



**THIRUVALLUVAR UNIVERSITY**  
**MASTER OF SCIENCE**  
**DEGREE COURSE**

**M. Sc. BIOTECHNOLOGY**

**Under CBCS**  
**Regulations & syllabus**  
**(For University Department)**

**(With effect from 2018-2019)**

**Regulations, Syllabus and Scheme of  
Examination for**

**M. Sc., BIOTECHNOLOGY**

**(With effect from 2018-2019)**



**DEPARTMENT OF BIOTECHNOLOGY  
THIRUVALLUVAR UNIVERSITY (State University)  
Vellore - 632 115**

# **THIRUVALLUVAR UNIVERSITY**

SERKKADU, VELLORE- 632 115

## **MASTER OF SCIENCE IN BIOTECHNOLOGY**

UNDER CBCS (effective from 2018-2019 onwards)

### **The course of study and scheme of examination**

1. Name of the course: **M.Sc., Biotechnology**

2. Medium of instructions: **English**

#### **3. Choice Based Credit System (CBCS)**

Choice based credit system is a flexible system of learning.

'Credit' defines the quantum of contents / syllabi prescribed for a course and determine the number of hours of instruction required.

The CBCS has unique features such as enhanced learning opportunities, ability to match students scholastic need and aspirations, inter institution transferability of students, part completion of an academic program in the institution of enrollment and part completion in specialized and recognized institution, improvement in educational quality and excellence, flexibility for working students to complete programme over an extended time and standardization and comparability of educational programmes across the country.

#### **4. Eligibility criteria**

A candidate with bachelor degree in any life science in the discipline of Biology/ Biochemistry/Botany/ Biotechnology /Bio-Informatics/Chemistry with Biology ancillary/ environment biotechnology/genetics/ microbiology/ zoology/ agriculture/ B.E./ genetic engineering /B.Tech.(Bio-tech)/B.V.Sc./M.B.B.S/B.D.S or examination of some other university accepted by the syndicate or equivalent thereto shall be permitted for admission into the course.

#### **5. Course details**

Duration of course	: <b>04 semesters (2 semesters /year)</b>
Total of papers	<b>16</b>
Total number of lab. Courses	<b>6</b>
Project	: <b>4<sup>th</sup> semester only</b>
Total marks for M.Sc. Degree	
Theory papers	: <b>1600 marks</b>
Lab courses	: <b>600 marks</b>
Project	: <b>200 marks</b>
Total	: <b>2400 marks / 90 credits</b>

## **6. Preamble of the syllabus**

Master of Science (M.Sc.) in Biotechnology, the curricula and course content were designed to meet the standards of UGC-CSIR (NET) and (SLET) examinations. The choice based credit system of learning develop a strong base in the core subject and specialize in the disciplines of his / her liking and abilities and develop in-depth understanding of various aspects of Biotechnology. The students develop experimental skills, to design and implementation of novel synthetic methods, and to develop the aptitude for academic and professional skills, by acquiring basic concepts for structural elucidation with hyphenated techniques, understanding the fundamental biological process and rationale towards computer. The project introduced in the curriculum will motivate the students to pursue research and towards entrepreneurial skill development.

## **Instruction to the Students**

The students admitted to M.Sc. Biotechnology course are to adhere to the following rules:

1. A minimum of 75% attendance for lecture / practical is the pre-requisite for grant of term.
2. There shall be tutorial / practical / surprise test / home assignment / referencing of research papers/ seminar/ industrial visits/ training course as a part of internal assessment in each semester. The students are supposed to attend all the tests. The students should note that re-test will not be given to those student who are absent for the tests.
3. FEE STRUCTURE

As per the Thiruvalluvar University norms

## **8. PATTERN OF EXAMINATION**

Evaluation of students

1. The odd-semester and even –semester examinations will be of 100 marks each.
2. A Student should obtain 50% marks in all the examinations (both theory and Laboratory Course).

## **9. SCHEME OF EXAMINATION**

The semester examination will be conducted at the end of each semester (both theory and lab course examination), for odd semesters in the month of November / December; for even semester in April/May. All theory examinations are conducted for three hours irrespective of total marks. However, duration of laboratory course examinations is for 4 hours only.

**Theory paper** will be of 75 marks each for university examination and 25 marks for internal evaluation.

### **Question paper settings**

Question papers will be set in the view of the entire syllabus by giving equal weight for each unit of syllabus.

**Pattern of question paper (theory):**

*(Part A & B –two questions from each unit & part C- one from each unit)*

**Part A**

10questions x 02Marks –No Choice (10x2=20Marks)  
(Answer in about 50words)

**Part B**

5questions (either or type) x 05 marks (5x5=25Marks)  
(Answer in about 200words)

**Part C**

3out of 05 questions x 10marks (3 x 10 = 30Marks)  
(Answer in about 500 words)

**Total = 75 marks****Internal assessment**

Test : 10 marks (best 2 out of 3)

Assignment : 5 marks

Seminar : 10 marks

**Total : 25 marks**

**Lab. Course examination (practical) will be of 75 marks each for university examinations and 25 marks for internal assessment.**

Distribution of marks for lab. Course (practical) examination

**University examinations experiment: 75 Marks**

Experiment &Result : 55 marks

Lab. Course viva –voce : 10 marks

Record : 10 marks

**Total : 75 marks**

**Lab. Course internal assessment: 25 Marks**

Performance : 15 marks

Record : 10 marks

**Total : 25 marks**

**Passing minimum in lab. Course (practical) examinations: 50% marks**

Project dissertation : 200 marks

Dissertation : 150 marks

Viva-voce : 50 marks

**Total : 200 marks**

**Distribution of marks for dissertation / project**

Project will evaluated by the concerned by the project guide along with departmental project committee. Assessment will be done by the committee every month. Evaluation will be on

the basis of monthly progress of project work, progress report, referencing, oral results and documentations.

<b>Project</b>	<b>: 150 marks</b>
Dissertation format	: 50marks
Scope of the research problem	: 20marks
Methodology	: 20 marks
Analysis	: 30 marks
Results and findings	: 30 marks
<b>Total</b>	<b>: 150 marks</b>

<b>Viva-voce examinations</b>	<b>: 50 marks</b>
Presentation	: 20 marks
Subject knowledge	: 20 marks
Interaction	: 10 marks
<b>Total</b>	<b>: 50marks</b>

### **Question paper settings**

Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

Standard of passing

A candidate should get not less than 50 % in the university examinations, compulsorily, in all papers, including lab, course. Also, the candidate who secures not less than 50% marks in the university examinations (UE) and internal assessment (IA) examinations put together in any theory paper/ practical shall be declared to have successfully passed the examinations.

Internal marks will not change. Students cannot repeat internal assessment. If a student misses internal assessment examinations, he / she will have score passing minimum in the external examinations only.

Illustration

Theory – internal assessment	: 12 marks
University examinations	: 38 marks

**OR**

Internal Assessment	: 0 marks
University examinations	: 50 marks

There shall be revaluation of answer script of end semester examinations, but not of internal assessment papers.

Internal assessment answer scripts may be shown to the concerned student but not end semester answer script.

# **THIRUVALLUVAR UNIVERSITY**

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Name of the course: **M.Sc., Biotechnology**

## **Choice based credit system (CBCS)**

Choice - based credit system is a flexible system of learning.

‘Credit’ defines the quantum of contents / syllabi prescribed for a course and determine the number of hours of instruction required.

Choice based credit system (CBCS) has unique features such as enhanced learning opportunities, ability to match students scholastic need and aspirations, inter institution transferability of students, part completion of an academic program in the institution of enrollment and part completion in specialized and recognized institution, improvement in educational quality and excellence, flexibility for working students to complete programme over an extended time and standardization and comparability of educational programmes across the country

## **Eligibility criteria**

A candidate with bachelor degree in any life science in the discipline of Biology/ Biochemistry/Botany/ Biotechnology /Bio-Informatics/Chemistry with Biology ancillary/ environment biotechnology/genetics/ microbiology/ zoology/ agriculture/ B.E./ genetic engineering /B.Tech.(Bio-tech)/ B.V.Sc. /M.B.B.S/B.D.S or examination of some other university accepted by the syndicate or equivalent thereto shall be permitted for admission into the course.

## **Duration of the Course:**

The duration of the course shall consist of 4 semesters in two academic years.

## **Examination Pattern:**

**Time allotted: Theory – 03Hrs. & Practical – 04 hrs**

## **Marks allotted for university examination:**

	<b>External marks</b>	<b>Internals marks</b>	<b>Total marks</b>
<b>Theory</b>	75	25	100
<b>Practical</b>	75	25	100

## **Marks distribution for internals:**

	<b>Test</b>	<b>seminars</b>	<b>Assignment</b>	<b>Total marks</b>
<b>Theory</b>	15	05	05	25

	<b>Test</b>	<b>Record</b>	<b>Total marks</b>
<b>Practical</b>	10	15	25

**Pattern of question paper (theory):***(Part A & B –two questions from each unit & part C- one from each unit)***Part A**

10questions x 02Marks –No Choice

(10x2=20Marks)

*(Answer in about 50 words)***Part B**

5questions (either or type) x 05 marks

(5x5=25Marks)

*(Answer in about 200 words)***Part C**

3out of 05 questions x 10marks

(3 x 10 = 30Marks)

*(Answer in about 500 words)***Total = 75 marks****M.sc., Biotechnology (CBCS)****The course of study and the scheme of Examination**

<b>S. No</b>	<b>Study components</b>	<b>Ins hrs/ week</b>	<b>Credit</b>	<b>Title of the paper</b>	<b>Paper code</b>	<b>Maximum marks</b>		
<b>SEMESTER I</b>								
1	Paper 1	5	4	Biochemistry	MDBT 11	25	75	100
2	Paper 2	5	4	Cell & Molecular Biology	MDBT 12	25	75	100
3	Paper 3	4	4	Microbiology	MDBT 13	25	75	100
4	Practical I	6	3	Lab In Biochemistry And Cell & Molecular Biology	MDBT 15	25	75	100
5	Practical II	6	3	Lab in Microbiology	MDBT 16	25	75	100
6	Elective I	4	3	Medical Laboratory Technology	MDBT 14A	25	75	100
				Virology	MDBT 14B			
				Basic Analytical methods	MDBT 14C			
				Food and Nutrition	MDBT 14D			
		<b>30</b>	<b>21</b>			<b>150</b>	<b>450</b>	<b>600</b>
<b>SEMESTER II</b>								
7	Paper 4	5	4	Immunology	MDBT 21	25	75	100
8	Paper 5	5	4	Genetic Engineering	MDBT 22	25	75	100



9	Paper 6	5	4	Genetics	MDBT 23	25	75	100
10	Paper 7	4	3	Bioinformatics	MDBT 24	25	75	100
11	Paper 8	3	2	Human Rights	MDHR 20	25	75	100
12	Practical III	4	3	Lab in Immunology	MDBT 26	25	75	100
13	Practical IV	4	3	Lab in Genetic Engineering & Bioinformatics	MDBT 27	25	75	100
14	Elective II	3	3	Enzyme technology	MDBT 25A	25	75	100
				Dairy technology	MDBT 25B			
				Pharmaceutical Technology	MDBT 25C			
				Genome technology	MDBT 25D			
		<b>33</b>	<b>26</b>			<b>200</b>	<b>600</b>	<b>800</b>
<b>SEMESTER III</b>								
15	Paper 9	5	4	Plant Biotechnology	MDBT 31	25	75	100
16	Paper 10	5	4	Animal biotechnology	MDBT 32	25	75	100
17	Paper 11	5	4	Microbial biotechnology	MDBT 33	25	75	100
18	Paper 12	4	4	Environmental Biotechnology	MDBT 34	25	75	100
19	Practical V	4	3	Lab in Plant Biotechnology & Animal Biotechnology	MDBT 36	25	75	100
20	Practical IV	4	3	Lab in Microbial Biotechnology & Environmental Biotechnology	MDBT 37	25	75	100
21	Elective III	3	3	Genomics & Proteomics	MDBT 35A	25	75	100
				Biodiversity	MDBT 35B			
				Nano Biotechnology	MDBT 35C			
				Stem Cell biology	MDBT 35D			
		<b>30</b>	<b>25</b>			<b>175</b>	<b>525</b>	<b>700</b>
<b>SEMESTER IV</b>								
22	Paper 13	6	5	Research methodology	MDBT 41	25	75	100
23	Project 1	24	13	Project/ dissertation with viva-voce	MDBT 42	50	150	200
		<b>30</b>	<b>18</b>			<b>75</b>	<b>225</b>	<b>300</b>
	<b>Grand total</b>	<b>123</b>	<b>90</b>			<b>600</b>	<b>1800</b>	<b>2400</b>

**Structure of the course:**

<b>Subject</b>	<b>Papers</b>	<b>Credit awarded</b>	<b>Total credits</b>	<b>Marks</b>	<b>Total marks</b>
<b>Core</b>	19	3-5	68	100	1900
<b>Elective</b>	3	3	9	100	300
<b>Project</b>	1	13	13	200	200
			<b>90</b>		<b>2400</b>

## SEMESTER I

### PAPER 1: BIOCHEMISTRY (MDBT 11)

**Objectives:** To enable the students to understand the basic concepts in biochemistry and biomolecules and also to learn the various metabolic cycles and also to analyze the significance of biochemical findings

#### UNIT I

**Basic Concepts:** Units of measurements of solutes in solution ,e.g. Normality, Molality ,molarity ,hyper and hypotonic solution pH, pK, acids ,bases ,ionic bonds, covalent bonds and secondary bonds (hydrogen bonds and Vander Waal's bonds).

#### UNIT II

**Biomolecules :** Definitions ,nomenclature, classification, structure, chemistry and properties of carbohydrates, amino acids ,proteins (hemoglobin, myoglobin and plasma proteins), lipids and Nucleic acids.

#### UNIT III

**Metabolism:** Metabolism of Carbohydrates –EMP, TCA, HMP. Amino Acids, Lipids and Nucleic Acids-Their Biosynthesis; Mechanism Of Oxidative Phosphorylation and Its Inhibitors, Photophosphorylation.

#### UNIT IV

**Enzymology:** Enzymes: general aspects(classifications and structure),allosteric mechanism, regulatory and active sites ,activation energy ,iso-enzymes, enzyme kinetics(MM, LB plot, Km) and hormones.

#### UNIT V

**Clinical biochemistry:** Blood sugar level-factors controlling blood sugar level – hypo, hyper glycemia , diabetes mellitus ,types – GTT, Metabolism of bilirubin- jaundice-types differential diagnosis and liver function tests. Renal functional test and gastric function test.

## Reference

1. Biochemistry ,7<sup>th</sup> Edition, jerry M.Berg John,L .Tymoczko, Lubert stryer 2012.W.H,freeman & company ,new York
2. Molecular Bio methods handbook,2<sup>nd</sup> edition R.Rapley &J.M Walker,2008,Humana press.
3. Principles of Biochmeistry ,5<sup>th</sup> Edition AL. Lehninger ,D.L. Nelson and M.M Cox ., 2008.worth publishers ,New York.
4. Biochemistry 4<sup>TH</sup> Edition,G.Zubay,1998.Mc Millan publishing Co.New York.
5. Harper's Biochemistry,29<sup>th</sup> Edition-Rober K.Murray,Daryl K.Grammer,2012 McGraw Hill, lange Medical Books
6. Understanding enzymes -5<sup>th</sup> editionTrevor palmer,Prentice Hall/Ellias Horwood 1995
7. Text Book Medical Biochemistry M.N.Chatterjee 8<sup>th</sup> edition Jaypee brothers Medical publishers 2013
8. Biochemistry – 4<sup>th</sup> edition Donald voet and Judith G.Voet ,VP Publishers 2011 steitz and A.M.Weiner ,The Benjamin /CUMMINGS publ.Co.,Inc .,California,2013
9. Genes VI(9<sup>th</sup> Ed).Benjamin Lewin, oxford university press,uk.,2007
10. Molecular biology of cell (5<sup>th</sup> edition) bruce alberts,alexander johnson,Julian lewis,martin raff,keith Roberts,peter walter ,garland science publications.2008
11. Molecular Biology (5<sup>th</sup> edition).weaver .R.F,McGraw Hill publications,2011.  
Cell and molecular biology : concepts and experiments (5<sup>th</sup> edition ).gerald karp,wiley publications,2013

## PAPER 2: CELL AND MOLECULAR BIOLOGY (MDBT 12)

**Objectives:** Understanding the structural and functional aspects of the cell provides the students with a strong foundations in molecular mechanism underlying cellular functions.

### UNIT I

**Cell Biology:** Structure and function of cells in prokaryotes and eukaryotes; Structure and organization of Membrane - Membrane Model, active and passive, transport channels and pumps., Structure & Biogenesis of Mitochondria and Chloroplast. Structure of Endoplasmic reticulum, Golgi complex, lysosomes.

### UNIT II

**Cell division:**Mitosis, Meiosis, regulation of cell cycle; factors regulating cell cycle. Nucleic acid structure,Genome Organization. **DNA replication** : Enzymes and mechanisms of DNA replication in prokaryotes and eukaryotes, Telomeres, telomerase and end replication. Role of telomerase in aging and cancer. DNA replication models DNA damage, Mutations, DNA repair and recombination.

### UNIT III

**Transcription:** Basic mechanism in prokaryotes and eukaryotes. RNA polymerase, Reverse transcriptase and regulation. Post-transcriptional processing: 5'-Cap formation; 3'-end processing and polyadenylation; splicing: RNA editing; Nuclear export of mRNA; mRNA stability.

**Translation**-Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination,Regulation of translation, co-and post-translational modifications of proteins and localization.

### UNIT IV

**Gene regulation: Prokaryotic gene regulation-** Operon concept ; Lac operon and tryptophan operon. **Eukaryotic gene regulation:** Chromatin Structure, Regulation at transcriptional Level: DNA binding domains of the regulatory proteins.

Biochemistry and applications of ribozyme technologies. Transposable genetic elements. CRISPR CAS gene editing.

### UNIT V

**Epigenetics** : Epigenetic regulation of gene expression, Modifications, Cancer Epigenetics.

**Cancer Biology:** Viral and cellular oncogenes; Tumor suppressor genes - Structure, function and mechanism of action of pRB and p53, p21, BRACA1.Oncogenes as transcriptional activators.

**References:**

1. Molecular cell Biology, by Darnell, Lodish, Baltimore, Scientific American Books, Inc., 1994.
2. Molecular and cellular Biology, Stephen L.Wolfe, Wadsworth Publishing Company, 1993.
3. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
4. Introduction to Practical Molecular Biology, P.D.Dabre, John Wiley & Sons Ltd., New York, 1998.
5. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford, 1991.
6. Molecular Biology of the Gene (4th Edition), J.D.Watson, N.H.Hopkins, J.W.Roberts, J.A. Steitz and A.M.Weiner, The Benjamin/Cummings Publ. Co., Inc., California, 1987.
7. Genes VI (6th Edition ) Benjamin Lewin, Oxford University Press, U.K., 1998
8. Molecular biology of cell – Albert Bruce et al.,1994 3rd Ed
9. Molecular Biology-Weaver. R. F. 3rd ed. Mc Graw Hill publication , 2005
- 10.Cell and Molecular Biology: Concepts and Experiments 5th Ed,Gerald Karp. Wiley publications,2013.
11. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication. 2002

### **PAPER 3: MICROBIOLOGY (MDBT 13)**

**Objective:** To develop skill of students in microbiology and understanding the current concepts in microbiology. At the end of this course, the students would have learnt about principles of microbiology, including bacteria ,fungi , algae and virus and their role in different environment and its applications. To develop highly qualified professional manpower with the basic requirement lies on the microbiology quality based coaching , R&D and training in industry oriented techniques (quality controller in pharmaceuticals & Food and Dairy products etc).

#### **UNIT- I**

History of Microbiology - Classification of microorganism – Kingdom - Protista, Prokaryotic and eukaryotic microorganisms, Five kingdom concept of classification, Archae bacteria, Eubacteria and eukaryotes. Microscope - Light field, Dark field, Fluorescent and Electron microscope, Prokaryotic and Eukaryotic cell structure. Staining techniques - Simple and Differential staining.

#### **UNIT II**

Nutritional classification of bacteria, Isolation, cultivation, enumeration and preservation of microbes; Culture media and its types - Pure culture technique - Growth curve; Axenic culture, Synchronous culture, Continuous culture; Effect of physical and chemical factors on microbial growth.

#### **UNIT- III**

Sterilization and Disinfection: Moist heat, Dry heat, Radiation, Filtration, Phenols, Halogens, Phenol coefficient method. Antibiotics - Inhibitors of Nucleic acid, protein and cell wall synthesis. Chemotherapeutic agents - Anti microbial susceptibility test.

#### **UNIT IV**

Microbial diversity- methods to assess microbial diversity, Culture dependent and culture independent methods. Molecular analysis of bacterial community; Denaturing Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length (TRFL) Polymorphism (T-RFLP), Amplified Ribosomal DNA and Restriction Analysis (ARDRA).

#### **UNIT- V**

Microbial community in natural habitats – air, water, soil, food and milk. Food and milk borne diseases, Extremophiles- habitant & Classification, Halophiles, Thermophiles, Alkaliphiles, Acidophiles, Biotechnological applications of Extremophiles.

## References:

1. General Microbiology .Tortora, funke and case.11<sup>th</sup> edition pearson Higher education,USA,2012.
2. Microbiology .L.M. Prescott, J.P.harley and D.A.klein 7/e,McGraw – Hill , Boston,2007.
3. Microbial functional genomics. J.ZHOU, d.k.Thomson, Y.Xu,J.m. Tiedje,J.Wiley,2004
4. Microbial ecology-fundamentals and application.Atlas.R.M and Bartha. M. Benjamin-Cummings, Menlo park, California, 2003.
5. Biology of Microorganisms. Madigan .M.T,martinko .J.M,Parker,J,Brock,10<sup>th</sup> edition, prentice hall publishers,2003.
6. Fundamentals of Microbiology ,Alcamo I. E, 6<sup>th</sup> Ed, Benjamin –Cummings publishing Company ,Inc 2001.
7. Microbiology ecology- fundamentals and applications .R. M. Atlas and R.Bartha,2000
8. Fundamentals principles of bacteriology .A.J. sale Tata McGraw – Hill Publishing company limited, New delhi,1999
9. Medical microbiology D.Greenwood , R.Slack and J.Peutherer.ELST with Churchill Livingstone, Hong kong,1997.
10. Molecular biology and biotechnology .Robert A. Meyers, Wiley India pvt Ltd,1995.
11. Microbiology .M.J.Pelzer Jr,E.C.S chan and N.R. Kreig.McGraw Hill,Inc, New York,1993
12. The Microbial world Stainer.R. Y,Ingraham. J.L, Wheelis.M.L and Painter.P.R. new Jercey, Prentice- hall,1986



## **Practical 1 : Lab In Biochemistry And Cell & Molecular Biology (MDBT 15)**

### **Lab in biochemistry**

1. Determination of Chl.a, Chl.b & total Chl. By Arnon method.
2. Estimation of Carbohydrates
3. Estimation of salivary amylase activity in relation to, substrate/pH/Temperature
4. Estimation of blood glucose & urea
5. Estimation of LDH.
6. Estimation of total serum proteins
7. Estimation of creatinine in urine .
8. Paper / thin layer chromatography

### **Lab in Cell and Molecular biology**

9. Isolation of Genomic DNA from E.coli
10. Isolation of plasmid DNA from E.coli
12. Elution & quantification of DNA from agarose gel.
13. Preparation of competent cells and transformation
14. PCR
15. Isolation of Total RNA from bacteria
16. Synthesis of cDNA by Reverse transcription polymerase chain reaction

### **Reference**

1. Introduction to Practical Biochemistry, E.F Plummer Mu, Plummer Tata McGraw-Hill Education,1998.
2. Molecular cloning: a laboratory manual,4<sup>th</sup> ed. J.Sambrook, Fritsch and T.Maniatis. cold spring harbor laboratory press ,New York,2012
3. Essential cell biology : a practical approach volume 1: cell structure. John Davey, J.Michaellord. Oxford university press, USA, 2003
4. Principles and techniques of biochemistry and molecular biology (7<sup>th</sup> ed).keith Wilson (editor),john walker (editor),Cambridge university press,2010.

## Practical II Microbiology (MDBT 16)

1. Sterilization techniques
2. Preparation of culture media(Selective and Enriched media)
3. Staining techniques- Simple, Differential, Negative staining and Motility studies
4. Determination of Bacterial growth curve
5. Enumeration of bacteria from environmental samples- soil, water, air and milk.
6. Pure culture techniques - Streak, pour plate and spread plate.
7. Biochemical tests for identification of bacteria (IMViC, TSI, Catalase, Oxidase)
8. Antimicrobial assay, phenol coefficient, agar plate sensitivity method.
9. Water quality analysis - MPN method.
10. Milk quality analysis – MBRT method

### References:

1. Microbiology- A Laboratory manual P. Gunasekaran . New age publications, New delhi, 1995.
2. Molecular cloning-A Laboratory manual. Sambrook, J , Fritsch. E.F, and T.Maniatis, 2<sup>nd</sup> Edition. Cold spring Harbor Laboratory press, New York, 1989.
3. Laboratory exercise of Microbiology, J.P. Harley and L.M. Prescott, 5<sup>th</sup> Edition, the McGraw-Hill companies, 2002.
4. Microbiology: A Laboratory Manual, J.G. Cappuccino and N. Sherman, Addison-Wesley, 2002.
5. Laboratory Manual of Experimental Microbiology ,R.M.Atlas, A.E.Brown and L.C.Parks, 1995. Mosby, St.Louis,2002.
6. Laboratory manual in General Microbiology, N.Kannan, Panima publishers.
7. Bergey's Manual of Determinative Bacteriology. Ninth Edition J.G.Holt, N.R.Krieg.,Lippincott Williams, Wilkin publishers, 2000.

## **ELECTIVE1: MEDICAL LABORATORY TECHNOLOGY (MDBT 14A)**

Objectives: to enable the students to learn about the General laboratory and instrumentation. Know the significance of biological samples examination & to understand the various types of infection and clinical symptoms caused by microorganisms.

### **UNIT I**

General Laboratory and instrumentation: Code of conduct for laboratory personnel-safety measures in the laboratory-chemical/Reagents, labeling, storage and usage .First aid in laboratory accidents-Precautions and first aid equipments. Sterilization , preparation of reagents .General approach to quality control, quality control of quantitative data.

### **UNIT II**

Clinical pathology: Urine analysis: Collection, composition, preservation, gross examination, chemical examination. Significance of sugar in urine, ketone bodies, bile pigment, hematuria, uric acid, microscopic examination of the urinary sediment: stool Examination-specimen collection, pH, Interfering substance. Test for occult blood, fecal fat, microscopic examination of stool specimen.

### **UNIT III**

Clinical Hematology: Collection of blood-Anticoagulant, preservation ,Estimation of Hb, PCV,WBC (TC & DC),RBC, platelets, ESR. Clotting time, bleeding time-normal value, clinical interpretation .Serology-VDRL,CRP,RA, HIV,HBs Ag.

### **UNIT IV**

Histology: Basic concepts of different mammalian tissues and their histological structure. Different human organs and their gross and histological structure and functions. Receiving of biopsy specimens at laboratory (Clinical notes/fixatives). Fixation of tissue –different fixatives and their mode of action .Methods of decalcification. Use of microtomes, selection and maintenance of knives, technique of section cutting & mounting on slides. Staining of tissue sections, preparation of different stains, staining methods for Haematoxylin & Eosin.

### **UNIT V**

Blood banking: blood group(ABO & Rh)-methods of grouping & reverse grouping .Basic blood banking procedures- collection of blood, anticoagulants used, cross matching ,different screening ;tests including Coomb's Test for incomplete antibodies preparation

of different blood components for use and how to serve a requisition. preparation of red cell suspension. Blood transfusion & hazards. Detect the time when to discard blood in blood bank, computerized record.

References:

1. Medical Laboratory Technology-6<sup>th</sup> edition L.Mukherjee.vol.I,II,III.2010Tata Mcgraw-Hill publishing company limited.
2. Hand book medical laboratory technology 2<sup>nd</sup> edition-V.H.Talib CBS publishers & 2008.
3. Clinical laboratory practices in CMC procedure, CMC, Vellore.
4. Text book of Medical lab technology, 1<sup>st</sup> Edition-Ranmnik sood.jaypee 2006.
5. Laboratory manual in biochemistry-Jayaraman New Age International Pvt Ltd publishers 2011.

## **ELECTIVE 1: VIROLOGY (MDBT-14B)**

Objectives: To understand the biology of viruses, pathogenesis, clinical features, epidemiology and prophylaxis of dreadful viral infections in susceptible hosts.

### **UNIT I**

General Virology: Structure of viruses: Enveloped and non-enveloped viruses, Capsid symmetries-icosahedral , polyhedral and helical, structural proteins-matrix proteins and lipoproteins, viral genomic organization and replication-types of nucleic acids, protein nucleic acid interactions and genome packaging, Virus related structures-viroids and prions. Cultivation of viruses: Inovo, In vivo ,Ex vivo/In vitro. Cytopathic effect-pock forming unit.

### **UNIT II**

Viral diagnostic and detection methods: Sample processing-enrichment and concentration, Direct methods of detection-light microscopy (inclusion bodies),electron microscopy ,Immuno diagnosis ,hemagglutination, Complement fixation, neutralization, Western blot, Radioactive Immuno precipitation Assay (RIPA), Flow Cytometry and Immuno histochemistry. Nucleic acid based diagnosis: Nucleic acid hybridization, PCR, microarray and nucleotide sequencing, LINE probe assay.

### **UNIT III**

Bacterio phages and plant viruses: Bacterio phage: Morphology, genome organization, classification-Lifecycle-Lytic and Lysogenic Cycle, Head and tail phages-T4 phage-phage-Filamentous Bacteriophages-174-M13,phage therapy for control of bacterial poultry diseases. Viral Disease in Plants: Histological, physiological and cytological changes in infected plants, Behavior of viruses in plants, Methods for detection of plant viruses, Transmission of plant viruses through vectors-insects, nematodes and fungi.

### **UNIT IV**

Clinical virology: Pathogenesis, clinical symptoms, epidemiology and prophylaxis of DNA Viruses-pox virus ,Herpes Virus ,Adenovirus, Hepatitis Virus. RNA Viruses-Picorna Virus, Orthomyxo Virus, Rabies Virus, HIV. Oncogenic viruses; Virus induced cell transformation and oncogenesis, Mechanism of cell transformation by tumor viruses, Retrovirus mediated oncogenesis.

## UNIT V

Viral vaccines and anti-viral drugs: Viral vaccine, conventional vaccines-killed and attenuated, Modern vaccines-DNA vaccines, recombinant DNA/protein vaccines, subunits vaccines, peptide vaccines, anti-idio type vaccines, edible vaccines, immunomodulators (cytokines), adjuvants to increase immunogenicity of vaccines. Antivirals: Interferons, designing and screening for antivirals, mechanisms of action, antiretrovirals-mechanism of action and drug resistance.

### References:

1. Flint S.J., V.R. Racaniello, L.W. Enquist, V.R. Rancaniello, A.M. Skalka, (2003), principle of virology: Molecular Biology, pathogenesis, and control of animal Viruses, American society Microbiology, Chapters 3-13
2. Topley & Wilson's. (1990) Principles of Bacteriology, Virology and Immunity VIII Edition Vol. Iv Virology, Edward Arnold, London.
3. Haaheim L.R., J.R. Pattison and R.J. Whitley, (2002), A practical Guide to Clinical virology, 2nd Ed. Edited by, John Wiley & Sons, Ltd.
4. International Congress on Taxonomy of Viruses ; <http://WWW.ncbi.nlm.nih.gov/ICTV>
5. Knipe David M., Peter M. Howley, Diane E. Griffin, Robert A. Lamb, Malcolm A. Martin, Bernard Roizman, Stephen E. Straus, (2007), Field's Virology, 5<sup>th</sup> Ed. Lippincott Williams & Wilkins
6. Cann Alan J, (2000), DNA virus Replication, Oxford University press
7. Plotkin Stanley A., Walter A. Orenstein, (2003), Vaccines Elsevier Health Sciences
8. Tying. Stephen K. (2004), Antiviral Agents, vaccines, and Immunotherapies, Marcel Dekker
9. Timbury MC. (1994) Medical Virology X Edition. Churchill Livingstone.

## **ELECTIVE 1: BASIC ANALYTICAL METHODS (MDBT 14C)**

Objective: To provide knowledge of various analytical techniques in biological research

### **UNIT I**

Electrochemical techniques- basic principles- The pH electrode- Ion-selective gas-sensing and oxygen electrodes- Elementary details of biosensors. Beer – Lambert law, light absorption and its transmittance. Basic principles & brief outline of instrumentation of UV-Visible Spectroscopy: Infrared Spectroscopy, NMR. Mass spectrometry. Spectrofluorimetry, Flame photometry, Atomic absorption spectrophotometry– Principles, instrumentation and applications

### **UNIT II**

Introduction & classification of chromatography. Theory, instrumentation & applications of Column chromatography, TLC, Paper chromatography, GC, HPTLC and HPLC - detection methods and systems qualitative and quantitative aspects applications.

### **UNIT III**

Centrifugation- basic principles-instrumentation-centrifugation units, Nature of particles-centrifugation methods and accessories - sedimentation velocity-sedimentation equilibrium-cell fractionation method. Differential, density gradient, isopycnic and equilibrium centrifugation. Preparative and analytical ultracentrifugation techniques. Isoelectric focusing- blotting methods-western- southern and northern- application- methods in life sciences and biotechnology.

### **UNIT IV**

General principles. Factors affecting the migration rate – sample, electric field, buffer and supporting medium. Tiselius moving boundary electrophoresis. PAGE. SDS– PAGE. Immunoelectrophoresis. Cellulose acetate membrane electrophoresis. Agarose gel electrophoresis.

### **UNIT V**

Radioisotopic techniques: Introduction to radioisotopes, Detection, Measurement and uses of radioisotopes, Counting efficiency and autoradiography, Biotechnological applications Microscopy: Principles of microscopy, Fluorescent, Transmission and Scanning electron microscopy, Confocal microscopy, Microtomy and analysis and measurement of images .

## References

1. Principles and Techniques of Practical Biochemistry (Paperback) by Keith Wilson (Editor), John Walker (Editor), John M. Walker (Author) “ Fifth Edition 2000
2. Introductory Practical Biochemistry (Hardcover).by S. K. Sawhney; Randhir Singh (Editor) 2005
3. Principles of Physical Biochemistry (2nd Edition) by Kensal E van Holde, Curtis Johnson, and Pui Shing Ho (Hardcover – April 16, 2005)
4. Physical Biochemistry: Applications to Biochemistry and Molecular Biology by David M. Freifelder (Paperback – Aug 15, 1982)
5. Instrumental Methods of Chemical Analysis by G R Chatwal and S K Anand (Hardcover – Jun 1980).



## **ELECTIVE 1: FOOD & NUTRITION (MDBT 14D)**

Objectives: To enable students to gain a deeper understanding about principles of nutrition and also to develop competence to carry out investigation in nutrition

### **UNIT I**

Nutrition and Dietary System: Definition of food nutrition, basic food groups, physiological role and nutritional significance of carbohydrates, protein, lipids, vitamins and minerals .protein malnutrition (Kwashiorkar) and under nutrition (marasmus) and their preventive, curatives measures.

### **UNIT II**

Nutrients: Macro minerals: Calcium ,phosphorus Magnesium, sodium, potassium chloride. Micro minerals :Iron, zinc, copper, selenium, chromium, iodine, manganese, molybdenum and fluoride. Ultra trace minerals :Arsenic, Boron, Nickel, silicon, vanadium & cobalt: Digestion & absorption, Functions, Toxicity, interaction with other nutrients. Fat soluble vitamins: Vitamin A, Vitamin D,E &k. Water soluble vitamins: Vitamin c, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12,Vitamin B6.

### **UNIT III**

Nutritive and calorific Value of food: Unit of energy measurements of food stuffs by Bomb calorimeter, calorific value and RQ of food stuffs. Basic metabolic rate (BMR), its measurements and influencing factors, SDA of food. Nutritive value of protein, essential amino acid. composition of balanced diet for infants, pregnancy and lactating women, old age.

### **UNIT IV**

Food adulteration & food poisoning: sources of floods, types ,advantages and disadvantages, constituents of foods, carbohydrate ,protein, fats, oils, colors, flavours, natural toxicants. Sources ,causes and remedies for acidity, gastritis, indigestion and constipation

### **UNIT V**

Food preservation and processing: food spoilage, causes of flood spoilage ,,types of food spoilage, food preservations, food processing – different types, sterilizations & pasteurization

**References:**

1. Seema yadav: - Food Chemistry, anmol publishing (P) Ltd, New Delhi
  2. Car H.Synder: -the extraordinary chemistry for ordinary things, John Wiley & sons inc, New York,1992.
- ivasankar – food processing and preservation – PHI learni9ng (P) LTD , New Delhi  
– 11001.

## SEMESTER II

### PAPER 4: IMMUNOLOGY (MDBT 21)

**Objective:** to provide the students insights into the various aspects of immunology such as classical immunology, clinical immunology, immunotherapy and diagnostic immunology.

#### UNIT I

Introduction to the study of Immunology: Historic perspective, Overview and Concepts, Humoral and cellular- Mediated Immunoresponses. Components of immunity, Innate and Adaptive immunity, Cells and Tissues of the immune system: Cells involved in the Immune response: Macrophages, B and T lymphocytes, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells. The lymphoid organs: Bone marrow, Spleen, lymph nodes, MALT. Haematopoiesis and differentiation, lymphocyte trafficking.

#### UNIT II

Antigens and Immunogenicity. Nature of Antigens and antibodies. Theories of Antibody formation. Antibody structure, structural basis of Antibody diversity; Immunoglobulin as Antigen, Properties of immunoglobulin and subtypes.

#### UNIT III

Antigen - Antibody Reaction, Strength of Antigen and Antibody reaction, Cross reactivity, Precipitation and Agglutination reactions, Radioimmunoassay and ELISA. B-cell generation, activation and differentiation. Antibody production, Regulation and Diversity.

#### UNIT IV

Cytokines: structure of Cytokines; function of Cytokines. Complement and its role in Immune Responses. Complement fixation. Structure and function of MHC class I and II molecules - antigen recognition and presentation, HLA typing, Cellular Immunity, Immune tolerance and suppression, Hypersensitivity Reactions, Types of Hypersensitivity, Autoimmunity.

#### UNIT V

Hybridoma secreting monoclonal antibodies-Recombinant antibody molecules. Catalytic Antibodies. Vaccine technology including DNA vaccines. Immunological techniques for identification of infectious diseases : immune-electrophoresis, western blot, flowcytometry and immune-fluorescence microscopy including *in situ* localization techniques such as FISH and GISH.

## References

1. Immunology (7<sup>th</sup> ed) J.Kuby ,W.H freeman and company , new York.2013
2. Basic immunology updates ed: functions and disorders of immune system (3<sup>rd</sup> ed). abul k.abbas, Andrew H.HLictman ,saunders publishers , new York,2010
3. Immunology: an introduction (4<sup>th</sup>) I.R Tizard, saunders college publishers, new York.
4. Essential immunology (11<sup>th</sup> ed).peter delves,seamus martin,dennjis burton, Ivan Roitt, Wiley – Blackwell publication, Singapore, 2006
5. Immunology (Lippincotts illustrated reviews series) thao doan, roger melvold, susan viselli, Carl Waltenbaugh, Lippincott Williams & Wilkins publications 2012
6. Fundamental immunology (7<sup>th</sup> ed) William e Paul, Lippincott Williams & Wilkins publications,2012
7. Essentials of clinical immunology (6<sup>th</sup> ed) Helen chapel ,Mansel haeney, Siraj misbah, Neil snowden, Wiley-Blackwell publications ,2014
8. Monoclonal antibodies principles and practice(3<sup>rd</sup> ed) W.Goodings, academic press,2010
9. Monoclonal antibodies :P methods and protocols (2<sup>nd</sup> ed) .Vincent ossipo, Nicolas fisher, Humana press, 2014
10. Essentials of clinical immunology (6<sup>th</sup> ed).Helen chapel, Mansel haeney, ,Siraj misbah, Neil Snowden, Wiley- Blackwell publications,2014 J.Kuby, 2003, Immunology 5<sup>th</sup> edition, W.H. Freeman and Company, New york..
11. C.V.Rao. 2002, An Introduction to Immunology, Narosa Publishing House, Chennai.
12. I.R.Tizard, 1995, Immunology: An Introduction , 4th edition , Saunders College Publishers, New York.
13. I.Roitt, 1994, Essential Immunology, Blackwell Science, Singapore.
14. A. Bul and K.Abbas, 1994, Cellular and Molecular immunology
15. Current Protocols in Immunology 3 Volumes, Wiley Publications 1994.
16. Monoclonal Antibodies: Principles and Practice, J. W. Goding, 1983. Academic Press
17. Hybridoma Technology in the Biosciences and medicine, T.A. Springer, 1985. Plenum Press NY.
18. Vaccines, New Approaches to immunization, F.Brown, R.M.Chanock, KA Lerner, 1986. Cold spring Harborolab.
19. Topley and Wilson principles of bacteriology, Virology and immunology, G. Wilson, A.Miles, M.T.Paker, 1984. Arnold, Heineman.
20. Basic and Clinical Immunology, D.P. Stities and J.D. Stobo.

## **PAPER 5: GENETIC ENGINEERING (MDBT 22)**

### **Objectives:**

To impart sound knowledge about core strategies of implementation and transmission of genetic material at molecular and cellular levels and also about the techniques to alter the genes to construct genetically modified organisms with biotechnologically desirable characters.

### **UNIT I**

Tools of Genetic Engineering: Enzymes - endo & exo nucleases, Restriction endonucleases-types, nomenclature, recognition sequences and mechanism of action; Isochizomers, Iso caudomers - star activity, Methylation and modification. Ligases – types (NAD and ATP dependent), mechanism of action. Role of Kinases, phosphotases, polynucleotide phosphorylase, polynucleotide kinases, terminal transferase, Alkaline phosphatase, Reverse transcriptase - Taq polymerase.

### **UNIT II**

Cloning vectors: General characteristics of vectors, Brief account of naturally occurring plasmids. Promoter, MCS, Ori, and Marker genes-lac Z. Construction of pBR 322, pBR325, pBR327, pUC8 , pUC 18 & 19 vectors and Expression vectors, Bacteriophage vectors, Lambda phage, Insertion vectors, Replacement vectors, Cosmids, Phagemids, Mini chromosomes, BAC's, YAC's, Shuttle vectors, Ti plasmids, Vectors for animals-SV40 and Bovine papilloma virus.

### **UNIT III**

Gene cloning strategies and transformation techniques: Chimeric DNA, Cloning strategies-ligation, Transformation and selection, use of adaptors and linkers, Homopolymer tailing in cDNA cloning, genomic DNA libraries, Short gun method, Partial digestion, End modification, Cloning from mRNA- Isolation and purification of RNA, Synthesis of cDNA, Isolation of plasmids, Cloning cDNA in plasmid vectors, Cloning cDNA in bacteriophage vectors. cDNA libray. Advanced cloning strategies-synthesis and Cloning of cDNA, PCR amplified DNA.

Transformation techniques: Preparation of competent cells, Physical methods - Electroporation, Microinjection, Gene gun, chemical methods - PEG, DEAE, CaCl<sub>2</sub>, calcium phosphate precipitation method, liposome mediated method

### **UNIT IV**

Selection, screening and analysis of recombinants: Genetic selection - Insertional inactivation, Antibiotic Resistant genes, lac Z genes, Blue white screening,  $\alpha$  - Complementation, colony hybridization, Immunological screening, Plaque hybridization, Blotting techniques, DNA sequencing - chemical and enzymatic methods, PCR and its variants, Preparation of radiolabelled and non - radiolabelled probes and its applications.

## UNIT V

Applications of rDNA technology: Production of vaccines – Hepatitis B, Edible Vaccine, Hormones – Somatotropin, Humulin, Blood clotting factor VIII , Interferons, Diagnostics of inherited disorders and infectious diseases, Gene therapy, ADA- Cystic fibrosis.

### References:

1. Nicholl D.S.T. Introduction to Genetic Engineering Cambridge (3rd Ed.) University press.UK. 2008
2. Old R.W., Primrose S.B. Principles of gene manipulation - An introduction to genetic engineering (5th Ed.), Blackwell Scientific Publications, UK. 1996.
3. David S L. Genetics to Gene Therapy – the molecular pathology of human disease (1st Ed.) BIOS scientific publishers, 1994.
4. Ernst-L Winnacker, From Genes to Clones: Introduction to Gene Technology. WILEY-VCH Verlag GmbH, Weinheim, Germany Reprinted by Panima Publishing Corporation, New Delhi. 2003
5. Benjamin Lewis, Genes VIII (3rd Ed.) Oxford University & Cell Press,NY.2004
6. Robert Williamson.Genetic Engineering (1st Ed.) Academic Press.1981.USA
  7. Rodriguez. R.L (Author), Denhardt D.T. Vectors: A Survey of Molecular Cloning Vectors and Their Uses (1st Ed.) Butterworth-Heinemann publisher.UK. 1987
  8. Ansubel F.M., Brent R., Kingston R.E., Moore D.D. et al. Short protocols in molecular biology(4th Ed), Wiley publishers. India. 1999.
  9. Sambrook J et al. Molecular cloning Volumes I, II and III. Cold Spring Harbor laboratory Press, New York, USA. (1989, 2000)
  10. Terence A Brown. Genomes, (2nd Ed.) BioScientific Publishers.UK.2002
  11. Anthony JF Griffiths, William M Gelbart, Jeffrey H Miller, and Richard C Lewontin Modern Genetic Analysis (1st Ed.)W. H. Freeman Publishers.NY. 1999
  12. S. B. Primrose, Richard M. Twyman.Principles of gene manipulation and genomics (7th Ed.) John Wiley & Sons publishers.2006

## **PAPER 6: GENETICS (MDBT 23)**

Objective: To provide lucid knowledge in Principles of Genetics, overall view about genetic makeup of organisms and to pave a path for the students to take up genetic engineering research.

### **Unit I**

History of Genetics: Definition and scope of Genetics- Pre-mendelian genetic concepts. Basis of Mendelian Inheritance and Mendelian genetics. Simple Problems Relating to Inheritance. Structure of gene-Interaction of Gene-Commentary factors, Supplementary factors, Inhibitory and lethal Factors-Atavism. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes

### **Unit- II**

Blood Groups and their Inheritance in Human – Linkage and Crossing Over:- Drosophila – Morgans' Experiments – Complete and Incomplete Linkage, Linkage Groups, Crossing Over types, Mechanisms – Cytological Evidence for Crossing Over, Mapping of Chromosomes – Interference and Coincidence.

### **Unit-III**

Sex Linkage in Drosophila and Man, Sex influenced and Sex Limited Genes – Non-Disjunction and Gynandromorphs – Cytoplasmic Inheritance – Maternal Effect on Limnaea (Shell Coiling), Male Sterility (Rode's Experiment). CO<sub>2</sub> sensitivity in Drosophila, Kappa particles in Paramecium, Milk factor Mice.

### **Unit-IV**

Nature and Function of Genetic Material – Genetic code – Why the genetic code is comma less, non ambiguous, degenerate triplet code. Fine Structure of the Gene – Cistron, Recon, Muton – Gene Regulation – Operon Concept – Lac Operon – Positive and Negative Regulation. Mutation – Molecular Basis of Mutation, Types of Mutation, Mutagens, Mutable and Mutator Genes. Chromosomal Aberrations – Numerical and Structural Examples from Human.

### **Unit-V**

Genetic engineering – Objectives, tools, gene cloning, and gene isolation. Transgenic plants and animals, Animal Breeding – Heterosis, Inbreeding, Out Breeding, Out Crossing, Hybrid Vigour. Population Genetics- Hardy Weinberg Law – Gene Frequency, Factors Affecting Gene Frequency, Eugenics, Euphenics and Ethenics, Bioethics.

**References:**

1. Gunther, S. Stent, 1986. Molecular Genetics. Macmillan Publishing Co Inc. 773 pp.
2. Goodenough, V., 1978. Genetics, 2<sup>nd</sup> ed., New York Holt, Rinchart and Winston, 894 pp.
3. Hart, D.L. and D. Freifelder, 1988. Basic Genetics, John & Barlet Publishers, 505 pp.
4. Garder, 1972. Principles of Genetics, Wiley Eastern Pvt. Ltd. 590 pp.
5. Watson, J.D. and W.A. Benjamin, 1976. Molecular Biology of the Gene, 3<sup>rd</sup>., Benjamin Co. Inc., New York, 739 pp.
6. Winchester, 1967. Genetics, Oxford IBH Publications, 504 pp.
7. Stickberger, 1968. Genetics, Macmillan Publications, New York, 914 pp.
8. Verma, P.S. and V.K. Agarwal, 1995. Genetics, 8<sup>th</sup> edition, S. Chand & Co., New Delhi – 110 055, 580 pp.



## **PAPER 7: BIOINFORMATICS (MDBT 24)**

**Objective:** to provide information an understanding of the major computational problems in the field of molecular biology and to gain knowledge on molecular databases, comparative genomics, pattern search, classification of sequence and structure, alignment of sequence, rapid similarity searching, phylogenies, automated pattern learning, representing and searching protein structure, gene expression profiling, clustering expressed genes, discovering transcription factor bindings sites, discovering common functions of co-expressed genes, metabolic pathways, signal transduction pathways.

### **UNIT I**

Biological data bases: gen bank: sequence data/ types ; - protein data bases – ESTs STSs – GSSs – HTGS; NCBI- PubMed- Entrez –BLAST – OMIM; Types Of Accession Numbers- Locus Link, Unigene, Entrez, EBI and Expasy.

### **UNIT II**

Sequence alignment: alignment algorithms – global and local – significance ; BLAST search steps –BLAST algorithm –BLAST search strategies ; advanced BLAST-alignment tools.

### **UNIT III**

Gene expression analysis tools: the mRNA-c DNA-libraries ; microarrays: experimental design – probe – hybridization – image analysis – data analysis- biological confirmation – microarray database.

### **UNIT IV**

Proteomic analysis tools: protein domains and motifs – bio informatic tools for high throughput protein analysis – protein structure – homology and functional genomics.

### **UNIT V**

Pathway bioinformatics : protein – carbohydrate metabolism – biochemical cycles – interconnection of pathways – metabolic regulation – translating biochemical networks into linear algebra –KEGG: theory and practice. computational methods : nucleic acid and protein sequence databases; determining methods for sequence analysis, web based tools for sequence searches, motif analysis and presentation.

**Reference :**

1. Bioinformatics and functional genomics ( 2<sup>nd</sup> ed). Jonathan Pevsner, Wiley Blackwell publications 2009
2. Introduction to bioinformatics (4<sup>th</sup> ed).Arthur M .lesk ,oxford university press (UK),2013
3. Bioinformatics for biologists. Paval pevzner, ron Shamir, Cambridge university press.2011.
4. practical bioinformatics (1<sup>st</sup> ed).Michael Agostino ,Garland science publication,2012
5. Exploring informatics (2<sup>st</sup> ed) .Caroline St.clair, Jonathan E.Visick , Jones & Barlett learning,2013.
6. Bioinformatics : sequence and genome analysis(2<sup>nd</sup> ) David mount, cold spring harbor laboratory press 2013.
7. Bioinformatics and molecular evolution .Paul G.Higgs, Teresa K.Attwood, Wiley – Blackwell publication,
- 8.instant notes in bioinformatics (2<sup>nd</sup> ed).Charlie Hodgman, Andrew French, David West head, Taylor & francis,2009.
9. next-generations DNA sequencing informatics. Stuart M. Brown, cold spring harbor laboratory press,2013
10. from genes to genomes: concepts and applications of Dddna TECHNOLOGY (3<sup>rd</sup> Ed).Jeremy W.Dale, Malcom von Schantz, Nicholas plant, Wiley publications, 2011

### **PRACTICAL III: LAB IN IMMUNOLOGY (MDBT 26)**

1. Blood grouping
2. Lymphocyte subset identification and enumeration.
3. Radial immuno-diffusion test.
4. Ouchterlony double diffusion
5. Immuno electrophoresis
6. Rocket Immuno electrophoresis
7. Latex Agglutination
8. Quantitative Precipitin assay
9. Complement fixation test
10. ELISA
11. Western Blotting
12. Antigen-antibody reaction (precipitation and agglutination reaction tests).

#### **References:**

1. Practical Immunology. Franck C. Hay, Olwyn M.R. Westwood. Wiley-Blackwell publications, 2010.
2. immunoassays: A Practical Approach. James P. Gosling (editor). Oxford university press, USA, 2010.
3. Lab manual in biochemistry, immunology and biotechnology .Arti Nigam Archana ayyagari. McGraw-Hill education, 2008.
4. Practical immunology . Rabindra Narain, dom & wisdom publications, 2012

## **PRACTICAL IV**

### **LAB IN GENETIC ENGINEERING AND BIOINFORMATICS (MDBT 27)**

#### **GENETIC ENGINEERING**

1. Isolation of genomic DNA from the given sample and its molecular weight determination
2. Isolation of RNA from the given sample and its molecular weight determination
3. Isolation of plasmid DNA from the given sample
4. Restriction digestion of Lambda phage DNA
5. Ligation of DNA and analysis by electrophoresis
6. DNA amplification by PCR and RAPD
7. Preparation of competent cells and transformation by CaCl<sub>2</sub> method and Selection of transformed colony by X-Gal method
8. Determination of molecular weight of proteins by SDS PAGE

#### **BIOINFORMATICS**

1. Restriction mapping
2. PCR Primer Designing
3. ORF finding
4. Homology search
5. Multiple sequence alignment

## **ELECTIVE 2: ENZYME TECHNOLOGY (MDBT 25A)**

**Objective:** To provide knowledge of various enzymes and enzyme technology applied in the industries.

### **UNIT I**

Introduction to enzymes: History of enzymes, nomenclature and classification of enzymes. Structural features of Enzymes: Chemical nature of Enzymes: amino acids, protein structure: Primary, secondary, tertiary and quaternary structure. Specificity of Enzymes: Types of specificity, the Koshland "induced fit" hypothesis, strain or transition-state stabilization hypothesis.

### **UNIT II**

Enzyme Catalysis and Kinetics: Factors affecting the rate of chemical reactions, kinetics of an catalyzed chemical reactions, kinetics of enzymes catalyzed reaction, methods for investigating the kinetics of enzyme-catalyzed reaction, nature of enzyme catalysis, inhibition of enzyme activity.

### **UNIT III**

Extraction and purification of microbial enzymes : Importance of enzyme purification, different sources of enzymes. Extracellular and intracellular enzymes. Physical and Chemical methods used for cell disintegration. Enzyme fractionation by precipitation (using Temperature, salt, solvent pH, etc.), liquid-liquid extraction, ionic exchange, gel chromatography, affinity chromatography and other special purification methods, Enzyme crystallization techniques. Criteria of purity of enzymes. Pitfalls in working with pure enzymes.

### **UNIT IV**

Enzymes inhibition and Co-factors: Irreversible, reversible, competitive, non-competitive and un-competitive inhibition with suitable examples and their kinetic studies. Allosteric inhibition, types of allosteric inhibition and their significance in metabolic regulation & their kinetic study Vitamins and their co-enzymes: Structure and functions with suitable examples, Metallo enzymes and Metal ions as co-factors and enzymes activators.

### **UNIT V**

Immobilization of microbial enzymes and Enzyme Engineering: Methods viz. adsorption, covalent bonding, entrapment & membrane confinement and their analytical, therapeutic & industrial applications. Properties of immobilized enzymes. Enzyme Engineering-Chemical modification and site-directed mutagenesis to study the structure-function relationship of industrially important enzymes.

## UNIT VI

Applications of microbial enzymes: Microbial enzymes in textile ,leather, wood industries and detergents. Enzymes in clinical diagnostics. Enzyme sensors for clinical processes and environmental analyses. Enzymes as therapeutic agents.

### Reference:

1. Enzymes by palmer(2001): Horwood publishing series.
2. Fundamentals of Enzymology by price and Stevens (2002): Oxford University Press.
3. Enzyme Technology by Helmut Uling (1998): John Wiley.
4. Introduction to proteins Structure by Branden and Tooze (1998): Garland Publishing Group.
5. Methods in Enzymology. Volume 22-Enzyme purification and related techniques. Edited by William B. Jakoby. Academic press, New York.
6. Allosteric Enzymes-Kinetic Behaviour. 1982. By B.I .Kurganov ,John Wiley and Sons. Inc., New York.
7. Biotechnology . Volume 7 A- Enzymes in Biotechnology. 1983 Edited by H.J.Rehm and G.Reed. Verlag Chemie.
8. Enzymes as Drugs Edited by John S. Holcenberg and Joseph Roberts, John Wiley & sons New York.
9. Methods of Enzymatic analysis by Hans Ulrich, Bergmeyer, Academic Press.
10. Methods in Enzymology by W.A.Wood, Academic Press.
11. Advances in Enzymology by Alton Meister, Interscience Publishers.
12. Topics in Enzyme and Fermentation Biotechnology by L.N. Wiseman ,John Wiley and sons.

## **ELECTIVE 2: DAIRY TECHNOLOGY (MDBT 25B)**

**Objective:** to impart current knowledge of basic and applied microbiological aspects of fluid milks and dairy products for improved quality and food safety.

### **Unit I**

Common microbes in milk and their significance .sources of microbial contamination of raw milk in influencing quality of milk during production, collection, transformation and storage. Clean milk production and antimicrobial systems in raw milk. Microbial changes in raw milk during long storage. Microbiological grading of raw milk.

### **UNIT II**

**Microbiological processing techniques:** bactofugation, thermization ,pasteurization, sterilization ,boiling ,UHT, non thermal processes and membrane filtration of milk role of psychrophilic mesophilic, thermophilic and thermoduric bacteria in spoilage of processed milks and prevention microbiological standards (BIS/PFA) of heat treated fluid milks.

### **UNIT III**

Microbiological quality of dairy products; fat rich (cream and butter),frozen (ice cream),concentrated (evaporated and condensed milk),dried milks(roller and spray dried), infant dairy foods and legal standards. Factors affecting microbial quality of these products during processing, storage and distribution. Pro biotics and pre biotics(GRAS),cloning - sanitation, control of micro organisms in dairy processing.

### **UNIT IV**

Microbiology quality of traditional dairy products; heat desiccated (khoa, burfi, peda, kheer),acid coagulated (paneer, chhana, rasgulla), fermented (lassi, srikhand)and frozen (kulfi).sources of microbial contaminants and their role in spolage. Importance of personnel and environmental hygiene on quality of traditional milk products. microbiological standards for indigenous dairy foods.

### **UNIT V**

Milk-borne diseases – viral and bacterial, zoonotic infections ,pathogens associated with fluids milks, dairy products and their public health significance. sources of pathogens and their prevention .importance of bio flims, their role in transmission of pathogens in dairy products and preventive strategies. regulatory control of dairy products, testing of milk and milk products, treatment of dairy wastes.

## References:

1. Adams MR and Moss MO.(1995).food microbiology, the royal society of chemistry, Cambridge.
2. Andrews AT, Varley J(1994) biochemistry of milk products. Royal society of chemistry.
3. Banwart GJ(1989),basic food microbiology, Chapman & hall, new York .
4. Frazier WC and Westhoff DC.(1988) food microbiology, TATA McGraw hill publishing company Ltd. New Delhi.
5. Hobbs BC and Roberts D. (1993) food poisoning and food hygiene, Edward Arnold (a division of Hodder and Stoughton), London.
6. May JM. (1987) modern food microbiology, CBS publishers and distributors, New Delhi.
7. Robinson RK. 1990.the microbiology of milk. Elsevier applied Science. London
8. Edward Harth , J.T.Steele. Applied dairy microbiology .1998. Marcel Decker Inc.
9. Modi, HA (2009) dairy microbiology pointer publishers, India. Marth, E.H and steel J. L(2001) applied Dairy microbiology, 2<sup>nd</sup> Edition, Marcel Dekker, Inc.270 Madison Avenue, new York, New York 10016.



## ELECTIVE 2: PHARMACEUTICAL TECHNOLOGY (MDBT 25C)

**Objectives:** To impart knowledge on the importance of drug during life span. To enlighten on the biotechnological modifications in drugs. To find mechanism of action of drugs used in therapy.

### UNIT I

Drug- structural feature and pharmacology activity, pro drug concept. Absorption – first – pass effect . distributor , metabolism- phase I, II reactions, action of cyto chrome p450 & elimination of drug receptor- localization, type and subtypes, models and their drug- receptor interaction, against & antagonist .

### UNIT II

Adverse response to drugs, drug tolerance, drug intolerance , Idio SYNERACY (pharmacogenesis), drug allergy. Tachy phylaxis, drug abuse, vaccination against infection , factor that modifies the effect of drug. Assay of drug potency – bioassay and immunoassay.

### UNIT III

**Biotechnology and pharmacy:** genetically engineered protein and peptide agents. novel drug delivery systems – non conventional routes of administration. Anti AIDS drug development, oncogenes target for drugs, multi- drugs resistance.

### UNIT IV

**Mechanism of action of drugs used in therapy of :** respiratory system-cough, bronchial-asthma, pulmonary tuberculosis .GIT – digestents , appetite suppressants. hypolipidemia agents,, vomiting, constipation and peptic ulcer. antimicrobial drugs- sulfonamide s,trimethoprim, cotrimoxazole, penicillin and macrolides . aminoglycosides, cephalosporin and bacterial resistance .Insulin and oral diabetic drugs, anti fertility and ovulation inducing drugs.

### UNIT V

**Drugs of plant origin:** drug dependence and abuse- management of self poisoning cancer. Chemotherapy- cytotoxic drug. immuno suppressive drug therapy. New biological targets for drug development. Novel drug screening strategies.

**Reference:**

1. The pharmacology Vol I and Vol II– Goodman and Gillman, Mc Graw Hill professional;12 ed (2010)
2. Basic pharmacology – Foxter cox bulter worth's 1980.
3. Pharmacology and pharmaco therapeutics – R.S.Satoskar. S.D.Bhandhhakar & S.S.Anilapure popular Prakashar Bombay.
4. Principles of medical chemistry – William O. Foge. B.I. Waverks Pvt Ltd, New Delhi.
5. Oxford text books of clinical pharmacology and drug therapy. D.G.Burger's Medical chemistry & drug discovery.
6. Principles and practice – Manfred. E. Wolf John Wiley and sons.

## **ELECTIVE 2: GENOME TECHNOLOGY (MDBT 25D)**

Objective: To enable us to understand genome organization and its relation to biotechnological applications.

### **UNIT I**

Structural Organization: Definition, historical prospective and strategies. Prokaryotic and Eukaryotic genome size & structure-genome physical mapping Structural and functional annotations of genes and genomes.

### **UNIT II**

Genes and Genomes: Interpreting expression data using Gene ontology; Evolution of modularity and transcriptional networks, Ribo switches metabolite sensing and translational control-Microarrays-types and applications.

### **UNIT III**

Taxonomy and phylogeny: Basic concepts in Systematics, taxonomy and phylogeny; molecular evolution; nature of data used in Taxonomy and Phylogeny, Definition and description of phylogenetic trees various types of trees, phylo genetic analysis algorithms such as maximum parsimony, UPGMA.

### **UNIT IV**

Whole genome library: Whole genome shotgun sequencing: DNA sequencing theory pair wise and end sequencing, the Institute for Genomic Research (TIGR), Celera Genomics. Hierarchical shotgun sequencing, High throughput pyro sequencing, Next-generation sequencing and full genome sequencing platforms and sequencing – tools in genome analysis.

### **UNIT V**

Synthetic biology and bio engineering introduction to synthetic biology – metabolomics and synthetic microbiology, predictive model building (metabolomes)- secondary metabolism and synthetic biology – synthetic bacterium, mycoplasma laboratorium, omics concept – metabolomics, transcriptomics, intactomics, phenomics, localizomes; gene networks – integration of networks.

## References:

1. From genes to genomes: concepts and applications of DNA technology . Jeremy W.Dale, Malcom von schantz, Nicholas plant Wiley; 3 ed, 2011
2. Molecular cell biology, Harvey lodish, W. H. freeman; seventh Ed 2012
3. Gene and genome synthesis : technologies and applications .jingdong tian, crc pr L1c;1 edition 2014.
4. Molecular biology of the gene James D. Watson, Tania A. baker, Stephan p. bell, Alexander Gann, Michalle Levine, Richard losick, Benjamin cummings; 7 edition 2013.
5. Molecular cell biology – Darnell lodish Baltimore .scientific American books inc.
6. Human genetics, a. Gardener. R.T.Howell and T.Davies. published by Vinod Vasista for viva books Private ltd.
7. Hartl, D.L.A Primer of populations genetics, III Ed. Sinauer associates Inc. Sunderland 2000

## SEMESTER III

### PAPER 8: PLANT BIOTECHNOLOGY (MDBT 31)

**Objective:** This paper has been designed to give the students comprehensive knowledge about the applications of plant Molecular biotechnology for increasing agricultural production, environment improvement, human, nutrition and health. Help students to get a career in both industry/R & D.

**UNIT – I Genome organization in Plants:** Nucleus, Chloroplast and Mitochondria, Molecular Marker-aided Breeding: RFLP maps, linkage analysis, RAPD markers, STS, Microsatellites, SCAR (Sequence Characterized Amplified Regions), SSCP (Single Strand Conformational Polymorphism), AFLP, QTL, map based cloning, molecular marker assisted selection.

**UNIT – II Plant Cell and Tissue Culture:** Tissue culture media (composition and preparation), Callus and suspension culture; Somaclonal variation; Micropropagation; Organogenesis; Somatic embryogenesis; transfer and establishment of whole plants in soil; greenhouse technology. Embryo culture and embryo rescue. Artificial seeds. Protoplast fusion and somatic hybridization; cybrids; anther, pollen and ovary culture for production of haploid plants. Cryopreservation and DNA banking for germplasm conservation.

#### **UNIT – III Concepts in Plant Genetic Engineering :**

Plant vectors :Co-integrate, binary vectors and viral vectors, 35S and other promoters, Terminators, selectable Antibiotic resistance marker and reporter genes GUS gene, Lux gene and GFP protein. Transgene stability and gene silencing.

#### **UNIT-IV Methods of gene transfer in plants**

Transient and stable gene transformation:Agrobacterium mediated gene transfer, Ti & Ri plasmid, the process of T DNA transfer and integration. Physical method of gene transfer, Particle bombardment, electroporation, microinjection, chemical mediated transformation, silicon carbide mediated and floral dip method. Transplastomics: Chloroplast transformation: advantages, vectors, success with tobacco and potato. Strategies for marker free transformation.

#### **UNIT-V**

Application of transgenesis in crop improvement: Insect resistance, disease resistance, virus resistance, herbicide resistance, and resistance to biotic & abiotic stress. Transgenesis for male sterility and terminator seed. Transgenesis for quality improvement: Protein, lipids, carbohydrates, vitamins & mineral nutrients. Molecular pharming: Exploitation of Biotechnological techniques for plant therapeutic compounds - production of recombinant proteins in plants. Expression of antibodies in plants for immunotherapy. Expression of recombinant antibody fragments in plants.

## References:

1. Slater A, NW Scott, MR Fowler. Plant bio technology, Oxford University Press, 2003
2. Hans Walter Heldt. Plant Biotechnology & Molecular Biology, Oxford University Press, 1997
3. Nigel W. Scott, Mark R. Fowler, Adrian Slater. Plant Biotechnology: The genetic manipulation of plants 2nd Edition 2nd Edition, Oxford University Press, 2008
4. J. Hammond, P. McGarvey, V. Yusibov. Plant Biotechnology: New Products and Applications 1st ed. Springer 1999.
5. Bob Buchanan, Wilhelm Gruissem, Russell Jones. Biochemistry & Molecular Biology of Plants. I.k. International Pvt. Ltd, 2007.
6. Robert J. Henry. Practical Applications of Plant Molecular Biology. Routledge Chapman & Hall, 1997.
7. Introduction to Plant Biotechnology by H.S. Chawla, 2002. Oxford and IBH P Publishing Co.Pvt. Ltd. New Delhi.
8. Plant molecular genetics by Monica. A. Hughes.1999. Pearson Education limited, England.
9. An introduction to genetic engineering in plants, Mantel S.H, Mathews J.A. Mickee R.A.1985. Blackwell Scientific Publishers. London.
10. Scott and Mark R. Fowler, 2003, Oxford University press, UK. 11. Molecular Plant Biology: A practical approach (Vol. I and II), Edited by Gilmartin and Bowler, 2002, Oxford University press, UK.
11. In Vitro culture of higher plants by R.L.M. Pierik, 1987. MartinusNijhoff Publisher, Dordrecht.
12. Gonzales.1994.Oxford University Press. Oxford. 4. Plant Molecular Biology by Donald Grierson and S.V. Convey.1984. Blackie and Son.
13. Plant cell culture. A practical approach. Second edition. Edited by R.A. Dixon and R.A.

## **PAPER 9: ANIMAL BIOTECHNOLOGY (MDBT 32)**

**Objective:** To provide an overview and current developments in different areas of animal Biotechnology and its application.

### **UNIT I**

Culture of mammalian cells, Tissues and Organs, Primary Culture, Secondary Culture, Continuous cell lines, Suspension cultures, Cryopreservation and transport of Animal germplasm ( Embryo, Semen and ovum).

### **UNIT II**

Cell cultures media and Growth parameters of animal cell culture, Role of serum and essential supplements to medium and their applications. Cell Synchronization, Cell cloning Methods and Micromanipulation.

### **UNIT III**

Gene transfer to Animal cell, Animal Germ cell and development, Valuable genes for Animal biotechnology, Transgenic Animals (story of Dolly) and gene knockout, Somatic cell cloning and Hybridization, Transfection and Transformation of cells, Production of transgenic animals – mice, sheep and fish. Potential applications of transgenic animals – Animal models for diseases and disorders. Transgenic poultry, transgenic insects as bioreactor.

### **UNIT IV**

Commercial scale production of animal cells, application of animal cell culture for in vitro, testing of drugs, testing the toxicity of environmental pollutants in cell culture, application of cell cultures technology in production of pharmaceutical proteins, human and animal viral vaccines.

### **UNIT V**

Stem cell culture, embryonic stem cells and their applications. Cytotoxicity, Apoptosis, Tissue engineering. Diagnostic antigens and other pharmaceutical agents.

References:

1. Culture of Animal cells, 2006, 3<sup>rd</sup> Edition, R. Ian Freshney . A John Wiley & Sons, Inc., publications.
2. Animal Cell Culture – Practical Approach, R.W. Masters, Oxford. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
3. Biotechnology by Kashav. T (Wiley Eastern Ltd).
4. Animal Cell Biotechnology; Methods and protocols, Nigel Jenkins, Humana Press.
5. Biotechnology of Animal Tissue. P.R. Yadav & Rajiv Tyagi, 2006. Discovery publishing House. New Delhi.
6. From Genes to Clones Introduction to Gene Technology – Winnacker, E.L.1987., Panima Educational Book Agency, New Delhi.
7. Gene VII – Benjamin Lewin, 2000. Oxford University Press, UK.
8. Principles of Gene Manipulation and Genomics – Primrose, S.B. and Twyman, R.M. 2006. 7<sup>th</sup> Edition. Blackwell Publishing Company.
9. Recombinant DNA Second Edition – James D. Watson, Micheal Gilman, MarkZoller, 2001. W.H. Freeman and Company, New York.
10. Biotechnology, Satyanarayanan .U, (2008), Books and Allied (p) Ltd.



## **PAPER 10: MICROBIAL BIOTECHNOLOGY (MDBT 33)**

**Objective:** To understand the various processes involved in Microbial Technology uses in industries for the production of Primary and secondary metabolites that will be useful for the benefit of human beings.

### **UNIT I**

Scope and importance of bioprocess engineering technology, Development and strain improvement of industrially important microorganisms. Bioreactors: Typical structure of advanced bioreactor and their working mechanism; Design features - Heat transfer and Mass transfer; Specialized bioreactors- design and their functions; Airlift bioreactor, Tubular bioreactors, Membrane bioreactors, Tower bioreactors, Fluidized bed reactor, Packed bed reactors and Photo bioreactors.

### **UNIT II**

Fermentation technology: Natural and synthetic media; Strategies for media formulation, sources of carbon, nitrogen, vitamins and minerals. Role of buffers, precursors, inhibitors, inducers and antifoam agents. Types of fermentation process-submerged fermentation, surface or solid state fermentation, batch fermentation, continuous fermentation, kinetics of fermentation process, bioprocess control, monitoring of variables-temperature, agitation, pH and pressure.

### **UNIT III**

Downstream processing: cell disruption, precipitation methods, solid-liquid separation, liquid-liquid extraction, filtration, centrifugation, chromatography, drying devices (Lyophilization and spray dry technology), crystallization-biosensors-construction and applications

### **UNIT IV**

Immobilization and Biotransformation: Methods of immobilization - adsorption, crosslinking, ionic bonding, entrapment, encapsulation; Advantages and industrial applications of Immobilization of enzymes and whole cells. Biotransformation of antibiotics, steroids and their applications.

### **UNIT V**

Production of Industrially important products: Alcohol- Ethanol, glycerol, butanol, Acetone; Organic acids- citric, acetic, and gluconic acid; Amino acids- lysine, glutamic acid; Antibiotics- penicillin, streptomycin, tetracycline; Vitamins- riboflavin; Enzymes- amylase, protease; biodegradable plastic- polyhydroxyalkanoates (butyrate, propionate).

## References:

1. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.
2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002.
3. Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
4. Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, (2nd Ed). Taylor & Francis Ltd, UK, 2007.
5. Colin Ratledge and Bjorn Kristiansen, Basic Biotechnology (2nd Ed.).Cambridge University Press. 2002.
6. Prescott, Sc and Dunn, C. Industrial Microbiology, McGraw Hill, New York. 1984
7. Michael, L. Shulers and FikretKargi. Bioprocess Engineering: Basic concepts (2nd Ed.) Prientice Hall Publishers. 2001
8. Paulins, M. D. Bioprocess Engineering Principles. John Wiley Publishers.

## **PAPER 11: ENVIRONMENTAL BIOTECHNOLOGY (MDBT 34)**

**Objective:** To acquire a basic comprehension of the environment in its totality and of its problems and to provide an understanding of the environmental and biological challenges facing society through the integration of biology with legal, regulatory and social issues.

### **UNIT-I**

**Environmental pollution:** Basic concepts and global issues-Global warming & Acid rain. Pollution measurements- air and water. Biosensor in environmental monitoring. Bioremediation of environmental pollutants in soil and water- oils, heavy metals and detergents. Biofouling and Biosensors.

### **UNIT-II**

**Waste treatment:** Waste water treatment: Physical, chemical and biological treatment processes. Various industrial effluent treatment methods- Sugar, distillery, dairy, tannery and pharmaceutical industries. Solid wastes: Types and characteristics. Solid waste disposal- land filling, incineration. Biogas from solid waste. Composting and vermicomposting. Monitoring parameters for composting.

### **UNIT-III**

**Bioremediation:** Introduction of Bioremediation advantages and applications; Types of bioremediation. Microbial remediation of phenolics-sewage nutrients (phosphate and nittare). Impact of bioremediation in petroleum industry, paper industry, marine oil pollutants and chemical industry. Phytoremediation advantages and applications (agriculture).

### **UNIT-IV**

**Biocorrosion and microbial mediated recovery:** Microbial corrosion and its control (petroleum industry and cooling tower system). Bio metallurgy- Bioleaching- application, biotechnology approaches for heavy metal elimination from effluents. Bio-mediated recovery of metals (gold and platinum). Recovery of petroleum-MEOR- Biosurfactant.

### **UNIT-V**

**Biodegradation:** Biodegradation of organic pollutants: Mechanisms and factors affecting biodegradation. Pollution problems and biodegradation of simple aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes, lignin and pesticides. Bioenergy.

## References

1. Murugesan AG and Rajakumari C. (2005). Environmental Science and Biotechnology: theory and Techniques.
2. Sharma PD. (1994). Environmental Biology, Rastogi Publications.
3. Eugenia J.Olguin. (2000). Environmental Biotechnology and cleaner Bioprocesses, Tayloir and Francis.
4. Beech IB and Gaylarde CC (1999). Recent advance in the study of biocorrosion- an overview. *Rev Microbial* **30**, 177- 190.
5. Booth GH (1971). Microbiological corrosion, M and B monographs CE11, Mills and Boon ,London.
6. Agarwall KV. (2005). Environmental Biotechnology, Nidhi Publishers.
7. Jogdand SN.(2008).Environmental Biotechnology, 4th Edition, Himalaya Publishing House Pvt. Ltd.

## **PRACTICAL V: LAB IN PLANT BIOTECHNOLOGY & ANIMAL BIOTECHNOLOGY (MDBT 36)**

### **Plant Biotechnology**

1. Introduction to plant tissue culture-induction of callus and suspension cultures.
2. Isolation and purify the protoplasts and check its viability.
3. Induction of somatic embryogenesis and analysis of different stages.
4. Extract the genomic DNA from plants by CTAB
5. Culture and selection of *Agrobacterium* on Agar medium
6. *Agrobacterium* mediated gene transformation
7. Use of Agroinfiltration for Transient Expression in Plant
8. Gus assay
9. Analysis of WT/ Transgenic plant by PCR
10. Isolation of Total RNA from leaves
11. Gene gun method of transformation
12. Synthetic seed preparation

### **Lab in Animal Biotechnology**

1. Development of primary cell lines/maintenance of established cell lines.
2. Cell counting and cell viability.
3. Trypsinization of monolayer and sub culturing.
4. Gene transfer by transfection
5. Preparation of metaphase chromosomes from cultured cells.
6. Isolation of DNA and demonstration of apoptosis of DNA laddering
7. MTT assay for cell viability and growth

## References

1. Practical Applications of Plant Molecular Biology. Robert J. Henry . Routledge Chapman & Hall, 2008.
2. Molecular Plant Biology: A practical approach (Vol. I and II). Gilmartin and Bowler. Oxford University press, UK, 2002.
3. Plant Cell Culture: Essential Methods. Michael R. Davey, Paul Anthony. Wiley, 2010.
4. Plant Tissue Culture, Third Edition: Techniques and Experiments . Roberta H. Smith. Academic Press, 2012.
5. Plant cell culture Protocols (Methods in Molecular Biology, 3<sup>rd</sup> Ed). Victor M. Loyola-Vargas, Neftali Ochoa-Alejo. Humana Press, 2012.
6. Plant Cell, Tissue and Organ Culture: Fundamental Methods (Springer Lab Manuals). Oluf L. Gamborg (Editor), Gregory Phillips (Editor), Springer, 2013.

## **PRACTICAL VI: LAB IN MICROBIAL TECHNOLOGY & ENVIRONMENTAL BIOTECHNOLOGY (MDBT 37)**

### **Microbial Technology**

1. Study of fermentor- Demonstration.
2. Production and isolation of antibiotics (Penicillin and Streptomycin)
3. Production and analysis of Single cell protein (Spirulina and yeast)
4. Production of yoghurt and estimation of lactic acid.
5. Estimation of percentage of alcohol of given sample
6. Production and assay of  $\alpha$ -amylase from *Aspergillus niger* by solid substrate fermentation.
7. Immobilization of given enzyme/whole cells
8. Estimation of amount of citric acid in the given sample.

### **References:**

### **Environmental Biotechnology**

1. Water Analysis: Measurement of Total Solids, Total – dissolved solids, Total-suspended solids, dissolved oxygen, total hardness, chloride, turbidity, nitrite, nitrate, fluoride and total nitrogen.
2. Estimation of COD, BOD of industrial effluents.
3. Potability test of water (MPN technique).
4. Degradation of phenols. Colorimetric assay
5. Estimation of MIC and Heavy metal tolerance of chromium resistant bacteria
6. Screening of Biosurfactant activity-Oil Displacement test-Drop collapse test
7. Isolation of *Thiobacillus ferrooxidans* and *Thiobacillus thiooxidans* from metal sulphides, rock and acid mine water.
8. Microbial degradation, decolourisation and adsorption of organic dyes by free and immobilized cells
9. Studies on halophiles from sea water (pigmentation and salt tolerance)

### **ELECTIVE 3: GENOMICS & PROTEOMICS (RPDBT 35A)**

**OBJECTIVE:** To enable us to explore many different components of living systems and the advent of proteomics will made it possible to identify a broad spectrum of proteins in living systems. This elective subject will help to understand basic principles and applications in genomics and proteomics.

#### **UNIT I :**

Organization of genes across living systems, interrupted genes, overlapping genes, alternative genes , (RNA editing and RNA Splicing ) etc. identification and characterization of insert DNA fragments, gene content and C value paradox – gene cluster and gene families .restriction mapping, chromosome walking and chromosomal localization of genes. RFLP and other uses of cloned sequences, cloning of microbial genes.

#### **UNIT II**

Methods of preparing genomic DNA, DNA sequence analysis methods, Sanger Di deoxy method, next generation sequencing, SNP – single nucleotide polymorphism, expressed sequenced Tags(ESTs),Gene disease association, site directed mutagenesis and molecular chimeras , gungal genome and genomics.PCR based Analysis, DNA Fingerprinting.

#### **UNIT III**

Scope of proteomics, protein separation techniques – ion exchange chromatography, size – exclusion and affinity chromatography techniques, size – exclusion and affinity chromatography techniques , protein analysis (includes measurement of concentration , amino acid composition, N-terminal sequencing ); SDS-PAGE , two dimensional gel electrophoresis and image analysis.

#### **UNIT IV**

Introduction to mass spectrometry; strategies for protein identification ; protein sequencing ; protein modifications and proteomics ; applications of proteome analysis to drug; protein – protein interaction (Two hybrid interaction screening ), analysis and sequencing individual spots by mass spectrometry (Maldi toff) and protein microarrays .

#### **UNIT V**

Meta genomics – construction, vector design and screening o f meta genomic libraries-biotechnological applications of meta genomics.



## Reference

1. Microbial Genomes. Fraser, Clarie M:read ,timothy D:Nelson , Karen E,Ed. Humana press 2004.
2. mobile DNA II. Craig Nancy, Craigie , Robert: Gellert, Martin: Lambowitz. Alan M. ASM Press 2002.
3. Genomes 2<sup>nd</sup> ed. Brown.T.A Wiley- Liss, Oxford 2002.
4. Laboratory Manual winter school on Meta genomics .P.Gunasekaran, MKU Press, Madurai,2009.
5. Laboratory manual : Winter school on Microbial genome typing . P.Gunasekaran, MKU press, Madurai, 2008.
6. Biotechnology of antibiotics, Stroh, William R, 2<sup>nd</sup> ed. Marcel Dekker Inc. 1997.
7. Gnesenomics, proteomics & vaccines. Gudio grandi. John Wiley&sons, New York.2004
8. Ge, Benjamin Lewin, Jones and Bartletts Publishers, 2008.
9. Molecular genetics MYOBACTERIA. W.R. Jacobs, ASM press 2000.

## **ELECTIVE 3: BIODIVERSITY (MDBT 35B)**

### **Unit 1:**

Ecosystem concept Introduction and overview of ecosystem ecology - History of ecosystem ecology, Ecosystem structure and functioning, Ecosystem diversity and landscapes, Ecosystem resilience and change, Trophic dynamics and temporal dynamics, Ecological efficiencies, Human induced Ecosystem change, Urban Ecosystem Species effects on ecosystem processes- Overview, Functional type effects, Functional type response, integrating the effects of traits on ecosystems, Species interaction and ecosystem processes, Ecosystem Services.

### **Unit 2:**

Biodiversity and its origin, Global and local trends , Mega biodiversity countries, hot spots and heritage sites, types of diversity, levels of biodiversity (genetic, species, ecological diversities), value of biodiversity. Threats to biodiversity: Mass extinction, global climate change and its impact on biodiversity, ecosystem degradation and loss, habitat fragmentation, overexploitation, exotic and invasive species, deforestation and loss of biodiversity.

### **Unit 3:**

History, guiding principles, conservation challenges and models of conservation biology. IUCN Red list categories and criteria, habitat management and establishment of wildlife corridors and protected areas, bio-indicators. Biosphere reserves, in situ and ex situ conservations (sanctuaries, national parks, zoological parks, botanical gardens, oceanorium). Wild life conservation (Global and Indian) projects – scope and success. Biodiversity and wildlife policies: Biodiversity conventions, biodiversity Act and Rules, Global, National and Regional conservation efforts and legal aspects.

### **Unit IV**

Environmental Pollution- Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management. Environment Protection Act: Air, water, forest and wild life acts, issues involved in enforcement of environmental legislation.

### **Unit V**

Water conservation, Rain water harvesting & watershed management, and environmental ethics. Climate change, global warming, acid, rain, ozone layer depletion. Environmental protection act, population explosion. Disaster management: Types of disasters, impact of disasters on environment, infrastructure, and development. Basic principles of disaster mitigation, disaster management, and methodology, disaster management cycle, and disaster management in India.

## References

1. Alcock J 2013 *Animal Behavior: An Evolutionary Approach*, 10th edition (Sinauer Associates, Inc.)
2. Bolhuis J J and L Giraldeau (eds) 2005 *The behaviour of animals* (Blackwell Pub.)
3. Breed and Moore 2011 *Animal Behavior*, 1st Edition (Academic Press)
4. Burnse D (ed.) 2001 *Animal: the definitive visual guide to worlds' wildlife* (Cambridge University Press)
4. Collen B, Pettorelli N, Baillie J E M and Durant S M (Eds) 2013 *Biodiversity Monitoring and Conservation: Bridging the Gap Between Global Commitment and Local Action* (WileyBlackwell)
5. GL. Karia and R.A. Christian, *West Water Treatment, Concepts and Design Approach*, Prentice Hall of India, 2005.
6. Benny Joseph, *Environmental Studies*, Tata McGrawHill, 2005

## **ELCTIVE 3.NANO BIOTECHNOLOGY (MDBT 35C)**

**Objective:** This discipline helps to indicate the merger of biological research with various fields of nanotechnology. This technical approach to biology allows scientists to imagine and create systems that can be used for biological research. The most important objectives that are frequently found in nano biology involve applying nano tools to relevant medical/biological problems and refining these applications. developing new tools for the medical and biological fields in another primary objective in nanotechnology . microbes are playing an important role in the synthesis of nano particles. this syllabus would enlighten the students to understand basic concepts and applications of nanotechnology.

### **UNIT I**

Introduction to nanotechnology: characteristic scale for quantum phenomena, nano particles, nano-clusters ,nano composite ,nao tubes, nano wires emergence of bio nanotechnology. characterization of nano particles- UV-Vis spectroscopy, electron Microscopy- HRTEM,SEM,AFM,EDS,XRD.

### **UNIT II**

Microbial nanotechnology – microbial synthesis of nano drugs-metal nano particles and drug delivery vehicles- Nanoshells – Tecto dendrimers Nano particle drug systems – diagnostic applications of nanotechnology.

### **UNIT III**

Preparation of nano biomaterials – polymeric scaffolds collagen, elastins: Mucopolysaccharides, Proteoglycans ,cellulose and derivates; dextrans ; alginates; Pectins; Chitin. Nanoparticles – types, functions-Silver, Gold and Titanium. Physical and chemical properties of nanoparticles.

### **UNIT IV**

Nanoscale applications in biology and medicine: nanotechnology fro biology and medicine – micr and nano-fluides- scanning probe microscopy in biology and medicine- self –assembly of biological molecules .drug delivery – protein mediated and nanoparticle mediated. Hybrid conjugates of gold nano particles –DNA oligomers - use of DNA molecules in nanomechanics and computing . Nano particles as carrier for genetic material .Genetically modified organisms (GMO) and applications.

### **UNIT V**

Implications of nanotechnology : health and safety implications from nano particles: health issues- environmental issues- need for regulation – societal implications : possible military

applications – potential benefits and risk for developing countries – intellectual property issues – criticism of Nanotechnology – studies on the implications of Nanotechnology.

### **References:**

1. Parthasarathy, B.K(2007). Introduction to Nano technology , Isha publication.
2. Elisabeth Papazoglou and Aravind Parthasarathy (2007).Bio nanotechnology. Morgan & Claypool publishers.
3. Bernd Rehm (2006). Microbial bio nanotechnology: biological self-assembly systems and biopolymer – based nanostructures. Horizon scientific press.
4. David E. Reisner ,Joseph D. Bronzino (2008). Bio nanotechnology : global prospects.CRC Press.
5. Ehud Gazit (2006). Plenty of room for biology at the bottom: An introduction to bio nanotechnology.Imperial college press.
6. Hari Singh Nalwles , “ Nano structured materials and nanotechnology “,2002academic press
7. M.H.Fulekar,2010” Nanotechnology importance and applications .”I.K. International publishing house Pvt.
8. Nanotechnology : Global strategies, Industry Trends and applications 2005John Wiley & sons Ltd.

### **ELECTIVE 3: STEM CELL BIOLOGY (MDBT 35D)**

Objective: to understand the recent advances and its applications to modern biotechnology.

#### **UNIT I**

Introduction to concepts in stem cell biology (renewal and potency etc) introduction to tissue stem cells, Germ line stem cells and germ line derived pluripotent cell, Epigenetics, nuclear transfer and cloning, introduction to cell, tissues and organ.

#### **UNIT II**

Stem cell basic: embryonic development of human, introduction to embryonic and adult stem cell, sources of adult stem cells, reprogramming and induced pluripotent cells (iPS cells), chromatin and stem cells, telomeres and stem cells, stem cell differentiation and characterization: CD antigens and its role in stem cell differentiation.

#### **UNIT III**

Neuronal stem cell, mesenchymal stem cell, cardiac stem cells, planaria stem cells, prostate and breast stem cells, transforming growth factor (TGF $\beta$ ), G PROTEIN – COUPLED RECEPTORS (GPCRs). hematopoietic stem cells, stem cells and diabetes, techniques used for stem cell isolation, enumeration and Ex-VIVO expansion, techniques used for stem cell characterization.

#### **UNIT IV**

Therapeutic applications of stem cell: fundamentals of regenerative medicine, autologous and allogeneic stem cell transplantation, HLA typing, Animal models of regeneration.

#### **UNIT V**

Stem cell banking – cryopreservation techniques, national guideline by ICMR, recent advances in stem cell biology.

**References:**

1. Essentials of stem cell biology 2009, (second ed) Robert Lanza, John Gearhart , Brigid Hogan, Douglass Melton, roger Pedersen, E. Donnall Thomas, James Thomson and sir Ian Wilmutt.
2. Ann a. Kiessling, human embryonic stem cells: an introduction to the science and therapeutic potential, Jones and bartett,2003
3. Peter J ,Quesenberry, stem cell biology and gene therapy, 1<sup>st</sup> ed, willyless, 1998
4. Robert lanja, essential of stem cell biology , 2<sup>nd</sup> ed, academic press,2006
5. A. D. Ho. R. Hoffiman, stem cell transplantation biology processes therapy, willy – VCH, 2006
6. C.S. Potten, stem cells, Elsevier, 2006

## SEMESTER IV

### PAPER 12: RESEARCH METHODOLOGY (MDBT 41)

**Objectives:** To enable the students to understand the importance's of research, familiarize on writing the project report, learn about the various applications of statistics in the research.

**Unit-I - Objectives and types of research:** Motivation and objectives – Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.

**Unit-II - Research Formulation** – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs- patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

**Unit-III - Research design and methods** – Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models. Developing a research plan - Exploration, Description, Diagnosis, experimentation. Determining experimental and sample designs. Research techniques- microscopy, HPLC, HPTLC, GC-MS, FTIR, SEM/TEM, NMR and AAS.

**Unit-IV - Data Collection and analysis:** Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation.

**Unit-V - Reporting and ethics** – Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports. Environmental impacts - Ethical issues - ethical committees - Commercialisation – Copy right – royalty - Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material – Plagiarism - Citation and acknowledgement - Reproducibility and accountability.



## References

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to Research Methodology*, RBSA Publishers.
2. Kothari, C.R., 1990. *Research Methodology: Methods and Techniques*. New Age International. 418p.
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