



# C. U. SHAH UNIVERSITY



## Discipline Specific elective (DSE) subject pool Biotechnology

NAME: BIOINFORMATICS (THEORY)

### Course Content:

Sr. No.	Course contents	Teaching Hours
1	<b>Introduction to Computer Fundamentals:</b> RDBMS-Definition of relational database Mode of data transfer (FTP, SFTP, SCP), advantage of encrypted data transfer.	08
2	<b>Introduction to Bioinformatics and Biological Databases:</b> Biological databases-nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage-File formats-FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB	14
3	<b>Sequence Alignments, Phylogeny and Phylogenetic trees :</b> Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices. Types of phylogenetic trees, Different approaches of phylogenetic tree construction-UPGMA, Neighbour joining, Maximum Parsimony, Maximum likelihood.	16
4	<b>Genome organization and analysis:</b> Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes Genome, transcriptome, proteome, 2-D gel electrophoresis, MALDI TOF spectroscopy Major features of completed genomes: <i>E. coli</i> , <i>S. cerevisiae</i> , <i>Arabidopsis</i> , Human	10
5	<b>Protein Structure Predictions:</b> Hierarchy of protein structure-primary, secondary and tertiary structures, modeling, Structural Classes, Motifs, Folds and Domains Protein structure prediction in presence and absence of structure template Energy minimizations and evaluation by Ramachandran plot Protein structure and rational drug design.	12
<b>Total Hours</b>		<b>60</b>



# C. U. SHAH UNIVERSITY



## BIOINFORMATICS (PRACTICAL) SEMESTER V/VI

S.No	Experiment
1	Introduction to different operating systems - UNIX, LINUX and Windows
2	Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB
3	Sequence retrieval using BLAST
4	Sequence alignment & phylogenetic analysis using clustal W & phylip
5	Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeating genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN), Primer designing, Genscan/Genetool
6	Protein structure prediction: primary structure analysis, secondary structure prediction using psi-pred, homology modeling using Swiss model. Molecular visualization using jmol, Protein structure model evaluation (PROCHECK)
7	Prediction of different features of a functional gene

### SUGGESTED READING

1. **Saxena Sanjay** (2003) A First Course in Computers, Vikas Publishing House
2. **Pradeep and Sinha Preeti** (2007) Foundations of Computing, 4th ed., BPB Publications
3. **Lesk M.A.** (2008) Introduction to Bioinformatics. Oxford Publication, 3rd International Student Edition
4. **Rastogi S.C., Mendiratta N. and Rastogi P.** (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. **Primrose and Twyman** (2003) Principles of Genome Analysis & Genomics. Blackwell



# C. U. SHAH UNIVERSITY



NAME: MICROBIAL BIOTECHNOLOGY (THEORY)

**Course Content:**

S.No	
1	<b>Microbial Biotechnology and its Applications:</b> Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology Use of prokaryotic and eukaryotic microorganisms in biotechnological applications Genetically engineered microbes for industrial application: Bacteria and yeast
2	<b>Therapeutic and Industrial Biotechnology:</b> Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine) Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics, Microbial biosensors
3	<b>Applications of Microbes in Biotransformations:</b> Microbial based transformation of steroids and sterols, Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute
4	<b>Microbes for Bio-energy and Environment:</b> Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents
5	<b>RNAi:</b> RNAi and its applications in silencing genes, drug resistance, therapeutics and host pathogen interactions <b>Intellectual Property Rights:</b> Patents, Copyrights, Trademarks



## MICROBIAL BIOTECHNOLOGY (PRACTICAL) SEMESTER V/VI

S.No	Experiment
1	Study of yeast cell immobilization in calcium alginate gels
2	Study of enzyme immobilization by sodium alginate method
3	Pigment production from fungi ( <i>Trichoderma/Aspergillus/Penicillium</i> )
4	Isolation of xylanase or lipase producing bacteria
5	Study of algal Single Cell Proteins
6	Study of enzyme production.
7	Study of effect of pH on enzyme production
8	Study of effect of Temperature on enzyme production

### SUGGESTED READING

1. **Ratledge, C and Kristiansen, B.** (2001). *Basic Biotechnology*, 2nd Edition, Cambridge University Press.
2. **Demain, A. L and Davies, J. E.** (1999). *Manual of Industrial Microbiology and Biotechnology*, 2<sup>nd</sup> Edition, ASM Press.
3. **Swartz, J. R.** (2001). *Advances in Escherichia coli production of therapeutic proteins*. *Current Opinion in Biotechnology*, 12, 195–201.
4. **Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ** (2014), 9th edition, McGraw Hill Publishers.
5. **Gupta PK** (2009) *Elements of Biotechnology* 2<sup>nd</sup> edition, Rastogi Publications,
6. **Glazer A N and Nikaido H** (2007) *Microbial Biotechnology*, 2<sup>nd</sup> edition, Cambridge University Press
7. **Glick BR, Pasternak JJ, and Patten CL** (2010) *Molecular Biotechnology* 4<sup>th</sup> edition, ASM Press,
8. **Stanbury PF, Whitaker A, Hall SJ** (1995) *Principles of Fermentation Technology* 2<sup>nd</sup> edition., Elsevier Science
9. **Crueger W, Crueger A** (1990) *Biotechnology: A text Book of Industrial Microbiology* 2<sup>nd</sup> edition Sinauer associates, Inc



# C. U. SHAH UNIVERSITY



## ADVANCES IN MICROBIOLOGY (THEORY) SEMESTER-V/VI

Sr. No.	Course contents	Teaching Hours
1	<b>Evolution of Microbial Genomes:</b> Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pangenome, Horizontal gene transfer (HGT), Evolution of bacterial virulence-Genomic islands, Pathogenicity islands (PAI) and their characteristics	15
2	<b>Metagenomics :</b> Brief history and development of metagenomics, Understanding bacterial diversity using metagenomics approach, Prospecting genes of biotechnological importance using metagenomics. Basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics.	15
3	<b>Molecular Basis of Host-Microbe Interactions:</b> Epiphytic fitness and its mechanism in plant pathogens, Hypersensitive response (HR) to plant pathogens and its mechanism, Type three secretion systems (TTSS) of plant and animal pathogens, Biofilms: types of microorganisms, molecular aspects and significance in environment, healthcare, virulence and antimicrobial resistance	15
4	<b>Systems and Synthetic Biology:</b> Networking in biological systems, Quorum sensing in bacteria, Co-ordinated regulation of bacterial virulence factors, Basics of synthesis of poliovirus in laboratory, Future implications of synthetic biology with respect to bacteria and viruses	15
<b>TOTAL</b>		<b>60</b>

## ADVANCES IN MICROBIOLOGY (PRACTICAL) SEMESTER-V/VI

S.No	Experiment
1	Extraction of metagenomic DNA from soil
2	Understand the impediments in extracting metagenomic DNA from soil
3	PCR amplification of metagenomic DNA using universal 16S ribosomal gene primers
4	Case study to understand how the poliovirus genome was synthesized in the laboratory
5	Case study to understand how networking of metabolic pathways in bacteria takes place

### SUGGESTED READING

1. **Fraser CM, Read TD and Nelson KE.** Microbial Genomes, 2004, Humana Press
2. **Miller RV and Day MJ.** Microbial Evolution- Gene establishment, survival and exchange, 2004, ASM Press
3. **Bull AT.** Microbial Diversity and Bioprospecting, 2004, ASM Press
4. **Sangdun C.** Introduction to Systems Biology, 2007, Humana Press
5. **Klipp E, Liebermeister W.** Systems Biology – A Textbook, 2009, Wiley-VCH Verlag



# C. U. SHAH UNIVERSITY



## PLANT PATHOLOGY (THEORY) SEMESTER-V/VI

S.No	Experiment
1	<p><b>Introduction and History of plant pathology:</b> Concept of plant disease- definitions of disease, disease cycle &amp; pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton De Bary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates. Contributions of eminent Indian plant pathologists.</p>
2	<p><b>Stages in development of a disease:</b> Infection, invasion, colonization, dissemination of pathogens and perennation.</p>
3	<p><b>Plant disease epidemiology:</b> Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle &amp; disease pyramid, forecasting of plant diseases and its relevance in Indian context.</p>
4	<p><b>Host Pathogen Interaction</b> <i>Microbial Pathogenicity:</i> Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction). <i>Genetics of Plant Diseases:</i> Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance- horizontal &amp; vertical, apparent resistance. <i>Defense Mechanisms in Plants:</i> Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histological- cork layer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].</p>
5	<p><b>Control of Plant Diseases:</b> Principles &amp; practices involved in the management of plant diseases by different methods, viz. regulatory- quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material cultural- host eradication, crop rotation, sanitation, polyethylene traps and mulches chemical- protectants and systemic fungicides, antibiotics, resistance of pathogen to chemicals. biological- suppressive soils, antagonistic microbes- bacteria and fungi, trap plants genetic engineering of disease resistant plants- with plant derived genes and pathogen derived genes</p>



# C. U. SHAH UNIVERSITY



## PLANTPATHOLOGY(PRACTICAL) SEMESTER–V/VI

### Experiment

Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.  
Study of important diseases of crop plants by cutting sections of infected plant material-  
*Albugo, Puccinia, Ustilago, Fusarium, Colletotrichum*

### SUGGESTED READINGS

1. **Agrios GN.** (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. **Lucas JA.** (1998). Plant Pathology and Plant Pathogens. 3rd edition. Blackwell Science, Oxford.
3. **Mehrotra RS.** (1994). Plant Pathology. Tata McGraw-Hill Limited.
4. **Rangaswami G.** (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hall of India Pvt. Ltd., New Delhi.
5. **Singh RS.** (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi



# C. U. SHAH UNIVERSITY



## BIOMATHEMATICS AND BIostatISTICS (THEORY) SEMESTER–V/VI

TOTAL HOURS: 60

CREDITS: 4

Sr. No.	Course contents	Teaching Hours
1	<p><b>Biomathematics:</b>  Sets. Functions and their graphs: polynomial, sine, cosine, exponential and logarithmic functions. Motivation and illustration for these functions through projectile motion, simple pendulum, biological rhythms, cell division, muscular fibres etc.  Simple observations about these functions like increasing, decreasing and, periodicity.  Sequences to be introduced through the examples arising in Science beginning with finite sequences, followed by concepts of recursion and difference equations. For instance, the Fibonacci sequence arising from branching habit of trees and breeding habit of rabbits. Intuitive idea of algebraic relationships and convergence.  Infinite Geometric Series. Series formulas for <math>\exp</math>, <math>\log(1+x)</math>, <math>\sin x</math>, <math>\cos x</math>. Step function. Intuitive idea of discontinuity, continuity and limits.  Differentiation. Conception to be motivated through simple concrete examples as given above from Biological and Physical Sciences. Use of methods of differentiation like Chain rule, Product rule and Quotient rule. Second order derivatives of above functions.  Integration as reverse process of differentiation.  Integrals of the functions introduced above. Differential Equations of first order, Linear Differential Equations. Points in plane and space and coordinate form. Examples of matrices arising in Biological Sciences and Biological networks. Sum and Product of matrices upto order 3.</p>	30
2	<p><b>Biostatistics</b>  Measures of central tendency, Measures of dispersion; skewness, kurtosis; Elementary Probability and basic laws; Discrete and Continuous Random variable, Mathematical Expectation; Curve Fitting; Correlation and Regression. Emphasis on examples from Biological Sciences;  Mean and Variance of Discrete and Continuous Distributions namely Binomial, Poisson, Geometric, Weibull, Logistic and Normal distribution. Fitting of Distributions;  Statistical methods: Scope of statistics: utility and misuse. Principles of statistical analysis of biological data. Sampling parameters. Difference between sample and Population, Sampling Errors, Censoring, difference between parametric and non-parametric statistics;  Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom; Large Sample Test based on Normal Distribution, Small sample test based on t-test, Z-test and F test; Confidence Interval; Distribution-free test- Chi-square test; Basic introduction to Multivariate statistics, etc.</p>	30
<b>TOTAL</b>		<b>60</b>



# C. U. SHAH UNIVERSITY



## BIOMATHEMATICS AND BIOSTATISTICS (PRACTICAL) SEMESTER- V/VI

S.No	Experiment
1	Word Problems based on Differential Equations
2	Mean, Median, Mode from grouped and ungrouped Dataset
3	Standard Deviation and Coefficient of Variation
4	Skewness and Kurtosis
5	Curve fitting
6	Correlation
7	Regression
8	Finding area under the curve using normal probability
9	Testing of Hypothesis - Normal Distribution, t-test and Chi-Square-test
10	Confidence Interval

### SUGGESTED READINGS

1. **H.S. Bear: Understanding Calculus, John Wiley and Sons** (Second Edition); 2003.
2. **E. Batschelet: Introduction to Mathematics for Life Scientists, Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi** (1971, 1975)
3. **A. Edmondson and D. Druce: Advanced Biology Statistics, Oxford University Press; 1996.**
4. **W. Danial: Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004.**



# C. U. SHAH UNIVERSITY

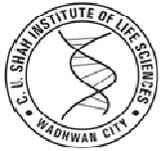


## INHERITANCE BIOLOGY (THEORY) SEMESTER-V/VI

Sr. No.	Course contents	Teaching Hours
1	<b>Introduction to Genetics:</b> Historical developments Model organisms in genetic analyses and experimentation: <i>Escherichia coli</i> , <i>Saccharomyces cerevisiae</i> , <i>Neurospora crassa</i> , <i>Caenorhabditis elegans</i> , <i>Drosophila melanogaster</i> , <i>Arabidopsis thaliana</i>	5
2	<b>Mendelian Principles:</b> Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance, Multiple alleles, Epistasis, penetrance and expressivity	15
3	<b>Linkage and Crossing over:</b> Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at four-strand stage, Molecular mechanism of crossing over, mapping	10
4	<b>Extra-Chromosomal Inheritance:</b> Rules of extranuclear inheritance, Organelle heredity- Chloroplast mutations in <i>Chlamydomonas</i> , mitochondrial, mutations in <i>Saccharomyces</i> , Maternal effects- Shell coiling in <i>Limnaea peregra</i> Infectious heredity- Kappa particles in <i>Paramecium</i>	10
5	<b>Characteristics of Chromosomes:</b> Structural organization of chromosomes- centromeres, telomeres and repetitive DNA, Packaging of DNA Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities- Klinefelter syndrome, Turner syndrome, Down syndrome	15
6	<b>Recombination:</b> Homologous and non-homologous recombination, including transposition, site-specific recombination.	5
<b>TOTAL</b>		<b>60</b>



# C. U. SHAH UNIVERSITY



## INHERITANCE BIOLOGY (PRACTICAL) SEMESTER-V/VI

S.No	Experiment
1	Mendelian deviations in dihybrid crosses
2	Studying Barr Body with the temporary mount of human cheek cells
3	Studying Rhoet translocation with the help of photographs
4	Karyotyping with the help of photographs
5	Chi-Square Analysis
6	Study of polytene chromosomes using temporary mounts of salivary glands of <i>Chiromonas</i> / <i>Drosophila</i> larvae
7	Study of pedigree analysis
8	Analysis of a representative quantitative trait

### SUGGESTED READING

1. **Gardner EJ, Simmons MJ, Snustad DP** (2008). Principles of Genetics. 8th Ed. Wiley-India
2. **Snustad DP, Simmons MJ** (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. **Weaver RF, Hedrick PW** (1997). Genetics. 3rd Ed. McGraw-Hill Education
4. **Klug WS, Cummings MR, Spencer CA, Palladino M** (2012). Concepts of Genetics. 10th Ed. Benjamin Cummings
5. **Griffith AJF, Wessler SR, Lewontin RC, Carroll SB.** (2007). Introduction to Genetic Analysis. 9<sup>th</sup> Ed. W.H. Freeman and Co., New York
6. **Hartl DL, Jones EW** (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett Publishers
7. **Russell PJ.** (2009). *i*Genetics-A Molecular Approach. 3rd Ed, Benjamin Cummings



# C. U. SHAH UNIVERSITY



## MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (THEORY) SEMESTER–V/VI

TOTAL HOURS: 60

CREDITS: 4

Sr. No.	Course contents	Teaching Hours
1	<b>Soil Microbiology</b> Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil	8
2	<b>Mineralization of Organic &amp; Inorganic Matter in Soil</b> Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium	8
3	<b>Microbial Activity in Soil and Green House Gases</b> Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control	5
4	<b>Microbial Control of Soil Borne Plant Pathogens</b> Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects, Weeds	8
5	<b>Biofertilization, Phytostimulation, Bioinsecticides</b> Plant growth promoting bacteria, biofertilizers – symbiotic ( <i>Bradyrhizobium</i> , <i>Rhizobium</i> , <i>Frankia</i> ), Non Symbiotic ( <i>Azospirillum</i> , <i>Azotobacter</i> , Mycorrhizae, MHBs, Phosphatesolubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs	15
6	<b>Secondary Agriculture Biotechnology</b> Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters <b>GM crops</b> Advantages, social and environmental aspects, Bt crops, golden rice, transgenic animals.	16



## MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (PRACTICAL) SEMESTER–V/VI

S.No	Experiment
1	Study soil profile
2	Study microflora of different types of soils
3	<i>Rhizobium</i> soil inoculants characteristics and field application
4	<i>Azotobacter</i> soil inoculants characteristics and field application
5	Design and functioning of a biogas plant
6	Isolation of cellulose degrading organisms

### SUGGESTED READINGS

1. **Agrios GN.** (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. **Singh RS.** (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. **Glick BR, Pasternak JJ, and Patten CL** (2010) Molecular Biotechnology 4<sup>th</sup> edition, ASM Press,
4. **Atlas RM and Bartha R.** (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition. Benjamin/Cummings Science Publishing, USA
5. **Maier RM, Pepper IL and Gerba CP.** (2009). Environmental Microbiology. 2<sup>nd</sup> edition, Academic Press
6. **Barton LL & Northup DE** (2011). Microbial Ecology. 1<sup>st</sup> edition, Wiley Blackwell, USA
7. **Campbell RE.** (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. **Coyne MS.** (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. **Altman A** (1998). Agriculture Biotechnology, 1<sup>st</sup> edition, Marcel Dekker Inc.
10. **Mahendra K. Rai** (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. **Reddy, S.M. et al.** (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. **Saleem F and Shakoori AR** (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG



# C. U. SHAH UNIVERSITY



## BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (THEORY) SEMESTER–V/VI

Sr. No.	Course contents	Teaching Hours
1	Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Level of Specific Microorganisms	8
2	Biosafety Guidelines: Biosafety guidelines and regulations (National and International); GMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements- Cartagena Protocol.	12
3	AERB/RSD/RES guidelines for using radioisotopes in laboratories and precautions.	4
4	Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR- patentable and non-patentable- patenting life- legal protection of biotechnological inventions- World Intellectual Property Rights Organization (WIPO).	12
5	Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.	12
6	Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms; UPOV & Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recent amendments.	12
<b>TOTAL</b>		<b>60</b>

## BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (PRACTICAL) SEMESTER–V/VI

S.No	Experiment
1	Study of components and design of a BSL-III laboratory
2	Filing applications for approval from biosafety committee
3	Filing primary applications for patents
4	Study of steps of a patenting process
5	A case study

### Suggested Reading

1. **Bare Act, 2007. Indian Patent Act 1970 Acts & Rules**, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. **Kankanala C (2007). Genetic Patent Law & Strategy**, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. **Mittal, D.P. (1999). Indian Patents Law**, Taxmann, Allied Services (p) Ltd.
4. **Singh KK (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications**, Springer India.
5. **Goel D & Prashar S (2013). IPR, Biosafety and Bioethics**. Pearson



# C. U. SHAH UNIVERSITY



6. **SenthilKumarSadhasivamandMohammedJaabir,M.S.**2008.IPR,Biosafetyand biotechnologyManagement.JasenPublications,Tiruchirappalli,India.



# C. U. SHAH UNIVERSITY



## INSTRUMENTATION AND BIOTECHNIQUES (THEORY) SEMESTER–V/VI

TOTAL HOURS: 60

CREDITS: 4

Sr. No.	Course contents	Teaching Hours
1	<b>Microscopy:</b> Bright field and dark field microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.	10
2	<b>Chromatography:</b> Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion-exchange chromatography and affinity chromatography, GLC, HPLC.	14
3	<b>Electrophoresis:</b> Principle and applications of native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis	14
4	<b>Spectrophotometry:</b> Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.	10
5	<b>Centrifugation:</b> Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.	12



## INSTRUMENTATION AND BIOTECHNIQUES (PRACTICAL) SEMESTER-V/VI

S.No	Experiment
1	Study of fluorescent micrographs to visualize bacterial cells.
2	Ray diagrams of phase contrast microscopy and Electron microscopy.
3	Separation of mixtures by paper/thin layer chromatography.
4	Demonstration of column packing in any form of column chromatography.
5	Separation of protein mixtures by any form of chromatography
6	Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
7	Determination of $\lambda_{max}$ for an unknown sample and calculation of extinction coefficient.
8	Separation of components of a given mixture using a laboratory scale centrifuge.
9	Understanding density gradient centrifugation with the help of pictures.

### SUGGESTED READINGS

1. **Wilson K and Walker J.** (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7<sup>th</sup> Ed., Cambridge University Press.
2. **Nelson DL and Cox MM.** (2008). Lehninger Principles of Biochemistry, 5<sup>th</sup> Ed., W.H. Freeman and Company.
3. **Willey MJ, Sherwood LM & Woolverton C J.** (2013). Prescott, Harley and Klein's Microbiology. 9<sup>th</sup> Ed., McGraw Hill.
4. **Karp G.** (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons, Inc.
5. **De Robertis ED and De Robertis EMF.** (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. **Cooper G.M. and Hausman R.E.** (2009). The Cell: A Molecular Approach. 5<sup>th</sup> Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. **Nigam A and Ayyagari A.** 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.