

Semester 1 (First Year)

Course Type	Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4+4+2)	23ScBIOP11	Major Paper 1 (Theory)	Advanced Biological Chemistry	4	4	50	50	100
	23ScBIOP12	Major Paper 2 (Theory)	Cell and Molecular Biology	4	4	50	50	100
	23ScBIOP13	Major Paper 3 (Practical)	Exercises in Biotechnology I (P)	4	4	50	50	100
	23ScBIOP14	Major Paper 4 (Practical)	Exercises in Environmental Biotechnology (P)	4	2	25	25	50
Major Electives (4)	23ScBIOP125	Major Elective 1 (Theory)	Genetics and Immunology OR Nanotechnology	4	4	50	50	100
	23ScBIOP126	Major Elective 2 (Theory)						
RM (4)	23ScBIOP137	RM Paper 1	RM Core Paper	2	4	50	50	100

		RM Paper 2	Research Methodology and Scientific Communication	2				
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Total				24	22	17 5	175	350

Semester 2 (First Year)

Course Type	Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4+4+2)	23ScBIOP211	Major Paper 1 (Theory)	Genetic Engineering	4	4	50	50	100
	23ScBIOP212	Major Paper 2 (Theory)	Principles of Bacteriology and Virology	4	4	50	50	100
	23ScBIOP213	Major Paper 3 (Practical)	Exercises in Biotechnology II (P)	4	4	50	50	100
	23ScBIOP214	Major Paper 4 (Theory)	Medical Biotechnology (T)	2	2	25	25	50
Major Electives (4)	23ScBIOP225	Major Elective 1 (Theory)	Plant Biotechnology	4	4	50	50	100
			OR Food Biotechnology					

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OJT(4)	23ScBIO P247	OJT	On Job Training	8	4	50	50	100
Total				30	22	175	175	350

Progressive Education Society's
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PG Part 1 Year of M.Sc. Biotechnology
(2023 Course under NEP 2020)
Course Code: 23ScBIOP111 Course Name: Advanced Biological Chemistry

Teaching Scheme: TH:4Hours/Week

Credit: 04 (60lectures)

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Prerequisite:

- Basic Knowledge of Biochemistry.

Course Objectives:

- To improve the ability of thinking in advanced biochemistry and protein chemistry fields.
- To develop a sufficient background for those students who wish to study more advanced biochemistry.
- 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

CO No	Course Outcomes (COs)	Blooms cognitive Taxonomy level
CO 1	Learn and understand the concept of proteins as enzymes Learn the importance of metabolic networks	1,2
CO 2	Define terms related to enzyme kinetics and understand their relevance. Understand the concept of metabolic fluxes and their important	2
CO 3	Examine a given problem and apply the kinetic equations. Work out the metabolic fluxes in a pathway	3
CO 4	Analyse the course of a reaction using kinetic equations calculate fluxes in a path way and analyse their effect	4
CO 5	calculate fluxes in a path way and analyse their effect	5
CO 6	Solve problems in enzyme kinetics and simulate outcomes using flux analysis	6

Unit 1	Protein Biochemistry I	18 Lectures
	• Structure of Proteins: Primary, Secondary, Tertiary, quaternary. Study of protein motifs and protein families.	4L
	• Protein folding mechanisms and Pathways. Factors affecting stability- Molten globule, energy funnel, chaperons.	5L
	• Protein misfolding and diseases	4L
	• Protein –protein interaction and protein –DNA interaction, Therapeutic Proteins	5L
Unit 2	Protein Biochemistry II-Enzymes	18 Lectures
	• Enzyme – Concept of active site, binding sites, Stereospecificity of enzyme and ES complex formation	3L
	• Enzyme Activity, Various factors influencing enzyme activity and	3L

	Enzyme inhibition • Mechanism of enzyme action and Enzyme regulation, multi-enzyme 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. • Clinical and Industrial Applications of enzymes-Enzyme Engineering, Biosensors (glucose oxidase, Cholesterol Oxidase), Antibodies as a biosensors, Enzymes: Diagnostics and therapeutic.	2L 6L 4L
Unit 3	Metabolomics	12 Lectures
	• Overview of metabolism, Integration of Metabolism • The Metabolome – Metabolic flux, Metabolic flux analysis • Metabolic engineering – 2 eg. Polyketides Synthesis, Xenobiotics	3L 4L 5L
Unit 4	Phytochemistry	12 Lectures
	• 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	3 4 3 2

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, Nirali Prakashan, 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), Hans BissWanger, 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, Lubert Stryer, 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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PG Part 1 Year of M.Sc. Biotechnology
(2023 Course under NEP 2020)
Course Code: 23ScBIOP112 Course Name: Cell and Molecular Biology

Teaching Scheme: TH:4Hours/Week

Credit: 4C (60L)

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Prerequisite Courses:

- Basic concepts of Cell Biology
- Basic of molecular biology- structure of DNA,RNA

Course Objectives:

- To study the advances in the knowledge of cell biology.
- To gain a better understanding of the cell, its function, and interactions in the organisms.
- 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.

CO No	Course Outcomes (COs)	Blooms cognitive Taxonomy level
CO 1	Learn and about cell process at cellular and molecular level Understand processes such as signaling, replication,transcription, and translation etc.	1,2
CO	Associate the relationships between processes to functioning in cells	2

2		
CO 3	Integrate and apply the information to examine the effect of changes to the cellular processes . Examine the genome organization of different cells	3
CO 4	Analyse processes such as signaling and transport and derive their relevance to the cellular system	4,5
CO 5	Predict or hypothesise outcomes in instances when cells are exposed to stress or undesirable changes. Review the regulation mechanism of living cells	5,6
CO 6	Design experiments to study cellular process	6

Course Contents

Cell Biology

Unit 1	Cell structure, function and cell signaling	15 lecture s
	- Cell structure- Study of cell organelles and their functions - Cell signaling- Signaling molecules, Concept of signal transduction, signaling pathways involved in signaling at cell surface, Intracellular transport at molecular level - Extracellular matrix and Cell junctions-relevance to tissue structure and function Communication between cells and environment	4L 6L 5L
Unit 2	Cell cycle and cell transformation	15 lecture s
	- Cell cycle and its regulation - Cell differentiation in plants and animals - Cell death, Mechanism of apoptosis including the study of role of hormones and growth factors in programmed cell death - Cell transformation and etiology of cancer	4L 3L 4L 4L

Molecular Biology		
Unit	Title	Lectures
Unit 1	Genome structure and organization	12 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 $\frac{1}{2}$ and Rot $\frac{1}{2}$ values, satellite DNA and DNA melting and buoyant density.	
Unit 2	DNA replication	6 Lectures
	• DNA replication: DNA replication models, connection of replication to cell cycle, Reverse Transcriptase.	
Unit 3	Gene expression in prokaryotes and Eukaryotes	12 Lectures
	• 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 (Ribosome concept) • Components of protein synthesis, Mechanism of protein synthesis, Genetic code, Regulation of protein synthesis, Post translational modification	

Reference books: Cell Biology

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K. Reiger 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, 12th edition (2018), 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, 5/e Edition (2011), Weaver R., McGraw 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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PG Part 1 Year of M.Sc. (Biotechnology)
(2023 Course under NEP 2020)
Course Code: 23ScBIOP113 Course Name: Exercises in Biotechnology I

Teaching Scheme: TH:4Hours/Week X 2 batches

Credit: 04 (30 P)

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Prerequisite Courses:

- Basics of isolation, purification, and chromatography techniques
- Basic techniques of cell biology
- Basic techniques like DNA isolation and electrophoresis

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
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- To Study advance techniques of cell biology –density gradient centrifugation, osmo-fragility, apoptosis.
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- To learn RNA isolation and separation, DNA damage and repair systems, DNA denaturation kinetics
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- **Course Outcomes:**
 - On completion of the course, student will be able to–
 - Design innovative /advanced cell and molecular biology practicals.
 - Expertise with various biochemistry techniques
 - Ability of thinking in biochemistry fields

Course Contents

Advanced Biological Chemistry		
Practical 1	Protein Biochemistry I	4P
	Extraction, purification, and characterization of enzyme (Beta galactosidase) • Assay of enzyme activity • Isolation and precipitation and dialysis • Enzyme Purification using Column Chromatography- Gel	

	filtration/ Ion exchange • Native SDS PAGE	
Practical 2	Protein Biochemistry II Enzymes	4P
	Enzymology: Study of Enzyme Kinetics. (Beta Galactosidase), Determination of K_m and V_{max} • 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 • Study of Inhibition of enzyme activity.	
Practical 3	Phytochemistry	2P
	Phytochemical Methods • Extraction Methods • Qualitative detection: TLC • Quantitative estimation of phytoconstituents	
Immunology		
Practical 4	ELISA	1P
	• Quantitative	
Practical 5	Immunodiffusion	1P
	• Radial immunodiffusion	
Practical 6	Immuno electrophoresis	1P
	• Rocket- immuno electrophoresis	
Practical 7	Western Blot	2P

Cell Biology

Sr. No.	Title	No. of practicals
1	Study of different plant cell types	1P
2	Isolation of cell organelles- Mitochondria and Lysosomes	2P

3	Study of cell cycle arrest	1P
4	Study of apoptosis in chick embryo	2P
5	Study of cell permeability using RBC's	1P

Molecular Biology

Sr. No.	Title	No. of practica ls
1	Isolation of RNA	2P
2	Isolation of DNA from a eukaryotic source (plant/animal)	2P
3	Study of gene regulation- Operon model	2P
4	Study of DNA denaturation and renaturation kinetics	2P

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PG Part 1 Year of M.Sc. (Biotechnology)
(2023 Course under NEP 2020)

Course Code: 23ScBIOP114

**Course Name: Exercises in Environmental
Biotechnology**

Teaching Scheme: TH:4Hours/Week X 2 batches

Credit: 02 (15P)

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Prerequisite Courses:

- Study of basic techniques in environmental biotechnology practical

Course Objectives:

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

Course Contents

Sr. No.	Title	No. of practicals
1	Qualitative and quantitative estimation of biodegradation of pesticide/ insecticide/fungicide.	2P

2	Genotoxicity assay on polluted water- Effect of polluted water on the growth of onion root tip	1P
3	Production of Biofertilizer using Rhizobium isolated from root nodules	3P
4	Estimation of Total suspended solids from waste water	1P
6	Determination of chemical oxygen demand (COD) of sewage sample (Demonstration).	1P
7	Determination of biological oxygen demand of sewage sample	1P
8	Acquisition of “Google Earth” images for the known and unknown area for land use - land cover mapping.	1P
9	Review on EIA case study.	1P
10	Solid Waste Management: Vermicomposting of kitchen waste	2P
11	Study and development of an ecosystem	2P

Reference books:

- 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
- 7 Textbook of Remote sensing and GIS (2006) M. Anji Reddy 3rd

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PG Part 1 Year of M.Sc. Biotechnology
(2023 Course under NEP 2020)
Course Code: 23ScBIOP125 Course Name: Genetics & Immunology

Teaching Scheme: 4Hours/Week

Credit: 04 (60L)

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.

CO No	Course Outcomes (COs)	Blooms cognitive Taxonomy level
CO 1	Understand the basic genetic variations and the immune system	2
CO 2	Determine Hardy-Weinberg equilibrium from the given data	3
CO 3	Link vaccine development to the immune system	4
CO 4	Analyse model systems	4
CO 5	Comment on the genetic variations	5
CO 6	Hypothesize antigen- antibody reactions	5

Course Contents

Unit 1	Basics of Genetics	7 Lecture s
	- 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.	2L 2L 1L
Unit 2	Population genetics & human genetics	7 Lecture s
	- Population genetics: Hardy –Weinberg principle and its applications. - Human genetics : Basics of Clinical genetics, testing and diagnosis of human genetic disorders	3L 2L
Unit 3	Plant genetics	8 Lecture s
	- Genetics of plant breeding- Genetic basis and mechanisms of pre- and post-zygotic incompatibility - Genetics of somaclonal variations, apomicts & androgenic plants	3L 3L
Unit 4	Important model systems in Genetics	8 Lecture s
	<i>Drosophila</i>, <i>C.elegans</i>, - Zebrafish <i>Arabidopsis</i>	2L 2L 2L 2L
	Immunology	
Unit 1	Basics of Immunology	8 Lecture s
	- Overview of immune system: Cells, Organs and Tissues of immune system. - Types of Immunity - Innate immunity, Acquired immunity Protective and Destructive	1L 2L 1L 1L

	• Autoimmunity, molecular mimicry • Parasitic immunology • Transplant immunology	1L
Unit 2	Complement System and Hypersensitivity	7 Lecture s
	• Complement system: Components of Complement system Three pathways of complement activation • Types of Hypersensitivity	3L 3L
Unit 3	Antigen – Antibody reactions	8 Lecture s
	• Applications in Diagnostics. • Techniques in molecular immunology Hybridoma technology (Monoclonal antibody) Antibody engineering, Chimeric antibodies, Phage display	2L 4L
Unit 4	Vaccine development	7 Lecture s
	• Recombinant vaccine, • Combined and polyvalent vaccines	3L 3L

References: Genetics

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), Acquaaah 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)

References: Immunology

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford, 7th edition (2012), Freeman and Co., NY
2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India
3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.

**PG Part 1 M.Sc. (Biotechnology)
(Course under NEP 2020)**

Course Code:23ScBIOP126

Course Name: Nanotechnology

Teaching Scheme: TH: 4Hours/Week

Credit: 04 C (60L)

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Teaching Scheme: TH:4Hours/Week

Prerequisite Courses:

- B.Sc. with basic understanding of chemistry and physics

Course Objectives:

- To Study the process of generation of nanoparticles
- To learn the characterization of nanoparticles

Course Outcomes:

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

- A basic knowledge of the synthesis and characterization of nanoparticles
- How this can be applied in various fields.

CO N o	Course Outcomes (COs)	Blooms Cognitive Taxonomy level
CO 1	Find basic concepts of nanoscience and nanotechnology.	1
CO 2	Classify nanomaterials based on properties.	2
CO 3	Develop nanoparticles using different methods.	3
CO 4	Analyze nanoparticles using several instruments.	4
CO 5	Determine applications of nanotechnology in various fields.	5
CO 6	Discuss ethical and patent issues associated with nanotechnology.	6

Course Contents

Unit 1	Nano scale Science and Technology	12 lectures
	• The nanoscale: Science and Technology. • Classification of nanostructured materials • Length scales involved and its effects on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.	
Unit 2	Preparation methods of Nanoparticles	12 lectures
	• Bottom-up and Top-down approach: Precipitation, Mechanical Milling. • Biological synthesis by bacteria, fungi, plants • Advantage and limitations of biological synthesis	
Unit 3	Characterization techniques	16 lectures
	• X-ray diffraction technique, • Scanning Electron Microscopy, • Environmental techniques, • Transmission Electron Microscopy including high-resolution imaging, • Confocal microscopy	
Unit 4	Application of Nanotechnology	12 lectures
	• Nano materials in medicine agriculture and environment • Environment applications :Nano remediation, nanopaints and nanofilters,nanocatalysts for degradation of pollutants • Medical applications: nanomedicines, antimicrobial agents, nanoparticles in drug delivery, Nanoparticles in cancer treatment andnanonephrology and tissue engineering, • Agricultural applications: nanofertilizers, nanopesticides, nanopigments.	
Unit 5	Impact of nanotechnology	8 lectures
	• Impact of nanotechnology • Ethical issues • Patent issues in nanotechnology • Health and environment ris measurements	

References:

1. Novel Nanocrystalline Alloys and Magnetic Nanomaterials- Brian Cantor
2. Nanoscale materials -Liz Marzan and Kamat.
3. Physical properties of Carbon Nanotube-R Satio.
4. Polymer nanocomposites: Edited by Yiu-Wing Mai and Zhong-Zhen Yu, First published 2006, Woodhead Publishing Limited and CRC Press LLC, USA.

5. Physics of Magnetism - S. Chikazumi and S.H. Charap.
6. Magnetostriction and Magnetomechanical Effects - E.W. Lee.
7. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
8. Nanotubes and Nanowires- CNR Rao and AGovindaraj RCS Publishing.
9. E.Garit. Plenty of room for biologyat the bottom: An introduction to bionanotechnology. Imperial College Press (2006)
10. T. Pradeep Nano: The essentials, McGraw-Hill education 2007

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PG Part 1
(2023 Course under NEP 2020)
Course Code: 23ScBIOP137Course Name: Research Methodology

Section 1

Teaching Scheme: 2 Hours/Week

Credit : 02C (30L)

Examination Scheme: CIA: 25 Marks

End-Sem: 25 Marks

Prerequisite Courses:

- B.A., B.Sc. B. Com, B.Voc., BBA, BBA IB, BBA CA

Course Objectives:

- To make students aware about research and its importance.
- To obtain knowledge regarding systematic gathering of data and get advanced knowledge in the selected topic.
- To inculcate logical and organized thinking in students.
- To investigate some existing situation or problem by creating new system or method.
- To help students to design research problem.

Course Outcomes:

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

1. Describe importance of research.
2. Differentiate between unethical and ethical practices of publication ethics.
3. Select research problem appropriately.
4. Prepare good hypothesis.
5. Design research problem systematically.
6. Analyze and organize data correctly.
7. Prepare good scientific research report.

CO No	Course Outcomes (COs)	Blooms Cognitive Taxonomy level
CO 1	Define fundamentals of research	1
CO 2	Outline research process	2
CO 3	Develop research designs including measurement and sampling	3
CO 4	Analyze and interpret the results	4
CO 5	Assess data analysis and representation	5
CO 6	Construct research designs	6

Course Contents

Unit 1	Research problem and design	No. of lectures
	Introduction to research: Meaning and definition of research, objective of research, importance of research, characteristics of good research, purpose and role of research, classification of research Research problem: defining of research problem, Criteria for selecting the research problem, importance of literature survey in defining research problem. Hypothesis: Defining Hypothesis, types of hypothesis, characteristics of good hypothesis, formulation of hypothesis Research Design: Definition and features of research design, Concept of research design, types of research design, preparation of research design, Sampling techniques, characteristics of good sampling designs	15
Unit 2	Data analysis, report writing and publication ethics	15

	Definition of Data, methods of data collection, analysis of data, types of data analysis, Questionnaire, Design of Questionnaire, Testing hypothesis: parametric and non-parametric tests: T-test, Z-test, Chi-square test, ANOVA Report writing: importance of interpretation of results, meaning, definition and significance of report /thesis writing, Principles of research report drafting, Types of reports, layout of research report, important parts of reports, precautions of preparation of report/ thesis Publication ethics: definition, introduction and importance, best practices/ standard settings initiative and guidelines COPE, WAME, etc, conflict of interest, Publication misconduct: definition, concept problems that lead to unethical behavior, violation of publication ethics, predatory publishers and journals, software tools to identify predatory publications developed by SPPU	
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References:

- C. R. Kothari (2004) *Research Methodology: Methods and Techniques* 2nd Edition, New age International (p) Ltd Publications, New Delhi, India
- J.W. Creswell and J.D. Creswell (2017) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5th Edition, SAGE Publications, USA.
- C. G. Thomas (2021) *Research Methodology and Scientific Writing*, 2nd Edition, Springer Nature, New York.
- M. Kheider lectures from University of Biskra (2017) <https://univ-biskra.dz/sites/fll/images/houadjli%20Ahmed%20Chaouki.pdf>

Section 2

Teaching Scheme: TH: 02 Hours/Week

Credit: 02 C (30L)

Examination Scheme: CIA: 25 Marks

End- Sem: 25Marks

Prerequisite:

- Basic Knowledge of scientific research concepts and scientific literature.

Course Objectives:

- Understand different scientific research designs and methods
- Learn how to set up a research study
- Understand correct ways to refer to and cite from scientific literature

Course Outcomes:

At the end of the study of the course the student will have ability to

- Critically assess different research designs
- Analyze, set as contrast, compare and review scientific literature
- Discuss own view in relation to the published research

Course Contents

Unit 1	Foundations of Research	09 Lectures
	• Foundations of Research: Meaning, Objectives, Utility • Concept of theory: empiricism, deductive and inductive theory • Characteristics of scientific method • Understanding the language of research: Concept, Construct, Variable • Research Process • Problem Identification & Formulation: Research Question or Investigation Question, Measurement Issues • Hypothesis – Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis • Hypothesis Testing – Logic & Importance	
Unit 2	Research Design	03 Lectures
	• Concept and Importance in Research • Features of a good research design • Types of Research Design: Exploratory and Descriptive • Experimental Design: Types of Variables Independent and Dependent variables	
Unit 3	Qualitative and Quantitative Research	03 Lectures
	• Qualitative research and Quantitative research • Causality, generalization, and replication	
Unit 4	Measurement	04 Lectures
	• Concept of measurement • Problems in measurement in research – Validity and Reliability	
Unit 5	Sampling	03 Lectures
	• Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size • Characteristics of a good sample • Probability Sample – Simple Random Sample, Systematic Sample	
Unit 6	Data Analysis	03 Lectures

	• Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages) • Bivariate analysis – Cross tabulations • Chi-square test including testing hypothesis of association	
Unit 7	Interpretation of Data and Paper Writing	04 Lectures
	• Journals in Biotechnology • Impact factor of Journals • Layout of a Research Paper • When and where to publish? • Ethical issues related to publishing • Plagiarism and Self-Plagiarism	
Unit 8	Tools / Techniques for Research	01 Lectures
	• Methods to search required information effectively: Use of research databases • Reference Management Software like Zotero or Mendeley • Software for detection of plagiarism	

References:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. **Health informatics research methods: principles and practice** Layman, Elizabeth; Watzlaf, Valerie J. Chicago, Ill. : American Health Information Management Association, c2009. - xiii, 439 p. ISBN:978-1-58426-181-0 : \$85.95 LIBRIS-ID:12452928 [Library search](#)
5. *Denscombe, Martyn. The good research guide [Elektroniskresurs] : for small-scale social research projects* 4th ed. : Maidenhead : Open University Press, cop.2010. - 373 p. ISBN: 9780335241408 (electronic bk.) LIBRIS-ID:12194897 [Library search](#)

Progressive Education Society's
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PG Part 1 Year of M.Sc. (Biotechnology)
(2023 Course under NEP 2020)

Course Code: 23ScBIOP211

Course Name: Genetic Engineering

Teaching Scheme: TH:4Hours/Week

Credit: 04 (60L)

Examination Scheme: CIA: 50 Marks

End-Sem : 50 Marks

Prerequisite Courses:

- Basic techniques of rDNA technology

Course Objectives:

- To Study the 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

CO No	Course Outcomes (COs)	Blooms cognitive Taxonomy level
CO 1	Identify different DNA markers preset in plants	1
CO 2	Understand the different DNA manipulation methods	2
CO 3	Apply the knowledge in creating biotherapeutics, vaccines and study their production	3
CO 4	Explain different analytical techniques used in Genetic engineering	4
CO 5	Detect the presence of a recombinant gene using different biological screening methods	5
CO 6	Design experiment to study application of genetic engineering	6

Course Contents

Unit1	Introduction to Genetic Engineering	12 lectures
	• Introduction to Genetic Engineering. • Enzymes used in Genetic engineering • Vectors ingene cloning-Plasmid, Cosmid,Phages, Phasmids, Advanced cloning vectors like BAC, YAC, PAC • Various expression vectors in bacteria and eukaryotes-Yeast, Baculovirus, Mammalian cells.	
Unit 2	Analytical techniques in GE	8 lectures
	• PCR – design and optimization, Types of PCR-Inverse, Nested, Reverse TranscriptionPCR, Hot Start PCR, Quantitative PCR. • Genomic and cDNA library: Construction, screening and selection.	
Unit 3	DNA sequencing techniques	10 lectures
	• Sanger's Dideoxy chain termination method • Automated DNA sequencing methods	

	• Nextgen Sequencing techniques • Genetic and Physical mapping techniques	
Unit 4	Transformation and Transfection	10 lectures
	• Methods of transformation- Physical, Chemical, Biological • Role of viruses in gene transfer – process of gene transfer	
Unit5	DNA marker technology	5 lectures
	• DNA marker technology in plants • DNA Fingerprinting and DNA profiling	
Unit6	Application of Genetic Engineering	10 lectures
	• Diagnosis and Detection of Genetic diseases • Gene therapy – <i>ex vivo</i>, <i>in vivo</i>, Viral and non-viral gene delivery systems in gene therapy. • Agriculture-Crop improvement • Healthcare- Recombinant vaccines and therapeutics • Transgenic animals and Bio-pharming	
Unit 7	Biosafety regulations	5 lectures
	• Principles of Biosafety regulations	

Reference Books:

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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PG Part 1 M.Sc. (Biotechnology)
(2023 Course under NEP 2020)

Course Code: 23ScBIOP212

Course Name: Principles of Bacteriology and Virology

Teaching Scheme: TH: 4 Hours/Week

Credit: 04

Examination Scheme: CIA : 50 Marks

End-Sem : 50 Marks

Prerequisite Courses:

- Prior knowledge of basic microbiology in UG and basic concepts of virology.

Course Objectives:

- To Study in detail the taxonomy and morphology of microorganisms.
- To learn the bacterial classification systems along with its characteristics.
- To learn the viral classification systems and viral replication 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.
- Understand biochemical cycles operative in microorganisms and use them for his/her benefit.
- Understand classification systems and replication of viruses and use this knowledge in development of methods of Viral diagnosis.

CO	Course Outcomes (COs)	Blooms cognitive
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No		Taxonomy level
CO 1	Identifying the organism based on Bergey's manual	1
CO 2	Understand the classification system of bacteria and viruses	2
CO 3	Examining the detailed structure of bacteria and viruses	3
CO 4	Explain the different types of viruses and bacteria	4
CO 5	Assessing the rate of spread of viruses in a particular area	5
CO 6	Write the biochemical pathways operative in bacteria	6

Course Contents

Units	Title	60 Lectures
Unit 1	Bacterial Diversity and Taxonomy	10 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	
Unit 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).	
Unit 3	Microbial Metabolism	10 Lectures

	• Aerobic Respiration: Oxidative phosphorylation and its significance, Energy generation in all groups of chemolithotrophs. • Anaerobic Respiration: Biochemistry of methanogenesis and ammonia oxidation	
Unit 4	Introduction to viruses	12 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 (ds DNA : adeno virus, ss DNA: parvo virus, +ss RNA: corona virus, -ss RNA: Orthomyxovirus, Ambisense: Arena virus, Retro viruses), Bacteriophages	
Unit 5	Maintenance of viruses	10 Lectures
	• General idea about cyanophages, actinophages and mycophages and viruses of insects. • Baculovirus System for insect cell lines, Sub viral particles- Prions, virusoids, satellite viruses. • Purification and maintenance of viruses	
Unit 6	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	

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. Joklik, 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, Jayaram Panakar, 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
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PG Part 1 Year of M.Sc. (Biotechnology)
(2023 Course under NEP 2020)
Course Code: 23ScBIOP213 **Course name: Exercises in**
Biotechnology II

Teaching Scheme: TH:4Hours/Week X 2 batches

Credit: 04 (30P)

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Prerequisite Courses:

- Basics of rDNA techniques and plant tissue culture
- Study of basic sterility techniques in UG

Course Objectives:

- To learn advanced techniques in GE and Plant Biotechnology.
- To Study in isolation of unknown microorganism from a natural source and identify it by doing biochemical tests.
- To learn the phenomenon of viral infection of bacteria.

Course Outcomes:

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

- Use the technique for innovative learning
- Identify unknown isolated microorganisms using suitable methods.
- Study different cultivation methods of viruses in a living system.

Course Contents

Genetic Engineering		
Practical 1	Transformation	2P
	Study of transformation technique and study of transformants	
Practical 2	PCR	1P
	Study of PCR and analysis of PCR product	
Practical 3	Southern Blotting	2P
	Southern blotting and hybridization technique	
Practical 4	Sequencing	1P
	Study of sequencing technique: Analysis of sequencing gels	
Practical 5	RFLP	1P
	RFLP technique: Study of DNA fingerprinting technique	
Practical 6	RAPD	1P
	DNA marker technology in plants: RAPD	
Plant Biotechnology		
Practical 7	Chlorella/Spirulina culture	1P
	Chlorella/Spirulina culture establishment and study of its growth using suitable parameters	

Practical 8	Somatic embryogenesis	1P
	In vitro induction of somatic embryogenesis	
Practical 9	Androgenesis	1P
	Induction of androgenesis in vitro	
Practical 10	Protoplast	1P
	Protoplast isolation and fusion	
Practical 11	Micropropagation	2 P
	Micropropagation: Initiation and multiplication	
Practical 12	Suspension culture	1P
	Initiation of suspension culture and identification of common secondary metabolite production	

Bacteriology

Practical 1	Introduction to Laboratory	1P
	• Cleanliness, Good laboratory practices practiced in Microbiology laboratory • Media preparation, calculations based on media preparation • Sterilization of media and glassware: Concept of autoclave and filter sterilization • Role of Biosafety Cabinets in Microbiology	
Practical 2	Isolation and characterization of microorganisms from environmental source	4P
	• Isolation of Pure Culture(from air/soil/water) using: 1. Streak plate 2. Spread plate and 3. Pour plate technique using serial dilution • Identification of the isolated bacteria till genus level: by morphology, motility, cultural characteristics, biochemical tests and identification of organism using Bergey's Manual	
Practical 3	Staining techniques	3P
	Perform Monochrome, Gram, Endospore and Capsule staining of the isolated organism	
Practical 4	Cultivation of Anaerobes	2P
	Cultivation of anaerobic organisms using any one method	
Virology		
Practical 5	Propagation of viruses	1P
	• Propagation of viruses in animals/tissue culture/embryonated eggs.	

Practical 6	Morphological study of viruses	1P
	• Study of microscopic images of different viruses.	
Practical 7	Phage titration	3P
	• Isolation of host cells and bacteriophage from sewage sample.	

Progressive Education Society's
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PG Part 1 Year of M.Sc. Biotechnology
(2023 Course under NEP 2020)

Course Code:23ScBIOP214

Course Name: Medical Biotechnology

Teaching Scheme: TH: 4Hours/Week

Credit: 04 (60L)

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.

CO No	Course Outcomes (COs)	Blooms cognitive Taxonomy level
CO 1	Study and learn about the genetic basis of disease	1
CO	Understand the differences between structural and	2,3

2	number abnormality basis of disorders	
CO 3	Understand and apply the use of diagnostics to understanding disease	3,4
CO 4	Experiment / analyse the possible ways to detect/ diagnose disease/disorder	4
CO 5	Simulate and hypothesise an application	5
CO 6	Create or design a device /application in diagnostics	6

Unit 1	Molecular basis of disease	15 lectures
	• Introduction to Chromosomal Disorders and Structural Disorders with examples • Classifications of Genetic diseases • Single Gene disorders Sickle cell anemia and Thalassemia, polygenic diseases e.g. Type I diabetes, Alzheimer Disease • Infectious disorders: hepatitis & HIV • Molecular pathology of genetic diseases	
Unit 2	Techniques for Genetic Diseases	15 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 Counselling	

Unit 3	Therapeutics and Disease Management	15 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: Gaucher's disease, • Hormone replacement therapy: Diabetes • DNA based Vaccines: Subunit Vaccines and Attenuated Vaccines.	
Unit 4	Regenerative Medicine, Nanotechnology, Drug delivery systems.	15 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	

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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PG Part 1 Year of M.Sc. (Biotechnology)
(2023 Course under NEP 2020)

Course Code: 23ScBIOP225

Course Name: Plant Biotechnology

Teaching Scheme: TH:4 Hours/Week

Credit: 04C (60L)

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Prerequisite Courses:

- Basic of Plant Tissue Culture

Course Objectives:

- To Study advanced in vitro techniques in theory and its applications
- To learn the progress in the field of plant biotechnology.

Course Outcomes:

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

- Obtain the latest developments in the field of plant biotechnology

CO No	Course Outcomes (COs)	Blooms cognitive Taxonomy level
CO 1	Find several specimens of Algae and Fungi to study them	1
CO 2	Summarize qualitative and quantitative improvements in algae and fungi	2
CO 3	Apply <i>in vitro</i> methods of plant propagation	3
CO 4	Categorize algal and fungal transgenics for various applications	4
CO 5	Compare genetic manipulations in plants for several purposes	5
CO 6	Discuss applications of techniques in improvement of plants	6

Course Contents

Unit	Title	Lectures
Unit 1	Algal Biotechnology	12 Lectures
	• Study of economically important algae like Spirulina, Chlorella, Dunaliella, Botryococcus • Qualitative (product improvement) and quantitative (yield) improvement of algae	
Unit 2	Fungal Biotechnology	12 Lectures
	• Study of economically important fungi like mushrooms (Agaricus, Pleurotus, Lentinus), yeasts, industrially important fungi • Qualitative (product improvement) and quantitative (yield) of fungi	
Unit 3	In vitro propagation methods	12 Lectures
	• Micropropagation: Advantages over conventional methods, stages of micropropagation, organogenesis, somatic embryogenesis, and clonal multiplication • In vitro androgenesis and its applications • Protoplast isolation, fusion somatic	

	hybridization, and its application • Suspension cultures-initiation, growth, and applications.	
Unit 4	Genetic Manipulation I	12 Lectures
	Algal and fungal transgenics • Introduction, vertical and horizontal gene transfer, • Algal and fungal transgenics and their applications with suitable examples (e.g. pigments, biofuels, pharmaceuticals etc.)	
Unit 5	Genetic Manipulation II: Plants	12 Lectures
	• Transgenics for Biotic and Abiotic stress, • Production of secondary metabolites • Increase in productivity by manipulation of photosynthesis and nitrogen fixation • Molecular farming (improvement in protein, lipid, carbohydrates), vaccines, antibodies, therapeutic proteins. • Advances in gene manipulation: CRISPR technology.	

References:

1. Introduction to plant biotechnology (Science Publ); Chawla HC (2004)
2. Plant pigments and their manipulation – Annual plant reviews, vol 14 (Blackwell Publ); Davies K (Ed) (2004)
3. Plant Biotechnology and agriculture Prospects for the 21st century (Academic press); Altman A, Hasegawa PM (Ed) (2012).
4. Plant Tissue Culture: Theory & Practice (Elsevier); Bhojwani SS. & Razdan MK (1996).
5. Biocatalysis and agricultural biotechnology (CRC Press); Hou CT, Shaw JF (2009).
6. Plant Biotechnology: the genetic manipulation of plants (Oxford Press); Slater A, Scott NW, Fowler MR (2008).
7. Fungal Biotechnology (IK International); Rai M (2009).
8. Plant cell and tissue culture (Springer); Vasil IK, Thorpe TA (1994).
9. Textbook of Biotechnology 4th edition; H K Das.

Progressive Education Society's
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PG Part 1 Year of M.Sc. (Biotechnology)
(2023 Course under NEP 2020)

Course Code: 23ScBIOP226 Course Name: Food Biotechnology

Teaching Scheme: TH: 4 Hours/Week

Credit: 04C (60L)

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Prerequisite Courses:

- Knowledge of Biotechnology up to 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

CO No	Course Outcomes (COs)	Blooms cognitive Taxonomy level
CO 1	Recall basic of RDT, PBT ABT, GMOs with respect to food production, Applications.	1
CO 2	Summarize fermentation technology and enzyme technology	2
CO 3	Apply concept of nanoparticles and nutrigenomics with respect to food biotechnology	3
CO 4	Analyze concepts of prebiotics, probiotics and nutraceuticals with respect to health disease and formulations of food	4
CO 5	Asses the role of QA and QC and legislations in food industry	5
CO 6	Elaborate roles of plant, animal, microbes, prebiotic, probiotic, and nutraceuticals in food biotechnology	6

Course Contents

Unit	Title	
Unit 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	
Unit 2	Microbial biotechnology	6Lectures
	• 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	
Unit 3	Enzyme Technology	8Lectures
	• 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	
Unit 4	Nanobiotechnology	8 lectures
	• Use of nanoparticles for delivery of bioactive constituents, nanoencapsulation, nano-packaging, nanosensors for detection of pesticides & pathogens • Applications of Nutrigenomics in the food industry Ethical Concerns, Safety and Regulatory Issues of biotechnological products	
Unit 5	Prebiotics and Probiotics	8Lectures
	• 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	
Unit 6	Nutraceuticals	8 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; defense services, sportsmen, space food	
Unit 7	Role of QC and QA Quality,	8Lectures

	• 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.	
Unit	Food Laws and FSSAI	8Lectures
	• 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	

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

