

**RAMA UNIVERSITY UTTAR PRADESH, KANPUR**

**Faculty of Sciences**



**SYLLABUS & EVALUATION SCHEME**

**[Effective from the Session 2014-15]**

**M.Sc. Biotechnology**

**1<sup>st</sup> & 2<sup>nd</sup> Year**



## RAMA UNIVERSITY UTTAR PRADESH, KANPUR

A meeting of the Board of Studies of the department of Biotechnology of Faculty of Sciences Rama University Uttar Pradesh, Kanpur was held on 5<sup>th</sup> July 2014 at 11 AM. The following members were present:

- |                                |                 |
|--------------------------------|-----------------|
| 1. Dr. Ajay Kumar              | Convener        |
| 2. Mr. Ajit Pratap Singh Yadav | Member          |
| 3. Mr. Vachaspati Rao          | Member          |
| 4.                             | External Member |
| 5.                             | External Member |

The quorum of the meeting was complete.

Agenda of the meeting:

1. Assessment Criteria
2. Question Paper Format
3. Syllabus

The meeting resolved unanimously that attached Assessment Criteria, Question Paper Format and Syllabus are justified and approved.

### Convener

Signature: .....

Name : Dr. Ajay Kumar

Date :

### Internal Members

Signature: 1.....

Name: Mr. Ajit Pratap Singh Yadav

Date:

2.....

Mr. Vachaspati Rao

### External Members

Signature: 1.....

Name: Prof. (Dr.).

Date:

2.....

Dr.

**Faculty of Sciences**  
**Rama University Uttar Pradesh, Kanpur**  
 Course Detail and Evaluation Scheme  
 (Effective from the Session 2014-15)

**M.Sc. Biotechnology**  
**FIRST YEAR (SEMESTER-I)**

S.N.	Subject Code	Subject Name	Period			Evaluation Scheme			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
<b>Theory subjects</b>										
1	MBT-101	Biomolecules	3	1	0	20	20	60	100	4
2	MBT-102	Microbiology	3	1	0	20	20	60	100	4
3	MBT-103	Molecular Cell Biology	3	1	0	20	20	60	100	4
4	MBT-104	Biophysical Tools and Techniques	3	1	0	20	20	60	100	4
<b>Practicals / Project</b>										
5	MBT-151	Cell & Microbiology Lab	0	0	2	30	20	50	100	2
6	MBT-152	Biophysical Tech Lab	0	0	2	30	20	50	100	2
<b>Total</b>			<b>12</b>	<b>4</b>	<b>4</b>	<b>140</b>	<b>120</b>	<b>340</b>	<b>600</b>	<b>20</b>

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

**Evaluation Scheme:**

• **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

- a. First Mid Term Examination: 10 marks
- b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

• **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks

Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks

- a. First Mid Term Examination: 10 marks
- b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

**Convener**

Signature: .....

Name : Dr. Ajay Kumar

Date :

**Internal Members**

Signature: 1..... 2.....

Name: Mr. Ajit Pratap Singh Yadav Mr. Vachaspati Rao

Date:

**External Members**

Signature: 1..... 2.....

Name: Prof. (Dr.). Dr.

Date:

**Faculty of Sciences**  
**Rama University Uttar Pradesh, Kanpur**  
 Course Detail and Evaluation Scheme  
 (Effective from the Session 2014-15)

**M.Sc. Biotechnology**  
**FIRST YEAR (SEMESTER-II)**

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
<b>Theory subjects</b>										
1	MBT-201	Molecular Biology	3	1	0	20	20	60	100	4
2	MBT-202	Enzymology	3	1	0	20	20	60	100	4
3	MBT-203	Intermediary Metabolism	3	1	0	20	20	60	100	4
4	MBT-204	Biostatistics & Bioinformatics	3	1	0	20	20	60	100	4
<b>Practicals / Project</b>										
5	MBT-251	Biochemistry & Molecular Biology Lab	0	0	2	30	20	50	100	2
6	MBT-252	Biostatistics And Bioinformatics Lab	0	0	2	30	20	50	100	2
<b>Total</b>			<b>12</b>	<b>4</b>	<b>4</b>	<b>140</b>	<b>120</b>	<b>340</b>	<b>600</b>	<b>20</b>

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

**Evaluation Scheme:**

• **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

- a. First Mid Term Examination: 10 marks
- b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

• **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks

Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks

- a. First Mid Term Examination: 10 marks
- b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

**Convener**

Signature: .....

Name : Dr. Ajay Kumar

Date :

**Internal Members**

Signature: 1..... 2.....

Name: Mr. Ajit Pratap Singh Yadav Mr. Vachaspati Rao

Date:

**External Members**

Signature: 1..... 2.....

Name: Prof. (Dr.). Dr.

Date:

**Faculty of Sciences**  
**Rama University Uttar Pradesh, Kanpur**  
 Course Detail and Evaluation Scheme  
 (Effective from the Session 2014-15)

**M.Sc. Biotechnology**  
**SECOND YEAR (SEMESTER-III)**

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
<b>Theory Subjects</b>										
1	MBT-301	Immunology	3	1	0	20	20	60	100	4
2	MBT-302	Plant Biotechnology	3	1	0	20	20	60	100	4
3	MBT-303	Animal Cell Science & Technology	3	1	0	20	20	60	100	4
4	MBT-304	Bioprocess Engg. & Fermentation Technology	3	1	0	20	20	60	100	4
<b>Practicals / Project</b>										
5	MBT-351	Tissue Culture Lab	0	0	2	30	20	50	100	2
6	MBT-352	Immunology Lab	0	0	2	30	20	50	100	2
<b>Total</b>			<b>12</b>	<b>4</b>	<b>4</b>	<b>140</b>	<b>120</b>	<b>340</b>	<b>600</b>	<b>20</b>

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

**Evaluation Scheme:**

• **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

- a. First Mid Term Examination: 10 marks
- b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

• **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks

Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks

- a. First Mid Term Examination: 10 marks
- b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

**Convener**

Signature: .....

Name : Dr. Ajay Kumar

Date :

**Internal Members**

Signature: 1..... 2.....

Name: Mr. Ajit Pratap Singh Yadav Mr. Vachaspati Rao

Date:

**External Members**

Signature: 1..... 2.....

Name: Prof. (Dr.). Dr.

Date:

**Faculty of Sciences**

# Rama University Uttar Pradesh, Kanpur

Course Detail and Evaluation Scheme  
(Effective from the Session 2014-15)

## M.Sc. Biotechnology SECOND YEAR (SEMESTER-IV)

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
<b>Theory Subjects</b>										
1	MBT-401	Genetic Engineering	3	1	0	20	20	60	100	4
2	MBT-402	Environmental Biotechnology	3	1	0	20	20	60	100	4
<b>Practicals / Project</b>										
3	MBT-451	Project Work & Presentation	0	0	12	300	-	100	400	12
Total			6	2	12	340	40	220	600	20

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

### Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

- a. First Mid Term Examination: 10 marks
- b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks  
Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks

- a. First Mid Term Examination: 10 marks
- b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

### Convener

Signature: .....

Name : Dr. Ajay Kumar

Date :

### Internal Members

Signature: 1..... 2.....

Name: Mr. Ajit Pratap Singh Yadav Mr. Vachaspati Rao

Date:

### External Members

Signature: 1..... 2.....

Name: Prof. (Dr.). Dr.

Date:

First year- 1st Semester

## MBT-101: BIOMOLECULES

**L T P**  
**3 1 0**

**Credit: 4**

### **Unit 1:**

Classification and physico-chemical properties of amino acids and proteins. Isolation, purification and criteria of purity of proteins. Definition, structural and functional features, and determination of primary, secondary, tertiary and quaternary structures of proteins. protein sequencing. [8]

### **Unit 2:**

Classification & properties of mono-, di-, oligo and poly- saccharides. Structural features and compositional analysis of polysaccharides. Biological importance of glucose, fructose, maltose, sucrose, lactose, starch, glycogen, lignin, kitin, cellulose, peptidoglycan and glycoproteins. [8]

### **Unit 3:**

Introduction to Vitamins, hormones, Phytohormones and their role. Classification, structure, properties and functions of lipids. Biological importance of choline, lecithine, lipoproteins, chylomicrons , VLDL, LDL, HDL. [8]

### **Unit 4:**

Structure, properties and functions of nucleic acids. Sequencing of DNA, RNA Polymorphism, T<sub>m</sub> and its relation to GC content, Cot value. [8]

### **Unit 5:**

Classification and properties of porphyrins, metalloproteins. Nature, synthesis and physiological significance of bile pigments. [8]

#### **Text/Reference Books:**

1. Christopher K. Mathews, K.E. van Holde and Kevlin G. Ahern,
2. *Biochemistry*, Pearson Education (Singapore) Pte. Ltd. Indian Branch, 482 F.I.E. Patparganj, Delhi.
3. 2 Lubert Stryer, *Biochemistry*, W.H. Freeman and Company, New York .
4. D.L. Nelson, M.M. Cox, *Lehninger's Principles of Biochemistry*, Macmillan Worth Pub. Inc. New York
5. Geoffery Zubey, *Biochemistry*, Macmillon Publishing Company, New York
6. Donald Voet and Judith Voet, *Biochemistry*, John Wiley & Sons, New York

# MBT-102: MICROBIOLOGY

**L T P**  
**3 1 0**

**Credit: 4**

## **Unit 1:**

History, development and scope of microbiology: Doctrine of spontaneous generation; controversy over spontaneous generation; contribution of Antony Van Leeuwenhoek, Lazzaro Spallanzani, John Tyndall, Louis Pasteur, Joseph Lister, Iwanowsky, Robert Koch in the development of microbiology, Microbiology in the 20<sup>th</sup> century. [8]

## **Unit 2:**

Structural and functional relation of prokaryotes. Cell wall, cell membrane, capsule, flagella, pili, Tactic movements, storage granules, metabolism of volutin (polyphosphates), glycogen, polyb-hydroxy alkanooates, endospore structure and process of sporulation. Microbial genetics (transformation, conjugation, transduction and transposition) Plasmids: F plasmids, R plasmids, Col plasmids etc. [8]

## **Unit 3:**

Different types of culture media, Isolation identification of microbes, culture techniques, preservation of cultures. Nutrition: Photoautotrophs, photoheterotrophs, chemoautotrophs, chemoheterotrophs. Growth: Microbial definition measurement of growth, generation time, arithmetic and exponential growth growth, Batch growth curve, continuous and synchronous culture, factors affecting microbial growth. P<sup>h</sup>, Temp, Oxygen etc. [8]

## **Unit 4:**

Microbial control: Methods and dynamics of sterilization, mechanisms of control (physical, chemical, and radiation etc), biocontrol. Concept of chemotherapy: chemotherapeutic agents (antibiotics, drugs, medicines etc), mechanisms of action. Drug resistance: Multi Drug Resistance, assessment and management of drug resistance. [8]

## **Unit 5:**

Application of microbiology: Microbial decomposition of organic matter cellulose, hemicelluloses, and lignin. Degradation of pesticides: Xenobiotics, Plastics, biodegradable plastics, and biopesticides. Microbiology of water, algal bloom, waste water treatment, biogas generation. Host-microbe interaction: rhizosphere, phyllosphere, mycorrhiza, PGPR, sidrophores in relation to rhizobacteria [8]

### **Text/Reference Books:**

1. Pelczar et al , *Microbiology* , Tata Mac Graw Hill , New Delhi
2. Presscott, Harley, Klein, *Microbiology-*, WCB Mc Graw Hill, New York.
3. Madigan, Martinko, Parker , *Brock's Biology of Microorganisms* , Prentice Hall, New Delhi.
4. J Black , *Microbiology: Principles and Explorations* , John Wiley & Sons, New York.
5. Cappuccino Sherman , *Microbiology- A Laboratory manual*, Benjamin Cummings.
6. R Y Stanier et al , *General Microbiology*, Mc Millan Press Ltd., New Delhi



## MBT-103: MOLECULAR CELL BIOLOGY

L T P  
3 1 0

Credit: 4

### Unit 1:

Origin of biomolecules, the ancient reducing environment of earth, origin of oxygen, origin of prokaryotes and eukaryotes, origin of mitochondria and chloroplast, Miller-Urey experiment, cell theory.

### Unit 2:

The structural and Functional relation of cellular organelles: Plasma membrane, cell wall, cytoskeleton their structural organization and extra cellular matrix. Mitochondria, chloroplast, endoplasmic reticulum, golgi bodies, ribosome, lysosomes, oil and carbohydrate containing bodies, nucleus, and other organelles and their organization. [8]

### Unit 3:

Biological membranes- Physicochemical properties of cell membranes and their structural constitution. Transport of nutrients across the membranes –simple, passive, facilitated diffusion, Protein targeting and sorting- Post transitional import of proteins to mitochondria lysosomes, nucleus, secretary vesicles, chloroplast and peroxisomes.[8]

### Unit 4:

Cellular responses (various types of chemicals) in bacteria, plants and animals, Mechanism of signal transduction. Cell cycle (mitosis and meiosis) molecular events and, cell cycle control, mechanism of aging with reference of mitochondrial gene action and their involvement. [8]

### Unit 5:

Cellular basis of differentiation and development – cell division, gametogenesis and fertilization, differential developmental pattern in vertebrates, differential gene activity and cell differentiation, cleavage, morulla, blastula, gastrulation and neurulation etc. morphogenetic determinants in egg cytoplasm, genetic regulation of early, embryonic development in Drosophilla, homeotic genes. [8]

#### Text/Reference Books:

1. H Lodish, D Baltimore, A Berk, SL Zipursky, P Matsudaira, J Darnell, *Molecular Cell Biology*, W.H.Freeman, USA.
2. Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, *Essential Cell Biology*, Garland, USA.
3. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, *Molecular Biology of the Cell*, Garland, USA.
4. Lubert Stryer, Jeremy Berg, John Tymoczko, *Biochemistry*, W.H.Freeman, USA.
5. David L. Nelson, Michael M. Cox, *Lehninger: Principles of Biochemistry*, W.H.Freeman, USA.

## MBT-104: BIOPHYSICAL TOOLS AND TECHNIQUES

L T P  
3 1 0

Credit: 4

### Unit 1:

**Microscopic techniques for observing cell structure:** Principles and applications of light, phase, contrast, fluorescence, scanning and transmission electron microscopy, electron cryomicroscopy, scanning tunneling microscopy, cytophotometry and flow cytometry. [8]

### Unit 2:

**Chromatographic Techniques:** TLC and Paper chromatography; Chromatographic methods for macromolecule separation - Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC; Criteria of protein purity.

**Electrophoretic techniques:** Theory and application of Polyacrylamide gel electrophoresis and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis, SDS PAGE. [8]

### Unit 3:

**Centrifugation:** Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Types of centrifuge - Microcentrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation; Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods. [8]

### Unit 4:

#### **Spectroscopic Techniques:**

NMR: basic principles; chemical shift; Use of NMR in studying protein structure and X-ray diffraction. Measurement of stable isotopes: Falling drop method and Mass spectrometry. UV, Visible and Raman Spectroscopy; Theory and application of Circular Dichroism, Fluorescence, ESR and Plasma Emission spectroscopy, MALDI-TOF, Mass spectrometry.

Radioisotope techniques: Application of radioisotopes in biology; autoradiography and radiation dosimetry. Nanotechnology- Nanoparticles; their application in medicine and biology. [8]

### Unit 5:

**Radioactivity:** Radioactive & stable isotopes, Pattern and rate of radioactive decay, Units of radioactivity. Measurement of radioactivity: Geiger-Muller counter, Solid & Liquid scintillation counters (Basic principle, instrumentation & technique), Brief idea of radiation dosimetry, Cerenkov radiation, autoradiography. Applications of isotopes in biochemistry, Principles of tracer techniques, Its advantages and limitations, Clinical application. Radioimmunoassay. [8]

#### **Text/Reference Books:**

1. Biophysical Chemistry vol. I, II & III (1997) Cantor and Schimmel **Pub:** W.H. Freeman & Com.
2. Molecular Biology of the gene (5th Edition), – J.D. Wastson, T.A. Baker, S.P. Bell,
3. Gann, M. Levine, R. Losick, **Pub:** Pearson Education (Singapore) Pvt. Ltd. Delhi
4. Biochemistry (3rd Edition) – G. Zubay., **Pub:** Wm. C. Brown Pub
5. Biochemistry (2nd Edition) – D. Voet and J.G. Voet **Pub:** John Willy & Sons.
6. Physical Biochemistry (2nd Edition) D. Friefelder **Pub:** W.H. Freeman & Com.
7. Biochemistry (5th Edition) – Lubert Stryer. **Pub:** W.H. Freeman & Com., NY.
8. Principles of Biochemistry (4th Edition)–Lehninger, Nelson & Cox. **Pub:** Macmillan Pub.

## **MBT-151: CELL & MICROBIOLOGY LAB**

**L T P**  
**0 0 2**

**Credit: 1**

### **Cell Biology Lab**

1. Mitotic metaphase chromosome preparation from bone marrow of mouse/rat.
2. Cell motility and flagellar staining.
3. Microscopic studies of cell organelles.
4. Isolation of neutrophils and demonstration of phagocytosis.
5. Determination of osmotic fragility of RBC membrane.
6. Vital Staining of Mitochondria with Janus green B.
7. Demonstration of diversity of cell types (Muscle, Neuron)
8. Study of mitosis (smear and squash method, root tip of onion).
9. Study of meiosis (pollen grain), Maize, Rat testis.
10. Determination of activity of sodium/potassium ATPase of plasma membrane.

### **Microbiology Lab**

1. Instruments/equipments commonly used in Microbiology.
2. Washing and Sterilization of Lab wares.
3. Media preparation for growing (i) Bacteria (ii) Moulds (iii) Yeast.
4. Culturing of Microorganisms – (i) Slant preparation (ii) Suspension culture (iii) Streaking (iv) Plating.
5. Simple and Gram staining
6. Isolation of soil organisms, plate streaking method.
7. Counting of microorganisms using Haemocytometer in given sample (serial dilution)
8. Size measurement of microorganisms using stage and ocular micrometer.
9. Growth measurement by optical density/plating method.

## MBT-152: BIOPHYSICAL TOOLS AND TECHNIQUES LAB

L T P  
0 0 2

Credit: 1

### pH meter :

1- List uses of pH meter, measurement, detailed diagram of pH electrode and reference electrode (combined electrode also), find pH of a solution giving detailed account of pH meter operation, trouble shooting.

2- Preparation of solution using pH meter.

3- Demonstration of the effect of the solution

### Spectroscopy :

To determine maximum absorption spectra of mixtures (potassium dichromate and potassium permanganate) solution.

### Centrifugation :

1. Measure components and working of centrifuges, solving g and RPM of centrifuge with respect to various heads. rotors

2. Isolation of cellular organelles by differential centrifugation

### Chromatography :

1- Solvent-solvent extraction of plant pigments,

2- Use of paper chromatography for separation of plant pigments

3- Use of thin-layer chromatography for amino acid (TLC)

4- Demonstration of Ion-exchange chromatography

5- Demonstration of Gel-exclusion chromatography

### Electrophoresis:

1- Electrophoresis of protein by SDS-PAGE

2- Electrophoresis of DNA by agarose gel

### Convener

Signature: .....

Name : Dr. Ajay Kumar

Date :

### Internal Members

Signature: 1..... 2.....

Name: Mr. Ajit Pratap Singh Yadav Mr. Vachaspati Rao

Date:

### External Members

Signature: 1..... 2.....

Name: Prof. (Dr.). Dr.

Date:

First year- 2<sup>nd</sup> Semester

**MBT-201: MOLECULAR BIOLOGY**

**L T P**  
**3 1 0**

**Credit: 4**

**Unit 1:**

DNA as a genetic material: Griffiths and Hershey-Chase experiment, central dogma of Molecular biology, Genomic organization of prokaryotes & eukaryotes, Polytene and Lampbrush chromosomes. Chromatin –histone and non-histone proteins, chromatin remodeling. Transposons. [8]

**Unit 2:**

DNA replication, modes of replication, replisomes, DNA polymerases the DNA replicating enzymes, mechanism and regulation of DNA replication in prokaryotes and eukaryotes. DNA repair. [8]

**Unit 3:**

Transcription, transcription unit, substrate for transcription, transcription apparatus, RNA polymerases, prokaryotic transcription, eukaryotic transcription, transcription factors, promoters and enhancers, various RNA species and their properties, processing of pre-mRNA to mature mRNA, RNA splicing, lariat Formation. [8]

**Unit 4:**

Translation: Prokaryotic & Eukaryotic and translation, the translational machinery, mechanisms of initiation elongation and termination, translation factors, regulation of translation .Protein localization and targeting.[8]

**Unit 5:**

The genetic code, properties of genetic code, wobble hypothesis, mechanism and regulation of translation in Prokaryotes and Eukaryotes, molecular chaperones, DNA-binding motifs, operon, negative and positive control, *lac* operon, *trp* operon, attenuation. [8]

**Text/Reference Books:**

1. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, *Molecular Biology of Genes*, The Benjamin/ Cummings Publishing Company, New York.
2. T. A. Brown, *Genomes*, Wiley Publishers (Asia Pvt Ltd).
3. Lubert Stryer, Jeremy Berg, John Tymoczko *Biochemistry*, W.H.Freeman, USA.
4. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, *Molecular Biology of the Cell*, Garland, USA.
5. David L. Nelson, Michael M. Cox, *Lehninger: Principles of Biochemistry*, W.H.Freeman, USA.
6. Hartl and Jones, *Genetics*, Jones and Bartlett publishers, USA.
7. H.K.Das, *Textbook of Biotechnology*, Wiley Dreamtech India Pvt. Ltd.
- 8.

# MBT-202 ENZYMOLOGY

**L T P**  
**3 1 0**

**Credit: 4**

## **Unit 1:**

Classification and nomenclature of enzymes. Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate- lock and key model, induced fit model. Features of active site, activation energy, Enzyme denaturation and renaturation, enzyme specificity and types. [8]

## **Unit 2:**

Kinetics of single substrate reactions; Derivation of Michaelis -Menten equation, turnover number; determination of  $K_m$  and  $V_{max}$  (LB plot, ED plot), Importance of  $K_m$  &  $V_{max}$ ; Multi-Substrate reaction mechanisms. Enzyme inhibition: irreversible; reversible (competitive, uncompetitive and non competitive inhibition); Substrate and Product inhibition, Ribozymes, Abzymes, allosteric enzyme, regulation of allosteric enzymes, concerted & sequential model; Deactivation Kinetics. Factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators. [8]

## **Unit 3:**

Extraction of crude enzyme from plant, animal and microbial source; some case study. Purification of enzymes by the help of different methods(chromatographic techniques). Methods of characterization of enzymes; criteria of purity. Unit of enzyme activity - definition and importance. Development of enzyme assays. [8]

## **Unit 4:**

Enzyme Immobilization: Adsorption, Matrix entrapment, Encapsulation, Cross linking, Covalent binding and their examples; Advantages and disadvantages of different immobilization techniques. Structure & stability of immobilized enzymes, kinetic properties of immobilized enzymes- partition effect, diffusion effect. Overview of applications of immobilized enzyme systems. [8]

## **Unit 5:**

Enzyme Biosensors: elements of biosensors, three generations of biosensors, Types of biosensors: calorimetric, potentiometric, amperometric, optical and piezoelectric. Design of enzyme electrodes and their applications as biosensors in industry, health care and environment. Design of Immobilized Enzyme Reactors- Stirred tank reactors(STR), Continuous Flow Stirred Tank Reactors (CSTR), Packed- bed reactors (PBR), Fluidized-bed Reactors (FBR); Membrane reactors. [8]

## **Text/Reference Books:**

1. Fundamentals of enzymology by Nicolas C. price and Lewis stevens . Oxford University Press
2. Enzymes by Trevor palmer, East west Press
3. Enzyme Technology by Messing
4. Enzymes: Dixon and Webb. (IRL Press)
5. Enzyme technology by Chaplin and Bucke. Cambridge Univerity Press
6. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw

## MBT-203: INTERMEDIARY METABOLISM

**L T P**  
**3 1 0**

**Credit: 4**

### **Unit 1:**

Energy, energy flow cycle, energy conversion; Structure and properties of ATP; High energy compounds, Thermodynamic considerations, Role of water as solvent,  $P^H$ ,  $P^{Ka}$ , Henderson Hasselbalch equation [8]

### **Unit 2:**

Metabolism of carbohydrates & its regulation- Gluconeogenesis, Glycolysis, TCA cycle, Regulatory mechanism of glycolysis, TCA, and ETS system. [8]

### **Unit 3:**

Metabolism of fatty acids- synthesis, beta -oxidation of saturated, unsaturated. Metabolism of cholesterol and lipid disorders [8]

### **Unit 4:**

Biosynthesis of amino acids Oxidation of amino acids and urea cycle, Nucleotide biosynthesis (De-novo and Salvage pathway, purines and pyrimidines), metabolic disorders of amino acids. [8]

### **Unit 5:**

Photosynthesis-light and dark reaction, cyclic and non cyclic photosynthesis,(C3 cycle, C4 cycle, and CAM pathway). [8]

### **Text/Reference Books:**

1. Harper's Illustrated Biochemistry, (26th Edition) – R.K. Murray, D.K. Garner, P.A. Mayers & V.W. Rockwell,
2. **Pub:** McGraw Hill International Edition.
3. Principles of Biochemistry (4th Edition) – Lehninger, Nelson & Cox. **Pub:** Macmillan
4. Biochemistry (3rd Edition) – G. Zubay., **Pub:** Wm. C. Brown Pub.
5. General Biochemistry (5th Edition, 1996) – Weil, **Pub:** New Age Intl. Ltd.
6. Biochemistry (5th Edition) – Lubert Stryer. **Pub:** W.H. Freeman & Com., NY.
7. Biochemistry – D. Voet and J.G. Voet **Pub:** John Willy & Sons
8. Biochemistry (4th Edition, 1974) – West & Todd **Pub:** Oxford IBH,
9. Biochemistry (9th Edition) – Debjyoti Das.–**Pub:** Academic Publishers Kollkata
10. Practical Biochemistry (3rd Edition) – David Plummer. **Pub:** Tata McGraw Hill
11. Practical Biochemistry (5th Edition) – K. Wilson and J. Walker. **Pub:** Cambridge Univ. Press, (U.K.)

# **MBT-204 BIOSTATISTICS & BIOINFORMATICS**

**L T P**  
**3 1 0**

**Credit: 4**

## **BIOSTATISTICS**

### **Unit 1:**

Scope of biostatistics, Variables in biology, Collection, classification, tabulations and diagrammatic presentation of statistical data, Concepts of statistical population and sample, Measures of central tendencies and Dispersion, Simple measure of Skewness and kurtosis. [8]

### **Unit 2:**

Probability – Definition, simple theorems of probability and simple application of probability. [8]

### **Unit 3:**

Correlation, correlation coefficient, standard error of estimate and regression, linear regressions, least square method of fitting, Basic idea of significance, testing level of significance, random variations, Chi-square test, ANOVA. [8]

## **BIOINFORMATICS**

### **Unit 4:**

Introduction, classification and generation of computers, components of a computer system, input and output devices. Biological Data Base: Primary, Secondary and Composite database ,Nucleotide sequence databases, Protein sequence databases. [8]

### **Unit 5:**

Structural sequence databases, Sequence analysis; Sequence alignment: Types and methods, Primer designing, Role of Bioinformatics in drug discovery and development. [8]

### **Text/Reference Books:**

1. Biostatistics – Garret
2. Encyclopedia of Biostatistics – Peter Armitage & Theodore Colton
3. Statistics – Schaum's Series Publication.
4. Statistical analysis – A computer oriented approach IIInd Ed. Academic Press New York
5. Fundamentals of statistics – D.N. Elhance
6. Statistical methods for research workers – Central publisher Ludhiana.
7. Bioinformatics: A practical guide to the analysis of genes & Proteins – Ed. Andreas,
8. Computer – Schaum Series Publication.
9. David W Mount : Bioinformatics : Sequence and Genome analysis , CSHL Press, New York
10. Lesk, Arthur M: Introduction to Bioinformatics: Oxford University press, Oxford



# **MBT-251: BIOCHEMISTRY & MOLECULAR BIOLOGY LAB**

**L T P**  
**0 0 2**

**Credit: 1**

## **Biochemistry Lab**

1. Preparation of buffers.
2. Standardization of pH meter, preparation of emulsions.
3. Spectroscopy: determination of absorption maxima of a given solution.
4. Quantitative estimation of carbohydrates
5. Distinguish reducing and non-reducing sugars
6. Quantitative and qualitative estimation of proteins
7. Separation of sugars, fatty acids and amino acids by paper chromatography
8. Extraction of lipids from plant material
9. Thin layer chromatography
10. Gel electrophoresis

## **Molecular Biology Lab**

1. Estimation of DNA content in the given sample by diphenylamine method.
2. (Nitrogen cylinders, -200C fridge, grinders, cooling centrifuges, etc.)
3. Estimation of RNA content by the Orcinol method.
4. Determination of T<sub>m</sub> of DNA and RNA.
5. Isolation of Plasmid DNA.
6. Isolation of bacterial/fungal genomic DNA.
7. Isolation of plant DNA.

## MBT-252: BIOSTATISTICS AND BIOINFORMATICS LAB

L T P  
0 0 2

Credit: 1

### (Sec. A) Biostatistics Lab

1. Measure of central tendencies and dispersion
2. Measure of skewness and kurtosis
3. Probability
4. Binomial and poisson distribution.
5. Correlation and regression

### (Sec. B) Bioinformatics Lab

1. Construction of database for specific class of proteins/enzymes, genes/ ORF/ EST/Promoter sequences.
2. DNA motifs or protein motifs using oracle.
3. Access and use of different online protein and gene alignment softwares.
4. Gene finding related search for a given nucleotide sequence in order to predict the gene.
5. ORF prediction for different proteins out of some given nucleotide sequences.
6. Exon identification using available softwares for a given nucleotide sequences
7. Secondary structure prediction for amino acid sequences of a given protein.

#### Convener

Signature: .....

Name : Dr. Ajay Kumar

Date :

#### Internal Members

Signature: 1..... 2.....

Name: Mr. Ajit Pratap Singh Yadav Mr. Vachaspati Rao

Date:

#### External Members

Signature: 1..... 2.....

Name: Prof. (Dr.). Dr.

Date:

**Second year- 3<sup>rd</sup> Semester**  
**MBT-301: IMMUNOLOGY**

**L T P**  
**3 1 0**

**Credit: 4**

**Unit 1:**

History & phylogeny of Immune system. Types of immunity. Cells & organs of the immune system. Structure and function of immunoglobulins. Nature of antigens, antigenicity and immunogenicity. Lymphocyte traffic. [8]

**Unit 2:**

BCR & TCR and generation of immunological diversity. Activation of B and T cell lymphocytes. Antigen antibody interactions, cross reactivity, precipitation reactions – their principles and applications serological techniques – ELISA, RIA and western blotting [8]

**Unit 3:**

Immunological tolerance. Induction of tolerance; T- cell energy; immunologically privileged sites. MHC structure and function; MHC –polymorphism; disease susceptibility, MHC restriction. Antigen processing and presentation: generation of MHC class-I and class-II peptides and their association with antigenic peptides. Generation of immunological response and its genetic control. Transplantation immunology: Immunological basis of graft rejection; immunosuppressive therapy. Complement system: Consequences of complement activation and regulation. [8]

**Unit 4:**

Hypersensitivity reactions: Types of hypersensitive reactions: immunoprophylactic interventions. Autoimmunity– systemic and localized autoimmunity and probable mechanisms to develop autoimmunity. Immunodeficiency; primary, secondary immunodeficiency; SCID and AIDS. Tumor immunology –tumor antigens, immunological factors influencing the incidence of cancer, effector mechanisms in cancer immunity. [8]

**Unit 5:**

Vaccines: Historical perspective; bacterial, viral vaccines and vaccines against cancer and birth control vaccines. Antibody engineering: monoclonal and polyclonal sera their role in clinical diagnosis; production of monoclonal antibodies; immunotoxins and their therapeutic uses; humanized and chimeric antibody., [8]

**Text/Reference Books:**

1. Richard A Goldsby, Thomas J Kindt, Barbara S Osborne : Kuby's Immunology. 5th Edition , W.H.Freeman & Coy , New York
2. Abbas , Basic Immunology: Functions& disorders of the immune system , WB Sanders Co. Philadelphia.
3. William Paul : Fundamental Immunology , Lippincot Raven, Philadelphia
4. Roitt : Essential Immunology :9th Edition, Blackwell Science ltd. London.
5. DP Stites, AL Terr, TG Parslow : Medical Immunology, 10th Edition, Appleton and Lange , New York
6. David Male, Jonathan Brostoff, David Roth & Ivan Roitt: Immunology: 7th Edition: Mosbey Title: Philadelphia

## MBT-302 PLANT BIOTECHNOLOGY

L T P  
3 1 0

Credit: 4

### Unit 1:

Conventional plant breeding (introductory), Introduction to cell and Tissue culture. Tissue culture as a technique to produce novel plants and hybrids. Tissue culture media (composition and preparation) Callus and suspension cultures: initiation and maintenance of callus and suspension cultures; single cell clones. Organogenesis. Embryogenesis; transfer and establishment of whole plants in soil. [8]

### Unit 2:

Shoot tip culture: rapid clonal propagation and production of virus free plants. Embryo culture and embryo rescue. Hybrid plants: protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrid. Production of haploid plants: anther, pollen and ovary cultures for production of haploid plants and homozygous lines. Germplasm conservation: cryopreservation, slow growth cultures and DNA banking for germplasm conservation. [8]

### Unit 3:

Applications of plant transformation for productivity and performance Herbicide resistance, phosphinothricine glyphosate, sulfonyl urea, atrazin, insect resistance, Bt genes, non- Bt-like protease inhibitor, virus resistance, coat protein mediated nucleocapsid gene, disease resistance, chitinase, 1-3 beta glucanase, RIP, antifungal proteins, thionins, PR proteins, nematode resistance, abiotic stress, post harvest losses, long shelf life of fruits and flowers, use of ACC synthase, polygalacturanase, ACC oxidase, male sterile lines, bar and barnase systems, carbohydrate composition and storage, ADP glucose pyrophosphatase. [8]

### Unit 4:

Basic Techniques of Plant transformation technology: basis tumor formation, hairy root, features of Ti and Ri plasmids, mechanisms of DNA transfer role of virulence genes, use of Ti and Ri as Vectors, binary vectors, genetic markers, Reporter genes, reporter gene, methods of transformation, viral vectors and their applications, multiple gene transfers, Vector less or direct DNA transfer, particle bombardment, electroporation, microinjection, transformation of monocots. Transgene stability and Gene silencing. [8]

### Unit 5:

Plant metabolic engineering and industrial products: plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, alkaloids, industrial enzymes, biodegradable plastics, polyhydroxybutyrate, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines, purification strategies, oleosin partitioning technology. Molecular marker aided breeding: RFLP maps, linkage analysis, RAPD markers, STS, microsatellite, SCAR (sequence characterized amplified regions), SSCP (single strand conformational polymorphism). [8]

### Text/Reference Books:

1. Adrian Slater, Mark Fowler, Nigel Scott, Plant Biotechnology: The genetic Manipulation of Plants , , Oxford University Press, USA.
2. B.D.singh Biotechnology: expanding horizons, Kalyani Publishers, New Delhi.
3. S. B. Primrose, Richard M. Twyman, R. W. Old, Principles of Gene Manipulation and Genomics, Blackwell Science (Asia Pvt Ltd).

# MBT-303 ANIMAL CELL SCIENCE AND TECHNOLOGY

**L T P**  
**3 1 0**

**Credit: 4**

## **Unit 1:**

Introduction to cell culture, Basic techniques of mammalian cell culture: Primary and established cell line cultures, disaggregation of tissue and primary culture .Measurement of viability and cytotoxicity. Measurement of growth; culture medium and role of serum.

Biology and characterization of the cultured cells and maintenance of cell culture. Cell separation, Scaling –up of animal cell culture. [8]

## **Unit 2:**

Cell cloning, micromanipulation, synchronization and transformation .Stem cell cultures, embryonic stem cells and their applications. Organ culture-Totipotency, Nuclear transfer experiments. Molecular events during fertilization and early development. Role of maternal gene contribution in early embryonic development. [8]

## **Unit 3:**

Biology of Cancer: Oncogenes. Chemical carcinogenesis. Tumor suppressor genes from humans, structure, function and mechanism of action of pRB and p53 tumor suppressor proteins. Apoptosis-morphologic and biochemical features of apoptosis, role of apoptosis in regulating lymphocyte development. [8]

## **Unit 4:**

Gene therapy and transgenic animals: Vector engineering, somatic and germ line manipulations, strategies of gene delivery, targeted gene replacement /augmentation, gene correction, gene editing and gene silencing. Genetic disorders; Construction of transgenic animals /gene knockouts. Ethical and biosafety considerations. [8]

## **Unit 5:**

Molecular markers linked to human disorders/ diseases infections and disease resistance genes. Application of RFLP in forensic, disease prognosis, genetic counseling, pedigree varietal etc. Animal trafficking and poaching. [8]

## **Text/Reference Books:**

1. Freshney, R.I : Culture of Animal cells , Wiley Publications , New York
2. Edi. Jhon R.W. Masters : Animal cell culture- practical approach , Oxford University press, Oxford
3. Ed. R.Basega : Cell growth and division : A practical approach , IRL press,Oxford University press, Oxford
4. Ed. Martin Clynes : Animal cell culture techniques , Springer- Verlag, New York,
5. F.Grasveld, George V. Kallias: Transgenic Animals, Academic press, Sandiego, USA
6. Asok Mukhopadhyay: Animal cell technology, IK International publishing House, New Delhi.

# **MBT-304: BIOPROCESS ENGINEERING & FERMENTATION TECHNOLOGY**

**L T P**  
**3 1 0**

**Credit: 4**

## **Unit 1:**

History and development of fermentation industry, Air and media sterilization (physical, chemical, and radiation sterilization) Media for industrial fermentation(carbon, nitrogen, hydrogen, oxygen, sulphur, and other nutrients like precursors, buffers, inhibitors, inducers, surfactant etc.) Isolation, preservation and maintenance of microorganisms, Kinetics of microbial growth and death. [8]

## **Unit 2:**

Types of fermentation process: batch, fed –batch and continuous bioreactors stability of microbial reactors, analysis of mixed microbial populations, Bioreactors (pulse, fluidized, photo bioreactors etc.). Measurement and control of bioprocess parameters. [8]

## **Unit 3:**

Downstream processing: Introduction, removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid –liquid extraction, chromatography, membrane process, drying and crystallization. [8]

## **Unit 4:**

Whole cell immobilization and its industrial application. Industrial production of chemicals: alcohol (ethanol), acids (citric, acetic and gluconic), solvents (glycerol, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline), amino acids (lysine glutamic acid), single cell protein. [8]

## **Unit 5:**

Introduction to food technology: Elementary idea of canning and packing. Sterilization and pasteurization of food products. Technology of typical food /food products (bread, butter, cheese, idli, curd, tea, coffee, jam, jelly, pickle, sauerkraut, and other processed food stuffs ), Food preservation. [8]

## **Text/Reference Books:**

1. Stanbury, P.F & Whittacker , *Principles of Fermentation technology* , Pergamon.
2. Press Oxford
3. Michael L Shuler & Fikret Kargi , *Bioprocess Engg.: Basic concepts* , Prentice Hall, New Delhi.
4. M.Yoong (Ed-in-Chief) , *Comprehensive Biotechnology Vol 3* , Pergamon, Oxford
5. B.D.Singh , *Biotechnology- Expanding Horizons* , Kalyani Publishers ,NewDelhi
6. H.K.Das , *Text book of Biotechnology* , Wiley Publications , New Delhi

## MBT-351: PLANT TISSUE CULTURE LAB

**L T P**  
**0 0 2**

**Credit: 1**

1. Preparation of plant tissue culture media.
2. Surface sterilization.
3. Transfer of plants to soil.
4. Cell types of plants – TS / LS of various tissue explants and identification of Xylem, trachea,
5. stomata, root hair etc.
6. Micropropagation of banana, citrus Papaya, Sugarcane etc.
7. Synthetic seed preparation.
8. Anther and ovule culture.

## MBT-352: IMMUNOLOGY LAB

**L T P**  
**0 0 2**

**Credit: 1**

1. To determine the blood group of given blood
2. To determine the Rh factor of given blood
3. To perform single radial immunodiffusion
4. To perform double immunodiffusion
5. To perform rocket immune electrophoresis
6. To perform ELISA
7. To prepare the blood smear and stain with Leishman stain
8. To identify the blood cells/ immune cell with the help of Leishman stain
9. To perform differential count (DLC) of given sample

### Convener

Signature: .....  
Name : Dr. Ajay Kumar  
Date :

### Internal Members

Signature: 1..... 2.....  
Name: Mr. Ajit Pratap Singh Yadav Mr. Vachaspati Rao  
Date:

### External Members

Signature: 1..... 2.....  
Name: Prof. (Dr.). Dr.  
Date:

**Second year- 4<sup>th</sup> Semester**  
**MBT-401: GENETIC ENGINEERING**

**L T P**  
**3 1 0**

**Credit: 4**

**Unit 1:**

Introduction and need of genetic engineering, Type of Restriction enzymes, Restriction modification, enzymes used in recombinant DNA technology endonucleases, ligases and other enzymes useful in gene cloning, PCR technology for gene/DNA detection, cDNA, Use of *Agrobacterium* for genetic engineering in plants; Gene libraries; Use of marker genes. Cloning of foreign genes: DNA delivery methods -physical methods and biological methods, Genetic transformation of prokaryotes: Transferring DNA into E. coli –Chemical induction and Electroporation. [8]

**Unit 2**

Gene cloning -concept and basic steps; application of bacteria and viruses in genetic engineering; Molecular biology of E. coli and bacteriophages in the context of their use in genetic engineering, Cloning vectors: Plasmid cloning vector PBR322, Vectors for cloning large piece of DNA– Bacteriophage- $\lambda$  and other phage vectors; Cosmids, Phagemids; YAC and BAC vectors, Model vectors for eukaryotes – Viruses. [8]

**Unit 3**

Gene library: Construction cDNA library and genomic library, Screening of gene libraries screening by DNA hybridization, immunological assay and protein activity, Marker genes: Selectable markers and Scorable markers, non antibiotic markers. [8]

**Unit 4**

Gene expression in prokaryotes: Tissue specific promoter, wound inducible promoters, Strong and regulatable promoters; increasing protein production; Fusion proteins; Translation expression vectors. [8]

**Unit 5**

Origins of organismal cloning in developmental biology research on frogs; nuclear transfer procedures and the cloning of sheep (Dolly) & other mammals; applications in conservation; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning; Two vector expression system; two-gene expression vector, Directed mutagenesis; transposon mutagenesis, Gene targeting, Site specific recombination. [8]

**Text/Reference Books:**

1. J Sambrook & EF Fritsch, Molecular Cloning: A laboratory manual, Cold Spring Harbor Laboratory press, U.S.A.
2. S.B Primerose, R M Twyman, Principles of Gene Manipulation and Genomics, Blackwell Science (Asia Pvt Ltd).
3. Richard J.Reece, Analysis of gene and genome, John Wiley and sons (Asia Pvt Ltd).
4. H.K.Das,Textbook of Biotechnology, Wiley Dreamtech India Pvt. Ltd.
5. T.A.Brown, Principles of Gene Manipulation and Genomics, Wiley Blackwell Publishers (Asia Pvt Ltd)
6. Bernard R. R. Glick, Jack J. Pasternak, Jack J. Pasternak, Jack J. Pasternak, Molecular Biotechnology: Principles and Applications of recombinant DNA, ASM Press, U.S.A.



## **MBT-402: ENVIRONMENTAL BIOTECHNOLOGY**

**L T P**  
**3 1 0**

**Credit: 4**

### **Unit-1**

Introduction of biotechnology in environment: basic concept and issues. Environmental pollution: types of pollution, methods for the measurement of pollution; methodology of environmental management the problem solving approach, its limitations. [8]

### **Unit-2**

Air pollution and its control through biotechnology .Water pollution and its control: water as a scarce natural resources, need for water management, measurement of water pollution, sources of water pollution, waste water treatment –physical, chemical and biological treatment processes. [8]

### **Unit-3**

Microbiology of waste water treatments, aerobic process: activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic processes: anaerobic digestion, anaerobic filters, upflow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic Industries. Solid wastes: sources and management (Composting, vermiculture and methane production). [8]

### **Unit-4**

Microbiology of degradation of xenobiotics in environment –ecological considerations, decay behaviour & xenobiotics degradative plasmids; hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biopesticides in integrated pest management. Bioremediation of contaminated soils and wasteland. [8]

### **Unit-5**

Global environmental problems: environmental issues related to BT cotton, BT brinjal, and GM foods and crops in Indian scenario, ozone depletion, UV-B, green house effect and acid rain, their impact and biotechnological approaches for management. [8]

### **Text/Reference Books:**

1. Metcall and Eddy, *Waste Water Engineering-Treatment, Disposal and Reuse*, McGraw Hill, New York.
2. I S Thakur, *Environmental Biotechnology*, I.K. International Pvt. Ltd, New Delhi.

## **MBT-451: PROJECT WORK AND PRESENTATION**

A student has to make a latest technology based project in their respective stream. It may be hardware or software based.

### **Convener**

Signature: .....

Name : Dr. Ajay Kumar

Date :

### **Internal Members**

Signature: 1.....

Name: Mr. Ajit Pratap Singh Yadav

Date:

2.....

Mr. Vachaspati Rao

### **External Members**

Signature: 1.....

Name: Prof. (Dr.).

Date:

2.....

Dr.