।। सा विद्या या विमुक्तये ।।

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

ACADEMIC (1-BOARD OF STUDIES) SECTION

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प्रस्तुत विद्यापीठातील जैवतंत्रशास्त्र संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे आराखडा (Structure) बदलासह CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २९ सप्टेंबर २०२० रोजी संपन्न झालेल्या ४९व्या मा. विद्या परिषद बैठकीतील विषय क्र.१०/४९–२०२०** च्या ठरावानुसार **प्रस्तुत विद्यापीठातील जैवतंत्रशास्त्र संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे आराखडा (Structure) बदलासह** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्यात येत आहेत.

01. M.Sc.-I & II Year-Botany
02. M.Sc.-I & II Year-Microbiology
03. M.Sc.-I & II Year-Zoology
04. M.Sc.-I & II Year-Biotechnology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.

जा.क्र.: शैक्षणिक–१/परिपत्रक/पदव्युत्तर(संकुल)–सीबीसीएस अभ्यासक्रम/२०२०–२१/**१४६५**

स्वाक्षरित
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

दिनांक : १२.११.२०२०.

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) मा. संचालक, जैवतंत्रशास्त्र संकुल, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

SCHOOL OF LIFE SCIENCES,

M. Sc. MICROBIOLOGY COURSE (TOTAL CREDITS: 100)

TOTAL MARKS : 2500

Program Structure – 2019 Onwards (CBCS Pattern)

Introduction:

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of the country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in the curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. Swami RamanandTeerthMarathwada University has several initiatives towards academic excellence, quality improvement and administrative reforms. In view of this priority and in keeping with Vision and Mission, process was already initiated towards introduction of semester system, grading system and credit system. University had implemented Choice Based Credit System (CBCS) pattern at PG level on Campus from the academic year 2014-2015 progressively. These regulations are called as Regulations on Swami RamanandTeerthMarathwada University Choice Based Credit System 2014. Further, Revised Guidelines for implementation of CBCS in Campus and Sub Centre w.e.f. 2020 were also issued. Revision and updating of the curriculum is the continuous process to provide an updated education to the students at large. In view of this priority and in-keeping with Vision and Mission, process of revision and updating the curriculum is initiated and implemented at PG level from the academic year 2019-2020 progressively.

Presently there is wide diversity in the curriculum of different Indian Universities which inhibited mobility of students in other Schools of the Campus, Universities or States. To ensure uniform curriculum at PG level , curriculum of different Indian Universities, syllabus of NET, SET, MPSC, UPSC, Forest Services and the UGC model curriculum are referred to serve as a base in updating the same. The CBCS provides choice for students to select from the prescribed courses .The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our university has already introduced the choice based credit system. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. Keeping in mind BOS in Microbiology prepared the curriculum to ensure up-to-date level of understanding of students in core and applied courses in Microbiology. Many excellent university syllabi were used while framing this syllabus. As Microbiology students find placement in food and pharmaceutical industries and diagnostic laboratories M. Sc. Microbiology.

School of Life Sciences, have designed syllabus to train students in these sectors. MOOC-NPTEL-SWAYAM courses will help student to learn courses using online platform. Discipline Specific Elective Courses have designed to cater requirements of employers of multinational companies. Two credit course like Communication skills, Teaching competency, Diagnostic techniques, bioinformatics, are incorporated in curriculum. The student will be equipped to take up a suitable position in academia or industry, and to pursue a career in research due to this comprehensive

curriculum. Overall after completion of this course, students will also acquire fundamental knowledge in Microbiology and will have special skills necessary to satisfy current practical difficulties and problems.

Outline and Salient Feature:

M. Sc. Microbiology syllabus is designed to serve the need of choice based credit system course structure to orient and practically train students in the field of Microbiology. The course is specifically bringing Core courses dealing additional domain of knowledge in Immunology, Virology, Microbial Physiology, Metabolism, Microbial Genetics, Extremophiles, Bioprocess and engineering aspect. Applied branches of Microbiology such as Environmental, Medical, Food, Pharmaceutical and Agriculture Microbiology. Special efforts have been taken to improve employability of student for which Communication skills, Diagnostic techniques, bioinformatics, are incorporated in curriculum. The student will be equipped to take up a suitable position in academia or industry, and to pursue a career in research if so desired.

The syllabus of M. Sc. microbiology course will orient and train the students in view of microbial genetics and molecular biology, occurrence of metabolic events and its relation to environment and agriculture, to understand and apply this knowledge for carrier orientation.

Specific Program Outcome: The student will understand and be able to explain different branches of Microbiology such as Immunology, Virology, Microbial Physiology, Metabolism, Microbial Genetics, Extremophiles, Bioprocess and engineering aspect. Applied branches of Microbiology such as Environmental, Medical, Food, Pharmaceutical and Agriculture Microbiology will help student to acquire necessary skills. Dissertation that is a short research project incorporating techniques of Basic and Advanced Microbiology under supervision will help student to execute the skills learned by them.

PO1: Students will acquire enough skills in core course like Immunology, Virology, Microbial Physiology, Metabolism, Microbial Genetics, Extremophiles, Bioprocess and engineering aspect.

PO2: Students will acquire knowledge in applied branches of Microbiology such as Environmental, Medical ,Food, Pharmaceutical and Agriculture Microbiology

PO3: This will provide updated curriculum with recent advances in the subject and enable the students to face NET, SET, UPSC and other competitive examinations successfully.

PO4: This program shall train and orient the students so as to develop[human resource for the educational institutes, industries and other organizations.

PO5: This will also develop specific skills amongst students for self employability through the development of their own enterprises.

PO6: This shall develop ability in the students for the application of the acquired knowledge in the fields of life so as to make our country self reliant and self sufficient.

M.Sc Microbiology (Total credit 100)
Total Marks:-2500
Programme Structure:-2020 onwards (CBCS Pattern)
Programe code:-

Semester	Course Code	Title of the Course	No. of Instructional hr / week		Total Credits	Marks		Total Marks
						CIA	ESA	
		THEORY & PRACTICAL						
First Semester	MBTC-101	Virology	04	CC	04	50	50	100
	MBTC-102	Microbial Physiology	04	CC	04	50	50	100
	MBTC-103	Immunology	04	CC	04	50	50	100
	MBTE-101 MBTE102	1. Biostatistics & Bioinstrumentation Or 2. Mycology & Protozoology	04 Or 04	DSC Or DSC	04 Or 04	50 Or 50	50 50	100 Or 50
	MBTE103	NPTL/MOOCS/SWAYAM	02	OE	02 02	25 25	25 25	50 50
	MBLC-I	Lab Course – I (Based on MBTC-101 &MBTC102)	4	CC	04	50	50	100
	MBLC-II	Lab Course-II (Based on MBTC-103 &MBTE101or MBTE102)	4	CC	04	50	50	100
				Total	26	325	325	650
Second Semester	MBTC-201	Extremophiles and Biodiversity	04	CC	04	50	50	100
	MBCT-202	Microbial Metabolism	04	CC	04	50	50	100
	MBTC-203	Microbial Genetics	04	CC	04	50	50	100
	MBTE-201 Or MBTE202 Or	Enzymology & Molecular Biology Genomics and Proteomics	04 04	EC EC	04 04	50 50	50 50	100 100
	MBLC-III	Lab Course –III (Based on MBTC-201 &MBTC202)	4	CC	04	50	50	100
	MBLC-IV	Lab Course –IV Based on MBTC-203 &MBTE201or MBTE202 MBTE 203)	4	CC	04	50	50	100
				Total	24	300	300	600
Third Semester	MBTC-301	Bioprocess Engineering and Technology	04	CC	04	50	50	100
	MBTC-302	Food & Dairy Microbiology	04	CC	04	50	50	100
	MBTC-303A or MBTC303 B	Environmental Microbiology Medical Microbiology	04 04	CC CC	04 04	50 50	50 50	100 100
	MBTC 304	Diagnostic Microbiology and Bioinformatics	04	SEC	02	25	25	100
	MBTO-305	Open elective	02	OEC	02	25	25	50
	MBLC-V	Lab Course – V (Based on MBTC-301 &MBTC302)	4	DSC	04	50	50	100
	MBLC-VI	Lab Course-VI (Based on MBTC-303 &MBTC304)	4	DSC	04	50	50	100
				Total	26	325	325	650
	MBTC-401	Genetic Engineering	04	CC	04	50	50	100

Fourth Semester	MBTC-402	Microbial Technology	04	CC	04	50	50	100
	MBTC-403A or MBTC-403B	Pharmaceutical Microbiology Agricultural Microbiology	04 04	CC	04 04	50 50	50 50	100 100
	MBT-404	Open Elective	04	OEC	04 Or 2+2	50 Or 25+25	50 Or 25+25	100 Or 100
	MBL-VIIC	Lab Course –VII (Based on MBTC-401 MBTC402 &MBTC403)	4	DSC	04	50	50	100
	MBL-VIIIE	Dissertation Or Review Writing Or Industry training	4 4 4	DSC DSC DSC	04 04 04	50	50 100 100	100 100 100
				Total	24	300	300	600
					100	1250	1250	2500

CC: Core Course, SEC Skill enhancement Course, EC: Elective Course, , CIA: Continuous Internal Assessment, ESA :End Semester Assessment. There will be four papers of practicals in first year and four papers of practicals or one dissertation/review writing instead of Lab course VIII. Each practical course and dissertation will be of 100 marks (04 credits).

- Total Credits / year = 50
- Total Credits of All Four Semesters = 100
- Total Marks of All Four Semesters = 2500

- CIA Two test of 15 marks each will be conducted 10 marks for home assignment/tutorial and 10 for seminar/conference presentation

The examinations for laboratory Courses (External) will be held at the end of Semesters.

MBTC-101 Virology

4 credit Periods 60

Course Objectives

- **To facilitate conceptual understanding of Classification of viruses**
- **To acquire knowledge on basic aspects cultivation of viruses**
- **To acquire knowledge on basic aspects important viral diseases.**

Learning outcome

- **student will able to illustrate morphology and replication strategy of viruses.**
- **student will acquire information on viral cultivation**
- **student will acquire information on diseases**

UNIT- I 14

Brief outline on discovery and origin of viruses. Classification and general properties of major families of viruses morphology and ultra-structure of viruses, capsid and their arrangements, types of envelopes and their composition, measurement of viruses. Viral genome; their types and structure, viral related agents-viroid and prions.

UNIT-II 14

Cultivation of inhibition, neutralization test, complement fixation, ELISA, RIA. Purification of viruses: gradient centrifuge, electrophoresis, and chromatography viruses- in embryonated eggs, experimental animals and cell lines; primary and secondary cell lines, diploid cell culture. 2. Assay of viruses: physical and chemical methods, end point method. Serological methods

UNIT-III16

Plant viruses: recent advance in classification of plant viruses. Structure and pathogenicity of TMV. 2. Transmission o plant viruses with vector (insect, nematodes and fungi) and without vector (contact, seed and pollens). Biochemical changes induced by virus in plant cell. 3. Animal viruses: nomenclature and classificatiofn of animal viruses. 4. General

idea about Cyanophage, and Mycophage.

Unit-IV16

Animal viruses: Structure, genomic organization, pathogenesis and control of Herpes virus, Polio virus, Influenza virus, Retrovirus, Adenovirus, Hepatitis virus, SV40 virus, Chicunguinea and Bird Flu virus.

Bacteriophage: classification, morphology and ultra structure. One step growth curve (latent period, eclipse period, and burst of size.) Life cycle: lytic and lysogenic life cycle of bacteriophages. . Brief account of M13, Mu, T4, Ø x174 and lambda phage.

Reference Books:

1. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA
2. An Introduction to viruses, S. B. Biswas and AmitaBiswas. Forth edition, Vikas Publishing House PVT LTD New Delhi.
3. Textbook of Microbiology by Ananthnarayanan and Paniker's, eighth edition, Universities Press .
4. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, Sixth edition, McGraw Hill Higher education.
5. Pelczar M., Chan E.C.S. and Krieg, N.R. Microbiology. Tata Mc Grew Hill PublishingCo. Ltd., New Delhi.
6. Stainier R.V., Ingraham, J.L., Wheelis, M.L. and Painter P.R. The Microbial WorldPrintice-Hall of India (Pvt.) Ltd., New Delhi
7. . Ellen Strauss, James Strauss.Viruses and Human Disease 2nd Edition. Academic Press

   Christopher Burrell Colin Howard Frederick Murphy. Fenner and White's MedicalVirology 5th Edition.Academic Press
8. Bernard N. Fields.Fields Virology Lippincott Williams & WilkinsS. Jane Flint..Principles of Virology.American Society for Microbiology

MBTC102 Microbial Physiology

4 credit **Periods 60**

Course Objectives:

- **To develop a sufficient background to students about the growth of Microbes.**
- **To acquire knowledge on basic aspects of bacterial respiration and photosynthesis.**
- **To acquire knowledge on microbial stress response.**

Learning Outcomes

- **Knowledge on growth of Microbes**
- **General Information about microbial respiration and photosynthesis**
- **Clear idea on physiological adaptations under stress conditions.**

Unit-I 14

Structure and functions of prokaryotes, Appandages, Glycocalyx, cell wall, Periplasm, Cell membrane and cytoplasm. Microbial Nutrition- Nutritional requirement for growth (macronutrients, micronutrients and growth factors), nutritional types of microorganism.

Unit –II: 14

Measurement of growth, growth physiology, cell division, growth yields, growth kinetics, steady state growth and continuous growth. Solute transport: ABC transporters, phosphotransferase system, iron transport, chemotaxix and flagellar movement, protein export, liposomes and proteo liposomes.

Unit III16

Oxidation reduction potential, components of electron transport chain free Oxidative phosphorylation and theories of ATP formation, inhibition of electron transport chain, Coupling sites, Q loops, Q cycles and proton pumps, patterns of electron flow in aerobic and anaerobic bacteria, ATP synthesis in heterotrophic and phototrophic bacteria. Phototrophic prokaryotes, photosynthetic pigments, reactions of photosynthetic apparatus, photosynthetic apparatus of cyanobacteria, photosynthesis in halobacteria,

Unit-IV16

Introduction to two component system, regulatory systems during aerobic, anaerobic shifts: Arc, Enr, Nar, Fhl A regulon, response to phosphate supply: The pho regulon, Quorum sensing : A to C signalling system, sporulation in Bacillus subtilis, control of competence in *Bacillus subtilis*. Response to environmental stress and homeostasis: Heat shock responses, response to osmotic stress, PH homeostasis and osmotic homeostasis.

References:

1. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. 2000. Twelth Edition, Biology Microorganisms, Prentice Hall, New Jerry.

2. Moat, A.G. and Foster, W.2002. Microbial Physiology, Fourth Edition, John Wiley and Sons, New York.

3. Postgate,J. 1998, Nitrogen Fixation, third edition,Cambridge University Press.

4. Salisbury,F.W. and W.Ross, 1992, Plant Physiology, fourth edition, Wardsworth Publishing Company, California.

5. Deb, A.C. 2006. Fundamentals of Biochemistry, New Central Book Agency Pvt. Ltd., Kolkata.

6. Donald Voet and Judith G. Voet, 2011.Biochemistry.Third Edition, John Wiley and Sons, Inc. New York. 7. Stryer, L. 2010. Biochemistry, Seventh Edition, W.H. Freeman and Company, New York.

8. Nelson, D.L. and Cox, M.M. 2012. Lehingers's Principles of Biochemistry, Sixth Edition, Mac Millan worth Publishers, New Delhi.

9. Srivastava, M.L. 2008. Microbial Biochemistry, Narosa Publishing House, New Delhi.

10. Satyanarayana, U. and Chakrapani, U. 2013. Biochemistry, Fourth Edition Book and Allied Pvt. Ltd., Kolkata.

11. Bacterial metabolism by Gerhard Gottschalk (second edition), (1986) Springer Verlag New York Inc.

MBTC-103 Immunology

4 credit 60

Course objectives

- **To facilitate conceptual understanding of Components and functions of Immune system,**
- **To acquire knowledge on basic aspects Development of Immune response interdependence of HI and CMI.**
- **To acquire knowledge on basic aspects Disorders of Immune system**

- **Learning outcome**
- **At the completion of course student will able to illustrate Anatomy and function of cells and organs of immune system,**
- **student will have clear idea on Antigen ,Antibody and their interactions. student will able to explain autoimmunity, hypersensitivity**

UNIT-I 14

History of immunology,. Immune response: mechanism of innate and adaptive immune response. Haematopoiesis: . Anatomical organization of immune system: primary and secondary lymphoid organs: structure and function. Antigens- structure and properties, factors affecting the immunogenicity, properties of B and T- cell epitopes, haptens, mitogens, super antigen, adjuvant. Antibody: structure, properties, types and function of antibodies,. Antigen- antibody interaction: avidity and affinity measurements, detection of antigen- antibody interaction by precipitation, agglutination, RIA, and ELISA.

UNIT-II14

Major histocompatibility complex: organization of MHC genes, types and function of MHC molecules, antigen presentation, MHC polymorphism, MHC related diseases. Complement system: components, activation pathways, regulation of activation pathways and role of complement system in immune response. Cytokines: types, structure and functions, cytokines receptors, cytokine regulation of immune receptors. Immune response to infectious diseases: viral infection, bacterial infection, protozoan diseases, helminthes related diseases.

UNIT-III16

Hypersensitivity: type I, II, III and types IV hypersensitivity. Immunodeficiency diseases: primary and secondary immunodeficiency. Autoimmunity: organ specific autoimmune diseases, mechanism of autoimmune diseases and therapeutic approaches. Transplantation immunology: immunologic basis of graft rejection, clinical manifestation of graft rejection and clinical transplantation.

UNIT-IV 16

Cancer immunology: tumor antigen, immune response to tumor, oncogene and induction, cancer immunotherapy Vaccines: Active and passive immunization, vaccine schedule, whole organism vaccine, subunit vaccine, vaccine, DNA vaccine, recombinant vaccine, subunit vaccines and anti-idiotype vaccine. Hybridoma technology:

Reference Books:

1. Kuby Immunology by Kindt TJ, Goldsby RA, Osborne BA, Kuby J: 6th edition. New York. WH Freeman; 2006.
2. Cellular and Molecular Immunology by Abbas AK, Lichtman AH, Pillai S: Saunders Elsevier; 2007.
3. Immunobiology: The immune system in health and disease by JanewayCA,TraversP,Walport M, Shlomchik MJ: 6th edition. New York. Garland Science Publishing; 2005.
4. Medical Microbiology and Immunology by Levinson W, Jawetz E: Lange publication; 2001.
5. 4. Ananthanarayan and Paniker. Text book of microbiology. University press. 8th edition 5. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill. 6. Willey,Sherwood,Woolverton. Prescott,Harley, and Klein's Microbiology McGraw-Hill publication
6. Tortora,Funke,Case. Microbiology.Pearson Benjamin Cummings.

7 DavidFrifielder,StanelyR.Maloy, MolecularbiologyandMicrobialgenetics. 2ndEdition,JonesandBarlettPublishers. (1994).

9.Roitt's Essential Immunology by Delves PJ, Martin SJ, Burton DR, Roitt IM; 11th edition. Blackwell

MBTE-101 Bio-statistics and Bioinstrumentation

4 credit **Periods 60**

Course Objectives

- **To learn how to effectively collect data, describe and use data to make inferences**
- **Demonstrate understanding of hypothesis testing and Choose and apply appropriate statistical methods for analyzing variables.**
- **To learn the principle, working and applications of basic bio-molecular techniques advanced instrumentation techniques.**

Learning Outcomes

- **General Information about basic bio-molecular techniques**
- **Knowledge on advanced instrumentation techniques.**
- **General Information about collection and analysis of data use of statistical method in analysis and interpretation of biological data.**

UNIT–I 14

Introduction to biostatistics, collection of data, sampling methods, processing and presentation of data. Measures of central tendency and dispersion (mean, median, mode, range, standard deviation, mean deviation, variance)

UNIT-II 16

Correlation, calculation of Karl Pearson's coefficient of correlation, Regression Analysis, linear regression, regression equation, Hypothesis testing: Types of hypothesis testing: t-test, χ^2 -test, and F- test., ANOVA. Software used in biostatistics- SPSS.

Unit III- Basic techniques14

Chromatography & Centrifugation: Principle, Working & Applications of chromatography (paper, thin layer, gel filtration, ion exchange, affinity, gas chromatography, HPLC, HPTLC) and centrifugation (preparative, analytical, ultracentrifugation, differential and density gradient methods). Electrophoretic Techniques: Basic principles, working and applications of paper, agarose gel electrophoresis, native and denaturing PAGE and two dimensional electrophoresis.

Unit IV – Spectroscopy and radio isotopic techniques:16

Principle, working and applications of UV, visible, IR, NMR, Fluorescence, Atomic Absorption, Mass and Raman Spectroscopy. Use of radioisotopes in biological sciences, principle and application of tracer techniques, Geiger-Muller and Scintillation counters, autoradiography and its applications

References:

1. Statistics in biology, Vol. 1 by Bliss, C.I.K. (1967) McGraw Hill, NewYork.
2. Practical Statistics for experimental biologist by Wardlaw, A.C. (1985).
3. Statistical Methods in Biology - 2000 by Bailey, N.T. J. English Univ. Press.
4. Practical Statistics for experimental biologist by Wardlaw, A.C. (1985).
5. Fundamental of Biostatistics by Khan
6. Biostatistics by P Rama Kkrishna, Saras Publication, 1995.
7. Biostatistical Methods by LachinBio-instrumentation

8. *Biochemistry.* 6th Edition by Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Freeman,New York.
9. *Biophysics: An Introduction* by Cotterill, R. M. J. (2002). John Wiley & Sons, England.
10. *Principles of protein X-ray crystallography* by Drenth, J. (2007). 3rd Ed. Springer,Germany.
11. *Biochemistry.* 3rd edition by Garrett, R. H. and Grisham, C. M. (2004). Brooks/Cole,Publishing Company, California.
12. *Understanding NMR Spectroscopy* by Keeler, J. (2002). John Wiley & Sons, England.

13. *Bioinformatics: sequence and genome analysis* by Mount, D. W. (2001). ColdSpringHarbor Laboratory Press, New York.
14. *Methods in Modern Biophysics.* Second Edition by Nölting, B. (2006). Springer,Germany.
15. *Biophysics* by Pattabhi, V. and Gautham, N. (2002). Kluwer Academic Publishers,NewYork and Narosa Publishing House, Delhi.
16. *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson Keith and Walker John (2005), 6th Ed. Cambridge University Press, New York.
17. *Proteins NMR Spectroscopy: Principles and Practice* by Cavanagh John *et.al.* (1995),Academic Press
18. *Molecular Biophysics: Structures in Motion* by Daune M. and W. J. Duffin (1999),Oxford University Press.
19. *Methods in Modern Biophysics by* Nalting B. and B. Nalting (2003) Springer Verlag
20. *Computational Analysis of Biochemical Systems by* Voit E. O. (2000) CambridgeUniversity Press.
21. *Physical Biochemistry: Applications to Biochemistry and Molecular Biology* by Freilder,D. Freeman, San. Francisco, 1976
22. *Biochemical Techniques: Theory and Practice* by Robyt, John F.; White, Bernard J.Waveland Press, Inc., U.S.A. Published: 1990.

MBTE-102

Mycology and Protozoology

4 Credit **Periods 60**

Course Objectives

- **To facilitate conceptual understanding of fungal pathogens,applications of fungi**
- **To study systematic of subkingdom protozoa**
- **To study biological importance of free living protozoa**

Learning Outcome

- **At the completion of course student will able to illustrate diagnosis ,spread prevention and treatment for fungal pathogens, application of fungi**
- **Student will acquire knowledge on methodology of collection and identification of free living protozoa**
- **Student will acquire knowledge on culture methods of free living protozoa**

Unit I 14

Medical Mycology, Introduction to fungi,Plant fungal pathogens and human fungal pathogens

diagnosis ,spread , prevention and treatment Tineapedis or athlete's foot , *Candida albicans*. Infection,

Ring worm,Aspergillosis

Unit II16

Applied Mycology: Role of fungi in biotechnology, Application of fungi in food industry. (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides);

Unit III:14

1. Classification of protozoa upto order level
2. Factors affecting growth of protozoa: Balanced growth and non-balanced growth
3. Ecology of free living protozoa
    i) Marine protozoa
    ii) Planktonic protozoa
    iii) Soil protozoa
    iv) Protozoan blooms

Unit IV:16

1. Nutrition in protozoa
    i) Methods of feeding: Filter feeding, Raptorial feeding, diffusion feeding
    ii) Digestion
    iii) Nutritional requirements

References

1. Introductory Mycology, 4ed Paperback – 2007 by C.JAlexopoulos (Author), C.W. Mims (Author), M. Blackwell (Author)
2. Textbook of Medical Mycology Hardcover – 2018 by JagdishChander (Author)
3. Aikawa and Sterling- Intracellular Parasitic Protozoa
4. Baker- Parasitic Protozoa
5. Chandler and Read- An introduction to Parasitology
6. Chattergy- Parasitology
7. Thomas C Cheng- General Parasitology
8. Hall- Protozoalogy
9. Kudo-Protozoalogy
10. Tayler and Baker- Cultivation of Parasites in vitro

Lab Course –I MBLC-I (Based on MBTC-101 &MBTC103

1 Detection of antigen antibody interaction using Widaltest ,

2 Detection of antigen antibody interaction VDRL/RPR TEST,

3 Detection of antigen antibody interaction using RA TEST,

4 Detection of blood group antigens

5 Detection of antigen antibody interaction performing Radial immunodiffusion ,

6 Detection of antigen antibody interaction using oucherloneyassay .

7 ELISA Test online assay performing and assay based quiz.

8 Enumeration of cells of Immune system DLC (differential leucocyte count) technique

9 Isolation and enumeration of bacteriophage .

10 Enumeration of Growth phase of phage and burst size.

11 Detection of viruses using Turbidometric assay

12 Study of plant viruses

13 collection of infected plant material and identification

14 Study of morphology of lesions on infected plant

Refeerences

A handbook of practical immunology by G. P. Talwar, Vikas Publishing House, New Delhi.

2. Genes VII by Benjamin Lewin, Oxford University Press.

3. Immunology (2nd edition) by C. VamanRao, Narosa publication.

4. Immunology (2nd edition) by Janis Kuby, W. H. Freeman and company. 5. Immunology (8th Edition) by D. M. Weir, Churchill Livingstone.

6. Roitt's Essential Immunology (9th edition) by Ivan Roitt, Blackwell Sciences

Lab Course-IIMBLC-II

(Based on MBTC-102 &MBTE101or MBTE102)

Preparation of microbiological media: autotrophic media, minimal media, basic media, enrichment media, enriched media and differential media.

1. Culturing techniques of microbes: Slant and stab, tube culture, flask culture and shake flask culture.
2. Anaerobic jar and its uses.
3. Studies on bacterial growth curve
4. Effect of pH, temperature, salt concentration on bacterial growth.
5. Microbial growth experiments: viable count of culture and generation time determination
6. Glucose uptake by *E. coli* or *Saccharomyces cerevisiae*
7. Isolation of photosynthetic bacteria.
8. Estimation of calcium ion in sporulating bacteria (AAS/ Colorimeter/ EDTA)
9. Measurement of growth rate and generation time by turbidometry method.
10. Studies on pH titration curves of amino acids/acetic acid and determination of pKa values

andHanderson-Hasselbach equation.

12. Paper chromatography- separation of amino acids and sugars.
13. Thin layer chromatography - separation of amino acid.
14. Spectrophotometric estimation of biomolecules (carbohydrates, proteins, lipids and nucleic acids)
15. Absorption maxima of proteins, nucleic acid, aromatic amino acid, riboflavin and photosynthetic pigments.
16. Representation of Statistical data by

    a) Histograms b) Ogive Curves c) Pie diagrams

17. Determination of Statistical averages/ central tendencies.

a) Arithmetic mean b) Median c) Mode

18. Determination of measures of Dispersion

a) Mean deviation b) Standard deviation and coefficient of variation

c) Quartile deviation

19. Tests of Significance-Application of following

a) Chi- Square test b) t- test c) Standard error

Reference books

1. Statistics in biology, Vol. 1 by Bliss, C.I.K. (1967) McGraw Hill, NewYork.
2. Practical Statistics for experimental biologist by Wardlaw, A.C. (1985).

3. Statistical Methods in Biology - 2000 by Bailey, N.T. J. English Univ. Press.
4. Biostatistics - 7th Edition by Daniel
5. Practical Statistics for experimental biologist by Wardlaw, A.C. (1985).
6. Fundamental of Biostatistics by Khan
7. Biostatistics by P Rama Kkrishna, Saras Publication, 1995.
8. Biostatistical Methods by Lachin Bio-instrumentation

MBTC 201 EXTREMOPHILES AND BIODIVERSITY

4 credit **Periods 60**

Course Objectives

- **To facilitate conceptual understanding of extremophiles and their types,**
- **To study Adaptive strategies in typical extremophiles,**
- **To Know systematic and occurrence of Archaea, methods of identification, Application of mycorrhiza**

Learning outcome

- **At the completion of course student will able to illustrate**
- **Student will acquire knowledge on Extreme habitats ,**
- **Student will acquire knowledge on applications of extremophiles, culture dependent and independent**

Unit-I 14

Microbial life at extreme temperature : prokaryotes and eukaryotes, habitats and ecological aspects, mechanism and molecular basis of thermophily and psychrophily commercial aspects of thermophiles and psychrophiles, application of thermozymes.

Microbial life at extreme P^H : Classification, habitats, soda lakes and deserts, calcium alkalophily, acidotolarance, mechanism of adaptation (external and internal PH, cell surface and membrane), applications.

Unit-II14

Halophily and Oligotrophy : Classification, dead sea, cell wall and membrane, purple membrane, compatible solutes, osmoadapation / halotolarance. Applications of halophiles, mechanism and regulation of oligotrophy. Life under high irradiation: Ionizing and non ionizing radiation, radiation sensitivity and nature of damage, mechanism of protection in radiation resistant strains.

Unit-III 16

Archaea : Systematics and occurrence, diversity, characteristic features, significance and potential applications (e.g. biochips, methane generation, ultra filtration membranes, production of PHB and PHA, desulfurization of coal and crude oil, bioleaching of metals, enzymes and compatible solutes) of different groups of archaebacteria (Crenarchaeota, Euarchaeota, Korarcheota and Nanoarchehaeota.)

Bacteria : Conventional and molecular systematic, occurance,diversity, characteristic features, significance and applications of various bacterial groups according to Bergey's Manual of Systematic Bacteriology.

Unit-IV16

Fungal systematic and diversity : Implications of molecular and biochemical methods including r-DNA analysis, RFLP, RAPD and other fingerprinting techniques, fatty acids, polysaccharides and lipids, role of secondary metabolites insystematics, endophytic fungi and their adaptations, endophytes as biocontrol agents. Mycorrhizalfungi : Diversity of endo and ectomycorrhizal fungi, biology of arbuscularmycorrhizal fungi, signalling, penetration and colonization inside roots, application and recent developments in the field of mycorrhiza. Algal diversity : Importance of algae in production of algal pigments, biofuels, hydrogen production, important bioactive molecules, role of algae in sustainable environment.

References:

1.Biology of Extremophiles. Microbiology of Extreme Environments edited by C. ...Environments, Academic Press. 5 Kushner, D.J., ed. (1978) Microbial Life.

2.Brock Biology of Microorganisms Hardcover – Import, 17 Dec 2010 by Michael T. Madigan (Author), John M. Martinko (Author), David A. Stahl

3.Advances in applied microbiology. Vol.X, by Wayne W. Umbreit and D. Pearlman Academic Press.

4. Microbial ecology. Fundamental and applications by Ronald M. Atlas and Richard Bartha.II and IV edition.

5. Microbial Ecology. IInd edition by R. Campbell.Blackwell scientific publication.

6. Microbial life in extreme Environment by D.J. Kushner. Academic Press.

7. Microbiology of extreme Environment and its potentials for Biotechnology by N. S. Da Coasta, J. C. Duarata,, R.A.D. Williams. Elsisver applied science, London 8. Thermophiles.General, Molecular and applied Microbiology by Thomas D.Brock.Wiley Interscience publication.

8 Recent Advances on Mycorrhizal Fungi (Fungal Biology) by Marcela C. Pagano (Editor)

9 Extreme environment. Metabolism of microbial Adaptation by Milton R., Heinirich Academic Press.

MBTC-202: Microbial Metabolism

4 credit **Periods 60**

Course Objectives

- **To learn the characteristics of enzymes**
- **To acquire knowledge on metabolism of bio - molecules.**
- **To acquire knowledge on methane fermentation, Sulfide fermentation**

Learning Outcomes

- **Student will know about General Information about enzymes**
- **Student will have Knowledge on metabolism of bio – molecules**
- **Student will have Knowledge on regulation of enzyme synthesis**

Unit-I14

1. General characteristics of enzymes, activation energy, coupled reactions, active site and its importance, forms and derivation of M.M Equation, Significance of Vmax and Km, types of enzyme inhibition.

2. Regulation of enzyme synthesis: Induction, catabolite repression, end product repression and attenuation, Allosteric enzymes and allosteric control, covalent modification of enzymes Nitrogen fixing organisms, biochemistry of nitrogen fixation, regulation of nitrogenase.

Unit-II14

1. Growth of E. coli on glucose and substrates other than glucose, PPP, ED pathway, citric acid cycle-Reversed TCA cycle, anapleurtotic reactions, glyoxylate cycle, Calvin cycle.

2. Assimilation of nitrate and sulfate, Dissimilation of nitrate and sulfate, ammonia oxidizing bacteria, nitrite

oxidizing bacteria, sulfur and iron oxidizing bacteria, Metabolism of hydrocarbons and lipids.

Unit-III16

1. Biosynthesis of amino acids- oxaloacetate and pyruvate family, phosphoglycerate family, α- oxoglutarate family and aromatic amino acids.

2. Biosynthesis of fatty acids, phosphatidic acids, phospholipids and macromolecules (Glycogen, cell wall, outer membrane layer, Levan and dextran synthesis), Biosynthesis of purines and pyrimidines.

Unit- IV16

1. Alcohol fermentation, Lactate fermentation, Butyrate and acetone –butanol fermentation, Propionate and succinate fermentation.

2. Methane fermentation, Sulfide fermentation, Anaerobic food chain, Fermentation of single amino acids, Stickland reaction and heterocyclic compounds.

References:

1. Bacterial metabolism by Gerhard Gottschalk (second edition), (1986) Springer Verlag New York Inc.
2. Bacterial metabolism by H. W. Doelle (Second edition), (2005), Academic press, Inc.
3. Biochemistry by A. L. Lehninger,
4. Biochemistry, Seventh Edition by Jeremy M. Berg, John L. Tymoczko and LubertStryer (Dec 24, 2010), W.H. Freeman & Company.
5. Chemolithoautotrophic bacteria: Biochemistry and environmental biology by Tateo Yamanaka, (Jan. 2008). Springer.
6. Lehninger: Principles of Biochemistry by Albert L. Lehninger, Michael Cox and David L. Nelson (4 May 2004), W. H. Freeman.
7. Microbial Biochemistry (Second Edition) by G.N. Cohen, (2011) Springer Dordrecht Heidelberg London New York.
8. Principles of Biochemistry (Lehninger Principles of Biochemistry) by Albert L.

Lehninger, Michael M. Cox and David L. Nelson (February 2008), W. H. Freeman.

MBTC 203 Microbial Genetics

4 credit **Periods 60**

Course Objectives

- **To learn the basics of microbial genome organization, mutation, DNA repair, recombination and regulation. To acquire knowledge on applicability of genetics**
- **To acquire basic and advanced knowledge ofgenome organization in microorganisms,**
- **To learn the recombination and gene transfer mechanism**

Learning Outcomes

on successful completion of this course students will be able;

- **Describe fundamental principles of microbial genetics.**
- **Understand mechanism of DNA damage, mutation and repair.**
- **Describe mechanism of gene transfer between and within the bacterial cells.**

Unit – I. 14

Brief historical evidences of genetic material in bacteria and viruses, features of genome organizations in viruses, prokaryotes, archea and eukaryotes.plasmids; bacteria and yeast. concept of operon, interrupted genes, gene families, structure of chromatin and chromosome. unique and repetitive DNA, heterochromatin, eucromatin, Allele, transposons.

Unit – II. 16

DNA Damage and Repair.

Mutation; spontaneous and induced, molecular mechanism of mutation, mutation rate, mutation priority, effect of mutation on gene product, significance of mutants, reversion of mutation, intragenic and intergenic mutation, suppressor mutation and complementation.

DNA protection and Repair: Role of restriction modification system in DNA protection and repair.

Unit – III. 14

Recombination and methods of gene transfer in bacteria; Homologous recombination, site-specific recombination, illegitimate recombination.

Conjugation: F-plasmid; structure and function, origin of conjugation, Hfr and F strain, interrupted and un-interrupted mating, time map and recombination, conjugation in E. coli, F-factor and their use in genetic mapping.

Transformation: Natural and artificial, competence, transformation in Bacillus, Himophillus and Streptococcus, mechanism of recombination, genetic mapping.

Transduction: Generalized and specialized transduction, λ-phage and P1-phage, HFT and LFT lysate, co-transduction and transduction mapping.

Transposons: Discovery of transposition, classes of bacterial transposons, analysis of transposition, transposon mutagenesis and Mu-transposon.

Unit – IV: 16

Gene regulation: control of gene expression, co-ordinated control of structural genes, stringent response, catabolite repression, instability of bacterial RNA, positive regulation in E. coli (arabinose operon) and negative regulation in E. coli (lac operon), inducers and repressors, trp operon- regulation by attenuation, gal, tol operon and regulons with recent advances.

References:

1. Fundamental Bacterial Genetics by Nancy Trun and JenanineTrumphy (2003), Publisher: Blackwell Publishers.
2. Genetics a conceptual approach (5^{th} Ed.) by Benjamin A. Pierce (2008) Publisher: W.H. Freeman and Company
3. Genetics A Molecular Approach (2^{nd} / 3^{rd} Ed.) by Peter J Russell (2006)
4. Modern Microbial Genetics (2^{nd} Ed.) by Uldis N. Streips, Ronald Yasbin. Publisher: Wiley-Liss, Inc.
5. Microbial Genetics by Maloy et.al. 1994. Jones and Bartlett Publishers.
6. Molecular Genetics of Bacteria by J.W.Dale 1994 John Wiley and Sons.
7. Gene XII by Lewin Oxford University press. 2017
8. Organization of Prokaryotic genome. 1999 by Robert L Charlebois, ASM Publications.
9. Recombinant DNA by Watson J.D.

201: Enzymology and Molecular Biology

4 credit **Periods 60**

Course Objectives

- **To learn the enzyme modification and recent developments in enzymes**
- **To acquire knowledge on applicability of enzymes.**
- **To acquire basic and advanced molecular biology**

Learning Outcomes

- **Student will have knowledge about enzyme modifications.**
- **Knowledge on applications of enzymes**
- **Student will have knowledge about basic and advanced molecular biology**

Unit I14

1. Enzyme engineering: Introduction to enzyme engineering and their application, genetic and chemical modification, methods of enzyme immobilization, homology modeling, biosensors, enzyme sensors for clinical processes and environmental analysis, abzymes, ribozymes, synzymes and recent developments, enzyme carriers, enzyme probe.

2. Enzymes in genetic recombination: Restriction endonucleases, SI nucleases, BAL 31 nucleases, DNA ligase, DNA polymerase, polynucleotide kinases, phosphatases and reverse transcriptase

Unit II16

1. Enzymes in medical diagnosis and therapy: Lactate dehydrogenase, malate dehydrogenase, Fructose 6 biphosphatase, acid and alkaline phosphatase, Glucose 6 phosphate dehydrogenase, Enzyme in cancer therapy, genetic diseases, clotting disorders, Neonatal jaundice, surgery, toxicity.

2. Industrial applications of enzymes - catalysts in the manufacturing and other conversion processes as analytical

tools (enzyme electrode).

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Unit – III: Nucleic Acid structure and replication14

The structure of Nucleic Acid, Weak chemical interactions, detailed account of ds DNA. A, B and Z DNA, Unusual DNA structures, Mitochondrial DNA, Structure of RNA. Denaturation and renaturation kinetics of nucleic acid, Topological properties of nucleic acid, Organization of prokaryotic and eukaryotic genome.

DNA replication; models of replication, Enzymes of replication, Specific features of replication in prokaryotes and eukaryotes, Action of topoisomerases, Telomere maintenance, single stranded DNA replication, Relationship between DNA replication and cell cycle, DNA copy number maintenance.

Unit – IV: Gene Expression 16

Concept of gene, Transcription machinery of prokaryotes and eukaryotes, transcription enzymes, Promoters, enhancers, silencers, activators transcription process and regulation. Post transcriptional processes: RNA processing, RNA editing, RNAi and miRNA, antisense RNA.

The genetic code, translation process in prokaryotes and eukaryotes, regulation of translation, inhibitors of translation. Post translational processes: protein modifications, folding, chaperones, transportation.

Reference Books:

1. Advances in Enzymology by Alton Meister (1996), Interscience Publishers.
2. Allosteric enzymes – kinetic Behaviour by B.I Kurganov (1982) John Wiley and sond
3. Inc., New York.
4. Biology enzymes in biotechnology by H.J.Rehm and G. Reed Verlag (1983) VCH
5. Publishers. New York.
6. Enzymes as Drugs by John S. Hoilenberg and Joseph Roberts (2001). John Wiley and
7. Sons New York.
8. Enzymes by Dixon, M., and E. C. Webb, 3rd edition, (1980), Academic Press. New York.
9. Enzymology by palmer
10. Hand Book of Enzyme Biotechnology by Wiseman (1985), Ellis Horwood.
11. Methods in Enzymology by W. A. Wood (1980) Academic Press New York.
12. Methods in Enzymology. Volume 22- Enzyme purification and related techniques by
13. William B. Jakoby. Academic press, New York.
14. Methods of Enzymatic Analysis by Hans Ulrich. Bergmeyer (1974) VerlagChemie.
15. Topics in enzymes and fermentation biotechnology by L.N.Weiseman, John wileyandSons.
16. Lewin B. (2004) Gene VIII, Pearson Prentice Hall, Pearson Education, Inc., NT, USA (ISBN: 0-13-123826-4).
17. Watson JD, Baker JA, Bell SP, Gann A, Lewin M, Losick R (2004) Molecular Biology of the Gene, Benjamin Cummings- CSHL Press, USA.
18. Dale WJ and Schontz VM (2007) From Genes to Genomes. John Wiley &sons ltd., England.
19. Stryer, Lubert Biochemistry 5th edn. W. H. Freeman & Co., New York.
20. Brown TA (1995) Essential Molecular Biology, Vol. I, A Practical Approach, IRL Pres, Oxford, UK.
21. Nelson DL & Cox MM (2005) Lehninger's Principles of Biochemistry, 4thedn., McMillan Worth Publ. Inc. NY.
22. Watson, JD, Baker AT and Bell PS (2008). Molecular Biology of Gene. 5thedn. Pearson Education Inc.

23. Kornberg A and Baker AT (2005) DNA Replication. 2nd edition. University Science Book, California.
24. Turner PC, McLennan AG, Bates AD and White, MRH (2002) Instant Notes: Molecular Biology, 2ndedn. Viva Books Pvt. Ltd., New Delhi (ISBN: 81-7649-215-9).
25. Gerald Karp (1996). Cell and Molecular Biology- Concepts and Experiments. John Wiley and Sons, Inc., New York.

MBT-E-202: Genomics and Proteomics

4 credit **Periods 60**

Course Objectives

- **To learn the genomemodification and recent developments in genomics**
- **To acquire knowledge on applicability of enes**
- **To acquire basic and advanced molecular biology**

Learning Outcomes

- **Student will have knowledge about genome modifications.**
- **Knowledge on applications of molecular biology**
- **Student will have knowledge about basic and advanced molecular biology and proteins**

UNIT I 14

Organization of genomes: Introduction: Genome, Genomics, Omics and importance, General features, C-value paradox. Gene identification; gene prediction rules and software's; Genome databases; Annotation of genome. Genome diversity: taxonomy and significance of genomes – bacteria, yeast, Caenorhabditis, Homo sapiens, Arabidopsis, etc.

UNIT II16

Mapping genomes: Genetic mapping – i) Cross breeding and pedigree analysis, ii)DNA markers - RFLPs, SSLPs, SNPs Physical mapping - Restriction mapping, Fluorescent in situ hybridization, Radiation hybrid mapping and Sequence tagged site mapping.

UNIT III 14

Genomics: Genome projects: The Human genome project, HapMap Project, The 1000 genome project, and The

ENCODE Project. Structural genomics: Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing Understanding a genome sequence: locating the genes in a genome sequence, determining the functions of individual genes and by studying the activity of a protein coded of an unknown gene

UNIT IV 16

Pattern of genome evolution: The origin of genomes- Origin of macromolecules, RNA world and DNA world Acquisition of new genes (By gene duplication) and Gene families – (Types, Pseudogenes, Origin of gene families (lateral gene transfer, allopolyploidy).Synthetic genomes and their applications

REFERENCES

1. Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York.

2. Dunham, I., 2003. Genome Mapping and sequencing.Horizon Scientific 3.Graur, D and W H Li, 2000.Fundamentals of molecular evolution.Sinauer Associates.

4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. 2004. Genetics from Genes to Genomes. McGraw Hill.

5. Lewin B. 2003. Genes VIII. Oxford University Press. Oxford.

6. The Human Genome 2001, Nature Vol. 409.

7. The Drosophila Genome. 2000, Science Vol. 267.

8. The Caenorhabditiselegans genome 1998. Science Vol. 282.

9. The Arabidopsis Genome 2000 Nature vol. 408. 10. Primrose, S. B., and R. M. Twyman . 2006. Principles of gene manipulation and Genomics, Blackwell Publishing MA. USA

Lab Course –III MBLC-III

(Based on MBTC-201 &MBTC202)

1 Studies on halophiles from sea water (pigmentation and salt tolerance).

2 Studies on alkalophiles isolated from lonar water (at least one enzyme).

3 Isolation of acidophiles from metal sulphides or acid mine water.

4 Demonstration of iron oxidation rate of Thiobacillusthiooxidans isolated

5)Physico chemical analysis of water sample ph, DO, phosphate,BOD,and COD.

6)Study of VAM fungi.

7)Demonstration of sewage treatment .

8) Enrichment and isolation of thermophiles from hot water spring (at least one enzyme)..

9 Isolation of fungal endophytes.

10 Studies on biocontrol activities of endophytes .

11 Isolation and identification of cyanobacteria.

12 Isolation and purification of degradative plasmid of microbes growing in polluted environments .

13 Utilization of microbial consortium for the treatment of solid waste.

14 Recovery of toxic metal ions an industrial effluent by immobilized cells .

Reference Books

1. Prescott, M.J.,Harley,J.P.andKlein,D.A.Microbiology. 5th Edition WCB McGrawHill, New York, (2002).

2. Tortora, G.J., Funke ,B.R. and Case, C.L. Microbiology : An Introduction. Pearson Education, Singapore, (2004).

3.Alcomo,I.E.FundamentalsofMicrobiology.VIEdition, onesandBartlettPublishers.Sudbury.Massachusetts, (2001).

4. Black J.G.Microbiology-PrinciplesandExplorations.JohnWiley&SonsInc.NewYork, (2002). 5. Tom Besty,D.C Jim Koegh.Microbiology Demystified McGRAW-HILL.

Lab Course –IV MBLC-IV

Based on MBTC-203 &MBTE201/MBTE202)

1) Isolation and identification of Reserve food material (Glycogen / Polyphosphate/ PHB) of *B.megaterium*and *Azotobacter sp.*

2) Demonstration of endogenous metabolism in *B. megaterium*or *E.coli*and their survival under saturation condition.

3) Quantitative estimation of amino acid by Rosen's method.

4) Quantitative estimation of sugar by Sumners method.

5) Quantitative estimation of protein by Folin Lowry /Biuret method.

6) Preparation and analysis of polar lipids from *S. aureus*and *E.coli*.

7) Isolation of autotrophs.

8) Isolation of hydrocarbon degraders

9) Isolation and characterization of nitrogen fixers.

10) Isolation and characterization of chemolithotrophic microorganisms.

11) Isolation of cellulose, pectin, xylan and chitin degraders and estimation of their activities.

12) Nitrification and denitrification by soil isolates

13) Qualitative study of photosynthesis in photosynthetic bacteria and Cynobaceria.

14) Isolation of iron and sulfur oxidizing bacteria.

15) Effect of UV, gamma radiations pH, disinfectants, chemicals and heavy metal ions on spore germination of *Bacillus SP.*

16) Determination of Iron Oxidation Rate of *Thiobacillusferrooxidans.*

17) Determination of Sulfur Oxidation Rate of *Thiobacillusthiooxidans.*

18) Microbial degradation, decolorization and adsorption of organic dyes

19) Detection of enzyme activity of lipase,Urease,invertase,protease,Tween 80 hydrolysis.

20) Determination of kinetic constant of amylase:-Amylase activity,Vmax.Km.

21) Effect of pH and temperature on amylase activity.

22) Effect of inhibitors on amylase activity.

23) An Enzyme Purification theme

(a)Preparation of cell-free lysates & Ammonium Sulfate precipitation

(b) Enzyme Kinetic Parameters: Km, Vmax and Kcat.

(c) Column Chromatography/ Ion-exchange Chromatagraphy/ Gel Filtration/ Affinity Chromatography/ Generating a purification Table

(d) Assessing purity by SDS-PAGE Gel Electrophoresis.

24) Determination of Molecular weight of Protein by Column chromatography

25) Determination of Surface Tension by Stalagmometer.

Reference Books

1. Prescott, M.J.,Harley,J.P.andKlein,D.A.Microbiology. 5th Edition WCB McGrawHill, New York, (2002).

2. Tortora, G.J., Funke ,B.R. and Case, C.L. Microbiology : An Introduction. Pearson Education, Singapore, (2004).

3.Alcomo,I.E.FundamentalsofMicrobiology.VIEdition,onesandBartlettPublishers.Sudbury.Massachusetts, (2001). 4BlackJ.G.Microbiology-Principlesand xplorations.JohnWiley&SonsInc.NewYork, (2002).

5. Tom Besty,D.C Jim Koegh.Microbiology Demystified McGRAW-HILL.

6Wilson& Walker Principles andTechniquesinPractical B i o c h e m i s t r y .5th Edition Cambridge University Press (2000).

7 MurphyD.B.FundamentalofLightMicroscopy&Electron Imaging.1st Edition.WileyLiss.(2001).

8 K L Ghatak. Techniques And Methods In Biology PHI Publication (2011) 4. Pranav Kumar. Fundamentals and Techniques of Biophysics and Molecular Biology

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

SCHOOL OF LIFE SCIENCES,

M. Sc. MICROBIOLOGY COURSE (TOTAL CREDITS: 100)

TOTAL MARKS : 2500

Program Structure – 2019 Onwards (CBCS Pattern)

Introduction:

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of the country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in the curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. Swami RamanandTeerthMarathwada University has several initiatives towards academic excellence, quality improvement and administrative reforms. In view of this priority and in keeping with Vision and Mission, process was already initiated towards introduction of semester system, grading system and credit system. University had implemented Choice Based Credit System (CBCS) pattern at PG level on Campus from the academic year 2014-2015 progressively. These regulations are called as Regulations on Swami RamanandTeerthMarathwada University Choice Based Credit System 2014. Further, Revised Guidelines for implementation of CBCS in Campus and Sub Centre w.e.f. 2019-20 were also issued. Revision and updating of the curriculum is the continuous process to provide an updated education to the students at large. In view of this priority and in-keeping with Vision and Mission, process of revision and updating the curriculum is initiated and implemented at PG level from the academic year 2019-2020 progressively. Presently there is wide diversity in the curriculum of different Indian Universities which inhibited mobility of students in other Schools of the Campus, Universities or States. To ensure uniform curriculum at PG level , curriculum of different Indian Universities, syllabus of NET, SET, MPSC, UPSC, Forest Services and the UGC model curriculum are referred to serve as a base in updating the same. The CBCS provides choice for students to select from the prescribed courses .The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our university has already introduced the choice based credit system. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. Keeping in mind BOS in Microbiology prepared the curriculum to ensure up-to-date level of understanding of students in core and applied courses in Microbiology. Many excellent university syllabi were used while framing this syllabus. As Microbiology students find placement in food and pharmaceutical industries and diagnostic laboratories M ScMicrbiology School of Life Sciences, have designed syllabus to train student in these sectors. MOOC-NPTEL-SWAYAM courses, will help student to learn courses using online platform. Discipline Specific Elective Courses have designed to cater requirements of employers of multinational companies. Two credit course like Communication skills, Teaching competency, Diagnostic techniques, bioinformatics, are incorporated in curriculum. The student will be equipped to take up a suitable position in academia or industry, and to pursue a career in research due to this comprehensive curriculum

Overall after completion of this course, students will also acquire fundamental knowledge in Microbiology and will have special skills necessary to satisfy current practical difficulties and problems

Outline and Salient Feature:

M. Sc. Microbiology syllabus is designed to serve the need of choice based credit system course structure to orient and

practically train students in the field of Microbiology. The course is specifically bringing Core courses dealing additional domain of knowledge in Immunology, Virology, Microbial Physiology, Metabolism, Microbial Genetics, Extremophiles, Bioprocess and engineering aspect. Applied branches of Microbiology such as Environmental ,Medical ,Food, Pharmaceutical and Agriculture Microbiology

Special efforts have been taken to improve employability of student for which Communication skills, Teaching competency ,Diagnostic techniques, bioinformatics, are incorporated in curriculum. The student will be equipped to take up a suitable position in academia or industry, and to pursue a career in research if so desired.

The syllabus of M. Sc. microbiology course will orient and train the students in view of microbial genetics and molecular biology, occurrence of metabolic events and its relation to environment and agriculture, to understand and apply this knowledge for carrier orientation.

Specific Program Outcome: The student will understand and be able to explain different branches of Microbiology such as Immunology, Virology, Microbial Physiology, Metabolism, Microbial Genetics, Extremophiles, Bioprocess and engineering aspect. Applied branches of Microbiology such as Environmental, Medical, Food, Pharmaceutical and Agriculture Microbiology will help student to acquire necessary skills . Dissertation that is a short research project incorporating techniques of Basic and Advanced Microbiology under supervision will help student to execute the skills learned by them.

PO1: Students will acquire enough skills in core course like Immunology, Virology, Microbial Physiology, Metabolism, Microbial Genetics, Extremophiles, Bioprocess and engineering aspect.

PO2: Students will acquire knowledge in applied branches of Microbiology such as Environmental, Medical ,Food, Pharmaceutical and Agriculture Microbiology

PO3: This will provide updated curriculum with recent advances in the subject and enable the students to face NET, SET, UPSC and other competitive examinations successfully.

PO4: This program shall train and orient the students so as to develop[human resource for the educational institutes, industries and other organizations.

PO5: This will also develop specific skills amongst students for self employability through the development of their own enterprises.

PO6: This shall develop ability in the students for the application of the acquired knowledge in the fields of life so as to make our country self reliant and self sufficient.

M.Sc Microbiology (Total credit 100)

Total Marks:-2500

Programme Structure:-2020 onwards (CBCS Pattern)

Programe code:-

Semester	Course Code	Title of the Course	No. of Instructional hr / week		Total Credits	Marks		Total Marks
						CIA	ESA	
First Semester		THEORY & PRACTICAL						
	MBTC-101	Virology	04	CC	04	50	50	100
	MBTC-102	Microbial Physiology	04	CC	04	50	50	100
	MBTC-103	Immunology	04	CC	04	50	50	100
	MBTE-101							
	MBTE102	1.Biostatistics & Bioinstrumentation Or 2. Mycology & Protozoology	04					
	Or							
	04	DSC						
	Or							
	DSC		04					

Or

04 50

Or

50 50

50

100

Or

50

MBT 105

MBT105 Communication skill

Teaching competency 02

02 SEC

SEC 02

02 25

25 25

25 50

50

MBLC-I	Lab Course – I (Based on MBTC-101 &MBTC102)	4	DSC	04	50	50	100
MBLC-II	Lab Course-II (Based on MBTC-103 &MBTE101or MBTE102)	4	DSC	04	50	50	100
	Total	26	325	325	650		

Second Semester

MBTC-201	Extremophiles and Biodiversity	04	CC	04	50	50	100
MBCT-202	Microbial Metabolism	04	CC	04	50	50	100
MBTC-203	Microbial Genetics	04	CC	04	50	50	100

MBTE-201

Or

MBTE202

Or

MBTE203

Enzymology & Molecular Biology

Proteomics & Genomics

Apiculture & Sericulture 04

04

04 EC

EC

EC 04

04

04 50

50

50 50

50

50 100

100

100

	MBLC-III	Lab Course –III (Based on MBTC-201 &MBTC202)	4	DSC	04	50	50	100
	MBLC-IV	Lab Course –IV Based on MBTC-203 &MBTE201or MBTE202 MBTE 203)	4	DSC	04	50	50	100
		Total	24		300	300	600	

Third Semester	MBTC-301	Bioprocess Engineering and Technology	04	CC	04	50	50	100
	MBTC-302	Food & Dairy Microbiology	04	CC	04	50	50	100
	MBTC-303A							
or								
	MBTC303 B	Environmental Microbiology						

Medical Microbiology 04

04 CC

CC 04

04 50

50 50

50 100

100

MBTC 304	Diagnostic Microbiology and Bioinformatics	04	SEC	02	25	25	100	
MBTO-305	Open elective	02	OEC	02	25	25	50	
MBLC-V	Lab Course – V (Based on MBTC-301 &MBTC302)	4	DSC	04	50	50	100	
MBLC-VI	Lab Course-VI (Based on MBTC-303 &MBTC304)	4	DSC	04	50	50	100	
	Total	26	325	325	650			

Fourth Semester	MBTC-401	Genetic Engineering	04	CC	04	50	50	100
	MBTC-402	Microbial Technology	04	CC	04	50	50	100
	MBTC-403A							

or

MBTC-403B Pharmaceutical Microbiology

Agricultural Microbiology

04

04 CC 04

04 50

50 50

50 100

100

MBT-404 Open Elective 04 OEC 04

Or

2+2 50

Or

25+25 50

Or

25+25 100

Or

100

MBL-VIIC Lab Course –VII (Based on MBTC-401 MBTC402 &MBTC403) 4 DSC 04

50 50 100

MBL-VIIIE Lab Course- VII(Based on Industry training)

Or

Dissertation

Or

Review Writing

4

4

4 DSC

DSC

DSC 04

04

04 50

50

100

100 100

100

100

Total	24	300	300	600
	100	1250	1250	2500

CC: Core Course, SEC Skill enhancement Course, EC: Elective Course, , CIA: Continuous Internal Assessment, ESA :End Semester Assessment. There will be four papers of practicals in first year and four papers of practicals or one dissertation/review writing instead of Lab course VIII. Each practical course and dissertation will be of 100 marks (04 credits).

- Total Credits / year = 50
- Total Credits of All Four Semesters = 100
- Total Marks of All Four Semesters = 2500
- CIA Two test of 15 marks each will be conducted 10 marks for home assignment/tutorial and 10 for seminar/conference presentation

CC: Core Course, SEC Skill enhancement Course, EC: Elective Course, , CIA: Continuous Internal Assessment, ESA

:End Semester Assessment. Credits of Theory of four semesters = 68.

There will be four papers of practicals in first year and three papers of practicals and one dissertation/review writing/Lab course program in Applied Microbiology in second year. Each practical course and dissertation will be of 100 marks (04 credits).

Laboratory Course: First Year (1st&IInd Semester)

Credits of Laboratory Courses of four semesters = 32

- Total Credits / year = 50
- Total Credits of All Four Semesters = 100
- Total Marks of All Four Semesters = 2500
- CIA Two test of 15 marks each will be conducted 10 marks for home assignment/tutorial and 10 for seminar/conference presentation/ The examinations for laboratory Courses (External) will be held at the end of 2nd& 4th Semesters.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY,

NANDED

SCHOOL OF LIFE SCIENCES,

M. Sc. MICROBIOLOGY COURSE

MBT- 301 Bioprocess Engineering and Technology

4 Credit 60 periods

Course objectives

This course has been designed to educate students about upstream, downstream processing in industrial bioprocess and Design of typical bioreactors are included.

Learning outcome

After attending classes student will have adequate knowledge of industrial fermentations that will help in placement.

Unit I (14)

Strain improvement for the selected organism: Mutation and Screening of improved cultures, Use of recombinant DNA technology, Protoplast fusion techniques for strain improvement of primary and secondary metabolites, Production of Recombinant molecules in heterologus system, Problems associated with strain improvement program, Improvement of characters other than products and its application in the industry, Preservation of cultures after strain improvement program, Media formulation and modification, Rheology of fermentation broth, Immobilization of cells.

Unit lI (16)

Media for industrial fermentations: Media ingredients, medium formulation, oxygen requirement, antifoams, medium optimization, media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter, filter sterilization of air and media. Inoculum development for industrial fermentation & Microbial Kinetics: Introduction, Criteria for transfer of inoculum, development of inocula for bacterial processes, yeast processes and mycelial processes. Achievement and maintenance of aseptic conditions.

Unit III (16)

Microbial growth kinetics: Microbial growth cycle, measurement of growth, Batch culture, continuous culture, fed-batch culture, Design of bioreactors: Basic objective of fermenter design, aseptic operation & body construction, agitator and sparger design, baffles, stirrer glands and bearings. Process parameters and measurement techniques: measurement of temperature, pressure and pH, DO, foam etc.; flow rate of liquid and gases; Bioreactor configurations and types: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Photobioreactor, Solid state fermenter, Animal and plant cell bioreactors. Scale up and Scale down studies of bioreactors. Heat and Mass transfer in Bioprocess.

Unit IV (14)

Basic concepts of Bio-separation Technology: Separation characteristics of methods for extraction of proteins -Cell disruption methods for intracellular products, Osmotic shock, Homogenization, various types of homogenizers, Sonication, Enzyme digestion. Centrifugation: basic principles, design characteristics; ultracentrifuges; principles and applications. Filtration (batch and continuous filtration), Membrane based separation processes, Micro-filtration; Reverse osmosis, Nanofiltration, Ultrafiltration and Affinity ultrafiltration, Membrane modules. Liquid-liquid extraction, Supercritical fluid extraction, precipitation, distillation, drying of product. Product Resolution/Fractionation - Chromatography: Gel filtration chromatography, Ion-exchange chromatography (IEC), Chromatofocusing. Affinity chromatography: Immunoaffinity, Electrophoretic purification.

Reference Books

1. Principles of Fermentation Technology by Stanbury, P.F., Whitekar A. and Hall. 1995., Pergaman. McNeul and Harvey.
2. Fermentations - A practical approach. IRL.
3. Bioprocess Technology: Fundamentals and Applications. Stockholm KTH.
4. Biochemical Reactors by Atkinson B., Pion, Ltd. London.
5. Biotechnology - A Text Book of Industrial Microbiology by Cruger.
6. Fermentation Biotechnology: Industrial Perspectives by Chand.
7. Biochemical Engineering Fundamentals by Bailey and Ollis, Tata McGraw Hill, N.Y.
8. Biotechnology. Volume 3.Edited by H. J. Rehm and G. Reed.VerlagChemie. 1983.
9. Advances in Biochemical Engineering by T.K. Bhosh, A.Fiechter and N. Blakebrough. Springer Verlag Publications, New York.
10. Bioprocess Engineering Kinetics, Mass Transport, Reactors, and Gene expressions by Veith, W.F., John Wiley and Sons.
11. Industrial Microbiology by L.E. Casida, Wiley Eastern

MBT- 302: Food and Dairy Microbiology

4 Credits 60 periods

Course objective

This course has been designed to educate students about microorganism associated with food and their impact.

Learning outcome

After attending classes student will have adequate knowledge of food spoilage and preservation. Knowledge of dairy industry, probiotic dairy products will help in placement.

Unit l (14)

Taxonomy, role, and significance of microorganisms in foods, primary sources of microorganisms found in foods. Synopsis of common foodborne bacteria, synopsis of common genera of foodborne molds, synopsis of common genera of foodborne yeasts. Intrinsic and extrinsic parameters of foods that affect microbial growth.

Unit II (16)

General principles - Principal underlying food spoilage, spoilage of poultry, spoilage of fruits, spoilage of fish and shellfish, milk and milk products. Mycotoxins and mycotic poisoning.Determination of microorganisms and/or their products in foods using culture, microscopic, and sampling methods. Conventional standard plate count, membrane filters, microscope colony counts. Foodborne diseases - Staphylococcal gastroenteritis, botulism, Bacillus Cereus gastroenteritis.

Unit III (16)

Food Preservation with chemicals: Benzoic acid and the parabens, sorbic acid, the propionates, sulfur dioxide and sulfites, nitrites and nitrates, NaCl and sugars. Indirect antimicrobials: acetic and lactic acids, antibiotics and bacteriocins. Agents for fruits: ethylene and propylene oxides, miscellaneous chemical preservatives, radiation preservation of foods and nature of microbial radiation resistance, characteristics of radiations of interest in food preservation, principles underlying the destruction of microorganisms by Low- Temperature food preservation.

Unit IV (14)

Probiotic dairy products, production cheddar cheese, yoghurt, Kefir. Indicators of Food Microbial Quality and Safety,

Study of Food safety Standards Act: 2006 BIS, Agmark, PFA, CAS & milk and milk product order 2006.• HACCP and its benefits and application, ISO 22000, GMP.• International food laws and regulatory agencies:• International organizations FAO (Food & Agriculture).

Reference books

1. Food Microbiology. 2nd Edition By Adams. Basic Food Microbiology by Banwart George J. Food Microbiology: Fundamentals and Frontiers by Dolle.

2. Essentials of Food Microbiology. Edited by John Garbult.Arnold International Students Edition.

3. Microbiology of Fermented Foods. Volume I and II. By Brian J. Wood.Elsiever Applied Science Publication.

4. Microbiology of Foods by John C. Ayres. J. OrwinMundt. William E. Sandinee.

5. W.H. Freeman and Co. Dairy Microbiology by Robinson. Volume II and I.

6. Food Microbiology: Fundamentals and Frontiers. 2nd Edition by Michaell P. Doyle, Larry R. Beuchat and Thomas I. Montville (Eds.), ASM Publications.

7. Bacterial Pathogenesis A Molecular Approach. 2nd Edition.2001 by Abigail A.Salyers and Dixie D. Whitt.ASM Publications.

8. Advances in Applied Microbiology by D. Pearlman, Academic Press.

9. Microbial biotechnology- principles and applications- by Lee Yuan Kun Biotechnology Vol. III and V edited by H J Rehman and G Reed Industrial and

10. food microbiology by James M Jay

MBT- 303A

Environmental Microbiology

4 Credits 60periods

Course objective

To facilitate conceptual understanding of factors of ecosystem and biosphere. Methods used for wastewater treatment. Bioremediation and different kind of pollution

Learning outcome

After completion of course student will able to illustrate composition of ecosystem interdependence of biotic and abiotic factors, Methods of heavy metal degradation causes and impact and management of pollution.

Unit I: Environment and Ecosystems (10)

Definitions: biotic and abiotic environment. Environmental segments.Composition and structure of environment.Concept of biosphere, communities and ecosystems. Ecosystem characteristics structure and function. Food chains, food webs and trophic structures. Ecological pyramids.

Unit II: Waste water treatment and solid waste management (18)

Microbiology of wastewater and solid waste treatment: Waste types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary treatments. Anaerobic processes: Anaerobic digestion, anaerobic filters, and up flow anaerobic sludge. Treatment schemes for effluents of dairy, distillery, tannery, sugar and antibiotic industries (Types, microbes used, types of effluent treatment plants).Bioconversion of solid waste and utilization as fertilizer- composting, vermicomposting and methane production.Bioaccumulation of heavy metal ions from industrial effluents.

Unit III: Bioremediation of Xenobiotics (16)

Microbiology of degradation of xenobiotics in the environment, ecological considerations, decay behavior, biomagnification and degredative plasmids hydrocarbons, substituted hydrocarbons, oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its environmental impact assessment and ethical issues.

Unit-IV: Global environmental problems (16)

Types and sources of pollution, methods for measurement of pollution-Water pollution, air pollution- bioaeropollutants zone depletion, UV-B, green house effect and acid rain, their impact and biotechnological approaches for management. Heavy metal pollution- Fluoride, mercury, lead, chromium and cadmium.

Reference books

Bioremediation by Baker K.H. And Herson D.S. 1994..MacGraw Hill Inc. N.Y.

Waste Water Engineering - Treatment, Disposal and Re-use by Metcalf and Eddy, Inc., Tata MacGraw Hill, New Delhi.

Pollution: Ecology and Biotreatment by EcEldowney, S. Hardman D.J. and Waite S. 1993. - Longman Scientific Technical.

Environmental Microbiology edited by Ralph Mitchell. A John Wiley and Sons.Inc.

Waste Water Microbiology 2nd Edition by Bitton.

Chemistry and Ecotoxicology of pollution.Edited by Des. W. Connell, G.J. Miller. Wiley Interscience Publications.

MBT- 303B

Medical Microbiology

4 Credits 60 periods

Course objectives

The aim of this course is to introduce basic principle & application relevance of clinical disease for students acquire working knowledge in basic medical science & research.

Learning outcome

Upon successful completion f this course the student will be able to

Understand basic principles of medical microbiology & infectious diseases.

Learn mechanisms of transmission of infectious diseases & role of normal flora of human body.

Understand importance of pathogens in disease formation.

Explain the methods of prevention & control of microbial diseases.

Unit-I (14)

History of infectious disease: Koch's postulates, molecular postulates, types of pathogens, sub cellular infectious entities, prokaryotic and eukaryotic microorganisms, normalmicroflora in healthy human body.

Host-Parasite interactions: Basic terminology of infectiology, determinants of bacterial pathogenicity and virulence, adhesion, invasion and spread and damage, action of toxins, regulation of bacterial virulence.

Unit II (16)

Bacterial Diseases: Transmission, mechanism of pathogenesis and laboratory diagnosis of the diseases caused by Pneumococcus, Neisseria, Clostridium, Mycobacterium, and Helicobacter pylori.

Biology of obligate parasites: Transmission, mechanism of pathogenesis and laboratory diagnosis of the diseases caused by Rickettsia, Chlamydia.

Viral Diseases: Orthomyxo virus – Influenza, Swine-flu, Arbo virus - Chikungunya, Dengue, Ebola Virus, Retro viruses - Hepatitis, Corona virus.

Unit III (14)

Mycotic infections in humans: Superficial, subcutaneous, cutaneous and systemic mycoses, source of infection, symptomatology & diagnosis of Aspergillosis, Candidiasis, Microsporum, Trichophyton&Epidermatophyton, Blastomycosis and Histoplasmosis.

Protozoal infections in humans: Pathogenesis, life cycles, diagnosis & prophylaxis of Plasmodium, Entamoeba, Toxoplasma, Trypanosome, Leishmania, Roundworm & Tapeworm.

Unit IV (16)

Hospital infections and methods of disease diagnosis - Types, sources, factors affecting and control measures of nosocomial and iatrogenic infections, collection, transport and preliminary processing of clinical pathogens. Clinical, microbiological, immunological and molecular diagnosis of microbial diseases.

Chemotherapeutic Agents: Mechanism of action of cell wall inhibitors (penicillin, bacitracin), inhibitors of membrane function (polyenes, tunicamycin, ionophores), inhibitors of ribosomal function (amino glycoside, tetracycline, chloramphenicol, puromycin), inhibitors of nucleic acid metabolism (Actinomycin D, mitomycin C) examples and sites of action of some commonly used antifungal agents. Viral vaccines, antiviral agents.

Reference Books

1. Mechanism of Microbial Diseases 2nd edition. Chaechter M. Medoff G. and Eisenstein BC.(1993), Williams and Wilkins, Baltimore.

2 Practical Medical Microbiology, Collee, JG. Duguid JP, Fraser AG, Marimon BP. (1989) Mackie and McCartney 13th Edition. Churchill Livingstone.

3. Medical Microbiology. David Greenwood, Richard CD, Slack, John Forrest Peutherer. (1992) 14th edition.ELBS with Churchill Livingstone.

4. Pharmaceutical Microbiology, Hugo WB and Russell AD, (1989) IV edition. Blackwell Scientific Publication, Oxford.

5. Clinical Microbiology, Joan Stokes E, Ridgway GL and Wren MWD (1993). 7th edition. Edward Arnold. A division of Hodder and Stoughton.

6. Microbiology. Fundamentals and Applications, Ronald M. Atlas.(1989), II edition, Maxwell Macmillan international editions.

7. Principles of Bacteriology, Virology and Immunity, Topley& Wilsons's. (1990), VIII

edition, Vol. III Bacterial Diseases, Edward Arnold, London.

8. Handbook of Microbiological Media, Atlas RM (1993) (ed) Parks L.C, CRC Press, London.

9. Manual of Clinical Microbiology, Balows A, HanslerJr K.L, Isenberg H.D, Shalomy H.J (1991).American Society

for Microbiology, Washington DC.

10. Modern Experimental Biochemistry, Boyer R (2001) 3rd edition: Benjamin/Cummings Publishing Company Inc.

11. Laboratory Immunology, Brawshaw L.J. (1988). Sandders College Publishing.

12. Experimental Biochemistry, Clark J.M Jr and Switzer RI (1977) 2nd Edition. W.H. Freeman, San Francisco.

13. Methods for General and Molecular Bacteriology Gerhardt P, Murray R.G, Wood W.A and Kreig N.R. (ed) (1994), American Society for Microbiology, Washington D.C.

14. Laboratory manual in Biochemistry, Jayaraman J (1981). New Age Int. Publishers, New Delhi.

15. Antibiotics in Laboratory Medicine, Lorian V (1991), 3rd edition, Williams and Wilkins, Baltimore.

16. Diagnostic procedures in medical microbiology, Myers R.M, Koshi G (1982) IELC Combodia Press.

MBT- 304 Diagnostic Microbiology And Bioinformatics

4 Credits 60 periods

Course objective

This course has been developed to develop basic principle and application of bioinformatics and new diagnostic techniques

Learning outcome

Student will be able to understand the diagnostic techniques used in the diagnosis of various diseases and disordersuse bioinformatics based analytical tools

Unit I (16)

Staining techniques in disease diagnosis (AFB), immunofluorescence, direct fluorescence, PCR in clinical microbiology, Real-time PCR, advanced PCR techniques next generation sequencing, radiology and hematology based diagnostic methods, serodiagnosis (agglutination, ELISA, radio immunoassay, T cell based tests skin tests, interferon gamma assays,) VITEK-2 system, anti microbial susceptibility testing (disc diffusion, inhibition zones E test , MIC) detection of viral infection (e- microscopy, ag&ab detection, virus culture).

Unit II (10)

Detection of blood glucose level, oral glucose tolerance test, gestational diabetes & HB, AC, detection of serum bilirubin, uric acid &cholesterapy LFT, KFT, alkaline phosphatase, Lipid profile.

Unit III (18)

Computers and peripherals like mouse, printer, wireless routers, scanners etc. Windows operating system and its features like MS-Paint, Internet Explorer OR Browser like Chrome or Firefox, Zipping & Unzipping, Fonts etc. General software used for DTP like MS-Word, MS-Excel, MS-Power Point etc.Connecting to Internet by Wired Connection (LAN) as well as Wireless Connection (WIFI). Use of popular search engines like Google, Yahoo etc, Study of sources of information like Wikipedia, TED, Youtubeetc, Use of Pen Drives for collecting and browsing information. Using Internet for communications as mailing, Skype or like software for Voice Communication, Video Communication, General knowledge about social networking sites like Tweeter, Facebook, Blogs, YouTube, Instagram etc.

Unit IV (16)

Introduction to Bioinformatics: Various definitions of bioinformatics, history of bioinformatics, applications of bioinformatics, scope of bioinformatics, bioinformatics in business. Introduction to central dogma of molecular biologyiology.Internet and Bioinformatics:General purpose search engine: Google, Biological search engine: Entrez, SRS. What is Database? Types of Databases Biological databases: Primary databases – GenBank, DDBJ, EMBL. Protein sequence databases – Swissprot, Uniprot,TrEMBL, Structural databases – PDB,PubChem, ChemBank,. Bibliographic databases:-Pubmed, PMC, PloS.

Reference Books

1. Blair, J.E.e., Lennette, E.H.e., and Truant, J.P.e. (1970). Manual of clinical

microbiology, American Society for Microbiology, Bethesda, Md.

2. Gradwohl, R.B.H., Sonnenwirth, A.C., and Jarett, L. (1980). Gradwohl's clinical

laboratory methods and diagnosis. Mosby, London.8th ed 53

3. Lennette, E.H., Balows, A., Hausler, W.J., and Shadomy, H.J. (1985). Manual of

clinical microbiology. American Society for Microbiology, Washington, D.C. 4th ed.

4. Topley, W.W.C., Wilson, G.S.S., Parker, T., and Collier, L.H. (1990b). Topley and

principles of bacteriology, virology and immunology. Edward Arnold,8thed

5. Mukherjee, K.L. (2010) Medical Laboratory Technology .Tata McGraw-Hill

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6. Sood, R. 1999. Medical Laboratory Technology - Methods and Interpretations.Jaypee Brothers Medical Publishers (P) Ltd. New Delhi. 5th ed.

7. Cheesbrough, M. (2006). District Laboratory Practice in Tropical Countries.

Cambridge University Press.2nd ed.

8. Mackie, T.J., McCartney, J.E., and Collee, J.G. (1989). Mackie & McCartney

practical medical microbiology. Churchill Livingstone, 13th ed

9. Black, J.G. (1999). Microbiology : principles and explorations. Prentice Hall

International, London. 4th ed.

10. Kindt, T.J., Goldsby, R.A., Osborne, B.A., and Kuby, J. (2006). Kuby

immunology.W.H. Freeman, New York. 6th ed.

11. Forbes, B.A., Sahm, D.F., Weissfeld, A.S., and Bailey, W.R.D. m. (2007). Bailey & Scott's diagnostic microbiologyt. Elsevier, Mosby, London. 12th ed.

12. Fundamentals of Computer by V. Rajaraman- PHI

13. Computer Fundamentals- P.K. Sinha- BPB Publication

14. MS DOS- Russel- BPB

15. DOS- Satish Jain- BPB

16. Windows 2000 Complete Reference- BPB

Lab Course V

1. Screening of industrially important enzyme producer (amylase, protease) using soil sample.

2. Screening of industrially important organic acid producer using soil sample.

3. Screening of industrially important antibiotic producer using soil sample.

4. Preservation of industrially important microbes by low temperature and oil overlay method.

5. Strain improvement using physical / chemical mutagen.

6. Inoculum built up using S. cerevisiae and bacillus species.

7. Microbiological Analysis of Milk (Practical): Raw and Pasteurized Milk - MBRT, SPC, Coliform, Sterilized Milk / LHT Milk - Spore Count.

8. Microbiological analysis of Milk Products (Practical): Analysis of butter, ice cream, Paneer, SMP - Standard plate count, coliform count, yeast and mold count.

9. Microbiological Analysis of Water and Dairy Effluents (Theory): Microflora of water. Methods of analysis: BOD in Dairy Effluents and its estimation.

10. Microbiological Analysis of Water and Dairy Effluents (Practical): Water-MPN, Coliform- SPC, Effluent – BOD.

Lab Course VI

1. Isolation & observation of air microflora.
2. Testing for microbial quality of water (coliform test).
3. Physicochemical analysis of water pH, DO, phosphate, BOD & COD.
4. Demonstration on use of microbial consortium for the treatment of solid waste.
5. Enrichment & isolation of bacteria degrading 2,4- Dichlorophenoxycatic acid.
6. Biodegradation of phenol compounds.
7. Film medium for the detection of coliforms in water.
8. Detection of waterborne parasites.
9. Synder test.
10. Isolation of hospital microflora.
11. AFB staining & capsule staining.
12. Morphological & biochemical characteristics of Staph aureus, Candida albicans& E. coli.
13. Isolation of normal flora.
14. Coagulase, haemolysis tests for identification of bacterial pathogens.
15. Antibiotic susceptibility of bacterial & fungal pathogens.
16. Examination of pathogens / permanent slides.
17. Preparation & observation of growth of bacterial pathogens of different types of culture media.
18. Use of biological database & sequence analysis.
19. Use of different browsers, search engines for desired data retrieval.
20. Study of major bioinformatics companies in India and overseas.
21. Explore the sitemap of NCBI. Study the resources available on NCBI.
22. Study format of Genbank entry data retrival from Genbank.
23. Various internal and external DOS commands.
24. Study of memory types of Computer.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

M.Sc. MICROBIOLOGY SYLLABUS

IV Semester

MBT- 401 Genetic Engineering

4 Credits 60 periods

Course objectives

This paper is designed to develop understanding of

1. Transgenic technology and gene manipulation vectors &cosmids.
2. Cell based DNA cloning, western blot northern blot are alsoincluded.

Learning outcome

By learning this course student will understand Techniques used for DNA manipulation modern genetic engineering tools.

Unit I (14)

Molecular biology- History, scope and definition, genetic engineering. Introduction and prospects in Post genomic era, transgenic technology in India. How to clone a gene fundamental techniques of gene manipulation, overview of the procedure, Gene library, hybridization, molecular cloning, construction of DNA library, library screening, expression libraries, restriction mapping.RFLP, DNA sequencing.

Unit II (16)

Vectors- plasmid vectors, vectors based on the lambda Bacteriophage, Cosmids, Plasmids, M13 vectors, Expression vectors, vectors for cloning and expression in Eukaryotic cells, Super vectors, YACs, BACs, PAC & MAC promoters- ubiquitous & tissue specific Signal peptide sequences, Cutting and joining DNA restriction endonucleases, Ligation, Alkaline phosphatase, double digest, Modification of restriction fragment ends, other ways of Joining DNA molecules.

Unit III (14)

cDNA synthesis, RT-PCR, PCR assay and cells based DNA cloning:- The importance of DNA cloning, PCR Primers, Basic features and applications, Gradient Nested. Touchdown, Hot, start, Principles of cell based DNA cloning, gene strategies, Cloning system for amplifying different sized fragments, cloning system for producing single stranded and mutagenized DNA. Nucleic acid hybridization- preparation of nucleic acid probes.

Unit IV (16)

Principle of nucleic acid hybridization, Nucleic acid hybridization assays, DDRT and microarrays, Gene recombination and gene transfer bacterial conjugation, Transformation Transduction, Episomes Plasmids, Microinjection. Electroporation, Micro projectile, Shot gun method, ultra sonication, liposome fusion microalser. Changing genes: Site directed mutagenesis and protein engineering- PCR based site directed mutagenesis, random mutagenesis, Use of Phage display techniques to facilitate in the selection of mutant peptides, gene shuffling, production of chimeric proteins, Tools for analyzing gene expression- Northen Blot insite hybridization, RNAse protection assay, RT- PCR, real time PCR, western blot, in situ, analysis, ELISA, genetic engineering in Microbes. Cloning in E.coli and other bacteria.

Reference books

1. Molecular cell biology by Harvey Lodish, Published by W.H.Freemanand company.

2. MolecularbiologyofthegenebyJames.D.Watson,PublishedbyPearsoneducation.

3. Cell and molecular biology by E.D.P. De Roberties, Published by Lippincutt William and wilkins.

4. Molecular Biotechnology : Principles and applications 3rded by R BernadGlick, Published by ASM press,Washington

MBT– 402 Microbial Technology

4 Credits 60 periods

Course objective

The aim of this course is to impart knowledge about biological & biochemical technologies with focus on biological products & design & operation of industrial practices.

Learning outcome

Upon successful completion of this course, the student will able to

1. Understand the basic concepts in a microbial production of different solvents, antibiotics, plants growth promoters, biofertilizers& other industrially important products.
2. Learn the process of patents filing, types of products to be patented & basic principles of IPR

Unit I: Microbial production of therapeutic agents (16)

- Antibiotics; Griseofulvin, Rifamycin
- Antiviral & anticancer agents
- Vaccines, insulin and siderophores
- Biotransformation of steroids and antibiotics.

Unit II: Microbial production of solvents, beverages and biofuels (14)

- Solvents : Ethanol, acetone-butanol.
- Beverages:Wine and beer.
- Biofuels- H_2 gas and bio-disel.

Unit III: Modern trends in Microbial Production (16)

- Biopolymers &Bioplastics: Dextran, Alginate, Xanthan, Pullulan, PHA & PHB.

- Bioferilizers: Nitrogens fixers, Phosphate solubilizers.
- Biomass: Mushroom and probiotics.
- Biosurfactants&Biopigments: Glycolipids, beta-carotene.
- Bio – insecticides &Bioweedicides.

Unit IV: IPR and IPR Practices (14)

- Introduction to IPR & patents: composition of patents, patent practices and problems, patent, Trademarks and copyrights.
- Patenting of biological materials: Microbial products, transgenic organisms and isolated genes.
- Patent regulation bodies at national and international level.

Reference books

1. Biotechnological innovations in Chemical Synthesis. BITOL.Publishers / Butterworth-Heinemann.
2. Industrial Microbiology by G.Reed (Ed,) CBS publishers (AVI publishingCo.)
3. Biology of industrial Microorganisms by A.L.Demain
4. Genetics and Biotechnology of Industrial Microorganism by C.I. Hershnergy, S.W. Queener and Q. Hegeman. Publisher.ASM Ewesis ET.AL 1998 Bioremediation Principles, Mac GrawHill.
5. Biotechnology, A textbook of industrial Microbiology by Creuger and Creugersinaeurassociates.
6. Manual of industrial microbiology and Biotechnology 2ndedition by Davis J.E. and Demain A.L. ASMpublications.
7. Mukhopadhayay, S.N. (2004) Process Biotechnology Fundamentals , 2ndedn., Viva Books Pvt. Ltd, Mumbai(ISBN:81-7649-496-8)
8. Rehm, H.J. and Reed, G, (1983) Biotechnology, Vol. 3 Dellweg, H. (ed.), VerlagChemie, Basel(ISBN:3-527-25765-9)
9. Martin, A.M. (1998) Bioconversion of Waste Materials to industrial products, 2ndedn,.BlackieAcademicandprofessional,London((ISBN:0-7514-0423-4)
10. Chincholkar, S.B. and Mukherji ,K. G.(2007)Biological Control of Plant Diseases, Hawarth Food and Agricultural Products Press, Oxford, UK(ISBN:1-56022-328-6)
11. The IndianEnvironmental Protection Act(EPA) ,1986
12. Rules for manufacture, use/ import / export and storage of hazardous microorganisms or cells Act ,1989

MMBT – 403 A

Pharmaceutical Microbiology

4 Credits 60 periods

Course objective

Aim of course is to provide knowledge of Antibiotics and Pharmaceutical product policies in pharmaceutical industries and validation of product.

Learning Outcome

After completing the course student will have idea of Pharmaceutical products their mode of action spoilage and validation policies of pharmaceutical industries

Unit I: Antibiotics and Synthetic antimicrobial agents (16)

- Concept of bioassay, therapeutic index, MIC andLD50
- Mechanism of action, microbial resistance, therapeutic, prophylactic usage and adverse Reactions of,

➢ Antibiotic and synthetic antimicrobial agents: β-lactam, aminoglycosides, tetracyclines, ansamycins, macrolides, peptide antibiotics, synthetic antibiotics: Sulphonamides, Chloramphenicol, Quinolone.

➢ Antifungal antibiotics: Amphotericin B, Griseofulvin and Fluconazole.

➢ Antiviral drugs: Acyclovir, Zidovudine, Amantidines.

➢ Antitumor drugs: Bleomycin, Ductinomycin.

Unit II: Microbial production and spoilage of Pharmaceutical products (14)

- Microbial contamination, spoilage and sterilization of pharmaceutical products: Injectables, non injectables, ophthalmic preparations and implants.
- Manufacturing procedures and in process control of pharmaceuticals.
- Microbial fermentation of other pharmaceutical products: Streptokinase, streptodornase.
- New vaccine technology: DNA Vaccines, synthetic peptide vaccines, multivalent subunit vaccines, vaccines in clinical trials.
- Drug targeting and drug delivery systems.

Unit III: Regulatory practices and policies in pharmaceutical industries (14)

- Financing R& D capital and market outlook.

- FDA, Govt. regulatory practices and policies.
- Significance of IP, BP and USP.
- Reimbursement of drugs- biological and legislative aspects.
- Rational of drug designing
- Patenting of drugs

Unit IV: Quality assurance and validation (16)

- Regulatory aspects of QC, QA and QM.
- GMP, GLP and CMP in pharma industries.
- ISO, WHO, US, FDA and US certification.
- Sterilization control and sterility testing: heat sterilization, D value, Z value, survival curve, radiation, gaseous and filter sterilization, Microbial limit test.
- Pyrogen testing and LAL test.
- Chemical and biological indicators of sterilization.
- Design and layout for Microbiology laboratory.

Reference books

1. Pharmaceutical Microbiology- Edited by W. B. Hugo & A.R. Russel Sixth Edition. Blackwell ScientificPublications.
2. Lippincott's illustrative Reviews: Pharmacology Edition: 02 Maryjnycck by Lippincott's review Publisher Pheladelphia1997.
3. Principles of medicinal chemistry Vol. 1 by Kadam S.S., Mahadik K.R., Bothra K.G. Edition: 18, NiraliPublication.
4. PharmacognosybyGokhleS.D.,KoKateC.K..Edition:18, NiraliPublicationtion.
5. Biotechnology – Expanding Horizon by B.D. Singh., First Edition, Kalyani Publication, Delhi.
6. Analytical Microbiology- Edited by Fredrick Kavanagh volume I &II. Academic Press, NewYork.
7. Pharmaceutical Biotechnology by S. P. Vyas& V.K. Dixit. CBS publishers & distributors, NewDelhi.
8. Quniolinone antimicrobial agents- Edited by David C. Hooper, John S. Wolfson. ASM Washington DC.
9. Quality control in the Pharmaceutical industry - Edited by Murray S. Cooper Vol. 2, Academic Press New York.
10. Biotechnology- Edited by H.J. Rhem& Reed, vol 4 VCH publications, Federal Republic of Germany.
11. Good manufacturing practices for Pharmaceuticals. By Sydney H. Willing, Murray M. Tuckerman, Willam S. Hitchings IV.Second edition Mercel Dekker NC New York.

12. Advances in Applied Biotechnology series Vol.10, Biopharmaceutical in transition., Industrial Biotechnology Association by Paine Webber,. Gulf Publishing Company Houston.

13. Drug carriers in biology & medicine Edited by Gregory Gregoriadis. Acedemic Press New York.

14. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan LalIhhpunjani. CBS publishers & distributors, New Delhi.

MBT – 403B

Agricultural Microbiology

4 Credits 60 periods

Course objective

This course will help students in understanding the diverse groups of microorganisms, their functions and applications in agricultural fields.

Learning Outcome

On completion of the course the students will be able to

-Know the diverse group of microorganisms

-Understand growth and development of soul microbes

-Understand the nutrient sources and cycles present in soil

-Develop and understanding about the beneficial effect of community

Unit I (14)

1. Soil as an environment: Classification of the soil, physico-chemical properties of soil biological properties of soil, soil microbial community, effect of heavy metals on microbial communities and processes.

2. Approaches to study soil microbiology: Microscopic methods, direct culture methods, molecular detection, soil dilution plate method, microbial biomass extraction, immunomagnetic capture, soil fractionation, enumeration and isolation of soil bacteria.

Unit II (16)

1. Biogeochemical cycles - Carbon cycle - role of microbes in carbon cycle,trophic

relationships, mobilization and immobilization of carbon with rhizosphere, Nitrogen cycle - mechanism of biological nitrogen fixation, ammonification, nitrification, denitrificatioin and microorganisms involved in such processes, Phosphorous and Sulphur cycle.

2. Biofertilizer for sustainable agriculture: Rhizobium, Azospirillum, Azotobacter, Azolla, BGA, mass production methods, methods of biofertilizer application and significance of biofertilizers.

Unit III (16)

1. Commercial development of biocontrol agents for soil borne diseases- Bacterial insecticides, conventional and engineered bacterial insecticides- Bacillus thuringiensis, Bacillus sphaericus, Paenibacillus papillae, Serratiaentemophila, molecular biology of BT insecticidal proteins, fungal insecticides-Trichoderma and Gliocladium, Viral insecticides- NPV and Baculovirus.

2. Fungi in agriculture - fungi in organic matter turnover, nutrient transfer, soil structure improvement, disease prevention and pollutant degradation, Mycorrhiza in sustainable development of plant health and soil fertility.

Unit IV (14)

1. Contribution of Nitrogen fixing bacteria and cyanobacteria in soil fertility with reference to nitrogen fixation, ammonia excretion, phosphate solubilization, siderophore production, secretion of phytohormones and biocontrol of plant pathogens.

2. Fungi in agriculture - fungi in organic matter turnover, nutrient transfer, soil structure improvement, disease prevention and pollutant degradation, Mycorrhiza in sustainable development of plant health and soil fertility.

Reference books

1. Soil Microbiology and Biochemistry, 2nd ed (1996), by E.A. Paul and F.E. Clark.

2. Methods of Soil Analysis—Part 2. Microbiological and Biochemical Properties, (1994), edited by R.W. Weaveretal., Soil Science Society of America, Inc., Madison, WI.

3. Modern Soil Microbiology, Van Dirk Van Elsas, Jack T Trevors and Elizabeth M. H. Wellington, Marcel Dekkar, Inc. New York.

4. Soil Microbiology, An Experimental Approach, Mark S. Koyne, Delmar Publishers, New York.

5. Plant Microbe Interactin and Biological Control, Greg J. Bolland and L. David Kuykenda, Marcel Dekkar, Inc. NewYork.

6. Soil Microbiology, 4th edn, N. S. SubbaRao, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.

7. Methods in Applied Soil Microbiology and Biochemistry, KaseemAlef and Paolo Nannipieri, Academic Press, Harcourt Brace and Company Publishers, New York.

Lab Course –VII

1. Production, extraction & recovery of amylase using A. niger / A. oryzae.
2. Production, extraction & recovery of citric acid using A. niger.
3. Guntamic acid using C. glutamium
4. Production of penicillin using Pencilliumnotatum.
5. Production of ethanol using tree & immobilized cause & S. cerevicea.
6. Sterility testing of pharmaceutical products.
7. Test for disinfectants (phenol coefficient / RWC method).
8. Determination of antibacterial spectrum for drugs/antibiotics.
9. Testing for antibiotic / drug sensitivity /resistance.
10. Determination of MIC value for antimicrobial chemicals.
11. Microbial production of biosurfactants.
12. Production of biofertilizers& testing of efficacy.
13. Production of siderophores using Pseudomonas aeruginosa.
14. Isolation & culturing of antibiotic resistant strains.
15. Isolation & culturing of auxotrophic mutant.
16. Replica plating.
17. Restriction mapping.
18. Ligation studies.
19. Demonstration of RAPD/RFLP southern transfer.
20. Isolation of DNA checking its purity
21. Determination of Tm value

Lab Course VIII

Industrial training

or

Dissertation

or

Research Review

SCHOOL OF LIFE SCIENCES,

M.Sc. MICROBIOLOGY COURSE

OPEN ELECTIVE

MBTO- 101/301 Fermentation Microbiology

2 Credits 30 periods

Course objective

To acquaint students with technical and biological aspects of microbial utilisation for production of microbial metabolites.

Learning outcome

After attending classes student will have adequate knowledge of industrial fermentations that will help in placement.

Unit I (15)

Fermentation, types of fermented foods, advantages & health benefits, milk based, grain based & vegetable based fermented foods.

Unit II (15)

Probiotic foods & beverages Definition, types, microorganism health benefits wine & beer fermentation.

Reference books

1. Frazier, W.C. food Microbiology.

2. Holzapfel W. Advances in fermented foods & beverages woodhead publishing, 2014

3. Yadav J.S. Comprehensive dairy microbiology, metropolitan 1993

4. Jay J.M. Loessner M.J. Modern food Microbiology (7th edition), springer 2003

MBTO – 102/302 Microbial Diseases

2 Credits 30 periods

Course objective

Course has been specially designed to share cause, prevention and treatment of common microbial diseases to any graduate.

Learning outcome

After completing the course student will get enough information regarding common diseases and disorders.

Unit I (15)

Respiratory diseases, gastrointestinal diseases, nevervous system & skin diseases. Types, route of transmission &preventation methods. Recent outbreaks of human diseases (SARS/Swine Flu /Ebola/ Corona) causes.Spread &controy.Mosquito borne diseases.

Unit II (15)

Treatment of microbial diseases using beta lactam, aminoglycosides & other antibiotics, concept of DOTS, emergence of antibiotic resistance, current issues of MDR / XDR strains, antiviral drugs.

Reference books

1. Ananthanarayan R. &panikar C.K.J. Textbook of Microbiology (9th edition) University press publication.

2. Brooks G.F. et al medical microbiology (26th edition) McGraw Hill publication ,2013

3. Goering R.et.al., Medical Microbiology (4th edition) Elsevier 2007.

4. Willey J.M. et.al Microbiology 2013.

SCHOOL OF LIFE SCIENCES

M.Sc. MICROBIOLOGY COURSE

OPEN ELECTIVE

MBTO – 201/401 Infectious and Non-Infectious Diseases

2 Credits 30periods

Course objective

Course has been specially designed to share cause, prevention and treatment of common infectious and non infectious diseases to any graduate.

Learning outcome

After completing the course student will get enough information regarding common diseases and disorders.

Unit I: Infectious diseases (15)

Types of Pathogen:- Virus, bacteria, parasite & fungi.

Transmission of diseases:- Food and water contamination, Insect bites Direct Contact, Indirect Contact

Unit II: Non- infectious diseases (15)

Autoimmune Disease – Type I diabetes life style disease

Type II diabetes contagious disease

Reference Books

1. Ananthanarayan R. &panikar C.K.J. Textbook of Microbiology (9th edition) University press publication.

2. Brooks G.F. et al medical microbiology (26th edition) McGraw Hill publication ,2013

3. Goering R.et.al., Medical Microbiology (4th edition) Elsevier 2007.