



# LOYOLA ACADEMY

ALWAL, SECUNDERABAD 500 010 TS

(Autonomous and affiliated to Osmania University)

Re-accredited with 'A' Grade (3.2/4.0 CGPA) by NAAC (III Cycle)

A "College with Potential for Excellence" by UGC

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## DEPARTMENT OF M.Sc. BIOTECHNOLOGY

### BOARD OF STUDIES MEETING

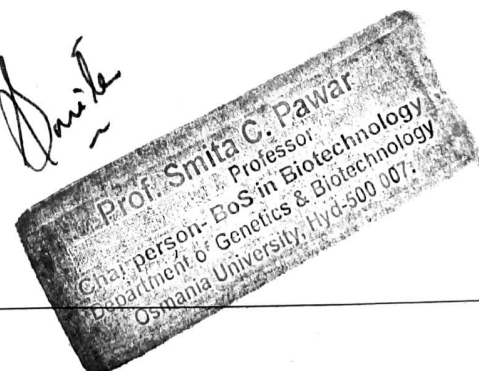
TUESDAY, 8 February 2022

10:00AM

ONLINE MODE (Google Meet)

### AGENDA

1. Welcome address by Principal
2. Background information:  
In last BOS Approved the Revised syllabus for Semester I & Semester II for I Year of batch(2021-23) Academic year (2021-22) under CBCS scheme.
3. To introduce & Approve the Revised syllabus for **Semester III & Semester IV** for II Year of **batch (2021-23) Academic year (2022-23)** under CBCS scheme.
4. To Approve the Consolidated Scheme Semester I, II, III & IV For Batch 2022-24 as per CBCS scheme.
5. To Approve the Syllabus for Semester I & II for Batch 2022-23 for Academic year 2022-23
4. Discussion on reforms for internal examinations.
5. Discussion on change of project credits from 6 to 8.
6. Proposal of Department Budget.
7. Any other matter for Discussion.
8. Vote of Thanks.



## BOARD OF STUDIES MEETING

A meeting of Board of Studies for the Department of M.Sc. Biotechnology was held on Tuesday, February, 2022 at 11 AM. Online mode Google meet in the college Board Room.

### The following members were present:

- Rev. Fr. Emmaneul Correspondent SJ, LA
- ✓ Rev. Fr. Dr. L. Joji Reddy SJ, Principal LA  
Associate professor, Dept. of M.Sc. Biotechnology, LA
- ✓ Fr. K Anand Kumar SJ, Assistant Controller of Examinations, LA
- ✓ ~~Dr. Smitha C. Pawar, Assistant~~ professor, Chairperson BOS,  
Dept. of Biotechnology, Osmania University Nominee
- ✓ Mrs. K. Rama, Dean of Academics, LA
- ✓ Mr. V. V. S. Chalapathi Rao, (HOD), LA
- ✓ Dr. Ch. Sirisha, Associate professor, M.Sc Biotechnology, LA
- ✓ Mrs.. D. Guru Devi, Lecturer in M.Sc Biotechnology, LA
- ✓ Ms.S.Dhavala Joseph, Lecturer in M.Sc Biotechnology, LA

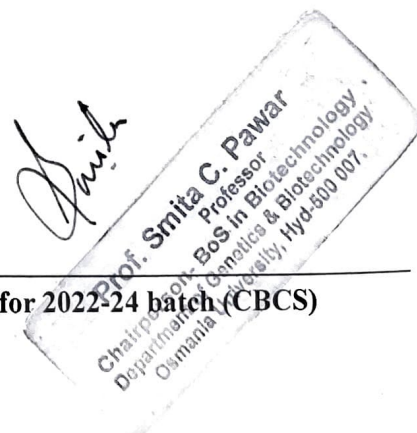
  
Prof. Smita C. Pawar  
Professor  
Chairperson- BoS in Biotechnology  
Department of Genetics & Biotechnology  
Osmania University, Hyd-500 007.





**YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS**  
**DEPARTMENT OF BIOTECHNOLOGY**  
**M. Sc - FIRST YEAR – FIRST SEMESTER**  
**ACADEMIC YEAR 2022-23 OF 2022-24 BATCH (CBCS)**

Sl. No	Part	Subject Code	Title of the subject	Hours / week	Duration of Exam (Hrs.)	Marks			Credits
						Internal	External	Total	
1	*I	*MBT 22101	*Communicative Competence (AECC-1)	3	2	*20	*30	*50	*2
2	I	MBT 22102	Environmental Awareness Activity (SEC-1)	2	1	20	30	50	2
3	II	MBT 22103	Genetics (Core-1)	4	3	40	60	100	4
4	II	MBT 22104	Cell Biology (Core-2)	4	3	40	60	100	4
5	II	MBT 22105	Biochemistry (Core-3)	4	3	40	60	100	4
6	II	MBT 22106	Microbiology (Core-4)	4	3	40	60	100	4
<b>PRACTICALS</b>									
7	II	MBT 22107	Genetics (Core-1)	3	2	20	30	50	2
8	II	MBT 22108	Cell Biology (Core-2)	3	2	20	30	50	2
9	II	MBT 22109	Biochemistry (Core -3)	3	2	20	30	50	2
10	II	MBT 22110	Microbiology (Core -4)	3	2	20	30	50	2
			<b>Total</b>	<b>33</b>		<b>260</b>	<b>390</b>	<b>650</b>	<b>26</b>





## COMMUNICATIVE COMPETENCE (AECC-1)

**Credits: 2**  
**Subject code: MBT22101**

**I Year/ I Semester**  
**No. of lecture hours: 30**

**Objective:**

English language course will help students to develop a natural and accurate style of English pronunciation.

**Outcome:** The course will improve students ability to express ideas clearly and confidently in English.

**Unit I:**

1. Features of Indian English
2. Correction of sentences, Structures
3. Tenses, ambiguity- idiomatic distortions
4. Informal conversation Vs Formal expression
5. Verbal and non-verbal communication
6. Barriers to effective communication – kinesics

**6Hrs**

(1)  
(1)  
(1)  
(1)  
(1)  
(1)

**Unit II: Types of Communication**

1. Oral, Aural, Writing and reading
2. Word-Power, Vocabulary-Jargon
3. Rate of Speech, Pitch, Tone-Clarity of voice
4. Technical presentations
5. Types of presentation, Video conferencing
6. Participation in meetings, Chairing sessions

**6Hrs**

(1)  
(1)  
(1)  
(1)  
(1)  
(1)

**Unit III:**

1. Formal and informal interviews
2. Ambiance and polemics
3. Interviewing in different settings and for different purposes
4. e.g., eliciting and giving information
5. Recruiting, performance appraisal
6. Group discussions and Curriculum vitae

**6Hrs**

(1)  
(1)  
(1)  
(1)  
(1)  
(1)

**Unit IV:**

1. Written communication
2. Differences between Spoken and Written Communication
3. Features of Effective Writing such "as Clarity, Brevity
4. Appropriate tone clarity, balance etc.
5. Analysis of sample reports from industry -Synopsis and thesis writing

**6Hrs**

(2)  
(1)  
(1)  
(1)  
(1)

**Unit V:**

1. Letter-writing business letters
2. Proforma, culture-format-style- effectiveness, promptness
3. Analysis of sample letters collected from industry –email, fax.
4. Technical Report writing –Business and Technical Reports
5. Types of reports-Progress Reports, Routine Reports
6. Annual Reports - Formats

**6Hrs**

(1)  
(1)  
(1)  
(1)  
(1)  
(1)

*Smith*

Prof. Smita C. Pawar  
Professor, Biotechnology  
Department of Genetic & Biotechnology  
Jawahar University, Hyderabad-500 007.



**Reference Books:**


1. Essentials of Business Communication, Rajendra Pal, J S KorlahaHi: Sultan Chand & Sons, New Delhi.
2. Basic Communication Skills for Technology, Andrea J. Rutherford: Pearson Education Asia, Patparganj, New Delhi-92.
3. Advanced Communication Skills, V. Prasad, Atma Ram Publications, New Delhi.
4. Raymond V. Lesikav; John D. Pettit Jr.; Business Communication; Theory & Application, All India Traveller Bookseller, New Delhi-51.
5. Business Communication, RK Madhukar, Vikas Publishing House Pvt. Ltd.

  
Prof. Smita C. Pawar  
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## PROGRAMME OUTCOMES

- **PO1 Scientific Knowledge.** Apply the knowledge of Science, Mathematics, Engineering & Technology fundamentals to solve the complex problems.
- **PO2. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO3. Problem analysis:** Identify, formulate, research literature, and analyze complex scientific problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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- **PO8. Life-long learning:** Recognize the need and ability to engage in independent and lifelong learning in the context of technological change.

  
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**ENVIRONMENTAL AWARENESS ACTIVITY**  
**Skill Enhancement Course (SEC-1)**

**Credits: 2**  
**Subject code: MBT 22102**

**I Year / I Semester**  
**No. of lecture hours: 2**

1. Students are given:
  - A case study
  - A survey
  - Planting trees to promote greenery in their locality
  - Study on solid & liquid waste management.
2. Students are involved in preparing charts and models on promoting environmental awareness.
3. Method of Evaluation:  
**Internal Evaluation:**20 marks  
MCQ based Test on present Environmental issues & Concerns(15Marks)  
Attendance:5Marks  
**External Evaluation:**30 marks  
Activity report submission & Viva voce.

A handwritten signature in black ink, appearing to read 'Smita'.

**Prof. Smita C. Pawar**  
Professor  
Chairperson- BOS in Biotechnology  
Department of Genetics & Biotechnology  
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## GENETICS

**Credits: 4**  
**Subject code: MBT 22103**

**I Year / I Semester**  
**No. of lecture hours: 60**

**Objective:** The syllabus covers all major areas of genetics balancing classical & molecular aspects to give students an integrated view of genetic principles; it also includes modern genetics of daily lives with numerous examples of applications from human genetics which provides a natural curiosity to learn about themselves and our species.

**CO1:** Explains the basics of genetics, Mendel's laws and dominance-recessive relationships

**CO2:** Gives detailed information about chromosomes and pedigree analysis in man

**CO3:** Explains the variations in chromosomal structure and numbers

**CO4:** Describes linkage and gene mapping concepts

**CO5:** Clearly gives information about Organellar inheritance in contrast to Mendelian inheritance

### Unit I: Mendelian Genetics

**12Hrs**

- 1.1 Basic concepts of Genetics- Terminology, notations and Organisms for genetic studies.
- 1.2 Mendel's experimental design, Monohybrid crosses and Mendel's principle of segregation. (2)
- 1.2.1 Dihybrid and trihybrid Crosses -Mendel's principle of Independent Assortment.
- 1.3 Extensions to Mendel's laws: Multiple Alleles (eg. Coat color in Rabbits, Eye color in drosophila, ABO Blood groups, Rh blood groups - incompatibility, Complex loci - R-locus in maize). (2)
- 1.4 Modifications of Dominance Relationships. (1)
- 1.4.1 Incomplete Dominance -Eg: flower color in Snapdragon & 4<sup>o</sup>clock plant.
- 1.4.2 Co dominance – Eg: ABO Blood groups & MN Blood groups.
- 1.5 Gene interactions and modified Mendelian ratios- i) Dominant epistasis ii) Recessive epistasis iii) Duplicate dominant epistasis, iv) Duplicate recessive epistasis v) Duplicate genes with cumulative effect, vi) Recessive and Dominant epistasis. (2)
- 1.6 Gene Expression & the Environment (Penetrance & Expressivity Eg: Polydactyly, Diabetes mellitus. (2)
- 1.7 Pleiotropism - Eg Marfan's syndrome, Vestigial wings in drosophila. (3)
- 1.8 Phenocopy – Eg: Phecomelia, Black coat phenocopy in himalayan rabbits.
- 1.9 Inheritance of quantitative traits - Skin color in man, kernel color in wheat.

### Unit II: Chromosomal basis of inheritance

**12Hrs**

- 2.1 Prokaryotic and Eukaryotic chromosomes- morphology, classification– karyotyping. (2)
- 2.2 Specialized chromosomes-Polytene, Lamp brush chromosomes & B-chromosomes. (2)
- 2.3 Chromosomal Theory of Inheritance-sex chromosomes and sex linkage. (1)

Unit

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- 2.4 Inheritance patterns in Man - Pedigree analysis. (1)  
 2.5 Sex determination - Drosophila, Birds, Man and Bonellia. (2)  
 2.6 X-linked inheritance and Y-linked inheritance (2)  
 2.7 Sex limited and sex influenced inheritance, Polygenic inheritance (2)  
 Norm of reaction

### Unit III: Chromatin Organization and Chromosomal aberrations

12Hrs

- 3.1 Euchromatin and Heterochromatin, X-chromosome inactivation. (2)  
 3.2 Chromatin organization-Nucleosome, loops & Scaffolds. (2)  
 3.3 Nucleosome phasing. (1)  
 3.4 Chromatin under transcription. (1)  
 3.5 Variation in chromosome number - Euploidy, Aneuploidy (plants & animals). (3)  
 3.6 Variation in chromosome structure- deletions, duplication, inversions & Translocations. (3)

### Unit IV: Linkage and gene mapping

12Hrs

- 4.1 Phases of linkage, test cross and back cross. (2)  
 4.2 Crossing over & gene recombination - Cytological proof of crossing over  
 Constructing Genetic Maps (1)  
 4.3 Gene mapping & determination of map distances based on two and three point  
 test crosses, coincidence, Interference (3)  
 4.4 Tetrad analysis – Neurospora, Yeast (2)  
 4.5 Mitotic Crossing Over. (2)  
 4.6 Genetic mapping, sib pairs, LOD scores, homozygosity mapping, Linkage  
 disequilibrium and Transmission disequilibrium (TDT) test. (2)

### Unit V: Organellar Inheritance

12Hrs

- 5.1 Non- Mendelian Inheritance-Organisation of Extranuclear Genomes  
 (Mitochondrial & Chloroplast Genome). (3)  
 5.2 Rules of Non Mendelian Inheritance. (1)  
 5.3 Examples of Non Mendelian Inheritance (Shoot Variegation in *Mirabilis jalapa*,  
 Poky in Neurospora, Yeast *petite* Mutants, Non- Mendelian Inheritance in  
 Chlamydomonas. (3)  
 5.4 Human Genetic Diseases due to Mitochondrial DNA defects Eg:Lebers  
 Hereditary Optic Neuropathy). (1)  
 5.5 Cytoplasmic male sterility in Maize. (1)  
 5.6 Exceptions to Maternal Inheritance (Infectious Heredity: Killer Yeast, kappa  
 particles in paramecium). (2)  
 5.7 Contrasts to Non Mendelian Inheritance (Maternal Effect- shell coiling in snail). (1)

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 Chairperson- BoS in Biotechnology  
 Department of Genetics & Biotechnology  
 Osmania University, Hyd-500 007.



**Reference Books:**

1. An introduction to Genetic analysis, J.F .Anthony, J.A. Miller, D.T. Suzuki, R.C. Richard Lewontin, W.M-Gilbert, W.H. Freeman & company, New York 7th edition, 1998
2. Principles of Genetics, E.J.Gardner, D.P. Snustad and Michael.J.Simmons, John Wiley & Sons, Newyork, 8th edition, 1984.
3. The science of Genetics, A.G. Atherly J.R. Girton, J.F. Mcdonald, Saunders College publication, Philadelphia, 1<sup>st</sup> edition,1999.
4. Concepts of Genetics, William S.Klug, Michael R.Cummings, Prentice hall International, New Jersey, 3rd edition, 2000
5. Genetics- A Molecular Approach, Peter J.Russell , Pearson Benjamin Cummings, san Francisco,5<sup>th</sup> edition ,2006
6. Principles of Genetics, Robert.H. Tamarin, McGrawhill publication, New York, 7th edition, 1996
7. Genetics Principles and Analysis, Daniel.L.Hartl, Elizabeth.W.Jones, Jones and Bartlett Publishers, Massachusetts, 4<sup>th</sup> edition, 1998
8. Genetics the continuity of life, Daniel.J.Fairbanks, W.Ralph Anderson Brooks/Cole Publishing Company, California, 1<sup>st</sup> edition, 2005
9. Principles of Genetics, Michael.J.Simmons and D.P. Snustad , John Wiley & Sons, New Jersey, 3th edition, 2003
10. Schaum out line series of Theory & problems in Genetics, Stansfield, McGrahill publication, New York, 3rd edition –2000





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**CELL BIOLOGY****Credits: 4****Subject code: MBT 22104****I Year / I Semester****No. of lecture hours: 60**

**Objective:** Covers the Different Molecular mechanism of cellular transport, signaling, cell division and cell death.

**CO1:** Structures and purposes of basic components of prokaryotic and eukaryotic cells, especially membranes, and organelles.

**CO2:** How the cellular components are used in protein sorting through various pathways.

**CO3:** How Cell Signalling Works and how cells will communicate with the surrounding cells & can have a clear understanding of the signal

**CO4:** Cellular components underlying mitotic cell division

**CO5:** The knowledge how the cells undergo apoptosis and its applications

**Unit I: Membrane Structure and Transport****12Hrs**

1.1 Membrane structure– The Lipid Bilayer (Properties and function). (2)

1.2 Structure & function of cytoskeleton- introduction to microfilaments, intermediate filaments, microtubules, myosin structure and role in motility. (2)

1.3 Membrane proteins (Spectrin, Glycophorin, Band 3 protein and Bacteriorhodopsin. (3)

1.4 Membrane transport - Active & Passive transport driven by ion gradients (uniport, symport and antiport). (2)

1.5 Ion Channels and Carriers. (2)

1.6 ABC Transporters. (1)

**Unit II: Protein sorting****12Hrs**

2.1 The transport of molecules between the nucleus and the cytosol. (2)

2.2 The transport of proteins into mitochondria and chloroplast. (3)

2.3 Transport from the ER through the Golgi apparatus. (2)

2.4 Transport from the Trans Golgi Network to Lysosomes (1)

2.5 Transport into the cell from the plasma membrane: Endocytosis (2)

2.6 Transport from the Trans Golgi Network to the cell exterior: Exocytosis (2)

**Unit III: Cell communication****12Hrs**

3.1 Overview of extra cellular & intra cellular cell signaling. (2)

3.2 Tight junctions and Gap junctions. (2)

3.3 Second messengers and their role in signal transduction-cAMP, lipid derived (PIP& IP3) & Calcium. (3)

3.4 Cell surface receptors in signal transduction - structure and function.

3.4.1 G-protein coupled receptor. (2)

3.4.2 Ion channel receptors. (1)

3.4.3 Tyrosine kinase linked receptors. (2)

**Unit IV: Cell Cycle and Cell Division****12Hrs**



- |       |  |     |
|-------|--|-----|
| 4.1   | Components in cell cycle control - Cyclin, CDKs.             | (2) |
| 4.2   | Check points in cell cycle.                                  | (1) |
| 4.3   | Abnormalities in Cell Cycle: Cancer                          | (1) |
| 4.4   | Mechanics of Cell Division - An over view of M-Phase.        | (1) |
| 4.4.1 | Different Stages of Mitosis.                                 | (1) |
| 4.4.2 | Cohesins and Condensins in sister chromosome segregations.   | (1) |
| 4.4.3 | Microtubules, Kinetochore & centrosomes in spindle assembly. | (1) |
| 4.5   | Cytokinesis - actin & myosin; Cytokinesis in plants.         | (1) |
| 4.6   | Meiosis, Significance.                                       | (1) |
| 4.6.1 | Chiasma formation - Synaptonemal complex.                    | (1) |
| 4.6.2 | Recombination during meiosis - Recombination nodules.        | (1) |

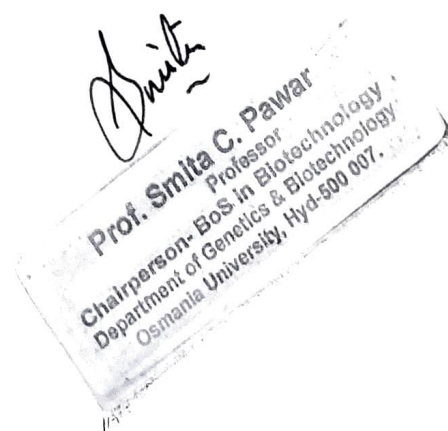
**Unit V: Cell Death Pathway**

**12Hrs**

- |       |   |     |
|-------|---|-----|
| 5.1   | Introduction to Necrosis, Senescence, Apoptosis - Programmed cell death | (1) |
| 5.2   | Mechanisms of apoptosis.  | (6) |
| 5.2.1 | Apoptosis triggered by internal signals.                                |     |
| 5.2.2 | Apoptosis triggered by external signals.                                |     |
| 5.2.3 | Apoptosis inducing factor.  | (1) |
| 5.3   | Apoptosis in cancer, immune system, organ transplants.                  | (3) |
| 5.4   | Apoptosis in plants.  | (1) |

**Reference Books:**

1. Cell & Molecular Biology. E. D. D. De Robertis & E. M. F De Robertis, Lippincott Williams and Wilkins, Philadelphia, 8th edition, 2005
2. Molecular biology of the cell. Bruce Alberts, Alexander Johnson, Lewis Julian, Raff Martin, Roberts Keith, Walter Peter, Garland Science publication, New York, 5th edition, 2008
3. Cell & Molecular Biology -Concepts & experiments, Gerald Karp, John Wiley & Sons, Newyork,3<sup>rd</sup> edition ,2002
4. Molecular Cell Biology, H. Lodish, D. Baltimore, A. Berk, S. L. Zipursky, J. Darnell W. H. Freeman & company, New York, 4th edition 2004
5. Cell Biology–organelle structure & Function, David E. Sadhava, Jones and Bartlett Publishers, Massachusetts, 1<sup>st</sup> edition, 1993
6. The Cell- A Molecular Approach, Geoffrey. M. Cooper, ASM Press, Washington. D. C, 1st edition, 1997





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## BIOCHEMISTRY

**Credits: 4**  
**Subject code: MBT 22105**

**I Year / I Semester**  
**No. of lecture hours: 60**

**Objective:** To Understand the Chemistry of Basic Biomolecules of Biological systems. To enable the students to gain knowledge about various Biochemical interactions of living systems. To focus on imparting strong foundations in chemistry to M.Sc. Biotechnology students.

- CO1:** Explains Chemical bonds, molecular interactions in cell
- CO2:** Apply the knowledge of bonds & shows in representing structure of carbohydrates
- CO3:** Identifies the structure of lipids, relates & distinguishes with carbohydrates.
- CO4:** Compares, discriminates the structure & functional relationship of proteins & nucleic acids with other biomolecules in cell.
- CO5:** Explains the catalytic nature & kinetic properties & inhibition mechanisms of enzymes.

<b>Unit I: Introductory Biochemistry</b>		<b>12Hrs</b>
1.1	Chemical basis of life, Hierarchy and emergent Properties of Biomolecules (1)	
1.2	Macromolecular Assemblies, Structure and Functional Relationships and hydro dynamic properties of Biomolecules (1)	
1.3	Interactions in biological systems (covalent & Non covalent)-Intra and intermolecular forces, Electrostatic and Hydrogen bonding interactions, Vanderwaal's and hydrophobic interaction, Weak inter actions Disulphide bridge (3)	
1.4	Buffers, pH, pK, Henderson Hassalbalch Equation (3)	
1.5	Basic concept of metabolism - definition, carbohydrate, lipid and amino acid Metabolism (outline)-Anabolic & Catabolic pathways with examples (3)	
1.6	ATP Cycle and Role of ATP in metabolism (1)	
<b>Unit II: Glycobiology</b>		<b>12Hrs</b>
2.	Overview of Classification of Carbohydrates with example (1)	
2.1	Derivatives of Sugars-DeoxySugars, Glycosides, Amino Sugars (1)	
2.2	Energy Storage Molecules, Homo Polysaccharides: Starch, Glycogen, Pectin, Chitin & Hemicelluloses (3)	
2.3	Hetero polysaccharides – Acid mucopolysaccharides (Glycosamino glycans)	
2.4	Structure, chemistry and Biological role of Cell Surface Molecules: Glyconjugates- Glycoproteins, Glycolipids, proteoglycans, and Bacterial Cell wall Polysaccharides (3)	
2.5	Carbohydrates as informatory molecules –Lectins (2)	
2.6	Methods of carbohydrate Analysis	
2.7.	Complete overview of carbohydrate metabolism and networks (2)	
<b>Unit III: Lipids</b>		<b>12Hrs</b>
3.1	Overview of Classification of lipids (2)	
3.2	Fatty acids in Plants and Animals (3)	
3.3	Comparative study of Structure, chemistry and biological properties of Phospholipids, Spingolipids and Glycolipids (3)	



- 3.4. Pharmacological role of Eicosanoids (1)  
 3.5. Steroid Lipids –Plant & Animal Sterols (2)  
 3.6. Lipoproteins and its Applications .  
 3.7. Fatty Acid Biosynthesis and Beta Oxidation of FattyAcids. (1)

#### Unit IV: Proteins and Nucleic Acids

12Hrs

- 4.1 Classification, structure and characteristics of amino acids (1)  
 4.2 Peptide bond stability & formation of polypeptides (Glutathione, oxytocin, vasopressin & Tyrocidin) Synthesis of peptides(solid phase technique) (1)  
 4.3 Methods for determining N–termini & C-terminus of Polypeptide (2)  
 4.4 Structural organization of proteins Primary, Secondary, Tertiary, Quaternary and subunit Structure of Protein & Denaturation and Renaturation of proteins  
 4.5 Structure of Hemoglobin, Myoglobin, Collagen (1)  
 4.6 Protein Folding –Models, Anfensons experiment-Ribonuclease (1)  
 4.7 Introduction to Protein Ligand interaction (Small Molecule including drugs)  
 4.7.1 Phospholipase A2 complex with anti-inflammatory agent Aspirin  
 4.7.2. Structure - ligand complex of Glucose transporter  
 4.8. Nucleic Acids (6)  
 4.8.1 Structure of Purines, Pyrimidines, Nucleosides and Nucleotides. Stability and formation of Phosphodiester bond  
 4.8.2 Structural features of Watson & Crick model of DNA, Polymorphic Structural forms of DNA (A,B,Z )Circular DNA, Cruciform & Hair pin, Palindromes, Inverted Repeats, DNA triple helix and quadruplex DNA and DNA super coiling,  
 4.8.3 Role of polymorphic Structural forms of DNA in Recognition.  
 4.8.4 Role of electrostatics in polymorphic structural transitions in DNA .  
 4.8.5. Chemical and enzymatic susceptibility of nucleic acids.

#### Unit V: Enzymology

12Hrs

- 5.1 General Characteristics and Catalytic Activity of Enzymes (2)  
 5.2 Enzyme Catalysis, Energy Considerations (3)  
 5.3 Enzyme kinetics: Michaelis-Menton Equation (2)  
 5.4 Transformations of Michaelis-Menton Equation & Double reciprocal plot (1)  
 5.5 Enzyme inhibitions: Reversible & Irreversible, Feedback inhibition (2)  
 5.6 Metabolic Regulation of Enzymes with Reference to Carbohydrate and Aminoacid Metabolism. (2)

#### Reference Books:

1. Lehninger Principles of Biochemistry, David.L.Nelson, Michael.M.Cox, W.H. Freeman & company, New York, 4th edition, 2005
2. Biochemistry, Jeremy M.Berg, John L.Tymorzko, Lubert Stryer W.H. Freeman & company, New York, 6th edition, 2007
3. Text Book of Biochemistry with Clinical Correlations Thomas M. Devlin, John Wiley & Sons, New Jersey, 6th edition, 2006.
4. Biochemistry Geoffrey L. Zubay McGrathill publication, San Francisco, 4th edition, 1997



5. Biochemistry Donald Voet, Judith G.Voet, John Wiley & Sons, New York, 2nd edition, 1995
6. Text Book of Biochemistry Edward Staunton West, Wilbert R.Todd, Howard S.Mason, MacMillan Publishing Co, New York, 4th edition, 1966
7. Enzymes, Trevor Palmer, Horwood Publishing Ltd, Chichester, 2<sup>nd</sup> edition 2004
8. Harpers Biochemistry, Robert K.Murray, Darye K.Granner, Peter A.Mayes McGrawhill publication, New York, 25th edition, 2000
9. An Introduction to Practical Biochemistry, David T.Plummer McGrawhill publication, New York, 3th edition, 2001
10. Experimental Biochemistry-A Student Companion, Beedu Sashidhar Rao, Vijay Deshpande. I.K. International Pvt ltd, Bangalore, 1<sup>st</sup> edition, 2005

### PROGRAMME OUTCOMES

- **PO1 Scientific Knowledge.** Apply the knowledge of Science, Mathematics, Engineering & Technology fundamentals to solve the complex problems.
- **PO2. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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- **PO8. Life-long learning:** Recognise the need and ability to engage in independent and lifelong learning in the context of technological change.

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## MICROBIOLOGY

Credits: 4  
Subject code: MBT 22106

I Year / I Semester  
No. of lecture hours: 60

**Objectives:** To impart knowledge about microbiology basic concepts and to comprehend easily. These concepts are very much useful for research purpose.

**CO1:** Explains the basics of Microbiology. Different media used for their culturing and their identification methods

**CO2:** Gives detailed information about systemic classification of Bacteria, Algae, Archae and Fungi

**CO3:** Explains in detail about microbial physiology and their growth

**CO4:** Describes about microbial genetics like Transformation, Transduction, and recombination

**CO5:** Clearly gives information about classification of viruses and chemotherapeutic agents.

### Unit I: Introduction to Microbiology

12Hrs

- 1.1 Microscopic identification of Microorganisms: (2)  
Microscopy (Light & Electron Microscopy)–Specimen preparation & Staining (2)
- 1.2 Microbiological media and its applications.
- 1.2.1 Bacteriological media: L.B media, Mac Conkey agar, EMB agar.
- 1.2.2 Fungal media: PDA agar, sabourauds Agar, Czapek-Dox Agar.
- 1.2.3 Algal media: Bristols media, Pringsteins Media.
- 1.3 Use of Physical methods in controlling microorganisms: sterilization - Methods of Sterilization and their application in industry (Dry heat, moist heat, Filtration & Radiation). (2)
- 1.4 Use of chemical agents in controlling microorganisms. (1)
- 1.4 Concept of pure culture and methods of pure culture development.
- 1.5 Methods of preservation of microbial cultures- (2)
  - A. repeated subculturing, preservation at low temperature
  - B. Sterile soil preservation, mineral oil preservation, deep freezing
  - C. Liquid nitrogen preservation, freeze-drying (lyophilization).

### Unit II: Systemic classification of bacteria, algae, archae and fungi.

12Hrs

- 2.1 Over view of Bergeys Manual of Systemic Bacteriology and general characters of bacteria (structure).1.5 (3)
  - Identification methods of bacteria and other microorganisms.
  - 2.1.1 Grams staining, Acid fast staining, spore staining. (3)
  - 2.1.2 IMVIC Test, oxidase and catalase test. (3)
  - 2.1.3 Detection & Isolation of mutants – Replica plating technique, Ames test. (1)




2.2. The characteristics of fungi	(2)
2.2.1 Fungal classification.	(1)
2.2.2 Fungal life cycles, importance, structure.	(1)
2.2.3. Lacto phenol test for fungi and Benecks broth for algae.	(2)
2.3 The characteristics of Algae, Algal classification, Algal reproduction.	(2)
2.4 The characteristics of Archea	(2)
2.4.1 Archea classification.	(1)
2.4.2 Structure, metabolism.	(1)
<b>Unit III: Microbial physiology and growth</b>	<b>12Hrs</b>
3.1 Nutrition in Microorganisms and assimilation of nutrients.	(1)
3.1.1 Macro Nutrients, Importance of each nutrient and its sources.	(1)
3.1.2 Trace elements and their importance.	(1)
3.1.3 Mechanism of assimilation of nutrients from surroundings by microbes.	(1)
3.2 Nutritional classification of microorganisms based on the energy, carbon and electron donors.	(2)
3.3 Microbial growth (Lag, log, stationary, death phase.) and growth curve.	(2)
3.4 Methods of measurement of growth	(2)
3.4.1 Cell number, Cell mass. Calculation of generation time	(2)
3.5 Continuous culture of microorganisms (turbidostat, chemostat).	(2)
3.6 Influence of environmental factors on growth pH, temperature. Oxygen concentration, Water activity and pressure	(3)
<b>Unit IV: Microbial Genetics</b>	<b>12Hrs</b>
4.1 Transformation: Competence factors, mechanism of transformation.	(2)
4.2 Conjugation	(1)
4.2.1 Structure of F plasmid, Mechanism of transfer of F plasmid.	(1)
4.2.2 Hfr Recombination.	(1)
4.2.3 Mechanism of integration of F plasmid into bacterial chromosome, Circularization of chromosome	(2)
4.3 Transduction - Generalized transduction, lysogeny and lytic cycle.	(2)
4.3.1 Example Structure and replication of Bacteriophage (T2).	(1)
4.3.2 Specialised Transduction – structure of $\lambda$ phage, mechanism of integration $\lambda$ bio $\lambda$ & dgal.	(1)
4.3.3 Structure and replication of lamda phage.	(2)
<b>Unit V: Viruses and Chemotherapeutic agents</b>	<b>12Hrs</b>
5.1. History of virology (latest Scientific investigations), Classification of viruses and important characters of each group.	(2)
5.2 Methods of cultivation of viruses. Chick embryo, Bacteriophage cultivation Detection of viruses: physical, biological, immunological and serological methods.	(1)
5.3 Structure and general characteristics of important viruses-TMV, HIV, B. Hepatitis virus C. Polio virus. Isolation and Purification of viruses by Filtration B. Precipitation and Centrifugation. Importance of viruses in biotechnology.	(2)
5.4 Chemotherapeutic agents - Classification of Antibiotics (Broad and narrow Spectrum Antibiotics), mode of action of Antibiotics	(3)
5.5 Overview of Anti-fungal and antiviral agents.	(2)
5.6 Mechanism of drug resistance.	(2)



**Reference Books:**

1. Microbiology Principles & Explorations, Jacquelyn G.Black, John Wiley & Sons, New Jersey, 6th edition, 2005
2. Microbiology, Lansing M.Prescott, John P.Harley, Donald A.Klein, McGrawhill publication, New Jersey, 6th edition, 2005
3. Microbiology, M.J. Pelzar, E.S.N. Cfan and N.R. Kreig, McGrawhill publication, New Jersey, 5th edition, 2011
4. General Microbiology by R.Y Stanier, J.L. Ingrahm, M.L. Wheel is & P.R. Painter, MacMillan Publishing Co, New Jersey, 5th edition, 1995
5. Brock Biology of Microorganisms, Michael T.Madigan,John M.Martinko, Prentice hall International, New Jersey, 11th edition, 2006
6. Foundations in Microbiology, Kathleen Park Talora, Arthur Talora, McGrawhill publication, New Jersey, 4th edition, 2002
7. Alcamos Fundamentals of Mirobiology, Jeffrey C. Pommerville Jones and Bartlett Publishers, Massachusetts, 7<sup>th</sup> edition, 2004
8. Microbiology- A Laboratory Manual, James G.Cappuccino & Natalie Sherman, Pearson Benjamin Cummings, san Francisco,6<sup>th</sup> edition ,2005
9. Practical Microbiogy, R.C.Dubey, D.K.Maheshwari, S.Chand& Company Ltd, 2<sup>nd</sup> edition, 2006

  
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## PROGRAMME OUTCOMES

- **PO1 Scientific Knowledge.** Apply the knowledge of Science, Mathematics, Engineering & Technology fundamentals to solve the complex problems.
- **PO2. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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*Smita*

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## GENETICS PRACTICALS


Credits: 2

Subject code: MBT 22107

I Year / I Semester

No. of lectures: 3hr/week

1. Drosophila Genetics-
  - a) Preparation of media
  - b) Observation of wild types and mutants,
  - c) Handling of drosophila
  - d) Life cycle of drosophila
2. Isolation and staining of salivary gland chromosomes in Drosophila
3. Monohybrid, Dihybrid ratios, Multiple alleles, Epistasis – Problems
4. Quantitative Inheritance–Problems
5. Inheritance patterns in Man–Pedigree analysis
6. Localization of genes–two & three point test crosses in drosophila–Problems
7. Tetrad analysis-Problems
8. Localisation of genes in man by sib pair method & Lod score estimation
9. Gene mapping by Transmission disequilibrium test (TDT) - Problems
10. Multipoint analysis- determining flanking loci
11. Demonstration of Barr bodies in buccal cells

  
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**CELL BIOLOGY PRACTICALS**


**Credits: 2**

**Subject code: MBT 22108**

**I Year / I Semester**

**No. of lectures: 3hrs/week**

1. Total count and differential count.
2. Study of mitosis in Onion Root tips.
3. Study of meiosis in plants Maize tassels.
4. Qualitative Estimation of cell wall Properties by Histo-Chemical Staining.
5. Demonstration of Cell Cycle Analysis by Flow Cytometry
6. Isolation of mitochondria.
7. Isolation of Chloroplast from spinach leaves.
8. Human Lymphocyte culture.
9. Giemsa banding of chromosomes.
10. Karyotyping of Human normal chromosome sets.
11. Karyotyping of Human abnormal chromosome sets.

  
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## BIOCHEMISTRY PRACTICALS

Credits: 2

Subject code: MBT 22109

I Year / I Semester

No. of lectures: 3hrs/week

### I. Instrumentation & Solutions Preparation.

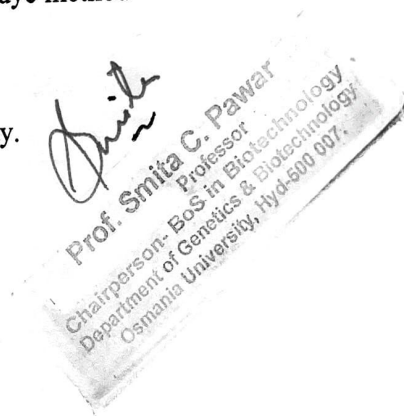
1. Lab Instrumentation.
2. Preparation of solutions (Molar and Normal),  
Preparation of Standard solutions. concept of primary and secondary standards solutions.
3. Calibration of pH meter & Preparation of buffers.( phosphate, Tris EDTA and saline sodium citrate.)

### II. Titrimetry & Colrimetry

4. Estimation of total sugars by Anthrone method.
5. Determination of Glycine by formal titration method.
6. Estimation of Vitamin C by Dichloro phenol indophenol dye method
7. Estimation of RNA by Orcinol method.

### II. Enzyme Assays:

8. Standardization of Conditions for Enzyme Activity.
9. Effect of Temperature on Enzyme Activity.
10. Effect of PH on Enzyme Activity.
14. Assay of Amylase.





## MICROBIOLOGY PRACTICALS

**Credits: 4**

**Subject code: MBT 22110**

**I Year / I Semester**

**No. of lectures: 3hrs/week**

1. Isolation and identification of bacteria and fungi by serial dilution method
2. Methods for detection of specific bacteria by - wet mount method and hanging drop mount method.
3. Microscopic observation and Staining of bacteria and fungi.
4. Preparation of microbiological media: minimal media, basic media, enriched media and differential media.
5. Methods of Sterilization (Autoclaving, Hot air oven, radiation and filtration).
6. Culturing methods of microorganisms:
  - i) Culturing of microorganisms using Tube culture (slant/broth method),
  - ii) Culturing of microorganisms using plate culture (spread, streak and pour plate)
  - iii) Culturing of microorganisms using flask culture, shake flask culture.
7. Staining techniques for bacteria – simple, differential and special staining.
8. Methods for Preservation and maintenance of microbial cultures.
9. Measurement of microbial growth (Viable count and turbidometry).
10. Study of bacterial growth curve.

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**YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS**  
**DEPARTMENT OF BIOTECHNOLOGY**  
**M. SC - FIRST YEAR – SECOND SEMESTER**  
**ACADEMIC YEAR 2020-21 OF 2020-22 BATCH (CBCS)**

Sl. No.	Part	Subject Code	Title of the subject	Hours/ week	Duration of Exam (Hrs.)	Marks			Credits
						Internal	External	Total	
1.	*I	*MBT 22201	* Computer Applications (AECC-2)	2	2	*20	*30	*50	*2
2.	I	MBT 22202	Biostatistics & Research Methodology (Core-5)	4	3	40	60	100	4
3.	II	MBT 22203	Immunology (Core -6)	4	3	40	60	100	4
4.	II	MBT 22204	Molecular biology (Core -7)	4	3	40	60	100	4
5	II	MBT 22205	Advanced Techniques in Biotechnology (Core -8)	4	3	40	60	100	4
6	II	MBT 22206	r-DNA Technology (Core -9)	4	3	40	60	100	4
<b>PRACTICALS</b>									
7	II	MBT 22207	Immunology (Core -6)	3	2	20	30	50	2
8	II	MBT 22208	Molecular biology (Core -7)	3	2	20	30	50	2
9	II	MBT 22209	r-DNA Technology (Core -8)	3	2	20	30	50	2
10	II	MBT 22210	Advanced Techniques in Biotechnology (Core -9)	3	2	20	30	50	2
<b>Total</b>				<b>34</b>		<b>280</b>	<b>420</b>	<b>700</b>	<b>28</b>


\*Ability Enhancement Compulsory Course (AECC) Marks are not included in CGPA Score in the main Certificate. But there is a Compulsory pass in the examination.

**Evaluation for AECC**

Internal : 20Marks(Mid Exam:2hrs-10M, Activity or interactive based:5M, Attendance:5M)

External: 30Marks(2hrs)

**Note :** No Prefinal Examination.

  
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External: 30Marks(2hrs)

Note : No Prefinal Examination.

**CIA Components for Internal Marks Of theory paper:**

(i) Weekly Test : 6M (ii) Mid Semester: 10M (iii) Prefinal: 16M (iv) Assignment: 2M

(v) Viva: 2M

(vi) Attendance: 4M

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**PROGRAMME OUTCOMES**



**COMPUTER APPLICATIONS**  
**Ability Enhancement Compulsory Course (AECC-3)**

**Credits: 2**  
**Subject code: MBT 22301**

**II Year / I Semester**  
**No. of lecture hours: 30**

**Objective:** To study the applications of computer and its techniques in Biotechnology.  
**Outcome:** Students will gain knowledge in computer techniques and their application in Biotechnology.

<b>UNIT-I: Basics of Computers</b>	<b>6Hrs</b>
1.1 History of computers, generations of computers	(1)
1.2 Characteristics of computers	(1)
1.3 Data representation – number system	(1)
1.4 Binary, octal and hexadecimal	(1)
1.5 Conversion from one number system to another	(1)
1.6 Hardware, Software, Translators, Compilers and interpreters	(1)
<b>UNIT- II: Concepts &amp; Commands</b>	<b>6Hrs</b>
2.1 System software, application software	(1)
2.2 Simple operating concepts, flowchart	(1)
2.3 Algorithms with simple examples	(1)
2.4 DOS commands – Internal and external commands	(2)
2.5 File management and directory structure	(1)
<b>UNIT- III: Computer Networks</b>	<b>6Hrs</b>
3.1 Network Types : Local Area Network, Metropolitan Network, Wide Area Network	(1)
3.2 LAN Topologies: Bus Topology, Ring Topology, Star Topology,	(1)
3.3 Communication Protocol	(1)
3.3 Network Devices: Network Interface Card, Repeater, Bridge, Hub, Switch, Router, Gateway.	(1)
3.4 Wireless Networking : Bluetooth Technology, Wireless LAN, Wireless WAN	(1)
3.5.1 Computer Security: Introduction, Security Threat and Security Attack.	(2)
3.5.2 Malicious Software: Virus, Worms, Torjan Horses.	(1)
<b>UNIT-IV: Computing Technologies</b>	<b>6Hrs</b>
4.1 Cloud computing: IAAS, PAAS, SAAS. Grid computing	(2)
4.2 Excel : Creating a new worksheet-select, edit (Copy, move, format, setting column width etc.)	(1)
4.3 Referencing cells (Addressing methods), Formulae, charts, macros.	(1)
4.4 Functions-logical, mathematical, statistical, date and time.	(1)
4.5 Creating an excel database-sort and filter database. Performing what-if analysis on worksheet data And Analysis data with pivot tables.	(1)


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	6Hrs
<b>UNIT-V: Fundamentals of Database</b>	(1)
5.1 Introduction	(1)
5.2 File-Oriented Approach and Database Approach	(2)
5.3 Characteristics of Database Approach, Data Models, Schema and Instances.	(2)
5.4 Access Basics: Database, tables, records, fields, Entering data, Queries.	(2)

#### ESSENTIAL READING

1. Bharihoke, Deepak. 2012. **Fundamentals of Information Technology**. Excel Books.
2. Crawford, Sharon. and Neil J. Salkind. 1998. **ABCs of Windows**. BPB Publications.
3. Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin. 2008. "**Information Technology**", **The Breaking Wake**. Tata Mc.Graw- Hill
4. Anita Goel, 2010. "**Computer Fundamentals**". Pearson

  
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A handwritten signature in black ink, appearing to read 'Smita'.

Prof. Smita C. Power  
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## BIostatistics, Ethical Issues & Research Methodology

Credits: 4

Subject code: MBT 22202

I Years / II Semester

No. of lecture hours: 60

**Objective:** To cover the theoretical, practical & applied aspects of Biostatistics & Research Methodology in a clear & exhaustive manner from fundamental core to advanced tools & methods which is comprehensive and easier to grasp.

CO1: Introduction to Bio-Statistics

CO2: Descriptive Statistics &amp; Probability Distribution

CO3: Statistical Inference of Qualitative &amp; Quantitative Variables

CO4: It describes importance of ethics in life. It values good laboratory and manufacturing practices.

CO5: Integrates training from different sources to solve a problem during research and writing a publication

**UNIT-I: Introduction to Bio-Statistics**

12Hrs

- |  |     |
|--|-----|
| 1.1. Data & Its Collection: Types of data  | (2) |
| 1.2. Tabulation & Frequency distribution   | (2) |
| 1.3. Diagrammatic representation of data: Line diagram, bar diagram & pie diagram                                | (2) |
| 1.4. Graphical representation of data: Histogram, Frequency polygon, Frequency curve, cumulative frequency curve | (2) |
| 1.5. Sampling: random methods of sampling  | (2) |
| 1.6. Non random methods of sampling, classification of errors  | (2) |

**UNIT-II: Descriptive Statistics & Probability Distribution**

12Hrs

- |  |     |
|--|-----|
| 2.1 Measures of Central Tendency: Mean, Median & Mode  | (2) |
| 2.2 Measures of Dispersion: Range, mean deviation, standard deviation, Coefficient of variation                      | (2) |
| 2.3 Moment, Skewness & kurtosis.   | (2) |
| 2.4 Probability: Concept of Probability  | (2) |
| 2.5 Theorems of probability  | (2) |
| 2.6 Probability Distributions: Binomial distribution, Normal distribution, Poisson distribution & their applications | (2) |

**UNIT-III: Statistical Inference of Qualitative & Quantitative Variables**

12Hrs

- |   |     |
|---|-----|
| 3.1 Concept of Test of Hypothesis: Null and alternative hypothesis, level of significance.  | (2) |
| 3.2 Chi-Square Test: Degrees of freedom, applications of chi-square test.   | (2) |
| 3.3 Large Sample Tests: Z-Test of mean  | (2) |
| 3.4 Small Sample Test: T-Test for mean  | (2) |
| 3.5 Analysis Of Variance And Covariance: one way ANOVA, two way ANOVA & F-Test.   | (2) |
| 3.6 Correlation And Regression Coefficients: Simple regression, Test of regression coefficient, correlation and correlation Coefficient | (2) |




<b>UNIT-IV: Ethical Issues</b>	<b>12Hrs</b>
4.1 Introduction- causes of unethical acts, ignorance of laws, codes, policies and procedures, recognition, friendship, personal gains	(2)
4.2 Professional ethics – professional conduct	(2)
4.3 Ethical decision making, Ethical dilemmas	(2)
4.4 Ethical values in Research,	(2)
4.5 Good laboratory practices, good manufacturing practices	(2)
4.6 Laboratory accreditation	(2)

<b>UNIT-V: Research Methodology</b>	<b>12Hrs</b>
5.1 Introduction- Basic researches, applied research, need based research	(2)
5.2 Identification of the problem, defining the problem	(2)
5.3 Research project planning: Introduction, review literature, materials methods, results and conclusion	(2)
5.4 Literature search–information sources, library resources-books, journals, abstracts, hand books, procedure manuals, encyclopedias, annual reports, data banks, CDROMS, online literature search–internet access, websites, directories of information resources	(2)
5.5 Design of the experimental programme–variables in the experiments, materials and methods, evolution of methods, and application of methods	(2)
5.6 Progress of research–evaluation of results, statistical approach, comparison with existing methodologies, validation of findings, research communications and impact factor of journals	(2)

**ESSENTIAL READING**

1. Khan, and Khanum. 2008 **Fundamentals of Biostatistics**. 3<sup>rd</sup> edition, Ukaaz publication.
2. Arora P. N, and Malhan P.K. 2006 **Biostatistics**. 2<sup>nd</sup> edition Himalaya Publishing House.
3. Albert R.Jonsen, Robert A. Pearlman, Nancy Ann Silbergeld Jecker. 1997 **Bioethics: an Introduction to the History, Methods and Practice**. 3<sup>rd</sup> edition, Jones & Bartlett Learning.
4. Richard Sherlock, John D. Morrey Rowman & Littlefield. 2002 **Ethical Issues in Biotechnology**. 1<sup>st</sup> edition, Rowman & Littlefield publishers.
5. C. R. Kothari . 1985 **Research Methodology: Methods and Techniques**. New age International publishers.
6. Ranjith Kumar. 2011, **Research Methodology A Step-By-Step Guide For Beginners**. 3<sup>rd</sup> edition. SAGE Publishers

  
**Prof. Smita C. Pawar**  
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## IMMUNOLOGY

**Credits: 4**

**Subject code: MBT 22203**

**I Year / II Semester**

**No. of lecture hours: 60**

**Objectives:** All the units cover basics of immunology, focusing on immunity types, cells, organs of immunity, antigens and antibodies, transplantation, B and T cell activation and MHC classes.

**CO1:** Explains the basics of immunology

**CO2:** Gives detailed information about antigens and their pathways

**CO3:** It gives knowledge about various types of Immunoglobulin structures their and functions

**CO4:** explains about Organization of MHC complex and Transplantation

**CO5:** Summarizes about cell mediated and humoral responses and auto immune diseases

<b>Unit I: Basics of Immunology</b>	<b>12Hrs</b>
1.1 Immunity – Phylogeny and Types of Immunity.	
1.1.2 Innate Immunity- deficiencies of innate immunity. Example- CGD	(2)
1.1.3 Acquired Immunity	(2)
1.2 Cells of the Immune System	
1.2.1 Innate cells of immune system	(2)
1.2.2 B & T Lymphocytes; T-cell sub-sets; The Antigen Presenting Cells	(2)
1.3 Organs of the System:	
1.3.1 Primary lymphoid organs (Bone marrow and Thymus)	(2)
1.3.1.1 Secondary lymphoid organs (lymph nodes, spleen and mucosal-associated lymphoid tissue)	(2)
<b>Unit II: Antigens</b>	<b>12Hrs</b>
2.1 Immunogenicity versus Antigenicity, Factors that influence immunogenicity (Physical factors: foreignness, molecular size, chemical composition, lipids as antigens and biological factors: genotype, immunogen dosage, route of administration and adjuvants	(2)
2.2 Epitopes - Properties of B-cell epitopes and T-cell epitopes.	(2)
2.3 Haptens and the study of Antigenicity.	(1)
2.4 Antigen processing by endocytic pathway	(2)
2.5 Antigen processing by exocytic pathway	(2)
2.6 Complement system– functions and components of complement system; complement activation; regulation of complement system	(3)
<b>Unit III: Immunoglobulins: Structure and Functions</b>	<b>12Hrs</b>
3.1 Basic structure of Immunoglobulins - The role of multiple myeloma in understanding Ig structure	(2)
3.2 Fine structure of Immunoglobulins - Immunoglobulin domains-variable region and constant region domains	(2)

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- 3.3 Immunoglobulin classes - IgG, IgM, IgA, IgD and IgE; functions of Ig classes (2)
- 3.4 Organization and expression of Immunoglobulin Light and Heavy chain genes (V-j and VDJ chain rearrangements and allelic exclusion). (2)
- 3.5 Antigen- Antibody interactions and applications (2)
- 3.6 Monoclonal Antibodies - Formation and selection of hybrid cells; Production of Monoclonal Antibodies and their clinical uses (2)

**Unit IV: Major Histocompatibility Complex (MHC) and transplantation 12Hrs**

- 4.1 General organization and inheritance of MHC; MHC Haplotypes (1)
- 4.2 The structure of MHC class-I and class-II molecules; (1)
- 4.2.1 Organization of MHC class I and class II genes, peptide binding of MHC molecules (2)
- 4.3 Polymorphism of MHC class I and class II molecules (1)
- 4.4 Role of HLA typing in organ transplantation (1)
- 4.5 Cellular distribution of MHC molecules; MHC molecules and immune responsiveness (2)
- 4.6 Immunologic basis of graft rejection (2)
- 4.7 Significance of immune suppressive therapy. (2)

**Unit V: Humoral and Cell-mediated Immune Responses 12Hrs**

- 5.1 B-cell activation and proliferation by Thymus independent and Thymus dependant antigens; *in vivo* sites for induction of humoral response; (2)
- 5.2 B-cell differentiation, class-switching and B-cell immunodeficiency disorders- X-linked agammaglobulinemia / selective immunoglobulin deficiency (2)
- 5.3 The structure and functions of T-cell receptors (TCR); the TCR-peptide-MHC tri-molecular complexes (1)
- 5.4 Cell-mediated immune response: General properties of effector T-cells; Direct Cytotoxic response; (2)
- 5.5 Auto-immunity and auto-immune diseases-Insulin Dependent Diabetes; Rheumatoid Arthritis and Auto-immune Thyroid disease. (2)
- 5.6 T cell primary immunodeficiency disorders- AIDS as an example (2)
- 5.7 Hypersensitivity- types; Delayed Type of Hypersensitivity (DTH) (2)

**Reference Books:**

1. Kuby Immunology, Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, W.H. Freeman & company, New York, 6th edition, 2007
2. Roitt's Essential Immunology, Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Roitt, Blackwell Publishing, Massachusetts, 11<sup>th</sup> edition, 2006
3. Basic & Clinical Immunology, Daniel P. Stites, Abba I. Terr, Tristram G. Parslow, Appleton & Lange, Connecticut, 8<sup>th</sup> edition, 1994
4. Cellular & Molecular Immunology, Abul K. Abbas, Andrew H. Litchman, Shiv Pillai, Saunders College Publishing, Philadelphia, 7th edition, 2012
5. An Introduction to Immunology, Ian R. Tizard, Saunders College Publishing, Philadelphia, 7th edition, 2004
6. Immunology: A Short Course, Richard Coico, Geoffrey Sunshine, Eli Benjamini, John Wiley & Sons, New York, 5th edition, 2003

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## MOLECULAR BIOLOGY

**Credits: 4**

**Subject code: MBT 22204**

**I Year / II Semester**

**No. of lecture hours: 60**

**Objectives:** Units cover the structure of DNA, Genome organization, molecular mechanism of mutations and repair; explains the DNA replication, Genome Rearrangements & Recombination.

**CO1:** Know the life with molecular functionalities, chemical and molecular processes that occur in and between cells.

**CO2:** Genome Organization from prokaryotes to Eukaryotes.

**CO3:** Genome Replication in from prokaryotes to Eukaryotes.

**CO4:** Knowledge about the changes or losses in cell function, includes alterations of cell function brought about by mutations and DNA repair

**CO5:** How genes are evolved by gene rearrangements and recombination and by transposons.

### UNIT 1: Genome Organization

- 1.1. Historical perspective: DNA as a genetic material, structure of DNA, Genome size, C-value paradox. (2)
- 1.2. Organization of prokaryotic genome and eukaryotic nuclear genome (Chromosome number, Gene size, Gene density). (2)
- 1.3. Unique sequences, repeated sequences – interspersed and tandem repeats; satellite DNA, mini satellites and microsatellites. (2)
- 1.4. Gene families (Clustered and Dispersive – Hemoglobin gene and Histone gene clusters). (2)
- 1.5. Pseudogenes– processed and unprocessed. (2)
- 1.6. Organization of Mitochondrial and Chloroplast genomes. (2)

### UNIT 2 : DNA Replication, Damage and Repair

- 2.1 DNA Replication–Enzymes involved in the replication of DNA, Origin of replication fork (2)
- 2.2 Replication of genome replication (Prokaryotes and Eukaryotes). (2)
- 2.3 Replication associated errors & Inhibitors of DNA replication (2)
- 2.4 Damage and Repair: Spontaneous and Induced mutations, physical and chemical mutagens, DNA damages (oxidative damages, depurinations, depyrimidinations, O<sup>6</sup>-methylguanines, cytosine deamination, single and double strand breaks). (2)
- 2.5 Types of mutagenesis–transition, transversion, frameshifts, missense and non-sense mutations. (2)
- 2.6 Repair mechanisms– Photo-reactivation, Excision repair (base excision repair, nucleotide excision repair), mismatch repair, SOS repair. (2)



### UNIT 3: Transcription and Translation

- 3.1 Transcription factors, activators, specific factors (Zinc fingers, Leucine zippers, helix loop helix and homeodomain); Types of RNA polymerases. (2)
- 3.2 Transcription in prokaryotes (components; initiation, elongation and termination of transcription) & Transcription in eukaryotes (components; initiation, elongation and termination of transcription. Post-transcriptional processing, 5'-capping and polyadenylation. Splicing mechanism alternate splicing, self-splicing & trans-splicing. (2)
- 3.3 Transcription inhibitors and their applications. (2)
- 3.4 Properties of genetic code (universal code, degeneracy, redundancy) & Correspondence of amino acid sequence with nucleotide sequence in DNA (Single letter code for amino acids. (2)
- 3.5 Translation machinery in prokaryotes & eukaryotes, initiation (factors, assembly of ribosomes), elongation, termination. Post translational modifications of proteins: glycosylation, lipidation, acetylation, ubiquitination, protein splicing, chaperones, modification of amino acids, disulphide bond formation. (2)
- 3.6 Translational activators and inhibitors. (2)

### UNIT 4: Genes, Genome Rearrangements and Recombination

- 4.1 Structure of Prokaryotic gene, operons, polycistronic mRNA, inducible operon (Lac operon), repressible operon (Trp operon) & Fine structure of eukaryotic gene (Core and proximal promoters & enhancers, exons, introns, UTRs), monocistronic mRNA (2)
- 4.2 Essential genes- Proportion and distribution in the genome (prokaryotes and eukaryotes). (2)
- 4.3 Functional RNA genes (rRNA, tRNA) & Regulatory small RNA coding genes (snoRNA, snRNA, miRNAs, lnc RNAs). (2)
- 4.4 Whole genome duplication. Mechanism of Gene Duplication and Amplification: Insertion, deletion and translocation of sequences (Eg: flip-flop inversion, yeast mating type, Tetrahymena DNA). (2)
- 4.5 Transposable genetic elements: Types of mobile elements, mechanisms of transposition, Transposable elements in prokaryotes and eukaryote (2)
- 4.6 Retrotransposon class I and class II, Retrogenes, Transposons and their role in genome evolution. (2)

### UNIT 5 Regulation of Gene expression and Epigenetics

- 5.1 Control of gene expression at transcription and translation level, co-ordinated regulation of gene expression. (2)
- 5.2 Regulation of gene expression in eukaryotes- genes controlling yeast mating type, regulation of Xenopus 5s rRNA in oocytes, using a strategically placed enhancer as genetic switch – chicken globin genes. (2)
- 5.3 Gene regulation exerted at the level of translation – silk fibroin gene, regulation at splice site selection – Drosophila sex determination. (2)
- 5.4 Role of chromatin in regulating gene expression and gene silencing, DNA methylation, histone modification (acetylation, deacetylation, analysis of epigenetic modifications, epigenetic memory). (2)

*Dr. S. S. S. S.*



5.5 Role of nutrition and environment in epigenetic modifications. (2)

**REFERENCE BOOKS :**

1. Molecular Biology of the Gene by J.D. Watson, N.H. Hopkins, J.W, Robertis
2. A.Steitz& A.M. Weiner, Benjamin Cummings Publ. California
3. Genes VII. Benjamin Lewin, Oxford Univ. Press, Oxford
4. Molecular Biology by D. Freifelder Narosa Publishing house New York, Delhi,
5. Molecular Cell Biology H.Lodish, D.Baltimore, A.Fesk,S.L.Zipursky, P.Matsudaride and Darnel American Scientific Books. W.H. Freeman, New York
6. Advance Molecular Biology R.M.Twyman, Bios Scientific publishers Oxford
7. Molecular Biology by T.A. Brown
8. Essentials of Molecular Biology. D. Freifelder, Panima publishing co-operatio
9. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff,Keith Roberts and Peter Walter.
10. Genes & Genomes – A changing perspective by Singer &Berr, Universal Science Books, California.
11. DNA Damage Repair, Repair Mechanisms and Aging by Allison E. Thomas Nova Science Publisher's, 2010.
12. Chromosomal Translocations and Genome Rearrangements in Cancer by Janet D. Rowley, Michelle M. Le Beau, Terence H. Rabbitts Springer International Publishing, 2015

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## ADVANCED TECHNIQUES IN BIOTECHNOLOGY

**Credits: 4**

**Subject code: MBT 22205**

**I Year / II Semester**

**No. of lecture hours: 60**

**Objective:** To have an exposure about Bioanalytical techniques and to prepare students to learn the techniques so that they are easily absorbed and placed in R&D Laboratories and Biotechnology industries.

**Out Comes:** students will be able to gain knowledge on techniques in biotechnology

<b>UNIT- I Chromatography</b>	<b>12Hrs</b>
1.1 Basic principle, instrumentation and applications of:	(2)
1.1.1 Paper chromatography.	
1.1.2 Thin layer chromatography.	(1)
1.1.3 Gel filtration (molecular sieve).	(1)
1.1.4 Ion Exchange chromatography.	(1)
1.1.5 Affinity chromatography.	(1)
1.2 Matrices & support materials used in chromatography.	(1)
1.3 Types of partition chromatography.	(2)
1.4 HPLC	(2)
1.5 Gas chromatography.	(1)
<b>UNIT- II Electrophoresis</b>	<b>12Hrs</b>
2.1 Introduction of electrophoresis - Migration of an ion in field, principle factors affecting rate of electrophoretic mobility.	(2)
2.2. Types of electrophoresis - Basic principle experimental procedures-	
2.3 Paper electrophoresis	(2)
2.4 Agarose gel electrophoresis	(2)
2.5 PAGE	(2)
2.6 Capillary electrophoresis & ImmunoElectrophoresis	(2)
2.7 2-D electrophoresis & Gradient Gel electrophoresis.	(1)
2.8 Isoelectric focusing.(IEF)	(1)
<b>UNIT- III</b>	
<b>Electrophysiological Techniques</b>	<b>12Hrs</b>
3.1 single neuron recording	(2)
3.2 patch-clamp recording	(2)
3.3 Electrocardiogram(ECG)	(2)
3.4 Brain activity recording	(2)
3.5 Lesion and stimulation of brain	(2)
3.6 Electroencephalogram(EEG)	(2)
<b>UNIT- IV Spectroscopy</b>	<b>12Hrs</b>




- |      |  |     |
|------|--|-----|
| 4.1  | Basic principles-electromagnetic radiation, electromagnetic spectrum.  | (1) |
| 4.2  | Calorimetry & Spectrophotometry  | (2) |
| 4.3  | U.V. & Visible absorption spectra                                      | (1) |
| 4.4. | I.R Spectroscopy - Basic principles & applications                     | (1) |
| 4.5. | N.M.R. Spectroscopy Basic principles & applications                    | (1) |
| 4.6  | Raman spectroscopy- Basic principles & applications                    | (1) |
| 4.7  | Optical rotatory Dispersion & circular Dichroism (CD, ORD)             |     |
| 4.8. | Mass spectrometry  | (1) |
| 4.9. | Basic principles & Applications of Autoradiography                     | (1) |
| 4.10 | Phosphorescence Fluorescence, Fluorescent Activated Cell Sorter (FACS) | (2) |

**UNIT- V Microscopy & Diagnostic Radiographic techniques** **12Hrs**

- |     |  |     |
|-----|--|-----|
| 5.1 | Basic Microscopy   | (2) |
| 5.2 | Confocal Microscopy & Laser microscopy   |     |
| 5.3 | Electron Microscopy-Transmission electron microscopy (TEM), Scanning Electron Microscopy (SEM) | (2) |
| 5.4 | Magnetic resonance imaging (MRI)   | (1) |
| 5.5 | PET SCANS  | (2) |
| 5.6 | Optical Tomography   | (2) |
| 5.7 | X-ray diffraction  | (1) |
| 5.8 | Imaging technologies   | (2) |

**ESSENTIAL READING**

1. Avinash Upadhyay, Kakoli Upadhyay, & Nirmalendu Nath. 2003 **Biophysical Chemistry-Principles & Techniques**. 4th edition, Himalaya Publishing House, Bangalore.
2. Freifelder, D. 1982 **Physical Biochemistry**. 2nd edition. ACS Publication, Washington.D.C.

  
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## r-DNA TECHNOLOGY

**Credits: 4**  
**Subject code: MBT 22206**

**I Year / II Semester**  
**No. of lecture hours: 60**

**Objectives:** Units cover the enzymes and vectors used in molecular cloning, construction of genomic and cDNA Libraries, techniques employed in molecular cloning, selection and analysis of recombinant Clones for better understanding of the subject of recombinant technology.

- CO1:** Explains usage of enzymes in molecular cloning  
**CO2:** Apply the principles of Vectors used in molecular cloning  
**CO3:** Illustrates Construction of Genomic and cDNA Libraries  
**CO4:** Describes Techniques employed in molecular cloning  
**CO5:** Relates Selection and Analysis of recombinant Clones

<b>Unit I: Enzymes used in molecular cloning</b>		<b>11Hrs</b>
1.1	Discovery of restriction enzymes - Host controlled modification	(2)
1.2	Restriction endonucleases and classification	(2)
1.3	Modifying enzymes used in molecular cloning; methylases, ligases, kinases & phosphatases	(3)
1.4	Nucleases	(2)
1.5	Polymerases: RNA dependent DNA polymerase, Terminal De-oxynucleotidyl transferase	(2)
<b>Unit II: Vectors used in molecular cloning</b>		<b>11Hrs</b>
2.1	E. coli plasmid vectors-pBR322, pUC18	(2)
2.2	Bacteriophage vectors - $\lambda$ and M13	(2)
2.3	Cosmids, phagemids and Phasmids	(2)
2.4	Shuttle vectors - Yeast vectors	(2)
2.5	Baculo virus vector, SV-40	(3)
<b>Unit III: Construction of Genomic and cDNA Libraries</b>		<b>10Hrs</b>
3.1	DNA cloning	(2)
3.2	Strategies for construction of genomic libraries	(2)
3.3	Jumping and linking libraries	(2)
3.4	Chromosome walking	(1)
3.5	Strategies for construction of cDNA libraries	(1)
3.6	Subtraction libraries	(2)
<b>Unit IV: Techniques employed in molecular cloning</b>		<b>16Hrs</b>
4.1	Labeling of Nucleic acids and proteins	(1)
4.2	Blotting and Hybridization techniques- Southern Blotting	(1)
4.2.1	Northern Blotting	(1)
4.2.2	Western Blotting	(1)



4.2.3	Zoo blots	(1)
4.2.4	Colony hybridization	(1)
4.3	DNA sequencing: Maxam and Gilbert method	(1)
4.3.1	Sanger's method	(2)
4.4	PCR technology	(1)
4.5	Genome editing techniques-TALENs, CRISPR-Cas system	(2)
4.6	Molecular marker types: Hybridization based	(2)
4.7	Molecular marker types: PCR based	(1)
4.8	Molecular markers: applications	(1)

### Unit 5: Selection and Analysis of recombinant Clones

12Hrs

5.1	Genetic selection: Alpha complementation & Insertional inactivation	(1)
5.2	Screening of libraries using labeled probes	(1)
5.3	Restriction mapping of cloned fragments	(2)
5.4	S <sub>1</sub> Nuclease Mapping	(1)
5.5	Hybrid arrest and hybrid released translation	
5.6	Site directed mutagenesis	(2)
5.7	Factors influencing cloned gene expression	(2)
5.8	Applications of rDNA technology	(2)

### Reference Books:

1. Principles of gene manipulation, S. B. Primrose, R. M. Twyman, R. W. Old Blackwell Publication, Massachusetts, 6th edition, 2001
2. Molecular Cloning –A laboratory Manual, Joseph Sambrook, David W. Russell, volume -I, II, III, Cold Spring Harbour Laboratory Press, Newyork, 3rd edition, 2001
3. Molecular Biotechnology-Principles & Applications of Recombinant DNA Bernard R. Glick, Jack. J. Pasternak, Panima Publishing House, New Delhi, 1<sup>st</sup> edition 2002
4. From Genes to Clones-Intoduction to Gene Technology, Ernst L.Winnacker, Panima Publishing House, New Delhi, 1<sup>st</sup> edition , 2003
5. DNA Science-A First Course, David A. Micklos,Greg A.Freyer, I. K International Pvt. Ltd, New Delhi, 2<sup>nd</sup> edition ,2003
6. Recombinant DNA: Genes & Genomes-A Short Course, James D.Watson,Amy A. Caudy, Cold Spring Harbour Laboratory Press,Newyork,3<sup>rd</sup> edition,2007
7. Molecular Biology, Robert F. Weaver, Mc Grawhill publication, Newyork, 2nd edition, 2002
8. Molecular Biology of the Gene J. D. Watson, N. H. Hopkins, J. W. Robertis, A. Steitz, A. M. Weiner, Benjamin Cummings Publication, California, 7<sup>th</sup> edition, 1988.
9. Genes: Volume VI, VII, VIII Benjamin Lewin, Oxford University Press, Oxford, 7th edition, 2000

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## IMMUNOLOGY PRACTICALS

Credits: 2

Subject code: MBT 22207

I Year / II Semester

No. of lecture hours: 3hrs/week

1. ABO blood grouping
2. Dot Enzyme-Linked Immuno-sorbent Assay
3. Single Radial Immunodiffusion
4. Micro-hemagglutination Test
5. Ouchterlony double diffusion
6. Counter current Immuno electrophoresis
7. IgG Purification
8. Differentiation of titers of Rheumatoid Arthritis
9. Principle and procedure for Enumeration of specific cell types by Fluorescence Activated Cell Sorter (FACS)

A handwritten signature in black ink, appearing to read 'Smita C. Pawar'.

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## MOLECULAR BIOLOGY PRACTICALS

**Credits: 4**

**Subject code: MBT 22208**

**I Year / II Semester**

**No. of lectures: 3hrs/week**

1. Isolation of Genomic DNA from bacteria.
2. Isolation of Genomic DNA from Plant Tissue/Animal Tissue/Human blood.
3. Determine purity of DNA by agarose gel electrophoresis.
4. Determination of melting temperature of DNA.
5. Determination of purity and concentration of DNA– Spectrophotometric method.
6. Re-association Kinetics and estimation of Cot values.
7. Induction of mutations by chemical agents.
8. Determination of DNA damage by Comet assay.
9. Isolation of mRNA from blood/tissue.
10. Gene expression analysis by qRTPCR.

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## r-DNA TECHNOLOGY PRACTICALS


Credits: 4

Subject code: MBT 22210

I Year / II Semester

No. of lectures: 3hrs/week

1. Restriction digestion of genomic or lambda DNA
2. Molecular size determination of the fragments
3. Double digestion of DNA and restriction mapping,
4. PCR analysis-interferon gene using own DNA
5. RAPD analysis - rice varieties
6. DNA fingerprinting by RFLP
7. Problems on restriction mapping

  
Prof. Smita C. Pawar  
Professor  
Chairperson- BoS in Biotechnology  
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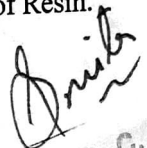
## ADVANCED TECHNIQUES IN BIOTECHNOLOGY PRACTICALS

Credits: 4

Subject code: MBT 22209

I Year / II Semester  
No. of lectures: 3hrs/week

1. Isolation of Starch from Potato.
2. Isolation of Glycogen from Liver.
3. Isolation of Casein from Milk
4. Isolation of Phospholipid from Egg.
5. Paper Chromatography of Sugars
6. Thin Layer Chromatography of lipids.
7. Desalting of Proteins by Dialysis.
8. Gel filtration Chromatography.
9. Ion exchange Chromatography. Determination of Ion exchange capacity of Resin.

  
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