to soil microbiology, John Wilery NY.
8) Subarao, N.S. 1977. Soil Microorganisms. Oxford. IBH. New Delhi.
9) Dube. H.C. and Bilgrami. K.S.1976 Text book of modern pathology. Vikas publishing house. New Delhi.
10) Rangaswami. G. 1979. Recent advances in biological nitrogen fixation. Oxford and IBH. New Delhi.

MB – 347: PRACTICAL COURSE – 1: APPLIED MICROBIOLOGY		
1.	Screening and isolation of antibiotic producing organisms (actinomycetes using giant colony method).	2
2.	Isolation and identification of lactic cultures upto genus level	2
3.	Laboratory scale fermentation, estimation, product recovery and yield calculation of Ethanol / organic acid (*any one*).	3
4.	Quality assurance tests: A. Antibiotic and growth factor assay (agar gel diffusion technique) B. Sterility testing of non-biocidal injectables	 2 1
5.	MIC and MBC of antibacterial compounds	2
6.	Tests for milk and dairy products Phosphatase test; MBRT test; Test for mastitis; Milk fat estimation; Standard Plate Count (for either milk or any milk product such as milk powder), Somatic cell count	5
7.	Enrichment, isolation, preparation and application of bioinoculants (*Azo-rhizo*, blue green algae (cyanobacteria), phosphate solubilizer - any one). Soil analysis (NPK, moisture and pH)	4
8.	Isolation and identification of *Xanthomonas citri* from infected sample	1
9.	Microscipical examination of rust and smut infections of plants (Demonstration only)	1
10.	Slide culture technique for actinomyctes	1
11.	Visit to a Dairy / Fermentation industry / Agriculture college	1

MB – 348: PRACTICAL COURSE – 2: BIOCHEMISTRY AND GENETICS		
1.	Determination of absorption spectra and molar extinction co-efficient (colorimetry/spectrophotometry)	1
2.	Clinical Biochemistry Estimation of blood sugar, blood urea, serum cholesterol, serum proteins and albumin (*any three*)	3
3	Qualitative analytical tests for proteins and carbohydrates	2
4	Preparation of buffers	1
5	Paper chromatography	1
6	Quantitative biochemical techniques a. Estimation of total carbohydrates (Phenol-sulfuric acid / Anthrone method) b. Estimation of reducing sugar by DNSA method c. Estimation of proteins by Folin Lowry / Bradford method	3
4.	Enzyme production a. Screening of amylase producing organisms b. Production of amylase using these isolates c. Precipitation of amylase from fermentation broth d. Determination of specific activity of crude and purified amylase	5
5.	Isolation and enumeration of bacteriophage	2
6.	UV survival curve. Isolation of mutants by replica plate technique	2
7.	Bacterial DNA isolation and detection (Demonstration)	2
8.	Visit to a research institute involved in biochemical / biotechnology research	1

MB – 349: PRACTICAL COURSE – 3: DIAGNOSTIC MICROBIOLOGY AND IMMUNOLOGY		
1.	Clinical microbiology Physical, chemical and microscopic examination of clinical samples – urine, stool and pus. Isolation, identification of pathogens from clinical samples (urine, stool, pus) of *E. coli*, *Salmonella* spp., *Pseudomonas spp.*, *Proteus* spp., *Klebsiella* spp., *Shigella* spp., *Staphylococcus, Streptococcus* spp., etc. (for identification use of keys as well as Bergey's Manual is recommended) Antibiotic sensitivity testing of the isolates	5
2.	Study of growth characters of isolated pathogens on following media: Mannitoal salt agar, Wilson Blair agar, Salmonella Shigella agar, Glucose azide medium, Cetrimide agar, Tetrathionate broth, Selenite F broth and TSI agar	2
3.	Demonstration of permanent slides of following parasites: *i.* *Entamoeba histolytica* *ii.* *Ascaris* spp. *iii.* *Plasmodium* spp.	1
4.	Epidemiological survey Report including statistical analysis and graphical representation using computers	3
5.	Hematological tests: i. Blood group typing for ABO and Rh systems ii. Blood cross-matching iii. Estimation of hemoglobin (Acid hematin and cyanmethemoglobin method) iv. ESR and PCV determination, Calculation of haematological indices.	4
6.	Agglutination test (Widal test – rapid)	1
7.	Immunoprecipitation (Ouchterlony technique)	1
8.	White blood cell differential counts from peripheral blood	2
9.	Counting of blood cells using counting chambers	3
10.	Demonstration of egg incolution technique	1
11.	Demonstration of serum protein separation by electrophoresis	1
12.	Visit to blood bank	1

University of Pune

Equivalences for the old Courses with New courses in Microbiology

T. Y. B. Sc. Microbiology

Semester III				Semester IV			
New Course		Old Course		New Course		Old course	
Paper	**Course Title**	**Paper**	**Course Title**	**Paper**	**Course Title**	**Paper**	**Course Title**
MB 331	Medical Microbiology - I	MB 331	Medical Microbiology - I	MB 341	Medical Microbiology - II	MB 341	Medical Microbiology - II
MB 332	Genetics & Molecular Biology - I	MB 332	Genetics & Molecular Biology - I	MB 342	Genetics & Molecular Biology - II	MB 342	Genetics & Molecular Biology - II
MB 333	Enzymology	MB 333	Enzymology	MB 343	Metabolism	MB 343	Metabolism
MB 334	Immunology -I	MB 334	Immunology -I	MB 344	Immunology -II	MB 344	Immunology -II
MB 335	Fermentation Technology - I	MB 335	Fermentation Technology - I	MB 345	Fermentation Technology - II	MB 345	Fermentation Technology - II
MB 336	Food & Dairy Microbiology	MB 336	Food & Dairy Microbiology	MB 346	Soil & Agricultural Microbiology	MB 346	Soil & Agricultural Microbiology

Practical Courses

New Course		Old Course	
Paper	Course title	Paper	Course title
MB 347	Practical course – I Applied Microbiology	MB 347	Practical course – I Applied Microbiology
MB 348	Practical course – II Biochemistry & Genetics	MB 348	Practical course – II Biochemistry & Genetics
MB 349	Practical course – III Diagnostic Microbiology & Immunology	MB 349	Practical course – III Diagnostic Microbiology & Immunology

ATKT Rules-As earlier