

Deccan Education Society's
FERGUSON COLLEGE, PUNE
(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY

FIRST YEAR M.Sc. Biotechnology
SEMESTER – I

Academic Year 2016-2017

**Deccan Education Society's
Fergusson College (Autonomous), Pune
Faculty of Science
Post Graduate Syllabus M.Sc. (Biotechnology)**

Sem	Course Code	Title of the Course	No. of Credits
I	BTH4101	Molecular Biology	4
	BTH4102	Biological Chemistry	4
	BTH4103	Cell Biology	4
	BTH4104	Database Management and IPR	4
	BTH4105	Practical - 1: Exercises in Molecular Biology and Cell Biology	4
	BTH4106	Practical - 2: Exercises in Biological Chemistry & Bioinformatics	4
	BTH4107	Scientific Model Making	1
		Total	25
II	BTH4201	Genetic Engineering	4
	BTH4202	Immunology and Virology	4
	BTH4203	Plant Biotechnology	4
	BTH4204	Bacteriology	2
	BTH4205	Environmental Biotechnology	2
	BTH4206	Practical - 1: Exercises in Genetic Engineering	2
	BTH4207	Practical - 2: Exercises in Immunology and Virology	2
	BTH4208	Practical - 3: Exercises in Plant & Environmental Biotechnology	2
	BTH4209	Practical - 4: Exercises in Bacteriology	2
	BTH4210	Poster Making & Presentation	1
		Total	25

**Deccan Education Society's
Fergusson College (Autonomous), Pune
Faculty of Science
Post Graduate Extra Credits**

Semester	Course Code	Title of the Course	No. of Credits
I	XHR0001	Human Rights - I	1
	XCS0002	Introduction to Cyber Security - I / Information Security - I	1
	XSD0003	Skill Development - I (Chromatographic Techniques)	1
II	XHR0004	Human Rights - II	1
	XCS0005	Introduction to Cyber Security - II / Information Security - II	1
	XSD0006	Skill Development - II	1

BTH4101 Molecular Biology (4C)

Sr. No.	Topic	Lecture (Total 60)
1	Genome Structure and Organization Definition and organization of viral, prokaryotic and eukaryotic genomes: Structure of chromatin, nucleosome, chromatin organization and remodeling, higher order organization- chromosome, centromere, telomere. Histones and their effect on structure and function of chromatin. C value paradox and genome size, Cot curves, repetitive and non-repetitive DNA sequences, satellite DNA, DNA melting and buoyant density. Gene families, clusters, Pseudogenes, super-families, Organelle genomes	8
2	Mobile DNA elements Transposable elements in bacteria, IS elements, composite transposons, replicative and non-replicative transposons, Mu transposition, p-elements, Controlling elements in TnA and Tn 10 transposition. SINES and LINES, retrotransposons	5
3	DNA damage and Repair Types of DNA damage, DNA repair mechanisms- nucleotide excision repair, base excision repair, mismatch repair, recombination repair, double strand break repair, transcriptional coupled repair	5
4	Recombination Homologous and site-specific recombination, models for homologous recombination- Holliday junction, NHEJ Proteins involved in recombination- RecA, RuvA, B, C, Gene conversion	5
5	DNA Replication and Regulation DNA polymerases and mechanisms of DNA replication in prokaryotes and eukaryotes DNA replication models, connection of replication to cell cycle, Gene amplification (rRNA) Reverse Transcriptase	10
6	Gene Expression and Regulation in Prokaryotes and Eukaryotes Transcription: Basic mechanism in prokaryotes and eukaryotes. RNA Polymerases, pseudo-ORFs 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 structure-function of ribonucleoproteins (Ribosome concept).	17
7	Protein Synthesis and Regulation Components of protein synthesis, Mechanism of protein synthesis, Genetic code, codon usage, Regulation of protein synthesis	10

Learning Outcome:

The students should acquire the knowledge about:

- How different genomes are packaged and organized
- Various transposable DNA elements and their mechanism of transposition
- Various Molecular Biology processes like replication, transcription, translation
- Control and regulation of various processes

Reference Books:

1. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA
2. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Tania Baker,

Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick. Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA

3. Molecular Biology, 5th Edition (2011), Weaver R., 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

BTH4102 Biological Chemistry (4C)

Sr. No.	Topic	Lecture (Total 60)
1	Protein Biochemistry Primary, Secondary, Tertiary, quaternary Structure of Proteins Protein folding mechanisms - Molten globule, energy funnel, chaperon, Protein Misfolding and misfolding diseases Protein Processing- Proteolytic cleavage (Pre, Pro, removal) Protein Modifications – Glycosylation, Phosphorylation, Lipids attachment, Glycolipids Protein degradation – Lysosomal & proteosomal ubiquitination	15
2	Protein Structure and interactions Structure determination: Databases, various structure determination techniques Structure-function relationship Techniques to study protein-protein and protein-small molecule interactions Spectroscopic techniques	15
3	Enzymology Enzymes–Activity, Regulation, Kinetics, Action of inhibitors and cofactors. Techniques for studying activity, kinetics, regulation	15
4	Biomolecules: their structure & function Glycoconjugates – Glycoproteins & Glycolipids, Lectins Lipids – Lipoproteins, Signaling molecules and hormones Proteins – Peptide hormones, Growth hormones, Kinases, Cytokine receptors	5
5	Systems Approach to understand Metabolism Interaction networks of biomolecules in a cell. How signaling and metabolic pathways interact. Study of key molecules which play a role as multiple regulators. Understanding complex disorders	10

Learning outcome:**The students should acquire the knowledge about:**

- Fundamentals of structure and function of biomolecules with special emphasis on proteins,
- Techniques to study protein structure and interactions
- Enzyme kinetics and the complexity of metabolic reactions

Reference Books:

1. Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet & Judith Voet , John Wiley and Sons, Inc. USA
2. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.
3. Biochemistry: 7th Edition, (2012), Jeremy Berg, Lubert Stryer, W.H.Freeman and company, NY
4. Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf ; John Wiley and Sons, USA
5. Proteins: biotechnology and biochemistry, 1st edition (2001), Gary Walsch, Wiley, USA
6. An Introduction to Practical Biochemistry.3rd Edition, (2001), David Plummer, Tata McGraw Hill Edu.Pvt.Ltd. India
7. Biochemical Calculations, 2nd Ed., (1997) Segel Irvin H., Publisher: John Wiley and Sons, New York.

BTH4103 Cell Biology (4C)

Sr. No.	Topic	Lecture (Total 60)
1	Cell structure and cytoplasmic membrane system structure and functions of organelles and membrane trafficking, Methods in Cell Biology Cell structure and function with inter relationship of cell organelles (mitochondria, chloroplast, vacuoles, peroxisomes and lysosomes, nucleus and its components), energy transformation Cell membrane – Plasma membrane types (animal, plant and bacterial) and cytoplasmic membrane system- structural and functional organization Transport across plasma membrane and intra-cellular transport (vesicular and membrane transport) at molecular level Ion channels and aquaporins	15
2	Cell signaling communication between cells and environment Cytoskeleton- Structure- assembly and disassembly of cytoskeletal elements, role in cell division Extracellular matrix and cell junctions- relevance to tissue structure and function Signalling at cell surface, signalling molecules, hormones and receptors signalling pathways that control gene activity, signal transduction and second messengers	15
3	Cell differentiation Cell differentiation, Cell death, cell transformation Cell Cycle and its regulation Cell differentiation in plants and animals including terminal cell differentiation, Role of hormones and growth factors Cell transformation and etiology of cancer	15
4	Plant Cell Structure of Plant Cell, Plant cell wall - primary and secondary, biogenesis role in growth and development, Plasmodesmata- structure and function Plastids - biogenesis, structure and types Plant cell communication	15

Learning Outcome:

The students should acquire the knowledge about:

- Cell differentiation, cell cycle regulation and programmed cell death.
- Hormones and growth factor effects on a cell. Cell transformation and cancer etiology.
- Structure and function of organelles in a cell
- Plant cell communication.
- Different types of transport systems across the plasma membrane
- Protein targeting and vesicular transport

Reference Books:

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

BTH4104 Database Management and IPR (4C)

Sr. No.	Topic	Lecture (Total 60)
1	Introduction to databases and database management: Concept of Database: An Introduction to database Systems, File System vs. DBMS, Data Models	8
2	Database System Terminology: Dependencies, Data Normalization, Organization and Design of Database, Data Mining ,Data Warehousing, Biological Databases	8
3	DBMS Concepts: DBMS Architecture Describing and Storing Data in DBMS Introduction to MySQL: Statements/Commands associated with Data Definition Language (DDL), Data Manipulation Language (DML), Data Query Language (DQL)	8
4	Intellectual Property Rights : Overview and Historical Perspectives: Intellectual Property Rights, Categories of Intellectual Property Rights Geographical Indications: Role of Biotechnology in Fostering the local genuine products Protection of Plant Varieties and Plant Breeders' Rights Industrial Design Patenting Biosimilars and Recent Cases in various Jurisdictions Patent Specification Drafting Exercise;	8
5	TRIPS (Trade Related Intellectual Property Rights): Agreement and International Treaties related to IPR Patents: Criteria of Patentability, Plant, Animal, Microbial Patents: Indian and International Perspective	8
6	Geographical Indications: Role of Biotechnology in Fostering the local genuine products,Protection of Plant Varieties and Plant Breeders' Rights	8
7	Industrial Design : Patenting Biosimilars and Recent Cases in various Jurisdictions Patent Specification Drafting Exercise; Case Studies	6
8	American & European Patent Regimes: I US Patent Regime: US Patent Regime, European Patent Regime, History of the Broad Definition of Patentability, Final form of European Patent system Development of EPO Practice in Relation to Biotech Industries, Patent specification – Best Mode	8

Learning Outcome:

The students should acquire the knowledge about:

- Various databases, their organization and data management
- Concept and importance of Patent laws, Intellectual Property Rights and its implications
- Concepts and approaches in Bioinformatics and its application in various biological fields
- Data mining, data retrieval, and sequence data analysis of wet lab experimentation computationally

References:

1. A text book of bioinformatics (2008) Sharma, Munjal and Shankar. Rastogi Publications, Meerut.
2. An introduction to Bioinformatics Algorithms (2004)Neil Jones, Pavel Pevzner A Bradford Book, The MIT Press, USA
3. Bioinformatics - From Genomes to Drugs (2001) Thomas Langauer (editor) Wiley-VCH; 1st edition, New York
4. Bioinformatics-Sequence and Genome Analysis (2004)David W Mount Cold Spring Harbor Laboratory Press; 2nd edition, USA

5. BLAST (2003) Joseph Bedell, Ian Korf, Mark Yandell. O'Reilly Media, USA
6. Discovering genomics, Proteomics and Bioinformatics (2006) A. Malcolm Campbell, Laurie J. Heyer Pearson-Benjamin Cummings; 2nd edition, USA
7. Essential Bioinformatics (2006) Jin Xiong Cambridge University Press; 1st edition, Cambridge
8. Genome analysis and bioinformatics (2009) Sharma T R I.K. International Publishing House Pvt. Limited, Delhi
9. Introduction to Bioinformatics (2008) Arthur M. Lesk OUP, Oxford
10. Introduction to genetic analysis (2008) Griffiths et al W. H. Freeman, New York
11. Introduction to Database Management System by Bipin Desai and Introduction to Database Management System by C.J. Date
12. Immunoinformatics (2008) Schönbach, Ranganathan, Brusic Springer, New York
13. Lehninger Principles of Biochemistry (2008) Nelson David, Cox Michael W. H. Freeman 5th edition, New York
14. Principles of proteomics (2004) Twyman Richard Taylor & Francis, UK
15. Protein Structure Prediction, methods and protocol (2000) David M. Webster Springer, New York
16. Proteomics from protein sequence to function (2001) Pennington SR, Dunn MJ., Stephen R BIOS Scientific publication, Oxford, UK
17. Intellectual property rights: basic concepts (2009) M M S Karki Atlantic Publishers & Distributors, New Delhi
18. Dr. B.L.Wadehra 2011, Law Relating To Intellectual Property, Fifth Edition, Universal Law Publishing Co.Pvt. Ltd.
19. TIFAC 2002 Some questions and answers on Patents and Copyrights
20. H K Das 2010, Text book of Biotechnology, 4th edition, Wiley India Pvt. Ltd, New Delhi
21. H S Chawala 2009, Introduction to Plant Biotechnology, 3rd Edition, Science Publishers
22. Hirvani R 2009, Patents in Plant Breeding: Guarding the Green Gold- Biotech News issue vol 4., No.4
23. Ganguli Prabuddh 2001, Intellectual Property Rights, Tata McGraw-Hill Publishing Company Ltd.

BTH4105 Exercises in Molecular and Cell Biology (4C)

Sr. No.	Topic	Practical (15Px4H)
	Molecular Biology	
1	Isolation of nuclei and chromatin Mononucleosome size determination by agarose gel electrophoresis	2
2	Extraction and Analysis of Histones	2
3	Isolation of RNA and analysis by agarose gel	2
	Cell Biology	
1	Isolation of mitochondria and lysosomes by sucrose gradient centrifugation and analysis of fractions by assay of SDH and acid phosphatase activity respectively Isolation of chloroplasts, mitochondria from plant cells	3
2	Programmed cell death during limb development In Chick	2
3	Micrometry: determination of different cell sizes: bacterial, fungal, plant and animal cells	2
4	Plant Bleeding of cucurbitaceae family	2

BTH4106 Exercises in Biological Chemistry & Bioinformatics (4C)

Sr. No.	Topic	Practical (15Px4H)
1	Extraction, purification and characterization of protein Ammonium sulphate precipitation Dialysis Column Chromatography- Gel filtration, Ion exchange, Affinity Native PAGE and activity staining SDS PAGE Quantification and spectral analysis at each step of purification	5
2	Sequence search of the purified protein from databases Homology search: BLAST and FASTA Structure determination and analysis from databases	5
3	Enzyme Assay : Beta- galactosidase/ LDH/ Invertase Effect of pH, Temperature, time, various Substrate concentration, inhibition on enzyme activity, Km and Vmax and LB plot	5

BTH4107 Scientific Model Making (1C)

Sr. No.	Topic	Hours
1	Model making in cell and molecular biology: Students will build a 3D representation of molecular or cellular process. The models should be cost effective and eco friendly in terms of concept and design. Models should demonstrate creativity and insight and should be combined with data and observations in coherence with the theory topics.	15

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BTH4201 Genetic Engineering (4C)

Sr. No.	Topic	Lecture (60L)
1	Tools in genetic engineering: DNA modifying enzymes and restriction enzymes for Genetic engineering , Vectors in gene cloning-Plasmid, Cosmid, Phages, Phasmids, Advanced cloning vectors-BAC, YAC, PAC Transformation and Transfection, cDNA and genomic DNA library, screening of gene libraries	5
2	Advanced Tools in genetic engineering: CRISPR, Genome re-coding, lentivirus and Cre/loxP system, phiC31 integrase, PiggyBac transposase and zinc finger nucleases Gene editing	10
3	DNA Sequencing Sanger Sequencing, Next-generation sequencing platforms: Sequencing by synthesis, Sequencing by ligation methods	10
4	Expression strategies and methods for producing industrially important molecules (with examples): Various expression vectors in bacteria and eukaryotes-Yeast, Baculovirus, Mammalian and Shuttle vectors. Induced expression strategies and protocols. Expression of industrially important products.	10
5	Analytical Techniques Techniques for analyzing genes and gene expression, transcriptomics, analyzing whole genomes	10
6	Applications and current research focus Based on current research publications	15

Learning Outcome:

The students should acquire the knowledge about:

- Various natural and laboratory based modifications of DNA
- How damage is repaired
- Tools creating DNA constructs
- Various protein expression strategies

References 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,
6. Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick, Pearson Education,
7. Inc. and Dorling Kindersley Publishing, Inc. USA

12. Molecular Biotechnology: 4th edition. (2010), Glick B.R., Pasternak J.J., Patten C. L.,
13. ASM press, USA.
14. Principles of Gene Manipulation & Genomics, 7th Edition (2006), Primrose and Twyman,
15. Blackwell Publishing, USA.
16. Molecular cloning – a laboratory manual – (Vol. 1-3), 4rd edition, (2012), Green and
17. Sambrook, Cold Spring Harbor Laboratory Press, USA

BTH4202 Immunology and Virology

Sr.No	Topic	Lectures (60L)
IMMUNOLOGY		
1	Overview of the immune system: Introduction to Immune system. Immune system cells, tissues and organs Antigens, Antibodies, organization and expression of immunoglobulin genes T-Cell receptor, T-cell generation, activation and differentiation B-Cell generation, activation and differentiation	3
2	Types of Immunity: Innate immunity, Acquired immunity (Humoral and Cellular) and Passive Immunity. Structure of MHC molecule and Antigen Presentation.	3
3	Complement system: Three pathways of complement activation. Regulation and Function of Complement.	3
4	Hypersensitivity Reactions -I, II and III with examples.	1
5	Autoimmunity: Mechanisms of Tolerance, Autoimmune diseases (Organ specific and Systemic), Molecular mimicry, Autoimmune therapy.	4
6	Transplant immunology : Classification of Grafts, Immunological basis of acceptance of autografts and rejection of allografts, Acute, Hyperacute and Chronic rejections of transplant, Xenotransplantation and its clinical future, GVHD and Immunosuppressive therapy.	4
7	Parasitic immunology: Immune response against protozoan infections, helminthes and fungal infections. Various approaches to design vaccines against parasitic infections.	3
8	Molecular immunology: Antibody engineering, Chimeric antibodies and Phage display techniques.	3
9	Animal Models : (Nude mouse, SCID mouse, NOD mouse, Obese-strain chicken, NZB and NZW mice, Knock – out mouse etc.), animal models for autoimmunity and their use in immunological studies.	3
10	Experimental immunology : Vaccine development (Live attenuated, Killed and Recombinant Vaccines). Important criteria for designing an effective vaccine.	3
VIROLOGY		
11	Introduction to viruses: General properties of viruses, Morphology, Symmetry and Ultra structure of Viruses	2
12	Classification of viruses: Classification and Characterization of DNA and RNA viruses, ICTV system and Baltimore system.	3
13	Replication of viruses: DNA (ds) - Poxvirus , RNA(ss+ve)- Poliovirus, RNA (ss -ve) - Influenza virus and RNA with RT- HIV .	3
14	Viral Diagnosis: Microscopy, Cultivation, Serological, Infectivity assays and Immunodiagnosics.	3
15	Antiviral :	3

	Mode of Action of various antiviral drugs with examples and Viral Vaccines.	
16	Types of Infections: Acute and persistent infections with example. Case study, Immunopathogenesis of HIV and Herpes.	3
17	Epidemiology: Principles and related terminologies, Current National and Global epidemiology of viral infections (with suitable examples).	2
18	Oncogenic virus and Cancer Immunology, Immunotherapy, Immunodeficiency (Primary and secondary) .	3
19	Emerging viral diseases: Re-emerging and New emerging viral diseases with example. (H1N1, SARS, Nipah , Marburg , Hendra virus , Ebola , H5N1, Dengue, yellow fever, West Nile Zika virus etc.).	2
20	Animal and Poultry viruses: Clinical symptoms with examples (FMD, Rinderpest Virus, Avian Influenza, Newcastle Disease etc.), Prevention.	2
21	Plant viruses: Mode of transmission and Prevention. Replication and Symptoms of TMV.	2
22	Concept of Biosafety Level and Microbial Containment .	2

Learning outcome:

Students are expected to learn the following:

- Concept of “Resistance” against diseases in our body..
Antigen antibody reactions.
- An Understanding of clinical transplantation.
- Autoimmunity and strategies for treating autoimmune diseases.
- Properties of viruses and their replication cycle.
- Mode of action of antiviral drugs and viral vaccines.
- Knowledge on Poultry and Plant viruses.
- Contribution of epidemiology in relation to public health.
- Concept of oncogenic virus and cancer immunology.

Reference Books:

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 Roitt and Mosby, USA. Roitt's Essential Immunology (2011), 12th edition, Wiley and Black Well.
The Elements of Immunology., F.H. Khan (2009), Pearson Education.
4. Principles of Virology 3rd edition, (1999), Flint Jane. S., ASM (American Society of Microbiology) Press Publisher, 2 volumes., USA.
5. Field's Virology - 2 volumes, 5th edition, (2006), Bernard.N. Fields, Lippincott and Williams Wilkins, USA
6. Microbiology: An introduction, 5th edition,(1992), Tortora, G.J., Funke B.R., Case C.L., Benjamin Pub. Co. NY

BTH4203 Plant Biotechnology (4C)

Sr. No.	Topic	Lectures (60L)
1	Algal Biotechnology- Quantitative improvement in economically important Algae like Spirulina, Dunaliella, Chlorella. Applications- Single Cell Proteins, Biofuels, Pigments Algal Transgenics	10
2	Fungal Biotechnology- Quantitative improvement in economically important Fungi like Mushrooms (Agaricus, Pleurotus, lentinus) Qualitative Improvement (Strain Improvement, Product improvement) Industrially important fungi like Yeast, Aspergillus, Penicillium (Fermentation technology)	10
3	Plant Tissue Culture- Micropropagation- Stages of Micropropagation (Stage 0 to Stage 4), Somatic embryogenesis and Artificial seeds <i>In Vitro</i> Androgenesis and its Applications Protoplast isolation, Somatic hybridization and Cybridization <i>In vitro</i> production of secondary metabolites	15
4	Transgenic Technology- Introduction, Methods of Transgenesis (Vector mediated and non vector based gene transfer) Transgenic plants for biotic stress tolerance (Fungi, bacteria, viruses, Insects, weeds) Transgenic plants for abiotic stress tolerance (Drought, Salt, Temperature) Transgenic plants for production of Secondary metabolites Increase in productivity by manipulation of Photosynthesis and Nitrogen fixation. Molecular Farming- Improvement in Carbohydrates, Proteins, Lipids, Plantibodies, Edible vaccines	25

Learning outcome:

The students should acquire the knowledge about:

- Various experiments in PTC like protoplast isolation, Micro propagation Anther culture
- Cultivation of Spirulina, Pleurotus which are very rich in proteins.
- Bioremediation, EIA study and impact of water pollution on plants.

Reference books:

1. Chawla, H. C. (2004) Introduction to Plant Biotechnology
2. Davies k (2004) –Plant Pigments and their manipulation-Annual plant reviews-Vol 14
3. Altman,A and Hasegawa P M (2012) – Plant Biotechnology and Agriculture Prospects for the 21st century
4. Bhojwani,S S and Razdan M.K.(1996) plant Tissue Culture: Theory and Practices
5. Slater A, Scott,N W, Fowler, M R(1008) –Plant Biotechnology: Genetic manipulation of plants
6. Rai, M (2009) Fungal Biotechnology (IK International)
7. Vasil K., Thorpe T A.(1994) plant cell and Tissue Culture

BTH4204 Bacteriology (2C)

S.No.	Topic	Lectures (30L)
1.	Microbial evolution and systematics : The Origin of life and Microbial Diversification, Microbial evolution, Evolutionary chronometers, Methods for determining evolutionary relationships, Microbial Taxonomy – Classical, Molecular, Concept of Species, Nomenclature and <i>Bergey's Manual</i>	4
2.	Molecular basis of Binary Fission, Cell Structure – Overview with emphasis on: Genetic mechanism determining bacterial shapes, Assembly of Flagella, Motility and Chemotaxes, Cell wall and Cell membrane (Gram Positive , Negative and Archaeobacterial), Protoplast, Spheroplast, Lforms, Mycoplasma, Endospore formation(mechanism describing role of sensor kinases)and Germination.	5
3.	Nutritional Classification and Metabolic diversity of bacteria with specific examples, Quorum Sensing in Bacteria, Biofilm formation and Significance.	5
4.	Microbial Growth Kinetics Environmental effects on bacterial growth, Extremophiles their molecular adaptations and significance.	5
5.	Bacterial Pathogenesis: Entry of Pathogen in the host, colonization, Virulence factors, host factors, Molecular mechanism of pathogenesis of: <i>Mycobacterium tuberculosis</i> , Pathogenic <i>E. coli</i> , <i>Helicobacter pylori</i> , Syphilis , Bacterial meningitis, Botulism. Pathogenicity Islands – Concept with example Molecular and immunological methods for disease diagnosis (of above mentioned pathogens) Antibacterial agents with mode of action (Natural and synthetic) Multidrug resistance in bacteria (cause and effect), Mechanisms of development of drug resistance of Methicillin resistant <i>Staphylococcus aureus</i> (MRSA) Plasmid curing a possible approach for overcoming drug resistance.	10
6	Current trends in Bacteriology, Threats of Bioterrorism	1

Learning Outcome:

The students should acquire the knowledge about:

- Microbial evolution and systematic
- Molecular basis of binary fission, bacterial cell structure, endospore formation
- Metabolic diversity, quorum sensing and biofilm formation
- Microbial growth kinetics, molecular adaptations of extremophiles
- Bacterial pathogenesis of various pathogens, antibacterial agents, multidrug resistance and plasmid curing.
- Current trends in bacteriology.

Reference Books:

1. Introduction to Microbiology. 3rd Edition, (2004), Ingraham JL and Ingraham CA. Thomson Brooks / Cole.
2. Brock's Biology of Microorganisms. 11th Edition, (2006). Madigan MT, Martinko JM. Pearson Education Inc. , USA
3. Fundamental Principles of Bacteriology. 7th Edition, (1971) Salle AJ. Tata MacGraw Publishing Co. India
4. Microbiology: An introduction, 5th edition,(1992), Tortora, G.J., Funke B.R., Case C.L, Benjamin Pub.Co. NY
5. Microbiology, 4th edition (1990), Davis B.D. ,DeBacco, J.B. Lippincott Co. NY
6. Zinsser, W , 1976, Microbiology Edition, W .K Jklik, NY
7. Medical Bacteriology, 14th edition, (1988), Dey, N.C and Dey, TK., Allied Agency, India
8. Text book of microbiology 5th edition (1996), Ananthnarayana, R. and C.E, Jayaram Panakar, Orient Longman.
9. General Microbiology, 5th edition (1987), Stanier R.Y., Adelberg E.A. and Ingraham J.L..Macmillan Press Ltd.
10. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. MacGraw HillCompanies Inc.

BTH4205 Environmental Biotechnology (2C)

S. No.	Topic	Lectures (60L)
1	Global and regional threats to the environment Air, water and soil pollution :Types, sources and impacts, Solid waste: Sources and types, Impact on land of solid waste disposal, Recycle, Reuse and Recovery.	4
2	Biotechnology and environmental pollution control (waste water and air), Biotechnology in control of Industrial pollution and safe disposal of industrial effluents (with 2-3 examples of Industrial effluent types and treatment) Hospital waste management	10
3	Biodegradation Biodegradation of xenobiotic compounds: Priority pollutants and their health effects Microbial basis of biodegradation Biopesticides, Microbial plastics Bioremediation:Meaning,Types, Process with examples Phytoremedaition Metal remediation Bioaugmentation, Biostimulation.	8
4	Environmental management: problems and need Environmental management Plan: scope, EMP preparation , Need of EMP Environmental Impact Assessment: Objectives of EIA EIA and International organizations Stages of EIA process EIA in India: Process Stages of Environmental clearance process ISO 14000 Environmental audits and ethics Environmental Laws and Policies	8

Learning Outcome:

The students should acquire the knowledge about:

- Global and regional threats to the environment; Air, water and soil pollution.
- Role of Biotechnology in effluent treatment, biodegradation, bioremediation, bioaugmentation with examples
- Concept of EIA and environmental laws.

Reference Books:

1. InduShekharThakur (2006) Environmental Biotechnology: Basic Concepts and Applications, I. K. International Pvt Ltd, 2006
2. Gareth M. Evans and Judith C. Furlong (2003) Environmental Biotechnology Theory and Application, John Wiley & Sons Inc.
3. Alan H. Scragg (2006) Environmental Biotechnology , 1st edition , Oxford University Press
4. S.K. Agarwal (2007) Environmental Biotechnology , APH Publishing Co-operation , New Delhi
5. Alexander N. Glazer and Hiroshi Nikaido (2010) Microbial Biotechnology, 2nd edition, Cambridge University press.
6. A.G. Murugesan and C. Rajakumari (2006) Environmental Science and Biotechnology Theory and techniques MJP Publishers , Chennai
7. Gwendolyn Holmes Bruce et al, (2000), Handbook of Environmental management and technology, Wiley Intersciences Publishers

8. Advanced Renewable Energy Sources (2012) GopalNathTiwari and R K Mishra,
9. RSC Publishing, London.
10. Agenda 21: Guidelines for Stakeholders Patwardhan&Gunale, Pune.
11. Air Pollution (2004) HVN Rao and M N RaoTata McGraw-Hill, , New Delhi
12. Air Pollution Control CP Mahajan, Capital Publishing Co, New Delhi
13. Air Pollution Engineering Manual (2000) Wayne T Davis (editor), Air and Waste
14. Management Association, Wiley Interscience,, New Jersey
15. An Introduction To Geographic Information Technology (2009) SuchandraChoudhury
16. I K International Pvt Ltd., New Delhi
17. Bioremediation (1994) Baker, K.H and Herson, D.S.McGraw Hill, Inc. New York
18. Biotreatment of Industrial & Hazardous Waste (1993) M.V.Levin and Gealt, M.A McGraw Hill. Inc, New York
19. Concepts and Techniques of Geographic Information Systems (2009) C.P.Lo.Albert and
20. K.W.Yeung2nd edition, Prentice Hall, Inc., New Jersey
21. Ecology and environmental biology (2011) Saha T K Books & Allied (p) Ltd, Delhi
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BTH4206 Exercises in Genetic Engineering (4C)

Sr. No.	Topic	Practical (15Px4H)
1	Designing a strategy for producing a recombinant product	1
2	Preparation of competent cells and transformation	2
3	Isolation of plasmid DNA and quantification	1
4	Expression of gene product and its analysis	2
5	Primer designing and PCR of gene product	2
6	RNA isolation (prokaryotes or eukaryotes)	2
7	RT-PCR	2
8	Restriction Mapping	1
9	Southern Blotting / Northern Blotting	2

BTH4207 Exercises in Immunology and Virology (2C)

Sr. No	Topic	Practical (10Px2H)
Immunology		
1	Agglutination Inhibition/Viral haemagglutination	1
2	Complement Fixation	1
3	ELISA	1
4	Western blotting	3
5	Widal Test	1
Virology		
1	Routes of virus inoculation in embryonated eggs.	1
2	Phage Assay.	2

BTH4208 Exercises in Plant & Environmental Biotechnology (2C)

Sr. No.	Topic	Practicals (10Px2H)
1	Spirulina culture or Pleurotus cultivation and biochemical analysis	1
2	Micropropagation (stages 0 to 4)	3
3	Protoplast isolation	1
4	<i>In vitro</i> production of secondary metabolites	2
5	Initiation of hairy root culture / Anther culture	1
6	Genotoxicity assay of polluted water	1
7	Review on EIA case study	1
8	Bioremediation of heavy metals	2

BTH4209 Exercises in Bacteriology (2C)

S. No.	Practical	Practical (10Px3H)
1	Good Laboratory Practices for Bacteriology Laboratory	1
2	Effect of environmental parameters on bacterial growth curve and generation time	1
3	Isolation, identification of following organisms by morphology, cultural characteristics and biochemical tests: <i>E. coli</i> , <i>Salmonella</i> spp. <i>Staphylococcus</i> spp, <i>Streptococcus</i> spp. (for identification use of keys as well as Bergey's Manual is recommended) Antibiotic sensitivity testing of the isolates (for Gram negative and Gram Positive) c. Study of growth characters of isolated pathogens on following media: Mannitol Salt Agar, Wilson Blair agar, Salmonella Shigella agar, Glucose azide medium, MacConkey's agar, EMB agar and TSI agar	5
4	Extraction of bioactive principles from plant and estimation of its antimicrobial activity using standard guidelines (CLSI)	2
5	Determination of MIC and MBC of an antibacterial agent	1

BTH4210 Poster Making & Presentation (1C)

Sr. No.	Topic	Hours
1	Students should learn all aspects of collection, analysis and interpretation of data. They should learn to prepare the results of experiments for presentation in the form of a poster	15