



## **PROGRAMME STRUCTURE**

### **M.Sc. Biotechnology Semester: IV**

Programme Outcome (PO) - For M.Sc. Biotechnology Programme	On successful completion of the Masters in Biotechnology course, the student will be able to: <ol style="list-style-type: none"><li>1. Demonstrate an ability for in depth analytical and critical thinking to identify and solve problems related to Biotechnology in industry, medicine and Agriculture</li><li>2. Comprehend and integrate theoretical and practical skills</li><li>3. Demonstrate mastery in handling sophisticated laboratory equipment and their appropriate applications.</li><li>4. Become a professional suitable to be employed in industry as well as academic institutions</li><li>5. Understand professional and ethical responsibility.</li></ol>
Programme Specific Outcome (PSO) - For MSc Biotechnology Semester - IV	<ol style="list-style-type: none"><li>1. Students will be able to demonstrate and apply their knowledge of cell structure and functions both at organelle and molecular level and solve the problems related to the field of biotechnology</li><li>2. Students will be exposed to basic physiological and metabolic processes and their relevance in Biotechnology</li></ol>
To Pass	<ol style="list-style-type: none"><li>(1) At least 40% marks in each paper at the University Examination and 40% aggregate marks in Internal and External Assessment.</li><li>(2) At least 33% Marks in each paper in Internal Assessment.</li></ol>





**SARDAR PATEL UNIVERSITY**  
**Vallabh Vidyanagar, Gujarat**  
**(Reaccredited with 'A' Grade by NAAC (CGPA 3.25))**  
**Syllabus with effect from the Academic Year 2022-2023**

Course Type	Course Code	Name Of Course	Theory/ Practical	Credit	Exam Duration in hrs	Component of Marks		
						Internal	External	Total
						Total	Total	Total
Core Course	PS04CBIT51	Downstream processing	T	4	3	30	70	100
	PS04CBIT52	Environmental Biotechnology	T	4	3	30	70	100
	PS04CBIT53	Practicals	P	4	3	30	70	100
	PS04CBIT54	Viva-Voce	=	1	=	=	50	50
Elective Course (Any Two)	PS04EBIT51	IPR and Biosafety	T	4	3	30	70	100
	PS04EBIT52	Research Ethics and Scientific Writing	T	4	3	30	70	100
	PS04EBIT53	Practicals	P	4	3	30	70	100
	PS04EBIT54	Systems Biology	T	4	3	30	70	100
	PS04EBIT55	Biomaterials and Tissue Engineering	T	4	3	30	70	100
	PS04EBIT56	Biodiversity and Conservation	T	4	3	30	70	100
	PS04EBIT57	Food and Dairy Microbiology	T	4	3	30	70	100
		<b>OR</b>						
Core Course	PS04CBIT51	Downstream processing	T	4	3	30	70	100
	PS04CBIT52	Environmental Biotechnology	T	4	3	30	70	100
	PS04CBIT53	Practicals	P	4	3	30	70	100
	PS04CBIT54	Viva-Voce	=	1	=	=	50	50
Elective Course	PS04EBIT58	Dissertation	=	12	=	=	300	300





Master of Science (Biotechnology)  
M.Sc. (Biotechnology) Semester (IV)

Course Code	PS04CBIT51	Title of the Course	Downstream processing
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	Students should be able to :  - Device a strategy and separate bioactive molecules.
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Course Content		
Unit	Description	Weightage* (%)
1.	Introduction to downstream processing principles, characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilization of bio products.	25
2.	Physical methods of separation: centrifugation and filtration. Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.	25
3.	Purification methods: Chromatography – principles, instruments and practice, adsorption, Reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bio affinity and pseudo affinity chromatographic techniques.	25
4.	Purification strategies: Case studies of animal based products -Tissue Plasminogen Activator, Erythropoietin; plant based products- shikonin and seed proteins; bacterial products- lipases, amylase, subtilisin, ethanol and citric acid.	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a
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	suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students should be able to handle downstream processing laboratory.

Suggested References:	
Sr. No.	References
1.	Gary Walsh Proteins: Biochemistry and Biotechnology. 2nd edition, Wiley Blackwell. 2002
2.	J.C. Janson and L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods and Applications, VCH Pub. 1989.
3.	R.K. Scopes – Protein Purification – Principles and Practice, Narosa Pub., 1994.
4.	B. Sivasanker – Bioseparations – Principles and Techniques, Prentice – Hall of India, 2005.
5.	Roger G. Harrison, Paul Todd- Bioseparations Science and Engineering, Oxford University Press, 2006.
6.	D. G. Rao, Introduction to Biochemical Engineering, Tata McGraw-Hill Education, 2005





On-line resources to be used if available as reference material
On-line Resources
Related review articles and research papers

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Master of Science (Biotechnology)  
M.Sc. (Biotechnology) Semester (IV)

Course Code	PS04CBIT52	Title of the Course	Environmental Biotechnology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none"><li>1. To address environment issues using biotechnology.</li><li>2. To understand characterization and treatment of waste waters.</li><li>3. To understand fundamentals of waste water treatment processes and biochemistry for removal of pollutants from water and technologies developed for that..</li><li>4. To understand basic concepts of biodegradation and bioremediation strategies for conservation of environment.</li><li>5. To understand some of the major pollution problems and their biotechnological solutions</li><li>6. To learn about eco-friendly biotechnological processes for recovery of various resources.</li><li>7. To learn about need and applications of various biofertilizers and biocontrol agents.</li></ol>
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Course Content		
Unit	Description	Weightage* (%)
1.	<p>Waste water treatment- Waste water characterization and its significance: COD, BOD, TOC, TOD, Inorganic constituents, solids, biological components.</p> <p>Principles and aims of biological wastewater treatment processes: Primary, secondary and tertiary treatment of waste water.</p> <p>Biochemistry and microbiology of inorganic phosphorus and nitrogen removal from waste water.</p> <p>Suspended growth processes: Activated sludge process: Biology of activated sludge, flocculation, sludge settling, oxidation ditches, waste stabilization ponds.</p> <p>Fixed film processes: Biofilm formation and slaughting, Trickling filters, rotating biological contactors, fluidized bed and submerged aerated filters.</p>	25
2.	<p>Anaerobic digestion: microbiological and biochemical fundamentals, factors influencing anaerobic digestion. Anaerobic waste water treatment systems: Upflow anaerobic sludge blanket , rotating biological contactors, anaerobic filters. Merits and demerits of anaerobic treatment of waste.</p> <p>Composting: Objectives, fundamentals, microbiology, factors influencing composting and composting systems. Compost quality and</p>	25





	uses. Vermicomposting. Toxicity testing in waste water treatment plants using microorganisms: Monitoring environmental processes with biosensors: BOD biosensor, Pesticide biosensor	
3.	Biodegradation of organic pollutants: Xenobiotic and recalcitrant organic compounds, mechanisms of biodegradation, factors affecting biodegradation, Acclimation phase in biodegradation. Biodegradation of simple aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes and lignin. Bioremediation approaches: Intrinsic bioremediation, Biostimulation, Bioaugmentation: Use of genetically modified organisms.. In situ and ex situ bioremediation technologies with examples. Bioremediation of heavy metal pollution, Phytoremediation. Biological treatment of waste gas (polluted air): biofilters, bioscrubbers, membrane bioreactors, biotrickling filters.	25
4.	Bioleaching of metals: Characteristics of commercially important microbes, mechanisms of bioleaching, factors affecting bioleaching and current biomining processes. Biobeneficiation of gold ores. Biodesulfurization of coal: Removal of organic and inorganic sulfur from coal. Microbially enhanced oil recovery. Microbial Insecticides: Bacterial, fungal and viral insecticides in pest management. Biofertilizers: applications of nitrogen fixing and phosphate solubilising/ mobilizing biofertilizers.	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%





Course Outcomes: Having completed this course, the learner will be able to

1.	Get trained with analysis of waste waters to judge pollution potential and biological waste water treatment.
2.	Develop ability to understand various biotechnological strategies to overcome pollution problems caused by various pollutants in air, water and soil.
3.	Understand and apply solid waste management technologies and significance of generating valuable products from waste.
4.	Gain technical knowledge about environment friendly biotechnological processes for recovery of valuable resources .
5.	Understand the need and production of biofertilizers and biopesticides for enhanced crop production in agriculture.

**Suggested References:**

- Comprehensive Biotechnology Vol-4, Murray Moo Young.
- Biotechnology-Rehm and Reid.
- Waste water microbiology by G. Bitton
- Biodegradation and bioremediation by M.Alexander
- Waste water treatment for pollution control, 2nd edition. Arceivala
- Environmental Biotechnology by H. Jordening and Josef Winter
- Handbook of water and waste water Microbiology by Horan
- Topic related review articles

On-line resources to be used if available as reference material

On-line Resources

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Course Code	PS04CBIT53	Title of the Course	LAB-I
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. To learn to do water analysis. 2. To learn analysis of environmental samples.
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**PS04CBIT54 (Lab 1)**

- 1) Qualitative analysis of amino acids by TLC
- 2) Elution and quantitative estimation of amino acids
- 3) HPTLC separation of secondary metabolites
- 4) Waste water characterization.
  - a) BOD
  - b) COD
  - c) Nitrate estimation
  - d) Sulfate estimation
- 5) Study of phosphate solubilizing activity
- 6) Isolation of 2,4 dichlorophenoxyacetic acid degrading bacteria
- 7) Isolation of naphthalene degrading bacteria
- 8) Dehydrogenase activity of soil
- 9) Bioremoval of chromium from polluted water
- 10) Decolourization of Azo dyes by microorganisms.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%





Course Outcomes: Having completed this course, the learner will be able to
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| 1. | Contribute to the field of environmental Biotechnology. |
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References:

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|---|---|
| 1 | Thimmaiah S. K. (2012). Standad Methods of Biochemical Analysis. Kalyani Publishes, New Delhi, India. |
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Master of Science (Biotechnology)  
M.Sc. (Biotechnology) Semester (IV)

Course Code	PS04EBIT51	Title of the Course	IPR and Biosafety
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. To introduce basic concepts of ethics and safety that are essential for different disciplines of science and procedures involved and protection of intellectual property and related rights. 2. To understand balanced integration of scientific and social knowledge in sustainable development.
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Course Content		
Unit	Description	Weightage* (%)
1.	<p><b>Biotechnology and society:</b> Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding.</p> <p><b>Bioethics:</b> Social and ethical issues in biotechnology. Principles of bioethics. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics. Introduction and need of bioethics, its relation with other branches, types of risk associated with genetically modified microorganisms, Ethical Issues involving GMOs; ethics related to human cloning, human genome project, prenatal diagnosis, agriculture and animal rights, data privacy of citizens health; ethical issues in India and abroad through case studies; Socio-economic impact of biotechnology.</p>	25%
2.	<p><b>Bio- safety:</b> Definition of bio-safety; History, evolution and concept of biosafety; need and application of biosafety in laboratories and industries; biosafety guidelines and regulations, international and national norms of biosafety; Implementation of biosafety guidelines; Classification and Description of Biosafety levels; Design of clean rooms and biosafety cabinets; Risk assessment and containment levels; biohazard, bio-medical and hazardous wastes, handling and disposal; transportation of biological materials; bio-terrorism; biosafety protocol (Cartagena biosafety protocol) regulations to protect nature, growers and consumers interest and nation interest; Good laboratory practice (GLP) and Good manufacturing practice (GMP), Use of GMO's and their release, GM products, issues in use of GMO's, risk for animal/human/agriculture and environment owing to GMOs., Biotechnology and bio-safety concerns at the level of individuals,</p>	25%





	institutions, society, region, country and world. Bio safety regulation: handling of recombinant DNA products and process in industry and in institutions.	
3.	<p><b>IPR I:</b>  The Concept/History of Intellectual Property; Intellectual Property System in India; Kinds of Intellectual Property Rights; Advantages and Disadvantages of IPR. International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, Trade Related Intellectual Property Rights (TRIPS), The World Intellectual Property Organization (WIPO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Intellectual Property Organisation (WIPO); World Trade Organization (WTO) European Patent Office (EPO). Patents Act, 1970 ; Trade Mark Act, 1999; The Designs Act, 2000; The Geographical Indications of Goods (Registration and Protection) Act, 1999; Copyright Act, 1957 ; The Protection of Plant Varieties and Farmers' Rights Act, 2001; The Semi Conductor Integrated Circuits Layout Design Act, 2000; Trade Secrets; Utility Models; IPR &amp; Biodiversity; The Convention on Biological Diversity (CBD) 1992;</p> <p>Application forms of IPR and Intellectual property protection. Concept of property with respect to intellectual creativity, Tangible and Intangible property.</p>	25%
4.	<p><b>IPR II:</b>  Classification of patents in India, Classification of patents by WIPO, Categories of Patent, Special Patents, Patenting Biological products, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the International patent system, Utility models, Concept related to patents novelty, non-obviousness, utility, anticipation, prior art etc. Type of patents. Indian patent act and foreign patents. Patentability, Patent application, Revocation of patent, Infringement and Litigation with case studies on patent, Commercialization and Licensing. Patent Cooperation Treaty (PCT);</p> <p>Copyright Overview of Copyright, Importance of Copyrights, Process for copyright, case studies.</p> <p>Overview of Trademarks &amp; Trade Secret, Importance of Trademarks &amp; Trade secret, Rights of Trademark &amp; Trade Secret, Types of Trademarks, Registration process for Trademark &amp; Trade Secret, Duration of Trademark and trade secret, Case Studies</p> <p>Geographical Indications Overview of Geographical Indications, Importance of Geographical Indication Protection, Case studies</p>	25%





	Infringement: Direct, Contributory, and Induced Infringement; How Infringement is Determined; Who Is an Infringer; Official Machinery, Controller, Powers and Functions Defences to Infringement; Case studies	
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Teaching-Learning Methodology	Online / Offline / Presentation / Videos
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Interpret basics of biosafety and bioethics and its impact on all the biological sciences and the quality of human life.
2.	Recognize importance of biosafety practices and guidelines in research.
3.	Comprehend benefits of GM technology and related issues.
4.	Recognize importance of protection of new knowledge and innovations and its role in business.

Suggested References:	
Sr. No.	References
1.	Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press.ISBN-1555811804,9781555811808.
2.	Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219





3.	Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.
4.	Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
5.	Intellectual Property Right- Wattal- Oxford Publication House.(1997) ISBN:0195905024.
6.	Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. (2 <sup>nd</sup> ed) ISBN-10 3527304320.
7.	Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748.
8.	Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3 <sup>rd</sup> Ed) Academic press.
9.	B.D. Singh. Biotechnology expanding horizons.
10.	H.K.Das. Text book of biotechnology 3 <sup>rd</sup> edition.
11.	<i>Sateesh, M.K., Bioethics and Biosafety, IK International Publishers (2008)</i>
12.	<i>Singh I. and Kaur, B., Patent law and Entrepreneurship, Kalyani Publishers (2006).</i>
13.	<i>Srinivasan, K. and Awasthi, H.K., Law of Patents, Jain Book Agency (1997)</i>
14.	Deepa Goel, ShominiParashar, (2013), IPR, Biosafety and Bioethics, Pearson.

On-line resources to be used if available as reference material

On-line Resources

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Master of Science (Biotechnology)  
M.Sc. (Biotechnology) Semester (IV)

Course Code	PS04EBIT52	Title of the Course	Research Ethics and Scientific Writing
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. To inculcate professional ethics in students of Science, especially in Biology 2. To familiarize types of plagiarism and tools for their detection 3. To teach various modes of data collection and its processing 4. To impart professional, scientific writing skills ...
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Course Content		
Unit	Description	Weightage* (%)
1.	Definition and significance of ethics; Professional ethics in Scientific research and development: Common ethical breaches; data fabrication; data falsification. Plagiarism: redundant publication; duplicate publication.	25%
2.	Types of plagiarism; tools and techniques for detection of plagiarism. Conflict of interest; salami slicing and authorship issues. Good Laboratory Practices (GLP): Instrument validation, reagents and materials certification, documentation and its record, Quality assurance and certification of laboratory facilities.	25%
3.	Data collection methods: Primary data and secondary data. Internet, online data collection, journals and books. References: Basic types of referencing; Quoting, paraphrasing and citing. APA, MLA and the Chicago/ Turabian styles of listing references.	25%
4.	Scientific writing: Basic differences between popular and scientific writing; fundamental rules of scientific writing; structure and content of research papers, thesis and dissertations. Do's and don't for scientific writing. Tools and techniques for correction and editing of manuscripts. Selection and publication in journals.	25%

Teaching-Learning	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power
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Methodology	point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the significance of professional ethics in Scientific research
2.	Appreciate the types and pitfalls of plagiarism
3.	Learn how to collect data from primary and secondary sources
4.	Understand the differences between, common, popular and scientific writing and learn the basics of scientific writing

Suggested References:	
Sr. No.	References
1.	Professional ethics and human values: M. Govindarajan, S. Natarajan and V.S. Senthilkumar
2.	The craft of Scientific writing: Michael Alley
3.	Science and Technology ethics: Raymond Spier
4.	Scientific writing and research quality: Prasanna Kumar and Pawan Kumar Bharti

On-line resources to be used if available as reference material
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On-line Resources

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Master of Science (Biotechnology)  
M.Sc. (Biotechnology) Semester (IV)

Course Code	PS04EBIT54	Title of the Course	Systems Biology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. To introduce the concept of systems and synthetic Biology to the students 2. To provide insight into quantitative modelling of biological systems at the molecular and cellular level, as well as how they are used, analysed and developed
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Course Content		
Unit	Description	Weightage* (%)
1.	Concepts and working principles of System Biology - Practical applications of System Biology in Life Sciences - Introduction to System Biology platforms, Proprietary system Biology platform. Microarray data analysis - Microarray analysis platforms - Introduction to Concepts and principles of Microarray technology	25%
2.	Models and Modeling: purpose, adequateness, advantage of computational modeling, basic notion for computational models, model scope, statements, system state, variables parameters constants, behavior, classification, steady states.	25%
3.	Analysis of complex biological systems: Sequencing (DNA & amino acid), Protein structure analysis. Metabolic networks and flux balance analysis: Mathematical modeling of metabolic networks; formulation and optimization of Flux Balance Analysis; computational tools for FBA.	25%
4.	Introduction to synthetic biology. Modeling synthetic Biology; Applications of synthetic Biology. Human and Pathogens--Cancer genomics (Tumor complexity)--Gene regulatory network Codon optimization Algorithmic Drug designs. Current and emerging areas in the field of computational and systems biology.	25%

Teaching-Learning Methodology	
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**Evaluation Pattern**

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

**Course Outcomes: Having completed this course, the learner will be able to**

1.	Model macromolecular complexes on different time and length scales model macromolecular structures with the help of experimental information
2.	Explain cellular processes by describing the interactions between macromolecules in a kinetic network
3.	Appreciate the significance of synthetic Biology and its potential in future

**Suggested References:**

Sr. No.	References
1.	System Biology: Computational Systems Biology (Hardcover) by Andres Kriete (Editor), Roland Eils (Editor)
2.	Microarray Data Analysis: Gene Expression Data Analysis. A Beginner's Guide By: Helen Causton (Imperial College), J Quackenbush and Alvis Brazma (The European Bioinformatics Institute)
3	Klipp E (2009) Systems biology: a textbook. Wiley-VCH, 1/e.

**On-line resources to be used if available as reference material**

**On-line Resources**

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Master of Science (Biotechnology)  
M.Sc. (Biotechnology) Semester (IV)

Course Code	PS04EBIT55	Title of the Course	Biomaterials and Tissue Engineering
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. To impart knowledge on the types and properties Biomaterials used in medicine. 2. Understand the composition of implants and their pros and cons. 3. Learn tissue engineering and its applications 4. Gain an understanding of stem cells and their emerging role in treatment of genetic and somatic disorders.
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Course Content		
Unit	Description	Weightage* (%)
1.	Biomaterials: Introduction-definition of biomaterials, applications of biomaterials, classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra-vascular system). Surface properties, physical properties and mechanical properties of materials. Types of implant materials: Metallic, polymeric, ceramic and composite materials.	25%
2.	Properties of commonly used implant materials: Stainless steel and alloy importance of stress- corrosion cracking; role of passive films in tissue adhesion. Polymeric implant materials: general classification; Polyolefin, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetals. Biodegradable polymers and synthetic polymers and their applications. Ceramic implant materials: Bioceramics; Common types of bioceramics. Bio-reabsorbable and bioactive ceramics Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction). Composite implant materials: different reinforcement materials, Composite theory of fiber reinforcement.	25%
3.	Tissue engineering: Introduction, stem cells, morphogenesis, generation of tissue in the embryo, Tissue homeostasis, Cellular signaling Extracellular matrix as a biologic scaffold for tissue engineering Scaffold fabrication, bioactive scaffold, Natural polymers in tissue engineering applications, Degradable polymers for tissue engineering.	25%
4.	Basic Biology Of Stem Cells: Stem Cells : Introduction, hematopoietic differentiation pathway; Potency and plasticity of stem cells, sources,	25%





	embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis and differentiation. Stem cell systems- Liver, neuronal stem cells, Types and sources of stem cell with characteristics: embryonic, adult, haematopoietic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pluripotent stem cells.	
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Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand about various types of biomaterials for a wide range of biomedical applications.
2.	Basic functions and performance of implant materials as well as corrosion and degradation mechanisms of biomaterials.
3.	Choice of biomaterials based on function, biological environments, toxicity, bioadhesion and implant surface interaction with tissues. Scaffolds for tissue-engineering, growth factor, stem cell signaling.

Suggested References:	
Sr. No.	References





**SARDAR PATEL UNIVERSITY**  
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**(Reaccredited with 'A' Grade by NAAC (CGPA 3.25))**  
**Syllabus with effect from the Academic Year 2022-2023**

1.	Tissue Engineering: Bernhard O Palsson, Sangeeta N. Bhatia.
2.	Fundamentals of Tissue Engineering and Regenerative Medicine: Meyer, U,; Meyer, Th.; Handschel, J.; Wiesmann,H.P .
3	Biomaterials: Science and Engineering: J B Park
4	Biomaterials: Sujata V. Bhat

On-line resources to be used if available as reference material
On-line Resources

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Master of Science (Biotechnology)  
M.Sc. (Biotechnology) Semester (IV)

Course Code	PS04EBIT56	Title of the Course	Biodiversity and Conservation
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none"> <li>1. To impart knowledge of fundamental concepts of biodiversity, the range of its extant and the need for conservation.</li> <li>2. To provide information of the main threats to biological diversity and the ability to evaluate the effects of human influences on biodiversity.</li> <li>3. To demonstrate the differences between the different categories of red listed species.</li> <li>4. To understand different modes of biodiversity conservation, their merits and limitations.</li> <li>5. To integrate the information generated from scientific investigations and use findings to address conservation and biodiversity issues.</li> </ol>
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Course Content		
Unit	Description	Weightage* (%)
1.	<p>Biodiversity: Concepts, levels and types, changes in time and space, evolution, species concept; significance of biodiversity for life security. Biogeography.</p> <p>Terrrestrial, Marine, Aquatic and Agricultural biodiversity: Changing patterns and practices. Influence of modern lifestyle on biodiversity. Pros and cons of genetically modified species</p>	25
2.	<p>Global conservation measures, institutions and conventions; IUCN concept of threatened and endangered species. The Red Data Books of Indian plants and animals.</p> <p>Causes and consequences of loss of biodiversity.</p> <p>Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): aims, major ratifications and amendments.</p> <p>Exotic and invasive species: A few case studies of intentional and non-intentional introduction of exotic species and their influence on local biodiversity.</p>	25
3.	<p>Principles and strategies of biological diversity conservation: <i>in-situ</i> conservation and <i>ex-situ</i> conservation.</p> <p>Biosphere reserves, major protected areas (sanctuaries, national parks, biosphere reserves) of India and Gujarat. Wetlands, mangroves and coral reefs for conservation of wild biodiversity.</p> <p>Concept of Sacred groves and their role in biodiversity conservation.</p>	25





	Role of botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks in conservation of plants and animal sperms. Role of Zoos, breeding centers in conservation of animals.	
4.	Biodiversity hot spots in India and world; Indian Biodiversity Act 2002; Major objectives of biodiversity authority board; Biodiversity and economics with special reference to India; People's Biodiversity register: Objectives, importance and modality of preparation. General account of the activities of Botanical Survey of India (BSI) and Zoological Survey of India (ZSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific & Industrial Research (CSIR), Department of Biotechnology (DBT) and Department of Environment and Forest, Wild life Protection Society of India, Wildlife Institute of India (WII), Animal Welfare Board of India and Bombay Natural History Society (BNHS) in the context of Indian biodiversity conservation.	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the concept of biodiversity, its role for our survival, different direct and indirect threats on biodiversity.
2.	Appreciate the global and national initiatives and local traditions for biodiversity







	conservation.
3.	Become familiar with different modes of conservation, institutes involved in biodiversity conservation.
4.	Learn various guidelines and regulations for utilizing the biodiversity judiciously.

**Suggested References:**

Sr. No.	References
1.	Wilson, E., O., (1988). Biodiversity. The National Academies Press. Harvard. Washington, DC.
2.	Hunter, M., L., Gibbs, J.P.,(2007).Fundamentals of Conservation Biology. 3 <sup>rd</sup> Edn. Blackwell Publishing, Malden.
3.	Myers, N., Mittermeier, R., A., Mittermeier, C. G., Fonseca, G., A., da, Kent, J., (2000). Biodiversity Hotspots for Conservation Priorities. Nature, 403, 853-858.
4.	Rodgers, N. A., Panwar, H. S. Planning a Wildlife Protected Area Network in India. Vol. 1. The Report Wildlife Institute of India, Dehradun.

On-line resources to be used if available as reference material

On-line Resources

Biodiversity: **Author:** John Spicer

Brian W. van Wilgen: Biological Invasions in South Africa

Recent review articles and research papers

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Master of Science (Biotechnology)  
M.Sc. (Biotechnology) Semester IV

Course Code	PS04EBIT57	Title of the Course	Food and Dairy Microbiology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none"> <li>1. To understand about types of food spoilage and factors influencing food spoilage as well as microorganisms associated with spoilage of food.</li> <li>2. To learn about food borne pathogens and types of infections or poisoning caused upon consumption of pathogen contaminated food products..</li> <li>3. To gain insights into methods of food preservation and production of fermented foods.</li> <li>4. To gain information about detection of pathogens in food as well as analysis of food quality.</li> <li>5. To learn about regulations governing and certifications for food quality and recommended sanitation practices for food processing plants.</li> </ol>
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Course Content		
Unit	Description	Weightage* (%)
1.	<p>Scope of food microbiology</p> <p>Food as a substrate</p> <p>a) Microorganisms important in food microbiology – Bacteria, yeasts and moulds.</p> <p>b) Factors influencing microbial growth in food.</p> <p>Food Spoilage</p> <p>a) General principles underlying food spoilage and contamination.</p> <p>b) Spoilage of canned food, sugar products, vegetables, fruits, meat and meat products, milk and milk products fish, seafood and poultry</p>	25
2.	<p>Food poisoning</p> <p>a) Indicator food borne pathogens</p> <p>b) Bacterial food borne infections and intoxications-<i>Brucella</i>, <i>Campylobacter</i>, <i>Clostridium</i>, <i>Escherichia</i> (ETEC/EHEC/EPEC/EAEC), <i>Salmonella</i>, <i>Shigella</i>, <i>Listeria</i>, <i>Vibrio</i>, and <i>Yersinia</i>.</p> <p>c) Non- bacterial food borne infections and intoxications- Nematodes, protozoa, algae, fungi, and viruses.</p> <p>d) Culture and non-culture based detection of food pathogens and viruses</p> <p>e) General methods for diagnosis of infections, intoxications and preventive measures.</p>	25
3.	<p>Food preservation</p> <p>Principles of food preservation – Physical and chemical preservation</p>	25





	methods, Bio preservatives Food fermentations Starter cultures for fermented foods: Biochemical activities in fermentation of foods. Oriental fermented foods: Shoyu, Temph, Kimchi etc Fermented milk products: Yogurt, Kefir, Koumiss etc. Fermented vegetables – Sauerkraut Application of microbial enzymes in food industry	
4.	Genetically modified foods. Biosensors in food Food research organizations/institutes in India Recent foodborne outbreaks Food sanitation – Microbiology of food plant sanitation, water and milk testing Food laws and quality control – HACCP, Codex alimentarius, PFA, FPO, MFPO, BIS, FSSAI AGMARK.	25
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Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to





1.	describe the types of food spoilage and factors influencing food spoilage.
2.	associate a type of food spoilage with the causative microorganisms
3.	describedifferent types of food poisoning or infection and design a study to determine the cause of food poisoning or food borne infection.
4.	recommend a method of preservation for a particular type of food and expected extension in the shelf life of foods preserved thereby.
5.	understand science and technology in production of a fermented food of high quality.
6.	decide a method of sanitation for a food processing plant
7.	describe the applicable laws for food processing and/packaging as well as associated quality certifications.

**Suggested References:**

- Food Microbiology, Frazier and Westhoff
- Food microbiology, Adam and Moss
- Dairy Microbiology by Robinson. Volume II and I.
- Fundamental Food Microbiology, Bibek Ray and ArunBhuniya

On-line resources to be used if available as reference material

On-line Resources

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