Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. Biotechnology

(2019 Course)

Course Code: 19ScBioP101

Course Name: Advanced Biological Chemistry

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite:

- Basic Knowledge of Biochemistry.

Course Objectives:

- To develop a sufficient background for those students who wish to study more advanced biochemistry.
- To improve the ability of thinking in advanced biochemistry and protein chemistry fields.
- To create a basic understanding of the importance of enzymes and enzyme kinetics as cellular catalyst and also applications of enzymes in different fields. Also to familiarize the student with enzymes purification techniques.
- Basic knowledge on phytochemistry, secondary metabolites and their analysis.

Course Outcomes:

- Expertise in various biochemistry techniques.
- Understand enzyme kinetics and enzyme inhibition.
- At the end of the course, the students will have sufficient scientific understanding of the enzymology, protein chemistry and phytochemistry. This knowledge would be applicable in different industries

Semester I

Course Contents

Chapter 1	**Protein Biochemistry I**	14 lectures
	• Structure of Proteins: Primary, Secondary, Tertiary, quaternary. Study of protein motifs and protein families. • Protein folding mechanisms and Pathways. Factors affecting stability- Molten globule, energy funnel, chaperons. • Protein misfolding and diseases • Protein Engineering and its applications • Protein –protein interaction and protein –DNA interaction Structure –function relationship Therapeutic Proteins	
Chapter 2	**Protein Biochemistry II-Enzymes**	14
	.Enzyme – Concept of active site, binding sites, Stereospecificity of enzyme and ES complex formation • Enzyme Activity,Various factors influencing enzyme activity and	

	Enzyme inhibition • Mechanism of enzyme action and Enzyme regulation.Multienzyme complexes • Enzyme kinetics Rate of reactions, steady state enzyme kinetics, Michaelis-Menten Equation - form and derivation. Significance of Vmax and Km, K/cat. Bisubstrate reactions. Graphical procedures in enzymology. Lineweaver Burke's Plot, EdieeHofstee plot • Clinical and Industrial Applications of enzymes -Enzyme Engineering, Biosensors (glucose oxidase, Cholesterol Oxidase),Antibodies as a biosensors, • Enzymes :Diagnostics and therapeutic.	
Chapter 3	**Metabolomics**	10
	• Overview of metabolism, Integration of Metabolism • The Metabolome – Metabolic flux, Metabolic flux analysis • Metabolic engineering – 2 eg. Polyketides Synthesis, Xenobiotics	
Chapter 4	**Phytochemsitry**	10
	• Introduction to secondary Metabolism, primary metabolite as precursors of secondary Metabolite • Pathways for secondary Metabolite 1. Mevalonate pathway 2.Shikimate Pathway 3.Isoprene Unit Pathway (IPP) • Study of secondary Metabolite 1. Alkaloids 2. Phenols 3. Terpenes • Extraction methods & Qualitative & Quantitative Analysis	
	Total Lectures	**48**

References:

1. Proteins: Biotechnology and Biochemistry, 1st edition (2001), Gary Walsch, Wiley, USA
2. Phytochemical Method, 3rd edition (1998), A.J. Harborne, Springer, UK.
3. Pharmacognosy, 14th edition, (2008), Dr. C. K. Kokate, A. P. Purohit, S. B. Gokhale, NiraliPrakashan, India.
4. Trease and Evans' Pharmacognosy, 16th edition (2009), William Charles Evans, Saunders Ltd. USA.
5. Introduction to Practical Biochemistry, (2000), S. K. Sawhney, Randhir Singh Narosa, 2000. Practical Enzymology, 2nd edition (2011), HansBissWanger, Wiley-Blackwell, USA.
6. Biochemical Calculations, 2nd Ed., (1997) Segel Irvin H., Publisher: John Wiley and Sons, New York.
7. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.
8. Metabolic Engineering: Principles and Methodologies. (1998). Gregory N Stephanopoulos, Aristos A Aristidou, Jens Nielsen. Publisher: Academic Press, San Diego, US

9. Outlines of Biochemistry: 5th Edition, Erice Conn & Paul Stumpf ; John Wiley and Sons, USA
10. Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet& Judith Voet , John Wiley and Sons, Inc. USA
11. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson& Michael Cox, W.H. Freeman and company, NY.
12. Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf ; John Wiley and Sons, USA
13. Biochemistry: 7th Edition, (2012), Jeremy Berg, LubertStryer, W.H.Freeman and company, NY
14. An Introduction to Practical Biochemistry.3rd Edition, (2001), David Plummer, Tata McGraw Hill Edu.Pvt.Ltd. India
15. Biochemical Methods.1st , (1995), S.Sadashivam, A.Manickam, New Age International Publishers, India

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. Biotechnology

(2019 Course)

Course Code: 19ScBioP102

Course Name: Cell and Molecular Biology

Teaching Scheme: TH:4Hours/Week **Credit: 04**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Basic of cell biology.
- Basic of molecular biology- structure of DNA,RNA

Course Objectives:

- To Study advances in information in cell biology
- To gain a better understanding of the cell, its function and interactions in an organism.
- To Study advances in information in molecular biology
- To gain a better understanding of the regulatory processes in the cell at molecular level

Course Outcomes:

On completion of the course, student will be able to–

- Obtain the latest developments in the field of cell biology and application of the information in understanding cell processes.
- Obtain the latest developments in the field of molecular biology and application of the information in understanding cell regulatory processes

Semester I

Course Contents

	Cell Biology	
Chapter 1	**Cell structureand interactions**	**12 Lectures**
	• Cell structure and Organization • Intracellular transport at molecular level. • Cell signaling – Signaling at cell surface, signaling molecules, Hormones and receptors, Signaling pathways Signal transduction and second messengers. • Communication between cells and environment, Extracellular matrix and cell junctions, plasmodesmata.	
Chapter 3	**Cell cycle and cell differentiation**	**12 Lectures**
	• Cell cycle and its regulation. • Cell differentiation in plants and animals including terminal cell differentiation. • Cell transformation and etiology of cancer. • Cell death, Role of hormones and growth factors in programmed cell death.	
	Molecular Biology	
Chapter 1	**Genome structure and organization**	**8 Lectures**
	• Introduction to Prokaryotic and Eukaryotic Genome.	

	• Chromatin Organization • Gene families, clusters, Pseudogenes, super-families • Mobile DNA elements: Transposable elements in bacteria, IS elements,composite transposons,replicative and non-replicative transposons, • Mu transposition,controlling elements in TnA and Tn10 transposition. SINEs and LINEs, retrotransposons. • C- Value paradox and genome size, Cot curves, repetitive and Non-repetitive DNA sequences, Cot ½ and Rot ½ values, satellite DNA and DNA melting and buoyant density.	
Chapter 2	**DNA replication**	**4Lectures**
	• DNA replication: DNA replication models, connection of replication to cell cycle, Reverse Transcriptase.	
Chapter 3	**Gene expression in prokaryotes and Eukaryotes**	**12Lectures**
	• Transcription in prokaryotes and eukaryotes. Chromatin remodeling in relation to gene expression, DNase hypersensitivity, DNA methylation. • Regulation of transcription including transcription factors. Post-transcriptional processing and transport of RNA. • Non coding RNAs. Organization and function of ribonucleoproteins (Ribonome concept) • Components of protein synthesis, Mechanism of protein synthesis, Genetic code, Regulation of protein synthesis, Post translational modification	
	Total Lectures	**48**

References: Cell Biology

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., KReiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA.

References: Molecular Biology

1. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA
2. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick. Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA
3. Molecular Biology, 5th Edition (2011), Weaver R., McGrew Hill Science. USA
4. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press. India
5. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp, Jones & Bartlett Learning, USA .

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First Year of M.Sc. Biotechnology

(2019 Course)

Course Code: 19ScBioP103

Course Name: Genetics & Immunology

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Basic of Genetics and Immunology

Course Objectives:

- To Study advanced Genetics and Immunology
- To gain a better understanding of the Applications of Genetics and Immunology

Course Outcomes:

On completion of the course, student will be able to–

- Obtain the latest developments in the field of Genetics and Immunology and applications of the same in diagnostics.

Semester I

Course Contents

Chapter 1	**Basics of Genetics**	5 lectures
	• Mendelian Genetics: Laws of heredity and modifications of monohybrid interactions (Incomplete dominance, Co-dominance and Over dominance, Multiple alleles, Lethal genes) • Gene interactions : dominant and recessive epistasis, duplicate genes, Complementary genes and dominant & recessive interactions, • Pleiotropy.	
Chapter 2	**Population genetics& human genetics**	5 lectures
	• Population genetics: Hardy –Weinberg principle and its applications. • Human genetics : Basics of Clinical genetics, testing and diagnosis of human genetic disorders	
Chapter 3	**Plant genetics**	6 lectures
	• Genetics of plant breeding- Genetic basis and mechanisms of pre- and post-zygotic incompatibility • Genetics of somaclonal variations, apomicts& androgenic plants	
Chapter 4	**Important model systems in Genetics**	8 lectures
	• *Drosophila*, • *C.elegans*, • Zebrafish • *Arabidopsis*	
Chapter 5	**Basics of Immunology**	6 lectures

	• Overview of immune system: Cells, Organs and Tissues of immune system. • Types of Immunity - Innate immunity, Acquired immunity Protective and Destructive • Autoimmunity, molecular mimicry • Parasitic immunology • Transplant immunology	
Chapter 6	**Complement System and Hypersensivity**	6 lectures
	• Complement system: Components of Complement system Three pathways of complement activation • Types of Hypersensitivity	
Chapter 7	**Antigen – Antibody reactions**	6 lectures
	• Applications in Diagnostics. • Techniques in molecular immunology Hybridoma technology (Monoclonal antibody) Antibody engineering, Chimeric antibodies, Phage display	
Chapter 8	**Vaccine development**	6 lectures
	• Recombinant vaccine, • Combined and polyvalent vaccines	
	Total Lectures	**48**

References:

1. Williams EG, Clarke AE, Bruce Knox R (1994) – Genetic control of self incompatibility and reproductive development in flowering plants (Kluwer Academic Publ, Netherlands)
2. Franklin-Tong VE (2008) – Self incompatibility in flowering plants – evolution, diversity and mechanisms (Springer, Berlin Heidelberg)
3. Principles of plant genetics and breeding, 2nd edition(2012), Acquaah G, Wiley –Blackwell, UK
4. Developmental genetics, 1st edition, (2006) Miglani GS, IK International, India
5. Savidan Y, Carman JG, Dresselhaus T Eds (2001) – The flowering of apomixis: From mechanisms to genetic engineering (CIMMYT, IRD, European commission DG VI (FAIR)
6. Plant breeding: principles and methods, 11th edition (2009), B D Singh, Kalyani Publisher, India.
7. iGenetics, 3rd edition (2011), Peter Russel, Benjamin Cummings, USA.
8. Strickberger MW (2006) - Genetics (Prentice Hall, India)
9. Hartl DL, Jones EW (2001) – Genentics: analysis of genes and genomes (Jones and Bartlett, Massachusetts)
10. Kuby immunology, Judy Owen , Jenni Punt , Sharon Stranford., 7th edition (2012), Freeman and Co., NY
11. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and ShubhangiSontakke, University Press, India
12. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. Biotechnology

(2019 Course)

Course Code: 19ScBioP104

Course Name: Environmental Biotechnology (T+P)

Teaching Scheme: TH: 2 Hours/Week **Credit : 04 (2+2)**
Examination Scheme: CIA: 50 Marks **End-Sem : 50 Marks**

Prerequisite Courses:

- Knowledge of Environment Science up graduation

Course Objectives:

- To Study the current scenario of environment and its effect on abiotic and biotic factors
- To learn advance techniques to slove environmental problems

Course Outcomes:

On completion of the course, student will be able to–

- Understand the environment and its ever changing climate so raising new problems and then finding the solution of it

Semester I

Course Contents

Chapter 1	**Energy and Environment**	**1 Lectures**
	• Natural energy resources and their exploitation (Conventional)	
Chapter 2	**Pollution and Environment**	**4 Lecture**
	• Introduction to environmental components, future scenarios of the global environment • Impact on environment (biotic & abiotic), transport and diffusion, monitoring, quality standards, carbon footprints • causes and consequences of climate change (global warming, Ozone hole, Sea level rise),	
Chapter 3	**Waste management**	**5 Lectures**
	• Waste water technology, Activated sludge process, Removal of organic and inorganic pollutants • Solid waste management: Sources and types, Impact of solid waste disposal, Recycle, Reuse and Recovery solutions	
Chapter 4	**Bioremediation Removing Pollutants from Environments**	**5 Lectures**

	• Introduction to use of biological agents in pollution control, Advantages, limitations and Principle, types of Bioremediation and factors affecting: Natural, Engineered, *Ex-situ* and *in- situ* • Xenobiotic degradation,: Biomining, Biomethanation, Bioleaching, Bio plastic technology • Biological Fertilizer and pesticides. • Principles and methods in: Bioaugmentation Biostimulation Phytoremediation	
Chapter 5	**Environment monitoring management**	**5 Lectures**
	• **Remote sensing and GIS :**Principal, and objectives, Energy sources for remote sensing, and GIS • Types of remote sensing Applications- Agricultural, Forestry, Water Resource, Urban Planning, Wild life Ecology, Environmental Informatics • **Environmental Impact Assessment:** Introduction, Objectives, Classification, Guidelines. Case Study. • **Environmental Audit:** Introduction, Types, General Methodology, International and Indian Eco-standards ISO14000 series overview.	
Chapter 6	**Environmental Laws and Policies**	**4 Lectures**
	International: in the view of global concerns, objectives of laws/regulations, importance Stockholm conference, Nairobi declaration, Rio conference, **India:** The water Act. 1974, The Air Act 1981, The Environment Protection Act 1986- Their important objectives	
	Total Lectures	**24**

References:

1. Alternative Energy: S. Vandana; APH Publishing Corporation
2. Bio-Energy Resources: Chaturvedi; Concept Pub.
3. Environmental Pollution, N. Manivasakam
4. Agenda 21: Guidelines for Stakeholders Patwardhan&Gunale
5. Air Pollution (2004) HVN Rao and M N Rao Tata McGraw-Hill
6. Air Pollution Control CP Mahajan, Capitol Publishing Co
7. Air Pollution Engineering Manual (2000) Wayne T Davis (editor), Air and Waste Management Association, Wiley Interscience
8. An Introduction To Geographic Information Technology (2009) SuchandraChoudhury I K International Pvt Ltd.
9. Bioremediation (1994) Baker, K.H and Herson, D.S.McGraw Hill, Inc. New York
10. Concepts and Techniques of Geographic Information Systems (2009)C.P.Lo.Albert and K.W.Yeung
11. Environment Impact Assessment (1996) Larry W. Canter McGraw-Hill Book Company
12. Environmental Audit (2002) Mhaskar A.K. Enviro Media Publications
13. Environmental biotechnology(2010) RanaRastogi Publications
14. Environmental Protection and Laws (1995) Jadhav and BhosaleV.M.Himalaya publishing House.
15. Environmental Science (2011) Santra S.C. New Central Book Agency
16. Remote sensing of the environment (2000) John R. Jensen Dorling Kindersley India Pvt. Ltd
17. Textbook of Remote sensing and GIS (2006) M. Anji Reddy 3rd

Semester I

Course Contents : Practical

Sr. No.	Title	No of practicals
1	Removal and estimation of pollutant from soil/water samples by biostimulation/ phytoremediation	2
2	Genotoxicity assay on polluted water- Onion root tip and pollen	2

	germination assay.	
3	Qualitative and quantitative estimation of biodegradation of pesticide/ insecticide/fungicide.	2
4	Estimation of Total suspended solids of waste water	1
5	Determination of dissolved oxygen concentration of water sample	1
6	Determination of chemical oxygen demand (COD) of sewage sample.	1
7	Determination of biological oxygen demand of sewage sample	1
8	Acquisition of "Google Earth" images for the known and unknown area for land use - land cover mapping.	1
9	Review on EIA case study.	1
	Total Lectures	**24**

References:

1 An Introduction To Geographic Information Technology (2009) SuchandraChoudhury I K International Pvt Ltd.
2 Bioremediation (1994) Baker, K.H and Herson, D.S.McGraw Hill, Inc. New York
3 Environment Impact Assessment (1996) Larry W. Canter McGraw-Hill Book Company
4 Environmental biotechnology(2010) RanaRastogi Publications
5 Environmental Science (2011) Santra S.C. New Central Book Agency
6 Remote sensing of the environment (2000) John R. Jensen Dorling Kindersley India Pvt. Ltd Textbook of Remote sensing and GIS (2006) M. Anji Reddy 3rd

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. Biotechnology

(2019 Course)

Course Code: 19ScBioP105

Course Name: Food Biotechnology

Teaching Scheme: TH: 4 Hours/Week **Credit : 04**

Examination Scheme: CIA : 50 Marks **End-Sem : 50 Marks**

Prerequisite Courses:

- Knowledge of Biotechnology upto graduation

Course Objectives:

1. To provide knowledge about techniques used in plant, animal and microbial biotechnology
2. To introduce students to new developments in the field of food biotechnology

Course Outcomes:

On completion of the course, student will be able to–

- To understand the role of biotechnology in Food processing and preservation

Semester I

Course Contents

Chapter 1	**Importance of Biotechnology in food processing**	**6 lectures**
	• Recombinant DNA Techniques • Plant and Animal Biotechnology • Genetically modified plants and animals- Applications in Food Production	
Chapter 2	**Microbial biotechnology**	**5 lectures**
	• Genetically modified microorganisms • Fermentation Technology- Use of microbes in the production of alcohols (Beer, Wine), bread, Yogurt, Organic acids (Acetic acid, Lactic acid, Citric acid), Vitamins • Pigments, Flavors, sweeteners	
Chapter 3	**Enzyme Technology**	**5 lectures**
	• Use of Biotechnology for the production of enzymes- Amylases, Proteases, Lipases, Cellulases, Pectinases. Applications of these enzymes in food processing • Applications of Biotechnology in food waste management and development of value added products	
Chapter 4	**Nanobiotechnology**	**6 lectures**
	• Use of nanoparticles for delivery of bioactive constituents, nanoencapsulation, nanopackaging, nanosensors for detection of pesticides & pathogens • Applications of Nutrigenomics in the food industry Ethical Concerns, Safety and Regulatory Issues of biotechnological products	
Chapter 5	**Prebiotics and Probiotics**	**8 lectures**

	• Food Sources- Prebiotics [Dietary fibre, Oligosaccharides (Galacto oligosaccharides, Fructo oligosaccharides), Resistant Starch, Sugar alcohols], • Traditional Fermented Foods as sources of Probiotics • Strains of microorganisms used as probiotics Role in Health and Disease, Mechanism of Action, Levels of Probiotics required for therapeutic efficacy	
Chapter 6	**Nutraceuticals**	**6 lectures**
	• Major nutraceuticals and their health applications- Bioactive peptides, Curcumin, Conjugated Linoleic acid, Glucosamine, Carnitine, Creatine • Safety and adverse effects associated with the consumption of functional foods and nutraceuticals • Recent trends in food formulation; antioxidant rich food products; concepts for formulation of foods for drought and disaster afflicted; defence services, sportsmen, space food	
Chapter 7	**Role of QC and QA Quality,**	**6 lectures**
	• **Role of QC and QA Quality**: Quality Control, Quality Assurance, Concepts of quality control and quality assurance functions in food industries. • **Quality Improvement** Total Quality management : principals of TQM, stages in implementation, TQM road map. Quality improvement tools, customer focus, cost of quality	
Chapter 8	**Food Laws and FSSAI**	**6 lectures**
	• Food Laws and Standards: National and International food laws, Mandatory and voluntary food laws. • **FSSAI** Indian Food Regulations and Certifications: Food Safety and Standards Act, FSSAI Rules, common adulterants in foods, Duties and responsibilities of Food Safety Authorities	
	Total Lectures	**48**

References

1. Anthony Pometto (2005). Food Biotechnology, 2nd Edition. CRC Press
2. Byong H Lee (2014). Fundamentals of Food Biotechnology, 2nd Edition, Wiley- Blackwell
3. Goldberg, I 1994. Functional Foods: Designer Foods, Pharma foods, Nutraceuticals Chapman & Hall
4. Gibson, GR and William, CM. 2000. Functional foods - Concept to Product. Woodhead publishing.
5. Aluko, R.E. (2012). Functional Foods and Nutraceuticals. Springer
6. Inteaz Alli. 2004. Food Quality Assurance: Principles and Practices. CRC Press, Boca Raton, FL, USA.
7. Ronald H. Schmidt and Gary E Rodrick. 2003. Food Safety Handbook. John Wiley & Sons, Inc., Hoboken. New Jersey, USA.
8. R.E. Hester and R.M.Harrison. 2001. Food Safety and Food Quality. Royal Society of Chemistry, Cambridge, UK

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First Year of M.Sc. Biotechnology

(2019 Course)

Course Code : 19ScBioP106

Course Name: LAB Course 2: Exercises in Advanced Biological Chemistry and Immunology

Teaching Scheme: 4 Hours/Week **Credit: 02**
Examination Scheme: CIA : 50 Marks **End-Sem : 50 Marks**

Prerequisite Courses:

- Basics of isolation, purification and chromatography techniques

Course Objectives:

- To develop a sufficient background for those students who wish to study more advanced biochemistry.
- To improve the ability of thinking in advanced biochemistry fields.
- To create a basic understanding of the importance of enzymes and enzyme kinetics as cellular catalyst and also applications of enzymes in different fields.
- Basic knowledge on bioactive compounds and secondary metabolites

Course Outcomes:

On completion of the course, student will be able to–

- Expertise with various biochemistry techniques
- Ability of thinking in biochemistry fields

Semester I

Course Contents

Practical 1	**Protein Biochemistry I**	3 P
	Extraction, purification and characterization of : Beta galactosidase Assay of enzyme activity Isolation and precipitation and dialysis Enzyme Purificationby using Column Chromatography- Gel filtration/ Ion exchange Native & SDS PAGE	
Practical 2	**Protein Biochemistry II Enzymes**	4P
	Enzymology : Study of Enzyme Kinetics of beta Galactosidase Effect of time on enzymatic reaction Effect of various substrate concentration on the rate of enzymatic reaction Effect of pH and temperature on the rate of enzyme reaction Determination of K m and Vmax study of Inhibition of enzyme activity	
Practical 3	**Phytochemistry**	2P

	Phytochemical Methods Extraction Methods Qualitative detection _TLC Quantitative estimation of phytoconstituents	
Practical 4	ELISA	1P
	• Qualitative • Quantitative	
Practical 5	Immunodiffusion	1P
	Radial immunodiffusion	
Practical 6	Immunoelectrophoresis	1P
	Rocket- immunoelectrophoresis	

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First Year of M.Sc. Biotechnology

(2019 Course)

Course Code: 19ScBioP107

Course Name: Lab Course 2 Exercises in Cell and Molecular Biology

Teaching Scheme: P: 4Hours/ Week two batches **Credit: 02**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Basic techniques of cell biology
- Basic techniques like DNA isolation and electrophoresis

Course Objectives:

- To Study advance techniques of cell biology –density gradient centrifugation, osmo fragility, apoptosis.
- To learn RNA isolation and separation, DNA damage and repair systems, DNA denaturation kinetics

Course Outcomes:

On completion of the course, student will be able to–

- Design innovative /advanced cell and molecular biology practicals

Semester I

Course Contents

Practical 1	DNA damage	1P
	Comet assay	
Practical 3	RNA isolation and purification	3P
	RNA isolation, gel electrophoresis and oligo dT purification of mRNA	
Practical 4	Study of gene regulation – operon model	1P
	Use of *E.coli* for inducing *lac* operon	
Practical 5	DNA renaturation kinetics	1P
	To study the Tm of DNA and its renaturation kinetics using spectrophotometry	
Practical 6	Study of cell types	1P
	Study of different cell types in macerated tissue.	
Practical 7	Cell organelle isolation and purification	1P
	Cell organelle isolation,Purification by density gradient centrifugation.Its characterization	
Practical 8	Study of cell permeability and osmosis	1 P
	Study of cell permeability and osmotic fragility by RBC's	
Practical 9	Study of extracellular matrix	1P
	Study of extracellular matrix using growing of cells in presence of cell adhesion molecules.	
Practical 10	Study of cell cycle arrest	1P
	Study of cell cycle arrest using colchicine	

Practical 11	Study of apoptosis	1P
	Demonstration of apoptosis using suitable model systems .	

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First Year of M.Sc. Biotechnology

(2019 Course)

Course Code: 19ScBioP201

Course Name: Genetic Engineering

Teaching Scheme: TH: 4Hours/Week **Credit: 04**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:
Basic techniques of rDNA technology

Course Objectives:

- To Study important techniques of genetic engineering
- To learn basic and advance concepts used in genetic engineering

Course Outcomes:

On completion of the course, student will be able to–

- design novel techniques and experiments in genetic engineering

Semester II

Course Contents

Chapter 1	Introduction to Genetic Engineering	5 Lectures
	Introduction to Genetic Engineering and gene cloning. DNA modifying enzymes and restriction enzymes for Genetic engineering , Vectors in gene cloning-Plasmid, Cosmid, Phages, Phasmids, Advanced cloning vectors-BAC, YAC, PAC	
Chapter 2	Transformation and transfection	5 Lectures
	Transformation and Transfection: Various expression vectors in bacteria and eukaryotes-Yeast, Baculovirus, Mammalian cells.	
Chapter 3	Analytical techniques in GE	15 Lectures
	PCR – design and optimization, Types of PCR-Inverse, Nested, Reverse Transcription-PCR, Hot Start PCR, Quantitative PCR used to engineerDNA. Genomic and cDNA library: Screening and selection.	
Chapter 4	DNA sequencing	7 lectures
	Maxam-Gilbert method, Sanger's Dideoxy chain termination method, Automated DNA sequencing methods. Human genome sequencing and mapping. . Genetic and Physical mapping techniques.	
Chapter 5	Application of G.E.	4 lectures
	Genetic diseases-diseases-Detection and Diagnosis, Gene therapy – *ex vivo*, *in vivo*, viral and non-viral gene delivery systems.	

Chapter 6	DNA marker technology	4 lectures
	DNA marker technology in plants, DNA fingerprinting and DNA profiling.	
Chapter 7	Transgenic animals and Bio-pharming	5 lectures
	Genetically engineered biotherapeutics and vaccines and their manufacturing. Transgenic animals and Bio-pharming.	
Chapter 8	Biosafety regulations	3 lectures
	Principles of Biosafety regulations	
	Total Lectures	**48**

References:

1. From Genes to Genomes, 2nd edition, (2008), J.Dale and M.Schantz, John Wiley & Son Ltd.USA
2. Gene Cloning and DNA Analysis: an introduction, 6th edition, (2010) T. A. Brown, Wiley-Blackwell Publisher, UK
3. From Gene to Clones; Introduction to gene technology, 4th edition, (2003), E. Winnacker, Panima Publisher, India
4. Molecular Biology Problem solver: A laboratory guide (2004), A. Gerstein, A John Wiley & Sons, Inc., Publication, USA.
5. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. Biotechnology

(2019 Course)

Course Code:19ScBioP202

Course Name: Principles of Bacteriology and Virology

Teaching Scheme: TH: 4Hours/Week **Credit 04**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Study of basic microbiology in UG and basic concepts of virology

Course Objectives:

- To Study in detail the taxonomy and morphology of microorganisms
- To learnthe bacterial classification systems along with its characteristics
- To learn the viral classification systems along with its characteristics

Course Outcomes:

On completion of the course, student will be able to–

- Study the proper classification systems of bacteria and classify the organisms using Bergey's manual.
- In detail knowledge of biochemical cycles operative in microbes.
- Study the proper classification systems of viruses
- Knowledge of methods of Viral diagnosis

Semester II

Course Contents

	Bacteriology	
Chapter 1	**Bacterial Diversity and Taxonomy:**	**6 Lectures**
	• **Microbial diversity**-Tools used along with the bacterial morphological features • Taxonomy and nomenclature of bacteria, Types of bacterial classification systems,Bergey's Manual – in detail	
Chapter 2	**Microbial Physiology:**	**10 Lectures**
	• Chemotaxis, Bioluminescence, Microbial toxins, Physiological and genetic aspects of sporulation and spore germination • Microbial reserve compounds, Microbial stress responses • Mechanism of action of antibiotics and its resistance • Quorum sensing, Microbial fuel cells. • A brief account of genetic recombination in bacteria (transformation, conjugation and transduction).	
Chapter 3	**Microbial Metabolism:**	**8 Lectures**
	• Aerobic Respiration: Oxidativephosphorylation and its significance, Energy generation in all groups of chemolithotrophs. • Anaerobic Respiration: Biochemistry of methanogenesis and ammonia oxidation	
	Virology1	
Chapter 1	**Introduction to viruses:**	**6 Lectures**
	• General properties of viruses Morphology and	

	ultrastructure of Viruses • Classification of viruses: ICTV system, Baltimore system • Viral replication: DNA and RNA viruses with example, Bacteriophages	
Chapter 2		**10 Lectures**
	• General idea about cyanophages, actinophages and mycophages and viruses of insects. • Baculovirus System for insect cell lines,Subviral particles-Prions, virusoids, satellite viruses. • Purification and maintenance of viruses	
Chapter 3	**Types of viral Infections :**	**8 Lectures**
	• Acute and persistent infections • Epidemiology • Emerging viral diseases and Current outbreaks • Animal and Poultry viruses • Plant viruses • Applications: Viral Diagnosis and Antivirals	
	Total Lectures	**48**

References: Bacteriology

1. Introduction to Microbiology. 3rd Edition, (2004), Ingraham JL and Ingraham CA. Thomson Brooks / Cole.
2. Brock's Biology of Microorganisms. 11th Edition, (2006). Madigan MT, Martinko JM. Pearson Education Inc. , USA
3. Fundamental Principles of Bacteriology. 7th Edition, (1971) Salle AJ. Tata MacGraw Publishing Co. India
4. Microbiology: An introduction, 5th edition,(1992), Tortora, G.J., Funke B.R., Case C.L, Benjamin Pub.Co. NY
5. Microbiology, 4th edition (1990), Davis B.D. ,Debacco, J.B. Lippincott Co. NY
6. Zinsser, W , 1976, Microbiology Edition, W .K Jklik, NY
7. Medical Bacteriology, 14th edition, (1988), Dey, N.C and Dey, TK., Allied Agency, India.
8. Text book of microbiology 5th edition (1996), Ananthnarayana, R. and C.E, JayaramPanakar, Orient Longman.
9. General Microbiology, 5th edition (1987), Stanier R.Y., Adelberg E.A. and Ingraham J. L. Macmillan Press Ltd.

References: Virology

1. Principles of Virology 3rd edition, (1999), Flint Jane. S., ASM (American Society of Microbiology) Press Publisher, 2 volumes. USA.
2. Field's Virology - 2 volumes, 5th edition, (2006), Bernard.N. Fields, Lippincott and Williams Wilkins, USA.
3. Understanding viruses. Teri Shores, 3rd edition, Jones & Bartlett Publishers.

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. Biotechnology

(2019 Course)

Course Code: 19ScBioP204

Course Name: Agriculture Biotechnology

Teaching Scheme: TH:4 Hours/Week **Credit : 04**

Examination Scheme: CIA : 50 Marks **End-Sem : 50 Marks**

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. Biotechnology

(2019 Course)

Course Code: 19ScBioP205

Course Name: Medical Biotechnology

Teaching Scheme: TH:4 Hours/Week **Credit : 04**
Examination Scheme: CIA : 50 Marks **End-Sem : 50 Marks**

Prerequisite :

- Basic knowledge of Biotechnology, Biochemistry and Microbiology

Course Objectives:

- To develop a background for those students who wish to study more advanced in the field of medical biotechnology.
- To improve the ability of thinking in advanced in different areas like research, pharma industry

Course Outcomes:

- Student will get exposure to various areas like Genetic Diseases, Molecular basis of diseases, and also various therapies.
- Expertise in different areas of Medical biotechnology which includes Gene therapy, Stem cell technology,
- Also get exposure to various disease diagnosis areas.

Semester II

Course Contents

Chapter 1	**Molecular basis of disease**	12 lectures
	• Introduction to Chromosomal Disorders and Structural Disorders with examples • Classifications of Genetic diseases • Single Gene disorders Sickle cell anaemia and Thalassemia, polygenic diseases eg Type I diabetes, Alzhimer Disease • Infectious disorders: hepatitis & HIV • Molecular pathology of genetic diseases	
Chapter 2	**Techniques for Genetic Diseases**	**12 lectures**
	• Prenatal diagnosis: Indications of prenatal diagnosis • Diagnosis using protein and enzyme markers : Enzyme probes Glucose oxidase, Monoamine oxidase. • Diagnosis using Monoclonal antibodies – hormonal disorders & infectious diseases • DNA/RNA based Diagnosis: DNA probes hepatitis, HIV • Biosensors in clinical diagnosis • Microarray Technology for disease diagnosis • Genetic Councelling	
Chapter 3	**Therapeutics and Disease Management**	**12 lectures**
	• Gene Therapy: ex vivo & in vivo gene therapy	

	• Strategies of Gene therapy:Gene augmentation, antisense therapy, ribozymes. • Vectors used in gene therapy and synthetic vectors • Gene therapy trials: ADA deficiency, Cystic fibrosis, HIV • Enzyme therapy: Gauchers disease, • Hormone replacement therapy: Diabetes • DNA based Vaccines: Subunit Vaccines and Attenuated Vaccines.	
Chapter 4	**Regenerative Medicine, Nanotechnology, Drug delivery systems.**	**12 lectures**
	• Stem cells in therapy -embryonic & adult stem cells, Characteristics & properties of stem cells. Potential use of stem cells • Cell & Tissue engineering • Bioartificial organs (liver,Blood cells, skin) • Nanomaterial in medicine: DNA based nano devices • Drug delivery carriers & controlled release mechanisms	
	Total Lectures	**48**

References Books:

1) Introduction to Human Molecular genetics- J J Pasternak, John willey Publications
2) Human Molecular genetics – Mc Conkey
3) Medical Biotechnology-Pratibha Nallari V Venugopal Rao Oxford Press
4) Medical Biotechnology-1st edition- Juditpongracz,Mary Keen
5) Medical Biotechnology-by Bernald Glick, Terry L Delovitch, Cheryl L Pattern ASM press 2014.
6) Molecular Biotechnology- Principles and Applications of Recombinant DNA, 4th Edition by Bernald Glick Cheryl L Pattern
7) Medical Biotechnology first edition by Trivedi P C Avishkar Publisher
8) Medical Biotechnology Principle and Applications by Kun L Y world Science Publications.
9) Methods of Biotechnology and Bioengineering by Vyas CBS publications 2004
10) Stem Cell technology by Marshak et al CSHL publications

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. Biotechnology

(2019 Course)

Course Code: 19ScBioP206

Course Name: LAB Course 3: Exercises in Genetic Engineering and Plant Biotechnology

Teaching Scheme: P 3Hours/Week **Credit: 02**

Examination Scheme: CIA : 50 Marks **End-Sem : 50 Marks**

Prerequisite Courses:

- Basics of rDnA techniques and plant tissue culture

Course Objectives:

- To learn advanced techniques in GE and Plant Biotechology

Course Outcomes:

On completion of the course, student will be able to–

- Use the technique for innovative learning

Semester II

Course Contents

Practical 1		1P
	Study of transformation technique and study of transformants	
Practical 2		1P
	Study of PCR and analysis of PCR product	
Practical 3		1P
	Southern blotting and hybridization technique	
Practical 4		1P
	Study of sequencing technique: Analysis of sequencing gels	
Practical 5		1P
	RFLP technique : Study of DNA fingerprinting technique	
Practical 6		1P
	DNA marker technology in plants: RAPD	
Practical 7		1P
	Chlorella/Spirulina culture establishment and study of its growth using suitable parameters	
Practical 8		1P
	In vitro induction of somatic embryogenesis	

Practical 9		1P
	Induction of androgenesis in vitro	
Practical 10		1P
	Protoplast isolation and fusion	
Practical 11		1 P
	Micropropagation : Initiation and multiplication	
Practical 12		1P
	Initiation of suspension culture and identification of common secondary metabolite production	