Department of Microbiology

Periyar University

Periyar Palkalai Nagar

Salem - 636 011

M.Sc. Microbiology

Syllabus

(For the students admitted from 2013 – 14 onwards)

M.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM

REGULATIONS (w.e.f. 2013-2014)

1. CONDITIONS FOR ADMISSION

A. ELIGIBILITY CONDITIONS FOR ADMISSION

Candidate who has passed the B.Sc. degree in any Life Sciences [Microbiology / Applied Microbiology/ Industrial Microbiology/ Botany/ Plant Sciences and Plant Biotechnology/ Zoology/ Animal Science/ Applied Animal Science and Animal Biotechnology/ Biochemistry/ Bioinformatics/ Biology/ Life Sciences/ Home Science/ Food Science & Nutrition/ BSMS/BAMS/BUMS/Chemistry with Botany/ Zoology as Allied Subjects of this University or an Examination of any other University accepted by the Syndicate as equivalent there to shall be eligible for admission to M.Sc. Degree Course in Microbiology.

Candidate shall be admitted to the examination only if he/she has taken the qualifying degree in Science/ Medical subjects as mentioned after having completed the prescribed courses consisting of twelve years of study and has passed the qualifying examination.

B. METHOD OF SELECTION

Candidates have to appear for an **entrance examination** in the respective subjects to be conducted by the respective departments and thereafter an interview. The date, venue, and time of the entrance examination and interview will be notified to the applicants separately as soon as it is fixed.

2. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed course of study in a college affiliated to the University for a period of not less than two academic years, passed the examination of all the four semesters prescribed earning 90 credits (plus 2 credits for Human Rights) and fulfilled such conditions as have been prescribed therefore.

3. DURATION OF THE COURSE

The duration of the course is for two academic years consisting of four semesters.

4. EXAMINATIONS

There shall be four semester examinations: first semester examinations at the middle of the first academic year and the second semester examination at the end of the first academic year. Similarly, the third and fourth semester examinations shall be held at the middle and end of the second academic year, respectively.

5. COURSE OF STUDY AND SCHEME OF EXAMINATIONS

Semester	Paper code	Course	Hrs/ week	Credits	Marks		
					CIA	EA	Total
Sem - I	13MBC01	Core I - General Microbiology	7	5	25	75	100
	13MBC02	Core II - Immunology and Immunotechnology	7	5	25	75	100
	13MBC03	Core III - Pharmaceutical Chemistry and Microbiology	6	5	25	75	100
	13MBCE01	Elective -1	4	4	25	75	100
	13MBCP01	Core Practical I - General Microbiology & Immunology	6	4	40	60	100
Sem - II	13MBC04	Core IV - Medical Bacteriology and Virology	4	5	25	75	100
	13MBC05	Core V - Medical Mycology and Parasitology	4	5	25	75	100
	13MBC06	Core VI - Industrial Microbiology and Bioprocess Technology	3	5	25	75	100
	13MBCE02	Elective - 2	3	4	25	75	100
	13MBCS01	Supportive - 1	4	4	40	60	100
	13MBCP02	Core Practical II - Medical Bacteriology, Virology, Mycology and Parasitology	6	4	40	60	100
	13MBCP03	Core Practical III - Industrial Microbiology & Fermentation Technology	6	4	40	60	100
	12MBCI01	Internship	2 wks	-	40	60	100
Sem - III	13MBC07	Core VII - Molecular Biology and Microbial Biotechnology	4	5	25	75	100
	13MBC08	Core VIII - Microbial Nano-technology and Infectomics	4	5	25	75	100
	13MBC09	Core IX - Applied Microbiology	4	5	25	75	100
	13MBCS02	Supportive - 2	4	4	25	75	100
	13MBCP04	Core Practical IV: Molecular Biology and Biotechnology	6	4	40	60	100
	13MBCP05	Core Practical V: Food, Agriculture and Environmental Microbiology	6	4	40	60	100
		Value Education	2	-	40	60	100
Sem - IV	13MBC10	Core XI- Research Methodology, Biostatistics and Bioinformatics	6	5	25	75	100
	13MBCPR01	PROJECT	24	4	40	60	100
Total				**90**			**2200**

Elective courses

1. Biofertilizer and Biomanure Technology
2. Entrepreneurship in Microbiology
3. Microbial Nanotechnology
4. Disease Diagnosis Technology
5. Marine Microbiology
6. IPR, Biosafety & Bioethics

Supportive courses for other Departments

1. Entrepreneurship in Microbiology
2. Human Infectious Diseases & Diagnostics
3. Microbial Technology
4. Medical Laboratory Technology
5. Microbial Nanotechnology

Details of the Course

1. No. of courses
   (Core paper + Practical's) : 16
2. Elective - Major : 2
3. Supportive course -Non Major : 2
4. Internship : 1
5. Value Education : 1

SCHEME OF EXAMINATIONS

The scheme of examinations for different semesters shall be as follows:

Theory Paper External

Theory	:	75 Marks
		[Part A: 25 Marks (5 Ques) + Part B: 50 Marks (5 Ques)]
Internal	:	25 Marks
Total	:	100 Marks
Time	:	3 hours.

The following procedure will be followed for Internal Marks:

Theory Papers Internal

Best two tests out of 3	:	10 marks
Attendance	:	5 marks
Seminar	:	5 marks
Assignment	:	5 marks
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		25 marks

Practical	:	**40 Internal Marks**
Attendance	:	5 marks
Practical Test Best 2 out of 3	:	30 marks
Record	:	5 marks
Project		
Internal Marks	:	20 marks
Presentations Viva	:	20 marks
Project Report	:	60 marks
Break-up Details for Attendance		
Below 60%	:	No Marks
60% to 75%	:	3 Marks
76% to 90%	:	4 Marks
91% to 100%	:	5 Marks

6. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS:

(i) Candidates shall register their names for the First semester examination after the admission in the PG courses.

(ii) Candidates shall be permitted to proceed from the First Semester upto the Final Semester irrespective of their failure in any of the Semester Examination subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subject) Semester subjects.

(iii) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Syndicate from time to time.

Provided in case of candidate earning less than 50% of attendance in any one of the semester due to any extraordinary circumstance such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorized Medical Attendant (AMA), duly certified by the Principal of the College, shall be permitted to proceed to the next semester and to complete the course of study. Such candidate shall have to repeat the missed semester by rejoining after completion of final semester of the course, after paying the fee for the break of study as prescribed by the University from time to time.

7. PASSING MINIMUM

a) There shall be no Passing Minimum for Internal.

b) For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.

c) In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.

d) Grading shall be based on overall marks obtained (internal + external).

8. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who secured not less than 60% of aggregate marks (Internal + External) in the whole examination shall be declared to have passed the examination in the First Class. All other successful candidates shall be declared to have passed in Second Class. Candidates who obtain 75% of the marks in the aggregate (Internal + External) shall be deemed to have passed the examination in First Class with Distinction, provided they pass all the examinations (theory papers, practicals, project and viva-voce) prescribed for the course in the First appearance.

9. GRADING SYSTEM

The term grading system indicates a Seven (7) Point Scale of evaluation of the performances of students in terms of marks obtained in the Internal and External Examination, grade points and letter grade.

SEVEN POINT SCALE (As per UGC notification 1998)

GRADE	GRADE POINT	PERCENTAGE EQUIVALENT
`O' = Outstanding	5.50 – 6.00	75 – 100
`A' = Very Good	4.50 – 5.49	65 – 74
`B' = Good	3.50 – 4.49	55 – 64
`C' = Average	3.00 – 3.49	50 – 54
`D' = Below Average	1.50 – 2.99	35 – 49
`E' = Poor	0.50 – 1.49	25 – 34
`F' = Fail	0.00 – 0.49	0 - 24

10. RANKING

Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / Distinction.

Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the First Appearance due to the reasons as furnished in the Regulations under "Requirements for Proceeding to subsequent Semester" are only eligible for Classification.

11. PATTERN OF QUESTION PAPER:

PART – A (200 words): Answer All 5 Questions either or type 5 x 5 = 25 marks

PART – B (500 words): Answer All 5 Questions either or type 5 x 10 = 50 marks

12. APPEARANCE FOR IMPROVEMENT:

Candidates who have passed in a theory paper / papers are allowed to appear again for theory paper / papers only once in order to improve his / her marks, by paying the fee prescribed from time to time. Such candidates are allowed to improve within a maximum period of 10 semesters counting from his / her first semester of his / her admission. If candidate improve his marks, then his improved marks will be taken into consideration for the award of Classification only. Such improved marks will not be counted for the award of Prizes / Medals, Rank and Distinction. If the candidate does not show improvement in the marks, his previous marks will be taken into consideration. Candidate will be allowed to improve marks in the Practicals, Project, Viva-voce, Field work.

13. TRANSITORY PROVISION:

Candidates who have undergone the course of study prior to the academic year 2008 - 2009 will be permitted to appear for the examinations under those Regulations for a period of three years i.e., up to and inclusive of April / May 2012 Examinations. Thereafter, they will be permitted to appear for the examination only under the Regulations then in force.

M.Sc. DEGREE COURSE IN MICROBIOLOGY - SYLLABUS

CORE - I: GENERAL MICROBIOLOGY (13MBC01)

UNIT - I

Introduction – Development of microbiology and the early discoveries - Isolation of different types of bacteria – fungi – actinomycetes – cyanobacteria – protozoa. Preservation methods of microbes for storage and microscopy studies, culture collections. Sterilization and disinfection – physical and chemical methods for controlling microorganisms.

UNIT - II

Microbial taxonomy – definition and systematics, nomenclature rules and identification, hierarchical organization and the position of microbes in the living world classification systems – artificial and phylogenetic – dendogram. Whittaker's five kingdom approach. Major characteristics used in taxonomy – morphological, physiological, metabolic, genetic and molecular. Numerical and chemotaxonomy of microorganisms. Classification and salient features of bacteria according to Bergeys Manual of determinative Bacteriology. Modern classification of fungi - Ascomycetes (*Aspergillus*), Deuteromycetes (Candida), Zyomycetes (Mucor), Basidiomycetes (Agaricus), Acrasiomycetes (Dictyostelium), oomycetes (Saproleina), Myxomycetes (Ceratiomyxa).

UNIT - III

Bacteria: Morphological types: cell wall – cell walls of Gram negative, Gram positive, halophiles, L-forms and archaebacteria. Cell wall synthesis, capsule types composition and function. Cell membranes in eubacteria, archaebacteria and cyanobacteria – membrane functions, periplasmic space. Structure and function of flagella, cilia and pili, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. Reserve food materials – poly hydroxy butyrate, polyphosphates, cyanophycin and sulphur inclusions. Nuclear material – bacterial chromosomes and bacterial plasmids. Endospore types structure and functions. **Fungi**: cell wall – chemical composition and functions, membranes and their functions. **Algae**: Structure of algal cells – classification – reproduction and characteristics of chlorophyta (green algae) chrysophyta (golden-brown and yellow), green algae, diatoms, Euglenophyta (Euglenoids), Rhodophyta (Red algae), Cyanophyta, Xanthophyta, Phaeophyta (Brown algae) – Brief account of protozoans. Thraustochytrids – Morphological features and it's biotechnological potential.

UNIT - IV

Microbial respiration and fermentative pathway – respiratory metabolism – Embden Mayer Hoff pathway – ED pathway – Glyoxalate pathway – Krebs cycle – ETC – oxidative

and substrate level phosphorylation – TCA cycle – gluconeogenesis – Fermentation of carbohydrates – homo and hetero lactic fermentation. Cell division – endospore – structure and properties.

UNIT - V

Microbial Ecosystems – Principles of microbial ecology, Metabolic diversity – phototrophy, auxotrophy and lithotrophs. Microbial Habitat, Microbial ecosystems - Fresh water, soil, plant, hydrothermal vents, hot springs, volcano, Marine (Open oceans and Deep sea organisms), barophiles and space. Nutrient cycles – Nitrogen, Sulphur, Phosphorus and Iron, Animal – Microbial symbiosis, Plant – Microbial symbiosis - Microbial communications – Quorum sensing.

Reference:

1. Prescott LM, Harley JP and Klein DA (2003) Microbiology (5th Edition) McGraw Hill New York
2. Pelczar Jr, M.J.Chan, E.C.S and Krei N.R (1993) Microbiology McGraw Hill New York
3. Alexopoulus CJ and C. W. Mims (1993) Introductory Mycology (3rd edition) Wiley Eastern Ltd. New Delhi
4. Elizabeth Moore Landecker (1996) Fundamentals of the Fungi (4th edition) Prentice Hall International Inc, London
5. Holt, JS., Kreig NR., Sneath P.H.A and Williams S.T Bergeys Manual of Determinative Bacteriology (9th edition) Williams and Wilkins, Baltimore
6. Madian MT, Martinko JM and Parker J Brock TD (1997). Biology of Microorganisms (8th edition) Prentice Hall International Inc. London

Web Site Address

http://www.sheffcol.ac.uk/links/Science/Biology/Microbiology

http://www.cat.cc.md.us/courses/bio141/Labmanal/index.html

http://www.microbiologyonline.org.uk/links.html

http://www.bact.wisc.edi/Microtextbook/index.php

http://www.bris.ac.uk/vetpath/cpl/tut.html

http://www.bmb.leeds.ac.uk/mbiology/ug/ugteach/elect/elect.htm

http://www.kensbiorefs.com/Microbio.html

http://www.microbeworld.org/

CORE - II: IMMUNOLOGY AND IMMUNOTECHNOLOGY (13MBC02)

UNIT - I

History and scope of immunology; Lymphoid tissues and organs. Types of immunity: Innate and acquired, active and passive. Cell mediated immunity and Humoral immunity. Kinetics of antibody production – primary and secondary antibody response.

UNIT - II

Haematopoeisis. Ontogeny, origin, development and differentiation of immune cells. Clonal selection theory. B-lymphocytes and their activation. Thymus derived lymphocytes, Antigen presenting cells, mechanism of T-cell activation. T-helper and T-cytotoxic cells, Natural killer cells, Dendritic cells, Langerhan cells, Macrophages, Microphages. Phagocytosis process. Structure and functions of Class I and II molecules. Major Histocompatibility Complex.

UNIT - III

Immunoglobulins - structure, distribution and function. Generation of antibody diversity. Organisation and expression of immunoglobulin genes. Antigenicity: factors governing antigenicity. Antigen types, haptens, epitopes, adjuvants, carriers, bacterial, viral and tumour antigens, autoantigens, blood group antigens, T dependent, T independent antigens. Antigen antibody reactions. Factors governing antigen-antibody interactions: affinity, avidity, valency, cross reactivity.

UNIT - IV

The complement systems: mode of activation, classical, alternate and lectin pathway Transplantation immunity - Organ transplantation and HLA tissue typing. Introduction to autoimmune disorders and immunology of infectious diseases.

UNIT - V

Hypersensitivity reactions. Immunological tolerance. Immunosuppression. Immunotherapy. Hybridoma and monoclonals. Recombinant antibodies. DNA vaccines and Edible vaccines. Immunotechniques – ELISA, Immunoelectrophoresis, etc.

References

1. Roitt.I.M. (1998). Essential Immunology. Blackwell Scientific Publications, Oxford.
2. Abbas, A.K., Litchman, A.H., Pober. J.S. (1994) Cellular and Molecular Immunology. Second Edition. W.B.Saunders, USA.
3. C.V. Rao, (2002) An Introduction to Immunology. Narosa Publisihng House, India
4. K. R. Joshi, N.O. Osama (2000) Immunology, Agrobios Ltd, India.
5. Kuby Immunology (2002) by R.A. Goldsby, T.J. Kindt and B.A. Osborne, W.H. Freeman and Company, New York.

6. C.A. Janeway, P. Travers, M. Walport and M.J. Shlomchik(2001), Immunobiology: The Immune System in Health and Disease. Garland Publishing, USA.
7. Ivan M. Roitt and Peter J. Delves (2001) Essential Immunology, Blackwell Science Ltd. Oxford.
8. Stefan E. Kaufmann, Alan Sher and Rafi Ahmed (2002) Immunology of Infectious diseases , ASM Press, USA.
9. Peter Wood, (2001).Understanding Immunology University of Manchester, Pearson Education Lts, Essex.

Websites

http://www-immuno.path.cam.ac.uk/-immuno/part1.html

http://www.Iclark.edu/-reiness/immuno/lectures.html

http://www.hhmi.org/biointeractive/immunology/lectures.html

http://www.immuneweb.xxmc.edu.cn/immunology/immunology.html

CORE - III: PHARMACEUTICAL CHEMISTRY AND MICROBIOLOGY (13MBC03)

UNIT - I

Basic Chemistry concepts - Standard periodic table of the chemical elements - Atomic structure: Atom - Ion - Electron - Proton - Neutron - Atomic orbital - Molecular orbital - Chemical element - Valence - Atomic nucleus - Isotope. Bonding : Chemical bond - Ionic bond - Covalent bond - Metallic bond - Hydrogen bond - Intermolecular force - Dipole - Electron pair - Unpaired electron. Chemical formula - Structural formula - Mole - Stoichiometry - Chemical equilibrium - Reversible reaction - Electrophile - Nucleophile - Redox.

UNIT - II

Chemial composition of cells – Macromolecular components of the cell – Structural conformation and Biological functions of Macromolecules. Carbohydrates – Monomers, Oligomers, Polymers, Isomers. Lipids – simple lipids, compound lipids and derived lipids. Proteins – Primary, Secondary, Tertiary and Quaternary structures. Nucleic acids – DNA & RNA. Nucleosides, Nucleotides, Complimentarity of nucleic acid strands. Homomacromolecules and Heteromacromolecules. Classification and uses of Vitamins.

UNIT - III

Microbial pharmaceutics – Mechanism of action of anti - microbials. General properties and drug action of Sulphonamides. Antibacterial chemicals – Bactericidal and bacteriostatic agents. Antibiotics - Penicillin, Chloramphenicol, Tetracyclin. Therapeutical agents against fungal diseases. Antiviral agents. Therapeutical agents against medically important parasitic diseases. Quality for medicines and formulations - British Pharmacopoeia and Indian Pharmacopoeia.

UNIT - IV

Pharmacokinetics and Pharmacodynamics - Routes of drug administration- volume of distribution – biotransformation – phase I and phase II reactions – bioavailability – excretion of drugs and their metabolites as defined by Hendersson hassle batch equation. Drug physical and chemical actions – drug interactions – therapeutic applications of beneficial interactions. Adverse drug reactions. Principles of toxicity, evaluation and determination of LD 50, ED 50 and Therapeutic Index.

UNIT - V

Techniques in pharmaceutics – Physical, chemical and biological screening methods to check drug purity. Extraction and purification procedure for drugs. Evaluation of the drug before marketing for drug safety and biomedical potential. Applications of drug evaluation in biological fluids. Indian medicinal plants and trees. Medical importance of magnesium, aluminium, phosphorus, silver, gold and iron.

References

1. Gajapathy, D. and Sasikala Amarasurya, 1995. Pharmaceutical chemistry. R.T.Publications, Vellore. 194pp.
2. Lakshmi. S. Pharmaceutical chemistry, 1st edition. 1995. Sultan Chand and Sons Publications, New Delhi. 212ppext Books
3. Satoskar R.S. and S.D. Bandarkar, 1989, Vol I and II. 11th edition
4. Marine Biotechnology Vol I. Pharmaceutical and Bioactive Natural Products (1993) Edited by D.H. Attaway and O.R. Zaborsky, Plenum Press, USA
5. Highlights of Marine Natural Products Chemistry (1972-1999). D. J. Faulkner, Natural Products Report, 2000, 17, 1-6
6. Marine Pharmacology. D. J. Faulkner, Antonie van Leeuwenhoek, 2000, 77, 135-145
7. Biosynthesis of Marine Natural Products: Microorganisms and Macroalgae. B. S. Moore, Natural Products Report, 1999, 16, 653- 674
8. Marqquis JK (authour). Contemporary issues in pesticide toxicology and pharmacology. London S Karger, 1986.
9. Ghosh MN (Ed.). Fundamentals of experimental pharmacology (2nd edn.). Scientifica book agency, Calcutta, 1984.
10. Rang HP, Dale MM, Ritter JM (Eds.). Pharmacology (4th edn.). Churchill Livingstone, New York, 1999.
11. Cooper JR, Bloom FE, Roth RH (Eds.). The biochemical basis of neuropharmacology (8th edn.). Oxford University Press, Chennai, 2003.
12. Purohit, S.S., 2003. Phamaceutical microbiology. 596.pp

Websites

http://www.chemlin.net/chemistry/pharmaceutical_chemistry.htm

http://www.internetchemie.info/chemistry/pharmaceutical-chemistry.htm

http://web.chem.ucla.edu/~harding/orglinks.html

http://en.wikipedia.org/wiki/H3_Pharmaceutical_Chemistry

http://ibchem.com/IB/ibfiles/options/opt_B/opb.htm

PRACTICAL - 1

PRACTICAL EXAM : 7 HRS / DAY; 2 CONSECUTIVE DAYS

CORE PRACTICAL I: GENERAL MICROBIOLOGY & IMMUNOLOGY (13MBCP01)

General Microbiology

UNIT-I

Direct microscopic observations of bacterial shape – simple, gram staining, acid-fast, metachromatic granular staining, spore staining, capsule staining, flagella staining,

LPCB staining, yeast budding, germ tube.

UNIT-II

Measurement of size of microbes – micrometry method, motility determination – hanging drop method.

Enumeration of bacterial / yeast cells viable count (pour plate and spread plate), total count (haemocytometer count), fungal slide culture technique.

Measurement of growth – growth curve, Determination of growth rate and generation time. Effect of pH, temperature and osmotic pressure on growth of bacteria.

UNIT-III

Biochemical tests: carbohydrate fermentation, IMVIC tests, starch hydrolysis, cellulose, gelatin, casein, catalase test, oxidase test, urease test, nitrate reduction, TSI.

UNIT-IV

Immunology

1. ABO Blood grouping – Rh typing and cross matching
2. Agglutination tests

   WIDAL, RA, ASO, CRP, Beta-HCG, TPHA and RPR
3. Precipitation
   a. Ouchterlony's Double Immuno-diffusion test,
   b. Counter Immunoelectrophoresis,
   c. Rocket Immunoelectrophoresis.

UNIT-V

1. VDRL 2. Isolation of buffy coat

Text Books

1. Sundaraj T, Mrs. Aswathy Sundararaj. (2002) Microbiology Laboratory Manual, First edition, Chennai.
2. Dubey, R.C. and Maheshwari, O.K. (2005) Practical Microbiology. S, Chand and Co.Ltd., First edition. New Delhi.
3. Baron E J and Finegold S M. (1995). Diagnostic Microbiology. Blackwell Scientific Systems.
4. An Introduction to Immunology (2002) by C.V. Rao, Narosa Publisihng House, India
5. Immunology (2000) by K. R. Joshi, N.O. Osama, Agrobios Ltd, India.
6. Manual of Clinical Laboratory Immunology (2002) Edited by N. R. Rose, R. G. Hamilton and B. Detrick, ASM Press.

Reference Books

1. Cappuccino, J and Sherman, N. (2002) Microbiology. A Laboratory Manual . 6th Edition. Pearson Education Publication, New Delhi.
2. Celis, V.E . (1994) Cell Biology Vol I to III .
3. Hand book of Experimental Immunology Vol.I & II (1986) by Weir, D.M. Blackwell Scientific Company.
4. Immunochemistry (Vol. IV) Publication, Chicago
5. Immunology (2000) Janis Kuby fourth edition, W H Freeman Company, USA
6. Essential Immunology (1997) Ivan Roitt (Blackwell Science Publishers, UK,
7. A Hand Book of Practical Immunology (1983) GP Talwar ,Vikas Publishing House, India.

Web sites

http://www.sheffcol.ac.uk/links/Science/Biology/Microbiology

http://www.cat.cc.md.us/courses/bio141/Labmanal/index.html

http://www.microbiologyonline.org.uk/links.html

http://www.bact.wisc.edi/Microtextbook/index.php

http://www.bris.ac.uk/vetpath/cpl/tut.html

http://www.bmb.leeds.ac.uk/mbiology/ug/ugteach/elect/elect.htm

http://www.kensbiorefs.com/Microbio.html

http://microbiology.mtsinai.on.ca/manual/default.asp

CORE - IV: MEDICAL BACTERIOLOGY AND VIROLOGY (13MBC04)

UNIT - I

Microscopic appearance and Colony characteristics of different bacteria. Various Synthetic and Non – synthetic media for bacterial cultivation. Applications of basal, Differential, Enriched and Selective media in bacterial growth. Different forms of media and their use – Broth tubes, Slants, Stabs, Plate media. Pure culture techniques – Streak plate, Pour plate, Spread plate, Micromanipulator. Anaerobic culturing techniques – Roll tube method, Robertson's cooked meat medium, Candle jar method, Mc Intosh jar. Maintenance and preservation techniques – Refrigeration, Freeze drying, Oil overlaying, Periodic transfers.

UNIT - II

Gram Negative bacteria - The epidemiology, pathogenesis, symptoms, diagnosis and treatment of infections caused by medically important pathogenic species of bacteria belonging to the genus – Escherichia, Klebsiella, Proteus, Salmonella, Shigella, Vibrio, Pseudomonas, Brucella, Bordetella, Neisseria, Leptospira, Ricketsia, Chlamydia and Mycoplasma. Indigenous normal microbial flora of human system and their importance. Virulence factors of pathogenic bacteria.

UNIT - III

Gram positive bacteria – The epidemiology, pathogenesis, symptoms, diagnosis and treatment of infections caused by medically important pathogenic species of bacteria belonging to the genus – Staphylococci, Streptococci, Enterococci, Corynebacterium, Mycobacterium, Bacillus and Clostridium. Collection and lab processing of clinical specimens – Urine, Sputum, CSF, Blood Pus and Stool. Hospital waste disposal – Nosocomial infections – Functions of Hospital Infection control and related ethical committee.

UNIT - IV

Discovery, Nomenclature and Classification of virus. Life cycle of Bacteriophage - Lytic and Lysogenic cycles. Definitions – Lysogen, Prophage, Temperate phage, Viroids, Virusoids, Satellite RNAs, Prions. Morphology and distinctive properties of phages – T4, Lambda, M13 & PI. Bacteriophage typing and its applications. Comparison of multiplication of bacteriophages and animal viruses. Morphology, transmission and infection process of plant viruses – Tobacco masaic virus and Cauliflower mosaic virus.

UNIT - V

Clinical virology – Grouping of animal viruses based on Baltimore system of classification. Epidemiology, lifecycle, pathogenicity , diagnosis, prevention and treatment of human viral infections caused by animal viruses – Pox virus, Parvo virus, Reo virus, Retro virus, Hepadna virus. Zoonotic viral infections – Rabbies, Yellow fever, Pappataci fever. Newly emerging viral diseases in Asia – SARS, Swine Flu, Hepatitis C, Hepadna Pulmonary Syndrome, Dengue fever, Chicken kunya.

Reference Books

1. Morag, C. and Timbury, M.C. (1994) *Medical Virology*, 10th Edn. Churchill Livingston, London.
2. Dimmock, N.J. and Pimrose, S.B. (1994) *Introduction to Modern Virology*, 4th Edn. Blackwell Scientific Publications, Oxford.
3. Conrat, H.F., Kimball, P.C. and Levy, J.A. (1994) *Virology*, 3rd Edn, Prentice Hall, New Jersey.
4. Flint, S.J., Enquist,L.W., Krung,R. Racaniello,VR. And Skalka,A.M. (2000). Principles of Virology,Molecular Biology,pathogenesis and control,ASM Press, Washinton D.C.
5. Maloy SR,Cronan Jr.JE, Freifelder D. (1998). Microbial genetics. Jones and Bartlett publishers.
6. Robert G. Welstar and Allan Garnoll. Encyclopaedia of Virology (1994). Vol. I, II &III Academic Press inc. San Diego, CA 92101. Ed.
7. Tom Parker,M., Leslie H. Collier. (1990). Topley &Wilson's Principles of Bacteriology,Virology and Immunity (VIII Edition).
8. Greenwood, D., Slack, R.B. and Peutherer, J.F.(2002) *Medical Microbiology*, 16th Edn. Churchill Livingstone, London.
9. Finegold, S.M. (2000) *Diagnostic Microbiology*, 10th Edn. C.V. Mosby Company, St. Louis.
10. Ananthanarayanan, R. and Jayaram Panicker C.K. (2004) *Text book of Microbiology*. Orient Longman, Hyderabad.
11. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Eds) (1994) *Methods for General and Molecular Bacteriology.* ASM Press, Washington, DC.
12. Topley and Wilson (1995) *Principles of Bacteriology Virology and Immunity*. 9th Edn. Vol I, Edward Arnold, London.

Web sites

1. http:// www.virology.net/garryfavwebaids.html
2. http:// www. virology.net/garryfavwebaids.html≠genaids
3. http:// www.bcm.edu/pedi/infect/dvl/links.htm
4. http://users.ox.ac.uk/-genemed/virology.htm
5. http:// www.bact.wisc.edu/bact330
6. http:// www-micro.msb.le.ac.uk/224/
7. http:// www.cellsalive.com/ecoli.htm
8. http:// www.bact.wise.edu/microtextbook/
9. http:// www. Pitt.edu/-super1/lecture/lec4771/
10. http:// www.textbook of bacteriology.net/

CORE - V: MEDICAL MYCOLOGY AND PARASITOLOGY (13MBC05)

UNIT - I

Basics of fungi - Morphology and classification of medically important fungi, Isolation Identification, and Transport of fungal specimens - Antifungal agents - sensitivity test – NCCLS guidelines for antifungal testing - Agar & Broth dilution methods, mycotoxins and mushroom poisoning - Types and Effects.

UNIT - II

Superficial mycosis - Tinea, Piedra. Cutaneous mycosis - Dermatophytosis. Subcutaneous mycosis - Sporotrichosis, Mycetoma, Systemic mycosis Blastomycosis and Histoplasmosis. Opportunistic mycosis - Candidiasis, Cryptococcosis and Aspergillosis. Emerging fungal diseases - Zygomycosis, candidemia

UNIT - III

Ocular Mycology - Fungal keratitis, Endophthalmitis, - causative agents - Therapy, orbital fungal infections - Phycomycetes (Mucor & Rhizopus), Aspergillus, Ocular histoplasmosis - causative agent, therapy, Diagnosis of fungal infections of the eye - culture and molecular methods. Dental Mycology – Anaerobic dental plaques- Dental hygine, Microbial flora of oral cavity, oral fungal infections - Oropharyngeal candidiasis, invasive fungi - Mucormycosis, Allergic fungal sinusitis - aetiology, diagnosis, treatment and prognosis.

UNIT - IV

Parasitology introduction and classification. Sarco Mastigophora – Sarcodina - Intestinal amoeba – *Entamaeba histolytica*. Free living amoebae – *Naegleria fowleri, Acanthamoeba* spp. Mastigophora – Intestinal and genital flagellates – Giardia, Trichomonas. Blood and tissue flagellates – *Leishmania donovani, Trypanosoma cruzi* and *T. brucei* complex. Apicomplexa – Haemosporina – Malarial Plasmodium, Coccidian – Toxoplasma, Cryptosporidium. Ciliates – *Balantidium coli*.

UNIT - V

Helminthology – Cestodes – *Taenia solium, Taenia saginata, Echinococcus granulosus*. Trematodes – *Schistosoma haematobium, Faciola hepatica, Faciola buski, Paragonimus westermani*. Nematodes – *Trichuris trichura*, Intestinal nematode - *Ancyclostama duodenale, Enterobius vermicularis, Ascaris lumbricoides*. Filarial nematode - *Wucheriria bancrofti, Onchocerca volvulus*. Extra intestinal nematodes – *Dracunculus medinensis, Trichinella spiralis*.

References

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CORE - VI: INDUSTRIAL MICROBIOLOGY AND BIOPROCESS TECHNOLOGY (13MBC06)

UNIT - I

An Introduction on fermentation process - The range of fermentation process – Microbial Biomass, Microbial enzymes, Microbial metabolites and Recombinant products, chronological development - component parts of fermentation process - fermentation economics.

UNIT - II

Industrially important microorganisms - Isolation, preservation and improvement of strains – handling, media for industrial fermentation – formulation and sterilization, development of inoculum for various fermentation processed upstream processing.

UNIT - III

Fermentor design - Body construction, individual parts, heat production - gas liquid exchange - mass transfer - heat transfer - oxygen transfer - stirring and mixing - Newtonian, non Newtonian fluids - effect of viscosity - scale up - control of temperature, pH, form pressure - Sterilization of Bioreactors and nutrients, computer application in fermentation technology.

UNIT - IV

Fermentation types - submerged and solid state fermentation - down stream processing - Recovery of intracellular and extra cellular products - Biomass separation by centrifugation, filtration, flocculation and other recent developments, Cell disintegration - physical, chemical and enzymatic methods. Extraction - solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods, Concentration by precipitation, ultra filtration, reverse osmosis. Drying and crystallization.

UNIT - V

Bioprocess Technology – An introduction, Microbial Products - Organic acids - amino acids, Antibiotics, Enzymes, Vitamins, Alcoholic beverages - wine and beer, Fermented foods - bread, cheese, soy nance. Recombinant Products - insulin, interferon and growth hormone, Fermentation products from natural wastes – molasses, starch wastes and cellulosic wastes. Microbial transformations - steroids and sterols, non steroid compounds - antibiotics and pesticides.

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1. Stanbury, P.F., Whittaker, A. and Hall, S.J., 1995. Principles of fermentation technology, 2nd edition, Pergamon press.
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PRACTICAL - 2

PRACTICAL EXAM : 7 HRS / DAY; 2 CONSECUTIVE DAYS

CORE PRACTICAL - II: MEDICAL BACTERIOLOGY, VIROLOGY, MYCOLOGY AND PARASITOLOGY (13MBCP02)

UNIT - I

Collection and transport of clinical specimens – Pre requisites – Proforma – Methodologies. Direct examinations – wet films/staining for Faeces (*V.cholerae, Shigella, Salmonella*) Pus, Sputum, throat/ear/nasal/wound swabs, CSF and other body fluids. Simple, differential and special staining methods.

UNIT - II

Cultivation methods – Transport media – Isolation methods – Basal, Differential Enriched, selective media & special media for the pathogenic bacteria. Biochemical identification tests for the respective bacteria up to species level. Antibiotic sensitivity tests - Kirby Bauer method – Dilution – Agar dilution & Broth dilution – MIC – Quality Control for antibiotics and standard strains.

UNIT - III

KOH preparation of skin / nail scrapings for fungi and for scabies mites, Hair infected under UV light. LPCB mount. Special stains for fungi – Gomori, PAS and Methanamine silver stain for sections. Cultivation of fungi and their identification – Mucor, Rhizopus, Aspergillus, Penicillium, Candida, Trichophyton, Microsporum, Epidermophtyon – SDA / corn meal agar. Slide culture method – Germ tube method – Sugar assimilation/fermentation tests for yeast.

UNIT - IV

Examination of parasites in clinical specimens – ova/cysts in Faeces – Direct and concentration: methods – Formal Ether and Zinc sulphate methods – Saturated salt solution method. Blood smear examination for malarial parasites. Thin smear by Leishman's stain.

UNIT - V

Isolation and characterization of bacteriophage from natural sources – phage titration – T4. Study of virus infected plants – Animal tissue culture – chick embryo isolation – fibroblast culture – preparation (demonstration). Spotters of viral inclusions and CPE – stained smears. Viral serology – HAI - ELISA kits, Western Blotting.

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http:// cal.vet.upenn.edu/parasitic/links.htm

PRACTICAL - 3

PRACTICAL EXAM : 7 HRS / DAY; 2 CONSECUTIVE DAYS

CORE PRACTICAL – III: INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY (13MBCP03)

UNIT – I

Preparation of inoculum for industrial fermentation process. Screening of antibiotic producing microorganisms from soil. Screening of enzyme producing organisms (e.g. Amylase and Cellulase).

UNIT - II

Production of industrially important enzymes by Submerged fermentation (Any one enzyme). Production of industrially important enzymes by Solid state fermentation (Any one enzyme). Assay of extracellular enzymes produced by bacteria: a) Amylase, b) Protease and c) Lipase. Purification of enzymes by Filtration method/Chemical method by ammonium sulphate.

UNIT - III

Production of wine. Production of alcohol from agricultural wastes (sugarcane molasses, beetroot).

UNIT - IV

Microbial Production of citric acid by using *Aspergillus*. Production of extracellular metabolites from actinomycetes.

UNIT - V

Separation of biomass – Wet and Dry mass. Immobilization of cells and enzymes. Isolation of dye degrading microorganism. Antibiotic sensitivity test: a) Kirby Bauer's method and b) MIC determination by filter paper assay and broth dilution assay.

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1. Dharmalingam K., 1986. Experiments with M13, Macmilan India Ltd. Chennai.
2. Lorian V., 1991. Antibiotics in Laboratory Medicine, Williams and Wilkins.
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CORE VII: MOLECULAR BIOLOGY AND MICROBIAL BIOTECHNOLOGY (13MBC07)

UNIT - I

DNA as genetic material - Hershey and Chase, Avery McLeod and McCarty. Bacterial conjugation, Transduction and transformation. Functions of DNA – Transcription, Translation and Replication, Gene expression and regulation – operon concept, DNA repair mechanism, Mutagenesis – Physical and Chemical.

UNIT – II

Extra chromosomal Heredity: Biology of plasmids, their discovery, types and the structure of F, Col factors and Ti - Replication and partitioning - Incompatibility and copy number control - Natural and artificial plasmid and their applications, Transposons - Types and importance.

UNIT - III

Role of genes within cells, Genetic elements that control gene expression, restriction and modifying enzymes. Basics of r-DNA Technology, Vectors - cosmids and phage vectors, Restriction and modifying enzymes, Restriction mapping, Linkers and adaptors, Yeast and mammalian vectors Construction of cDNA and genomic Libraries, Blotting techniques - PCR, RACE, RAPD, Identification of microorganisms by 16s rRNA, Safety guidelines of recombinant DNA research.

UNIT - IV

Introduction to microbial biotechnology: History and scope of microbial biotechnology. Microbial diversity and its use. Microbial metabolites: Production and its use of enzymes, Organic solvents, Single cell proteins, Beverages, Beer, Wine, Baker's yeast and Milk products. Production of microbes as biofertilizers and biopesticides. Biomass: Production from carbohydrates, higher alkanes and methanol. Bar coding of microbes – applications in clinical and industries.

UNIT - V

Biodegradation of natural substances: Cellulose, Xylan, Hemicelluloses, Starch, Fructose, Mannan, Pectin and Lignin. Microbial fuel cells (Biodiesel and H_2 production). Microbial gene therapy, Prevention of cancer and oxygen graft rejection. Gene Transfer Techniques, Genetic manipulation and engineering of microbes for the production of insulin, growth hormones, TPA, GMOs, Transgenic crops. Bioplastics and biopolymer.

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4. www.en.wikipedia.org/wiki/Molecular_biology
5. www.web-books.com/MoBio/

CORE VIII: MICROBIAL NANOTECHNOLOGY AND INFECTOMICS (13MBC08)

UNIT – I

The Journey of biotechnology to nanotechnology. Historical perspectives. Introduction and definition of nanoscience. Opportunities, challenges and principles of nanoscience. Types of nanomaterials - synthesis and characterization of nanoscale materials. Top down and Bottom up approaches. Microbial synthesis of nanomaterials – Silver, Gold, Platinum, CdS, ZnO, Se, Titania, etc. Characteristics and application of quantum dots, fullernes and CNTs.

UNIT – II

Application of semiconductor (metal) nanoparticles – Nanoscience in human disease control, nanomedicine, drug delivery & cancer treatment. Nanoparticles as carrier for genetic material –Nanoscience in agriculture – fertilizers and pesticides. Nanoscience for water treatment and fermentation process. Designer proteins, DNA computing, Biosensors. Nanotoxicology – Risks and Ethics. Nanoscience in India and abroad. Future of nanobiotechnology.

UNIT – III

Genomics: Introduction and concepts of microbial genomics. Methods of gene sequencing. Genome prediction. Types of genomics - structural, functional, comparative and environmental genomics. Metagenomics – study on unculturable microbes. SNPs, RAPD, RFLP. DNA microarray – Types and applications. Genomic databases, Future of genomics.

UNIT – IV

Proteomics: Introduction and basic principles of proteomics. Relation between gene and protein. Approaches for study of proteomics. Types of proteomics - expression proteomics, structural proteomics and functional proteomics. Protein sequences databases - SWISS-PROT, PDB, etc.

UNIT – V

Infectomics: Introduction and definitions of Infectomics. Infectomes. Genomics and proteomics of microbial infections – Structural and functional strategies. Types of infectomics - ecological, immuno - and chemical infectomics. DNA and protein microarrays, cloning, PCR, gene knockout and knockin, antisense strategies. Pharmacomes – definition and functions. Future of Infectomics.

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1. Subbiah Balaji. (2010). Nanobiotechnology, MJP Publishers.
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8. http://www.nature.com/nrmicro/focus/metagenomics/index.html

CORE IIX: APPLIED MICROBIOLOGY (13MBC09)

UNIT - I

Food Microbiology: Sources of contamination of microorganisms in foods, Factors influencing microbial growth in foods, Extrinsic and intrinsic. Principles and methods of food preservation: High temperature, Low temperature, Drying, Irradiation and Chemical preservatives. Food borne diseases: Bacteria, Fungi, Viruses, Algae and Protozoa. Spoilage of fruits, vegetables, meat, poultry, fish and seafood. Production of edible mushroom.

UNIT - II

Dairy Microbiology: Micro flora of milk, sources of contamination, preservation and spoilage of milk and milk products, Milk borne diseases, Preservation of milk. Fermented foods: Sauerkraut, Pickles, Buttermilk, Yogurt and Cheese. Prebiotics, Probiotics and Synbiotics. Food sanitation, food control agencies and their regulations.

UNIT - III

Soil Microbiology: Characteristics and classification of soil. Interactions between microorganisms: Mutualism, commensalism, ammensalism, synergism, parasitism, predation, competition. Interaction of microbes with plants and animals: Rhizosphere, phyllosphere, mycorrhizae. Symbiotic and asymbiotic nitrogen fixation. Genetics of nitrogen fixation. Interrelationships between microorganisms, plants and soil. Enzymes of microbial origin and their role in release of available plant nutrients. Biogeochemical cycles: Carbon, Nitrogen, Phosphorus and Sulfur.

UNIT - IV

Microbiology of air and water: Composition of air, Number and types of organisms in air, Distribution and sources of air borne organisms, Droplet and droplet nuclei, Assessment of air quality, Airborne diseases, Air sanitation, Microbes and climatic change, Microbial carbon sequestration. Microbiology of water: Physico – chemical properties of water, Microbial assessment of water, Types of aquatic habitats (freshwater and marine), Aquatic micro flora and fauna of lake, ponds, river, estuary, mangrove and sea. Impact of environmental factors on the aquatic biota.

UNIT - V

Environmental Microbiology: Waste treatment - Types of wastes. Characterization of solid and liquid wastes. Treatment of solid wastes - composting, vermiform composting, silage, pyrolysis and saccharifications. Treatment of liquid wastes - Primary, secondary (anaerobic and aerobic) - trickling, activated sludge, oxidation pond, and oxidation ditch-tertiary - disinfection. Biodegradation: Natural substances - Cellulose, Xylan, Hemicellulose, Starch, Fructose, Mannan, Pectin and Lignin; Xenobiotic compounds: Crude oil, Hydrocarbon, pesticides, paper, leather, wood, textile and paints. Bioaccumulation of heavy metals, Biofouling, Bioleaching, Biofilm and Bioremediation. Bioluminescence and microbes. Quorum sensing and microbes.

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14. Microbiology of Fermented Foods. Volume II and I. By Brian J. Wood. Elsevier Applied Science Publication.
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PRACTICAL – IV

PRACTICAL EXAM : 7 HRS / DAY: 2 CONSECUTIVE DAYS

CORE PRACTICAL IV: MOLECULAR BIOLOGY AND BIOTECHNOLOGY (13MBCP04)

UNIT - I

1. Isolation of DNA and RNA from microbial system – quantification of DNA and RNA - Chemical methods: dinitrophenol, orcinol, physical methods - UV - Adsorption.
2. Isolation of plasmid DNA from bacteria (mini preparation).
3. Isolation of plasmid DNA from Cyanobacteria (mini preparation)
4. Size Characterization of DNA by agarose gel electrophoresis.
5. Enzyme immobilization technique.

UNIT - II

1. Isolation of antibiotic resistant microbes.
2. Induction of mutation by Ultra-Violet radiation and chemical mutagens**.**

UNIT - III

1. Protoplast / Spheroplast isolation.
2. Purification of plasmids-large scale.

UNIT - IV

1. Preparation of competent *E.coli* cells.
2. Transformation of plasmid DNA to the *E.coli* cells.
3. PCR amplification -16s rRNA and RAPD.
4. Southern blotting
5. Northern blotting

UNIT - V

1. Separation of proteins by column chromatography, ion exchange-gel Exclusion-adsorption
2. Separation of proteins by SDS - PAGE and native gel.
3. Production of proteases - optimization of conditions-pH-temperature.
4. Antibiotic assays – MIC - antibiotic resistance
5. Lipid separation using TLC.
6. Microbial synthesis of Nanoparticles.

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CORE PRACTICAL V: FOOD, AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY (13MBCP05)

UNIT - I

Isolation and enumeration of soil microorganisms (bacteria, fungi and actinomycetes). Isolation of phosphate solubilizers from soil. Isolation of nitrogen fixers (a) *Rhizobium* from root nodule and (b) *Azotobacter* from rhizosphere. Screening of antagonistic bacteria in soil by agar block overlay method. Isolation of Cyanobacteria and photosynthetic bacteria from soil / water.

UNIT - II

Isolation of plant pathogens - Study of the following diseases: Tobacco mosaic, Bacterial blight of paddy, Red root of sugarcane, Citrus cancer, Downy mildew of bajra, Powdery mildow of cucurbits, Head smut of sorghum, Leaf rust of coffee, Leaf spot of mulberry, Red rot of sugarcane, Root knot of mulberry.

UNIT - III

Detection of number of bacteria in milk by breed count. Determination of quality of milk sample by methylene blue reductase test and resazurin method. Detection of number of bacteria in milk by standard plate count. Isolation of yeast and molds from spoiled nuts, fruits and vegetables. Bacteriological examination of specific food (a) Curd (b) Raw meat (c) Fish (d) Ice cream.

UNIT - IV

Extracellular enzyme activities - phosphatase. Quantification of microorganisms in air – solid and liquid impingement techniques.

UNIT - V

Physical, chemical and microbial assessment of water and potability test for water. Colour, pH, alkalinity, acidity, COD, BOD, anions and cations. Microbiological - MPN index presumptive and confirmatory tests. Isolation of dye degrading microbes.

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4. www.en.wikipedia.org/wiki/Environmental_microbiology
5. www.microbes.info/resources/Environmental microbiology

CORE X : RESEARCH METHODOLOGY, BIOSTATISTICS AND BIOINFORMATICS (13MBC10)

UNIT - I

Research Methodology - Meaning and importance. Statement, Constraints, Review of literature - Review and synopsis presentation. Types of research, Research tools, Qualities of a good researcher.

UNIT - II

Research process, Research designs - Experimental and non - experimental. Preparation of research report. Guidelines for preparing an article - ISSN, ISBN, impact factor, citation index, h-index, I-index, Google scholar, Scopus, Thomson & Rueter, Web of Science. Computers in biological research.

UNIT - III

Biostatistics - Introduction - Basic concepts, Measurement and measurement scales, Sampling and data collection, Data presentation, Descriptive Statistics - Measures of central tendency and Measures of dispersion, Population parameters, sample estimates and confidence intervals. Basic concepts of probability. Probability distributions, Z - scores, Student's t - test, Chi square test, Correlation, regression, ANOVA, RSM.

UNIT - IV

Bioinstrumentation - Principles and applications of pH meter, Centrifuge & Electrophoresis apparatus. Chromatography - Thin layer, Column, Gas and high pressure liquid chromatography. Nuclear Magnetic Resonance spectrometry (NMR), IR Spectroscopy. Microbial Identification System. ELISA Reader. Gas chromatography - Mass spectrometry (GC-MS). Matrix Assisted Laser Desorption/Ionization – Time of Flight (MALDI-Tof).

UNIT - V

Bioinformatics - Biological databases- Database searching, Sequence analysis, Pair alignment, Visualizing protein structures, Predicting structure and function of protein using sequences, QSAR, computer based drug designing.

References

1. Balagurusamy. E, 1992, Programming in ANSIC, Tata Mcgraw Hill.
2. Bernard Rosner, 1999, Fundamentals of Biostatistics ,Duxbury Press
3. Attwood T.K. and D.J. Parry-Smith, 2001. Introduction to Bioinformatics, Pearson Education Asia
4. Jeffrey A. Witmer Myra L. Samuels, 2002. Prentice Hall Statistics for the Life Sciences (3^{rd} Edition)

5. Gurumani .N., 2006. Research methodology for biological sciences. 1st edition, MJP Publishers. A unit of Tamilnadu Book House, Chennai.
6. Wayne W. Daniel, 2006. Biostatistics- A foundation for analysis in the Health Sciences. 7TH edition. Wiley India publication.
7. Rastogi. S. C, N. Mendiratta and P. Rastogi, 2008. Bioinformatics- Methods and Applications Genomics, Proteomics and Drug Discovery 3rd edition
8. Harvey Motulsky, 1995, Intuitive Biostatistics, Oxford University Press.
9. Marcello Pagano Kimberlee Gauvreau, 2000. Principles of Biostatistics , 2nd Edition, Brooks Cole
10. Higginns . D and W. Taylor (Eds.) 2000. Bioinformatics. Sequence, Structure and databanks- A Practical Approach by Oxford University Press.
11. Baxevanis A.D and B.F. Francis Ouellette (Eds.) Wiley-Interscience, 2001. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins
12. Stanton A. Glantz, 2001. Primer of Biostatistics McGraw-Hill
13. David W. Mount, Cold Bioinformatics, 2001. Sequence and Genome Analysis, Spring Harbor Laboratory Press.
14. Claverie J-M and C. Notredame, 2003. Bioinformatics for Dummies, Wiley Publishing, Inc.
15. Beth Dawson Robert G. Trapp Beth Dawson Robert Trapp, 2004. Basic and Clinical Biostatistics (LANGE Basic Science), McGraw-Hill.

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3. www.math.yorku.ca/scs/statResource.html# General
4. www.jegsworks.com/Lessons/index.html
5. www.bettycjung.net/statsites.html
6. www.biostat.harvard.edu/links/
7. www.ped.mod.utah.edu/genpedscrr/Epibio.html

Elective Courses

ELECTIVE PAPER I

BIOFERTILIZER AND BIOMANURE TECHNOLOGY

UNIT - I

Introduction - History, importance and present status of different types of fertilizers and their application to crop plants. Importance of macro and micro nutrients. Biological fixation of nitrogen; Natural cycles associated with microorganisms - carbon, nitrogen, phosphorous and sulphur.

UNIT - II

Cyanobacterial Biofertilizers - Nostoc, Anabaena, Gloeocaps and Scytonema as biofertilizers; Symbiotic association with Azolla; Multiplication of blue green algae and its effect on agricultural (rice) yields. Bacterial Biofertilizers - Free living forms: Azatobacter, Azospirillum; Symbiotic forms: Rhizobium - Legume Association; Pseudomonas, Nonlegume association.

UNIT - III

Fungal Biofertilizers – Types of fungal biofertilizers, Ectomycorrhizal association with pines; Vescicular arbuscular mycorrizal association (VAM) - *Glomus* sp; Actimomycetes as Biofertilizers – Actinorhiza, Actinorhizal associations - *Frankia* sp.

UNIT - IV

Biomanures - A general account of manures – moulds; Composts Farm Yard Manure-Oil seed cakes - Castor and neem; Green leaf manures - Gyricidia, Sesbania and Crotalaria; Agro-industrial wastes - Poultry manure and saw-dust; Vermi Compost; Microbial compost - pure culture techniques, consortium - types of compost pits. Biodegradation of organic components.

UNIT - V

Mass production of biofertilizers – Rhizobium, mycorrhiza. Synthesis of micro and macro nutrients. Application of Biofertilizers and manures - A combination of biofertilizer and manure applications with reference to soil, seed and leaf sprays. Laboratory and field application; Cost analysis of biofertilizer and biomanure production.

References

1. Burns, R.C. and Hardy, R.W.F., 1975. "Nitrogen fixation in bacteria and higher plants. Springer - Verlag, Bertin.
2. Gallen and Chaplin, 1987. Introduction to N2 fixation. Elswer Publications.
3. Harley, J.L. and Smith, S.E. 1983. Mycorrhizal Symbiosis. Academic Press, London.

4. Kumar, H.D., 1990. Introductory Phycology. Affiliated East-West Press Ltd., Madras.
5. Marks, G.C. and Koslowski, TT. (Eds.) 1973. Ectomycorrhizae, Academic Press, London.
6. Rao, N.S., Venkataraman, G.S. and Kanyan, 1983. Biological N2 fixation, ICAR Publications, New Delhi.
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10. Tilak, K.V.B.R., 1990. Bacterial Biofertilizers. IARI Publications, New Delhi.
11. Tirdale, Nelson, S.L., Werver, L. and Becton, J.D., 1985. Soil fertility and fertilizers. Macmillan Publishing Co., New York.
12. Venkataraman, G.S., 1972. Algal Biofertilizers and Rice Cultivation. Today and Tomorrow's Printers and Publishers, New Delhi.
13. Totawat, K.L., Somani, L.L., Sharma, R.A. and Maloo, S.R., 2004. Biofertilizer Technology. Agrotech Publishing Academy. Udaipur, Rajasthan.
14. Kannaiyan, S., Kumar, K. and Govindarajan, K., Biofertilizer Technology.
15. Subba Rao, N.S., 1995. Soil Microorganisms and plant growth. Oxford and IBH, New york.
16. Subba Rao, N.S., 1995. Biofertilizer in agriculture and forestry. Oxford and IBH, New york.

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1. www.fnca.mext.go.jp/english/bf/e_ws_2003.html
2. stary.biom.cz/sborniky/sb97PrVana/sb97PrVana_archip.html
3. www.tnau.ac.in/micro/ug.htm
4. www.indianindustry.com/fertilizers/126.html
5. www.inforse.dk/asia/M_III_biogas.htm
6. www.scienceandsociety-dst.org/highlights.htm

ELECTIVE PAPER II: ENTREPRENEURSHIP IN MICROBIOLOGY

UNIT - I

Evolution of the concept of entrepreneur – Entrepreneurship: Definitions – concept of Entrepreneurship, development – need – role of resource, talent and spirit – process of Entrepreneurship to socio – economic gains.

UNIT - II

Institutions and schemes of government of India – Schemes and programmes, Department of science and technology schemes, Nationalized banks – other financial institutions etc – SIDBI – NSIC – NABARD – IDBI – IFCI – ICICI etc.

UNIT - III

Skills for entrepreneurs – communication skills, problem solving skills; Business plan development; Market need – market research, SWOT analysis, identify your competition. Financial plan – obtain financing for your business, insure your business, Marketing – mix – product, distribution, price, promotion, and set marketing goals.

UNIT - IV

Composting – domestic waste, agricultural and industrial waste, vermi – composting. SCP production – mushroom cultivation.

UNIT - V

Biofertilizers and Biopesticides. Production of teaching kits (plasmid DNA isolation, serum electrophoresis) and diagnostic kits (WIDAL test kits, ABO blood grouping kits)

References

1. Venkataraman, G.S., 1972. Algal Biofertilizers and Rice Cultivation. Today and Tomorrow's Printers and Publishers, New Delhi.
2. Marks, G.C. and T.T. Koslowski (Eds.),1973. Ectomycorrhizae, Academic Press. London.
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2. www.orgs.tigweb.org/33065

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4. www.entretechforum.org/mm_May19_2009.htm

5. www.linkedin.com/pub/dir/george/hlass.

ELECTIVE PAPER III: MICROBIAL NANOTECHNOLOGY

UNIT - I

Definition – Evolution of Nano science – Need of Nano technology – Hurdles for Nanotechnology development – Factors affecting the manufacturing process of nano materials – Role of physicists, chemists, medical doctors, engineers, biologists and computer scientists in nanotechnology.

UNIT - II

Spectroscopy and Microscopy – the two most important tools used in nanotechnology research – Infra red spectroscopy, Raman spectroscopy, Ultra violet - visible spectroscopy. Atomic force microscope – Scanning electron microscope – Transmission electron microscope – Scanning tunnelling microscope – Magnetic resonance force microscopy.

UNIT - III

Nanospectra biosciences. Nanocrystals – Quantum dot as Biological fluorescent tag – Bucky balls for medical imaging – Ganolidium for for Magnetic resonance imaging – Dendrimers in molecular imaging. Nanoprobles for nucleic and hybridization detection. Nucleophillic carbenes. Working on the DNA chain gangs. DNA and protein based nanocircuity.

UNIT - IV

Nanotechnology for drug development and medical applications. Nanotechnology for drug solubilization and drug delivery. Diagnosis using nanomaterials. Nanotherapy for cancer treatment – Interior artery expansions – Replacing joints with better stuff. - Radioactive tuberene cages in Nuclear medicine.

UNIT - V

Cleaner environment with Nanotech. Cleaning the air with Nanotechnology – Nanotechnology for water treatment. Microbial nanoparticles. Nanocarbon ball as deodorizer in ferment process. Biomotors for engineered devices. Possible harm from Nanomaterials. Nanoscience in India – Nanoscience education abroad – Looking at ethics and society.

References

1. Richard Brooker and Earl Boysen (2006). Nanotechnology. Wiley Publishing Inc., India. Pp 361.
2. Paul Dieppe and Paul Calvert. (1983). Crystals and Joint disease, Chapman and Hall Ltd, London.
3. Duckruix, A. and R. Giege, (1992). Crystallization of Nucleic acids and Proteins. A practical approach, Oxford Umiversity Press, England.

Web Sites

1. www.nanotechnologyfordummies.com
2. www.nanobotblogspot.com
3. www.azonano.com
4. www.nano.gov
5. www.forbesnanotech.com
6. www.foresight.org
7. www.nanotech-now.com

ELECTIVE PAPER IV – DISEASE DIAGNOSIS TECHNOLOGY

UNIT - I

Scope and relevance of Microbiology – Definition and concepts, Type of micro organism, Distribution of Microorganism in nature; Development of Microbiology as a Scientific discipline; General characteristics of microorganisms – General principles, Taxonomy, classification and structural organization of Bacteria, fungi, viruses, algae, actinomycetes, Mycoplasma, and ricketssiae; Microscopy – Principles and application of Phase contrast, Dark field, Fluorescent, and Electron microscope; Micrometry – B asic principles and applications.

UNIT - II

Fixatives and Fixation of smears, Stains – Definition, Acidic, Basic stains, simple and differential staining, use and significance of stains in microbiology; cultivation of micro organism – Definition, concept, use and types of different culture media for cultivation of microorganism, Pure culture techniques; cultivation of anaerobes; control of microorganism – sterilization by physical and chemical methods, Antiseptics.

UNIT - III

Binomial nomenclature; Outline classification of living organisms – Haekel, Whittaker, and woese system, normal micro flora in human body and their beneficial effects; Lymphoid organs and types of immunity; General principles of diagnostic microbiology-collection, transport, and processing of clinical specimens, General methods of laboratory diagnosis – cultural, biochemical, serological, and molecular methods.

UNIT - IV

Host pathogen interaction- virulence factors, General account of the following diseases – Causal organisms, pathogenesis, diagnosis, prevention and therapy of Typhoid, cholera, dysentery, whooping cough, tuberculosis, urinary tract infection, syphilis, ring-worm, dermatophytes, Malaria, small pox, measles, hepatitis, and AIDS. General account of Nosocomial Infections and prevention.

UNIT - V

Antimicrobial therapy in the diagnosis of diseases; *In vitro* diagnostic methods – agglutination, precipitation, immunofloresence, ELISA, Skin test; Vaccines: Principles underlying the preparation of live and attenuated vaccines. Synthetic peptide vaccines. Immunization, its rationale, schedules and its importance in public health; Automation in Disease diagnosis; Ethical committee – structure and functions

Reference Books

1. Morag, C. and Timbury, M.C. (1994) *Medical Virology*, 10th Edn. Churchill Livingston, London.
2. Dimmock, N.J. and Pimrose, S.B. (1994) *Introduction to Modern Virology*, 4th Edn. Blackwell Scientific Publications, Oxford.
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4. Maloy SR,Cronan Jr.JE, Freifelder D. (1998). Microbial Genetics. Jones and Bartlett publishers.
1. Robert G. Welstar and Allan Garnoll. Encyclopaedia of Virology (1994). Vol. I, II &III Academic Press inc. San Diego, CA 92101. Ed.
2. Greenwood, D., Slack, R.B. and Peutherer, J.F.(2002) *Medical Microbiology*, 16th Edn. Churchill Livingstone, London.
3. Finegold, S.M. (2000) *Diagnostic Microbiology*, 10th Edn. C.V. Mosby Company, St. Louis.
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5. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Eds) (1994) *Methods for General and Molecular Bacteriology.* ASM Press, Washington, DC.
6. Topley and Wilson (1995) *Principles of Bacteriology Virology and Immunity*. 9th Edn. Vol I, Edward Arnold, London.

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1.http:// www.microbiologyonline.org.uk/sgmprac.htm

2.http:// www.cvm.uiuc.edu/vdl/AppenA_man.html

3.http:// www.microbes.info/resources/education_and learning

4.http://infohost.nmt.edu/-nmtlib/subj/boil.html

5.http:// www.hoflink.com/%7Ehouse/microbio.html

6.http:// www. Splammo.net/bact102/home102.html

7.http:// www.pathmicro.med.sc.edu/book/bact-sta.htm

8.http:// www.textbookofbacteriology.net/

9.http://libweb.sonoma.edu/search/articles.html

10. http:// www.ucmp.berkeley.edu/bacteria/bacterialh.html

ELECTIVE PAPER V – MARINE MICROBIOLOGY

UNIT - I

Structure: Bacteria, fungi, algae, protozoa and viruses; Classification of microbes (Genetic level) - conventional and modern methods. Biology of micro-organisms used in genetic engineering (*Escherichia coli, Rhizobium sp., Agrobacterium tumefaciens, Saccharomyces cerevisiae, phage lambda, Nostoc, Spirulina, Aspergillus, Pencillium* and *Streptomyces*).

UNIT - II

Methods of studying the marine micro-organisms – Methods of collection, enumeration (total and viable counts), Isolation, culture & identification based on morphological, physiological and biochemical characteristics; Preservation of marine microbes; Culture collection Centers (ATCC, IMTECH, etc.).Microbial nutrition - influence of environment factors on microbial growth, activity and distribution

UNIT - III

Microbial nitrogen fixation; Carbon, nitrogen and phosphorus cycle; Decomposition of organic matter; Bioleaching and biodeteroriation of natural and synthetic materials.

UNIT - IV

Microbes of Biotechnological importance; Primary and secondary metabolites (enzymes, antibiotics, organic acid, toxins, etc.)

UNIT - V

Seafood microbiology - normal genera associated with fish, food spoilage, fish & human pathogens; Indicator of Pollution – faecal coliforms; Prevention & control.

References

1. Pelczar MJ Jr., Chan ECS and Kreig NR. Microbiology, 5th Edition, Tata McGraw Hill, 1993.
2. G Reed, Prescott and Dunn's, Industrial Microbiology, 4th Edition, CBS Publishers, 1987.
3. M.T. Madigan and J.M. Martinko, Biology of Microorganisms, 11th Edition, Pearson Prentice Hall, USA, 2006.
4. Rheinhemer, G., 1980. Aquatic Microbiology, Johnwiley & Sons, pp. 235.
5. Elay, A.R.1992. Microbial food poisoning. Chapman and Hall London, 191 pp.
6. Ford, T.E., 1993. Aquatic microbiology. An ecological approach.Blackwell scientific publication, London, 518 pp.
7. Krichman, D.L., 2000. Microbial ecology of the oceans. Wiley –liss, NewYork, pp.542

Web sites

1. http:// www.mba.ac.uk/
2. http:// www.mbl.edu/
3. http:// www.univie.ac.at/marine-biology/
4. http://oceanlink.island.net/
5. http:// life.biosunysb.edu/marinebio/mbweb.html
6. http:// wwwumi.com/pqdauto.

Journals

1. Limnology and oceanography
2. Quarterly review of Microbiology
3. Journal of Marine Research
4. Marine Technology Society Journal
5. Marine Technology and SNAME news.

ELECTIVE PAPER VI - INTELLECTUAL PROPERTY RIGHTS (IPR) AND BIO-SAFETY

UNIT - I

Introduction to Intellectual Property

IPR - Definition - Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, IP as a factor in R&D; IPs of relevance to Microbiology / Biotechnology and few Case Studies

WTO - Definition - Functions - Forms of IPR Protection.

UNIT - II

Agreements and Treaties

History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments.

UNIT - III

Basics of Patents and Concept of Prior Art

Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, esp@cenet(EPO), PATENTScope (WIPO), IPO, etc.).

National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies

UNIT - IV

Biosafety

Introduction; Historical Backround; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Biosafety in relation to transgenic research and applications.

UNIT - V

Bioethics

Bioethics - Definition - Animal ethics - Norms in India - Licensing of animal house - Ethical clearance norms for conducting studies on human subjects.

References:

1. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007

2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition,

Manupatra Information Solution Pvt. Ltd., 2007

3. Gurumani, N. Research Methodology,;For Biological Sciences . MJP Publishers, Chennai 2006

Important Links:

1. http://www.w3.org/IPR/
2. http://www.wipo.int/portal/index.html.en
3. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
4. www.patentoffice.nic.in
5. www.iprlawindia.org/
6. http://www.cbd.int/biosafety/background.shtml
7. http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm
8. http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html

Supportive Courses

SUPPORTIVE I : ENTREPRENEURSHIP IN MICROBIOLOGY

UNIT - I

Evolution of the concept of entrepreneur – Entrepreneurship: Definitions-concept of Entrepreneurship, development – need – role of resource, talent and spirit – process of Entrepreneurship to socio-economic gains.

UNIT - II

Institutions and schemes of government of India- Schemes and programmes, Department of science and technology schemes, Nationalized banks – other financial institutions, etc – SIDBI – NSIC – NABARD – IDBI – IFCI – ICICI etc.

UNIT - III

Skills for entrepreneurs – communication skills, problem solving skills; Business plan development; Market need – market research, SWOT analysis, identify your competition. Financial plan – obtain financing for your business, insure your business, Marketing – mix-product, distribution, price, promotion, set marketing goals.

UNIT - IV

Composting – domestic waste, agricultural and industrial waste, vermi – composting. SCP production – mushroom cultivation.

UNIT - V

Biofertilizers and Biopesticides. Production of teaching kits (plasmid DNA isolation, serum electrophoresis) and diagnostic kits (WIDAL test kits, ABO blood grouping kits)

References

1. Venkataraman, G.S., 1972. Algal Biofertilizers and Rice Cultivation. Today and Tomorrow's Printers and Publishers, New Delhi.
2. Marks, G.C. and T.T. Koslowski (Eds.),1973. Ectomycorrhizae, Academic Press. London.
3. Sandera, F.E., B. Mosse. and P.B. Tinke, 1975. Endomycorrhizae. Academic Press, London.
4. Thompson, L. M. and T. Fredrick, 1979. Soils and Soil Fertility. Tata Mc Graw-Hill Publishing Co., New Delhi.
5. Rao, N.S., 1980. Biofertilizers in Agriculture. Oxford and IBH Publishing Co. Pvt. Ltd., Bombay.
6. Rao, N.S., G.S. Venkataraman and Kannaiyan, 1983. Biological N2 fixation. ICAR Publications, New Delhi.
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8. Tirdale, S.L. Nelson, L. Werver and J.D. Becton, 1985. Soil fertility and fertilizers. Macmillan Publishing Co., New York.
9. Kumar, H.D., 1990. Introductory Phycology. Affiliated East-West Press Ltd., Madras.
10. Tilak, K.V.B.R., 1990. Bacterial Biofertilizers. IARI Publications, New Delhi.
11. Subba Rao, N.S., 1995. Soil Microorganisms and plant growth. Oxford and IBH, New york.
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2. www.orgs.tigweb.org/33065
3. www.womensjoblist.com/resumes/18143-Microbiologist.html
4. www.entretechforum.org/mm_May19_2009.htm
5. www.linkedin.com/pub/dir/george/hlass.

SUPPORTIVE PAPER II: HUMAN INFECTIOUS DISEASES AND DIAGNOSTICS

UNIT - I

Scope and relevance of Microbiology - Definition and concepts, Type of micro organism, Distribution of Microorganism in nature; Development of Microbiology as a Scientific discipline; General characteristics of microorganisms- General principles, Taxonomy, classification and structural organization of Bacteria, fungi, viruses, algae, actinomycetes, Mycoplasma, and ricketssiae; Microscopy - Principles and application of Phase contrast, Dark field, Fluorescent, and Electron microscope; Micrometry - Basic principles and applications.

UNIT - II

Fixatives and Fixation of smears, Stains- Definition, Acidic, Basic stains, simple and differential staining, use and significance of stains in microbiology; cultivation of micro organism- Definition, concept, use and types of different culture media for cultivation of microorganism, Pure culture techniques; cultivation of anaerobes; control of microorganism-sterilization by physical and chemical methods , Antiseptics .

UNIT - III

Binomial nomenclature; Outline classification of living organisms- Haekel, Whittaker, and woese system, normal micro flora in human body and their beneficial effects; Lymphoid organs and types of immunity; General principles of diagnostic microbiology-collection, transport, and processing of clinical specimens, General methods of laboratory diagnosis-cultural, biochemical, serological, and molecular methods.

UNIT - IV

Host pathogen interaction- virulence factors, General account of the following diseases- Causal organisms, pathogenesis, diagnosis, prevention and therapy of Typhoid, cholera, dysentery, whooping cough, tuberculosis, , urinary tract infection, syphilis, ring-worm, dermatophytes, Malaria, small pox, measles, hepatitis, and AIDS. General account of Nosocomial Infections and prevention.

UNIT - V

Antimicrobial therapy in the diagnosis of diseases; *In vitro* diagnostic methods-agglutination, precipitation, immunofloresence, ELISA, Skin test; Vaccines: Principles underlying the preparation of live and attenuated vaccines. Synthetic peptide vaccines. Immunization, its rationale, schedules and its importance in public health; Automation in Disease diagnosis; Ethical committee – structure and functions

References

1. Morag, C. and Timbury, M.C. (1994) *Medical Virology*, 10th Edn. Churchill Livingston, London.
2. Dimmock, N.J. and Pimrose, S.B. (1994) *Introduction to Modern Virology*, 4th Edn. Blackwell Scientific Publications, Oxford.
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9. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Eds) (1994) *Methods for General and Molecular Bacteriology*. ASM Press, Washington, DC.
10. Topley and Wilson (1995) *Principles of Bacteriology Virology and Immunity*. 9th Edn. Vol I, Edward Arnold, London.

Web sites

http:// www.microbiologyonline.org.uk/sgmprac.htm

http:// www.cvm.uiuc.edu/vdl/AppenA_man.html

http:// www.microbes.info/resources/education_and learning

http://infohost.nmt.edu/-nmtlib/subj/boil.html

http:// www.hoflink.com/%7Ehouse/microbio.html

http:// www. Splammo.net/bact102/home102.html

http:// www.pathmicro.med.sc.edu/book/bact-sta.htm

http:// www.textbookofbacteriology.net/

http://libweb.sonoma.edu/search/articles.html

http:// www.ucmp.berkeley.edu/bacteria/bacterialh.html

SUPPORTIVE III: MICROBIAL TECHNOLOGY

UNIT - I

Industrially important microorganisms and their development, screening methods for industrial microbes - detection and assay of fermented products-classification of fermentation types-genetic control of fermentation-strain selection and improvement-mutation and recombinant DNA techniques for strain development

UNIT - II

Definition, concepts – history, biotechnological potentials of microalgae – food – feed– fuel and pharmaceutically valuable compounds. Cultivation methods of algae with reference to *Dunaliella* and *Phormidium valderianum*. Production of microbial biofertilizers – cyanobacteria, *Rhizobium, Azotobacter, Azospirillum, Phosphobacteria* and VAM.

UNIT - III

Single cell protein – Chlorella, Spirullina, Yeasts, Mushrooms, SCP from wastes. Economic implications of SCP, microbial production of enzymes – cellulase, lipase, Taq polymerase and restriction endonuclease. Production of wine, vinegar and alcohol.

UNIT - IV

Immobilization of enzymes – Starch processing industry – proteases – therapeutic enzymes - Diagnostic enzymes - Enhancement of enzyme activity – uses of engineered protein – advantages of protein engineering.

UNIT - V

Microbes involved in biodegradation of organic wastes and xenobiotic compounds – heavy metals, pesticides, insecticides, Bioinsecticides – BT toxin. Microbial leaching – Extraction of metals from ores. Biofuels, Microbial hydrogen production, Biodegradation of oils and petroleum products.

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SUPPORTIVE IV: MEDICAL LABORATORY TECHNOLOGY

UNIT - I

Units of Measurements, Laboratory glassware and instruments: Laboratory Calculations- Types of Reagents solutions - Preparation of standard solutions of Acid and Base. Solutions used in medical laboratory. Reagent Solutions - Staining solutions - Standard solutions Classification of standard solutions - Primary standard solution - Secondary standard solutions - Buffer solutions. Cleaning of glasswares, pipettes, flasks, beakers, cylinders and other glass wares. Laboratory Instruments - Balances - Centrifuges - Ovens - Water Bath - Incubator - Colorimeter (Photometer) - Flow cytometery - Automated analyzers.

UNIT - II

Medical laboratory rules, ethics and professional code of conduct: Infrastructure of a Medical Laboratory - Rules of medical laboratory - Medical Laboratory request form - Maintenance of laboratory records - Delivery of laboratory results - Professional code of conduct and ethics - Laboratory policies.

UNIT - III

Basics of Quality Control: General approaches. Common errors in Laboratory Procedure-Common terms used in quality control-Quality control in individual laboratories-Quality control of Quantitative data-Preparation of Quality control charts. Quality Assurance Types and causes of errors in medical - laboratories - Unpredictable errors - Predictable errors-Internal quality control (IQC) - External quality control (EQC)

UNIT - IV

Biological Hazards and Biomedical Waste Disposal: Biological Safety Cabinets (BSCs) - Physical Hazards and Others - Ergonomic Hazards - Ionizing Radiation - Non-ionizing Radiation - Factors contributing to laboratory accidents - First aid for laboratory hazards - Safe use and storage of chemicals and reagents - Planning for safety - General precautions for avoidance of laboratory accidents. Biomedical Waste – Introduction - Categories of waste-Standard protocol of waste disposal - Methods of waste disposal. Disinfection and decontamination of laboratory wastes.

UNIT - V

Specimen Collection Processing, Transport, Staining and Culture: General considerations. Types of specimens - Specimen collection and processing in Hematology. Biochemical analysis, Pathological analysis, Microbiological analysis, Preservation and Transport. Staining techniques and culture on various media for the differential diagnosis of pathogens.

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SUPPORTIVE V: MICROBIAL NANOTECHNOLOGY

UNIT - I

Definition – Evolution of Nanoscience – Need of Nanotechnology – Hurdles for Nanotechnology development – Factors affecting the manufacturing process of nano materials – Role of physicists, chemists, medical doctors, engineers, biologists and computer scientists in nanotechnology.

UNIT - II

Spectroscopy and Microscopy – the two most important tools used in nanotechnology research – Infra red spectroscopy, Raman spectroscopy, Ultra violet-visible spectroscopy. Atomic force microscope – Scanning electron microscope – Transmission electron microscope – Scanning tunnelling microscope- Magnetic resonance force microscopy.

UNIT - III

Nanospectra biosciences. Nanocrystals – Quantum dot as Biological fluorescent tag – Bucky balls for medical imaging – Ganolidium for for Magnetic resonance imaging – Dendrimers in molecular imaging. Nanoprobles for nucleic and hybridization detection. Nucleophillic carbenes. Working on the DNA chain gangs. DNA and protein based nanocircuity.

UNIT - IV

Nanotechnology for drug development and medical applications. Nanotechnology for drug solubilization and drug delivery. Diagnosis using nanomaterials. Nanotherapy for cancer treatment – Interior artery expansions – Replacing joints with better stuff. - Radioactive tuberene cages in Nuclear medicine.

UNIT - V

Cleaner environment with Nanotech. Cleaning the air with Nanotechnology – Nanotechnology for water treatment. Microbial nanoparticles. Nanocarbon ball as deodorizer in ferment process. Biomotors for engineered devices. Possible harm from Nanomaterials. Nanoscience in India – Nanoscience education abroad – Looking at ethics and society.

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