C. U. SHAH UNIVERSITY

Discipline Specific elective (DSE) subject pool Biotechnology

NAME:BIOINFORMATICS(THEORY)

Course Content:

Sr. No.	Course contents	Teaching Hours
1	**IntroductiontoComputerFundamentals:** RDBMS-Definitionofrelationaldatabase Modeofdatatransfer(FTP,SFTP,SCP),advantageofencrypteddatatransfer.	08
2	**IntroductiontoBioinformaticsandBiologicalDatabases:** Biologicaldatabases-nucleicacid,genome,proteinsequenceandstructure,geneexpression databases,Databaseofmetabolicpathways,Modeofdatastorage-Fileformats-FASTA,GenbankandUniprot,Datasubmission&retrievalfromNCBI,EMBL,DDBJ,Uniprot,PDB	14
3	**SequenceAlignments,PhylogenyandPhylogenetictrees :** LocalandGlobalSequencealignment,pairwiseandmultiplesequencealignment. Scoringanalignment,scoringmatrices,PAM&BLOSUMseriesofmatrices. Typesofphylogenetictrees,Differentapproachesofphylogenetictreeconstruction-UPGMA,Neighbourjoining,MaximumParsomony,Maximumlikelihood.	16
4	**Genomeorganizationandanalysis:** DiversityofGenomes:Viral,prokaryotic&eukaryoticgenomes Genome,transcriptome,proteome,2-Dgelelectrophoresis,MaldiToffspectroscopy Majorfeaturesofcompletedgenomes:*E.coli,S.cerevisiae,Arabidopsis,*Human	10
5	**ProteinStructurePredictions:** Hierarchyofproteinstructure-primary,secondaryandtertiarystructures,modeling, StructuralClasses,Motifs,FoldsandDomains Proteinstructurepredictioninpresenceandabsenceofstructuretemplate Energyminimizationsandevaluationby Ramachandranplot Proteinstructureandrationaldrugdesign.	12
	Total Hours	**60**

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BIOINFORMATICS
(PRACTICAL) SEMESTERV/VI

S.No	Experiment
1	Introductiontodifferentoperatingsystems-UNIX,LINUXandWindows
2	Introductiontobioinformaticsdatabases(anythree):NCBI/PDB/DDBJ,Uniprot,PDB
3	SequenceretrievalusingBLAST
4	Sequencealignment&phylogeneticanalysisusingclustalW&phylip
5	PickingoutagivengenefromgenomesusingGenscanorothersoftwares(promoterregion identification,repeatingenome,ORFprediction).Genefindingtools(Glimmer,GENSCAN),Primer designing,Genscan/Genetool
6	Proteinstructureprediction:primarystructureanalysis,secondarystructurepredictionusingpsi-pred, homologymodelingusingSwissmodel.Molecularvisualizationusingjmol,Proteinstructure modelevaluation(PROCHECK)
7	Predictionofdifferentfeaturesofafunctionalgene

SUGGESTEDREADING

1. **SaxenaSanjay**(2003)AFirstCourseinComputers,VikasPublishingHouse
2. **PradeepandSinhaPreeti**(2007)FoundationsofComputing,4thed.,BPBPublications
3. **LeskM.A**.(2008)IntroductiontoBioinformatics.OxfordPublication,3rdInternationalStudentEdition
4. **RastogiS.C.,MendirattaN.andRastogiP.**(2007)Bioinformatics:methodsandapplications, genomics,proteomicsanddrugdiscovery,2nded.PrenticeHallIndiaPublication
5. PrimroseandTwyman(2003)PrinciplesofGenomeAnalysis&Genomics.Blackwel

NAME:MICROBIAL BIOTECHNOLOGY(THEORY)

Course Content:

S.No	
1	**MicrobialBiotechnologyanditsApplications:** Microbialbiotechnology:Scopeanditsapplicationsinhumantherapeutics,agriculture(Biofertilizers, PGPR,Mycorrhizae),environmental,andfoodtechnology Useofprokaryoticandeukaryoticmicroorganismsinbiotechnologicalapplications Geneticallyengineeredmicrobesforindustrialapplication:Bacteriaandyeast
2	**TherapeuticandIndustrialBiotechnology:** Recombinantmicrobialproductionprocessesinpharmaceuticalindustries-Streptokinase, recombinantvaccines(HepatitisBvaccine) Microbialpolysaccharidesandpolyesters,Microbialproductionofbio-pesticides,bioplastics, Microbialbiosensors
3	**ApplicationsofMicrobesinBiotransformations:** Microbialbasedtransformationofsteroidsandsterols,Bio-catalyticprocessesandtheirindustrialapplications:Productionofhighfructosesyrupand productionofcocoabuttersubstitute
4	**MicrobesforBio-energyandEnvironment:** Bio-ethanolandbio-dieselproduction:commercialproductionfromlignocellulosicwasteandalgal biomass,Biogasproduction:Methaneandhydrogenproductionusingmicrobialculture. Microorganismsinbioremediation:Degradationofxenobiotics,mineralrecovery,removalofheavy metalsfromaqueouseffluents
5	**RNAi:** RNAianditsapplicationsinsilencinggenes,drugresistance,therapeuticsandhostpathogen interactions **IntellectualPropertyRights:** Patents,Copyrights,Trademarks

MICROBIALBIOTECHNOLOGY (PRACTICAL) SEMESTERV/VI

S.No	Experiment
1	Study of yeast cell immobilization in calciumalginategels
2	Study of enzyme immobilization by sodiumalginate method
3	Pigment production from fungi(*Trichoderma*/*Aspergillus*/*Penicillium*)
4	Isolation of xylanase or lipaseproducing 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

SUGGESTEDREADING

1. **Ratledge,CandKristiansen,B**.(2001).BasicBiotechnology,2ndEdition,Cambridge UniversityPress.
2. **Demain,A.LandDavies,J.E.**(1999).ManualofIndustrialMicrobiologyandBiotechnology,2nd Edition,ASMPress.
3. **Swartz,J.R**.(2001).AdvancesinEscherichiacoliproductionoftherapeuticproteins.Current OpinioninBiotechnology,12,195–201.
4. **Prescott,HarleyandKlein'sMicrobiologybyWilleyJM,SherwoodLM,Woolverton CJ**(2014), 9thedition,McGrawHillPublishers.
5. **GuptaPK**(2009)ElementsofBiotechnology2nd edition,RastogiPublications,
6. **GlazerANandNikaidoH**(2007)MicrobialBiotechnology,2nd edition,CambridgeUniversity Press
7. **GlickBR,PasternakJJ,andPattenCL**(2010)MolecularBiotechnology4th edition,ASMPress,
8. **StanburyPF,WhitakerA,HallSJ**(1995)PrinciplesofFermentationTechnology2ndedition., ElsevierScience
9. **CruegerW,CruegerA**(1990)Biotechnology:AtextBookofIndustrialMicrobiology2ndedition Sinauerassociates,Inc

ADVANCESINMICROBIOLOGY (THEORY) SEMESTER–V/VI

Sr. No.	Course contents	Teaching Hours
1	**EvolutionofMicrobialGenomes:** Salientfeaturesofsequencedmicrobialgenomes,coregenomepool,flexiblegenomepooland conceptofpangenome,Horizontalgenetransfer(HGT),Evolutionofbacterialvirulence-Genomic islands,Pathogenicityislands(PAI)andtheircharacteristics	**15**
2	**Metagenomics :** Briefhistoryanddevelopmentofmetagenomics,Understandingbacterialdiversityusing metagenomicsapproach,Prospectinggenesofbiotechnologicalimportanceusingmetagenomics Basicknowledgeofviralmetagenome,metatranscriptomics, metaproteomicsandmetabolomics.	**15**
3	**MolecularBasisofHost-MicrobeInteractions:** Epiphyticfitnessanditsmechanisminplantpathogens,Hypersensitiveresponse(HR)toplant pathogensanditsmechanism,Typethreesecretionsystems(TTSS)ofplantandanimalpathogens, Biofilms:typesofmicroorganisms,molecularaspectsandsignificanceinenvironment,healthcare, virulenceandantimicrobialresistance	**15**
4	**SystemsandSyntheticBiology:** Networkinginbiologicalsystems,Quorumsensinginbacteria,Co-ordinatedregulationofbacterial virulencefactors,Basicsofsynthesisofpoliovirusinlaboratory,Futureimplicationsofsynthetic biologywithrespecttobacteriaandviruses	**15**
	TOTAL	**60**

ADVANCESINMICROBIOLOGY(PRACTICAL) SEMESTER–V/VI

S.No	Experiment
1	ExtractionofmetagenomicDNAfromsoil
2	Understandtheimpedimentsinextractingmetagenomic DNAfromsoil
3	PCRamplificationofmetagenomicDNAusinguniversal16sribosomalgeneprimers
4	Casestudytounderstandhowthepoliovirusgenomewassynthesizedinthelaboratory
5	Casestudytounderstandhownetworkingofmetabolicpathwaysinbacteriatakesplace

SUGGESTEDREADING

1. **FraserCM,ReadTDandNelsonKE**.MicrobialGenomes,2004,HumanaPress
2. **MillerRVandDayMJ**.MicrobialEvolution-Geneestablishment,survivalandexchange,2004, ASMPress
3. **BullAT**.MicrobialDiversityandBioprospecting,2004,ASMPress
4. **SangdunC**.IntroductiontoSystemsBiology,2007,HumanaPress
5. **KlippE,LiebermeisterW**.SystemsBiology–ATextbook,2009,Wiley–VCHVerla

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PLANT PATHOLOGY (THEORY)
SEMESTER–V/VI

S.No	Experiment
1	**IntroductionandHistoryofplantpathology:** Conceptofplantdisease-definitionsofdisease,diseasecycle&pathogenicity,symptomsassociated withmicrobialplantdiseases,typesofplantpathogens,economiclossesandsocialimpactofplant diseases.Significantlandmarksinthefieldofplantpathology-ContributionsofAntonDeBary, Millardet,Burrill,E.Smith,AdolphMayer,Ivanowski,Diener,Stakman,H.H.Flor,VanDerPlank, molecularKoch'spostulates.ContributionsofeminentIndianplantpathologists.
2	**Stagesindevelopmentofadisease:** Infection,invasion,colonization,disseminationofpathogensandperennation.
3	**Plantdiseaseepidemiology:** Conceptsofmonocyclic,polycyclicandpolyeticdiseases,diseasetriangle&diseasepyramid, forecastingofplantdiseasesanditsrelevanceinIndiancontext.
4	**HostPathogenInteraction** *MicrobialPathogenicity:*Virulencefactorsofpathogens:enzymes,toxins(hostspecificandnonspecific) growthregulators, virulencefactorsinviruses(replicase,coatprotein,silencingsuppressors) indiseasedevelopment. Effects of pathogens on host physiological processes (photosynthesis,respiration,cellmembrane mermeability,translocationofwaterandnutrients, plantgrowthandreproduction). *Genetics of Plant Diseases:*Conceptofresistance(R)geneandavirulence(avr)gene;gene for genehypothesis, types of plant resistance:trueresistance–horizontal&vertical,apparentresistance. *DefenseMechanisms in Plants:* Conceptsofconstitutivedefensemechanismsinplants,induciblestructuraldefenses (histological-corklayer,abscissionlayer,tyloses,gums),induciblebiochemicaldefenses [hypersensitiveresponse (HR),systemicacquiredresistance(SAR),phytoalexins,pathogenesisrelated(PR)proteins, plantibodies,phenolics,quinones,oxidativebursts].
5	**ControlofPlantDiseases:** Principles&practicesinvolvedinthemanagementofplantdiseasesbydifferentmethods,*viz.* regulatory-quarantine,cropcertification,avoidanceofpathogen,useofpathogenfreepropagative materialcultural-hosteradication,croprotation,sanitation,polyethylenetrapsandmulcheschemical-protectantsandsystemicfungicides,antibiotics,resistanceofpathogenstochemicals. biological-suppressivesoils,antagonisticmicrobes-bacteriaandfungi,trapplants geneticengineeringofdiseaseresistantplants-withplantderivedgenesandpathogenderivedgenes

PLANTPATHOLOGY(PRACTICAL)
SEMESTER–V/VI

Experiment
DemonstrationofKoch'spostulatesinfungal,bacterialandviralplantpathogens. Studyofimportantdiseasesofcropplantsbycuttingsectionsofinfectedplantmaterial- *Albugo, Puccinia,Ustilago,Fusarium,Colletotrichum*

SUGGESTEDREADINGS

1. **AgriosGN**.(2006).PlantPathology.5thedition.Academicpress,SanDiego,
2. **LucasJA**.(1998).PlantPathologyandPlantPathogens.3rdedition.BlackwellScience, Oxford.
3. **MehrotraRS**.(1994).PlantPathology.TataMcGraw-HillLimited.
4. **RangaswamiG**.(2005).DiseasesofCropPlantsinIndia.4thedition.PrenticeHallo fIndiaPvt. Ltd.,NewDelhi.
5. **SinghRS**.(1998).PlantDiseasesManagement.7thedition.Oxford&IBH,Ne wDelhi

BIOMATHEMATICS AND BIOSTATISTICS
(THEORY) SEMESTER–V/VI

TOTALHOURS:60 **CREDITS:4**

Sr. No.	Course contents	Teaching Hours
1	**Biomathematics:** Sets.Functionsandtheirgraphs:polynomial,sine,cosine,exponentialandlogarithmicfunctions. Motivationandillustrationforthesefunctionsthroughprojectilemotion,simplependulum,biological rhythms,celldivision,musculafibresetc. Simpleobservationsaboutthesefunctionslikeincreasing,decreasingand,periodicity. Sequencestobeintroducedthroughtheexamplesarisinginsciencebeginningwithfinitesequences, followedbyconceptsofrecursionanddifferenceequations.Forinstance,theFibonaccisequence arisingfrombranchinghabitoftreesandbreedinghabitofrabbits.Intuitiveideaofalgebraic relationshipsandconvergence. InfiniteGeometricSeries.Seriesformulasforex,log(1+x),sinx,cosx.Stepfunction.Intuitiveidea ofdiscontinuity,continuityandlimits. Differentiation.Conceptiontobemotivatedthroughsimpleconcreteexamplesasgivenabovefrom BiologicalandPhysicalSciences.Useofmethodsofdifferentiationlikechainrule,Productruleand Quotientrule.Secondorderderivativesofabovefunctions. Integrationasreverseprocessofdifferentiation. Integralsofthefunctionsintroducedabove.DifferentialEquationsoffirstorder,LinearDifferentialEquations. Pointsinplaneandspaceandcoordinateform.Examplesofmatricesarisinginbiologicalsciences andBiologicalnetworks.SumandProduceofmatricesuptoorder3.	**30**
2	**Biostatistics** Measuresofcentraltendency,Measuresofdispersion;skewness,kurtosis;ElementaryProbabilityand basiclaws;DiscreteandContinuousRandomvariable,MathematicalExpectation;CurveFitting; CorrelationandRegression.EmphasisonexamplesfromBiologicalSciences; MeanandVarianceofDiscreteandContinuousDistributionsnamelyBinomial,Poisson,Geometric, Weibull,LogisticandNormaldistribution.FittingofDistributions; Statisticalmethods:Scopeofstatistics:utilityandmisuse.Principlesofstatisticalanalysisof biologicaldata.Samplingparameters. DifferencebetweensampleandPopulation, SamplingErrors, Censoring,differencebetweenparametricandnon-parametricstatistics; SamplingDistributions,StandardError,TestingofHypothesis,LevelofSignificanceandDegreeofFreedom; LargeSampleTestbasedonNormalDistribution, Smallsampletest basedont-test,Z-testandF test; ConfidenceInterval; Distribution-freetest-Chi-squaretest; BasicintroductiontoMultivariatestatistics,etc.	**30**
	TOTAL	**60**

BIOMATHEMATICS ANDBIOSTATISTICS(PRACTICAL) SEMESTER– V/VI

S.No	Experiment
1	WordProblemsbasedonDifferentialEquations
2	Mean,Median,ModefromgroupedandungroupedDataset
3	StandardDeviationandCoefficientofVariation
4	SkewnessandKurtosis
5	Curvefitting
6	Correlation
7	Regression
8	Findingareaunderthecurveusingnormalprobability
9	TestingofHypothesis-NormalDistribution,t-testandChi-Square-test
10	ConfidenceInterval

SUGGESTEDREADINGS

1. **H.S.Bear:UnderstandingCalculus,JohnWileyandSons**(SecondEdition);2003.
2. **E.Batschelet**:IntroductiontoMathematicsforLifeScientists,SpringerVerlag,International StudentEdition,NarosaPublishingHouse,NewDelhi(1971,1975)
3. **A.EdmondsonandD.Druce**:AdvancedBiologyStatistics,OxfordUniversityPress;1996.
4. **W.Danial:Biostatistics**:AfoundationforAnalysisinHealthSciences,JohnWileyand SonsInc;2004.

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INHERITANCE BIOLOGY (THEORY)
SEMESTER–V/VI

Sr. No.	Course contents	Teaching Hours
1	**IntroductiontoGenetics:** Historical developments Modelorganisms in genetic analyses andexperimentation:*Escherichiacoli*, *Saccharomyces cerevisiae, Neurosporacrassa, Caenorhabditiselegans Drosophilamelanogaster, Arabidopsis thaliana*	**5**
2	**Mendelian Principles:** Mendel'sLaws:Dominance,segregation,independentassortment,deviationfromMendelianinheritance, RediscoveryofMendel'sprinciples, Chromosometheoryofinheritance:Allele,multiple alleles,pseudoallele,complementationtests,ExtensionsofMendeliangenetics:Allelicinteractions, conceptofdominance,recessiveness,Incompletedominanceandco-dominance,Multiplealleles, Epistasis,penetranceandexpressivity	**15**
3	**Linkage and Crossingover:** Linkageandrecombinationofgenes,Cytologicalbasisofcrossingover,Crossingoveratfour-strand stage,Molecularmechanismofcrossingover,mapping	**10**
4	**Extra-Chromosomal Inheritance:** Rulesofextranuclearinheritance,Organelleheredity-Chloroplastmutationsin*Chlamydomonas*, mitochondrial,mutationsin*Saccharomyces,*Maternaleffects– Shellcoilingin*Limnaeaperegra*Infectiousheredity-Kappaparticlesin*Paramecium*	**10**
5	**Characteristics of Chromosomes:** Structural organization of chromosomes-centromeres, telomeres and repetitive DNA, Packaging of DNA Variations in chromosome structure: Deletion, duplication, inversion and translocation,Variationinchromosomalnumberandstructuralabnormalities- Klinefeltersyndrome,Turnersyndrome,Downsyndrome	**15**
6	**Recombination:** Homologousandnon-homologousrecombination,includingtransposition,site-specific recombination.	**5**
	TOTAL	**60**

INHERITANCEBIOLOGY
(PRACTICAL) SEMESTER–V/VI

S.No	Experiment
1	Mendeliandeviationsindihybridcrosses
2	StudyingBarrBodywiththetemporarymountofhumancheekcells
3	Studying*Rhoeo*translocationwiththehelpofphotographs
4	Karyotypingwiththehelpofphotographs
5	Chi-SquareAnalysis
6	Studyofpolytenechromosomesusingtemporarymountsofsalivaryglandsof*Chiromonas/ Drosophila*larvae
7	Studyofpedigreeanalysis
8	Analysisofarepresentativequantitativetrait

SUGGESTEDREADING

1. **GardnerEJ,SimmonsMJ,Snustad**DP(2008).PrinciplesofGenetics.8thEd.Wiley-India
2. **SnustadDP,Simmons**MJ(2011).PrinciplesofGenetics.6thEd.JohnWileyandSonsInc.
3. **WeaverRF,HedrickPW**(1997).Genetics.3rdEd.McGraw-HillEducation
4. **KlugWS,CummingsMR,SpencerCA,PalladinoM**(2012).ConceptsofGenetics.10thEd. BenjaminCummings
5. **GriffithAJF,WesslerSR,LewontinRC,CarrollSB.**(2007).IntroductiontoGenetic Analysis.9th Ed.W.H.FreemanandCo.,NewYork
6. **HartlDL,JonesEW**(2009).Genetics:AnalysisofGenesandGenomes.7thEd,JonesandBartlettPublishers
7. **RussellPJ**.(2009).*i*Genetics-AMolecularApproach.3rdEd,BenjaminCumming

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

TOTALHOURS:60 **CREDITS:4**

Sr. No.	Course contents	Teaching Hours
1	**SoilMicrobiology** SoilasMicrobialHabitat,Soilprofileandproperties,Soilformation,Diversityanddistributionof microorganismsinsoil	8
2	**MineralizationofOrganic&InorganicMatterinSoil** Mineralizationofcellulose,hemicelluloses,lignocelluloses,ligninandhumus,phosphate,nitrate, silica,potassium	8
3	**MicrobialActivityinSoilandGreenHouseGases** Carbondioxide,methane,nitrousoxide,nitricoxide–productionandcontrol	5
4	**MicrobialControlofSoilBornePlantPathogens** Biocontrolmechanismsandways,Microorganismsusedasbiocontrolagentsagainst Microbialplant pathogens,Insects,Weeds	8
5	**Biofertilization,Phytostimulation,Bioinsecticides** Plantgrowthpromotingbateria,biofertilizers– symbiotic(*Bradyrhizobium,Rhizobium,Frankia*), NonSymbiotic(*Azospirillum,Azotobacter*,Mycorrhizae,MHBs,Phosphatesolubilizers,algae), Novelcombinationofmicrobesasbiofertilizers,PGPRs	15
6	**SecondaryAgricultureBiotechnology** Biotechfeed,Silage,Biomanure,biogas,biofuels–advantagesandprocessingparameters **GMcrops** Advantages,socialandenvironmentalaspects,Btcrops,goldenrice,transgenicanimals.	16

MICROBESINSUSTAINABLEAGRICULTUREANDDEVELOPMENT (PRACTICAL)
SEMESTER–V/VI

S.No	Experiment
1	Studysoilprofile
2	Studymicrofloraofdifferenttypesofsoils
3	*Rhizobium*assoilinoculantscharacteristicsandfieldapplication
4	*Azotobacter*assoilinoculants characteristicsandfieldapplication
5	Designandfunctioningofabiogasplant
6	Isolationofcellulosedegradingorganisms

SUGGESTEDREADINGS

1. **AgriosGN**.(2006).PlantPathology.5thedition.Academicpress,SanDiego,
2. **SinghRS**.(1998).PlantDiseasesManagement.7thedition.Oxford&IBH,NewDelhi.
3. **GlickBR,PasternakJJ,andPattenCL**(2010)MolecularBiotechnology4th edition,ASM Press,
4. **AtlasRMandBarthaR.**(2000).MicrobialEcology:Fundamentals&Applications.4thedition.Benjamin/Cummings SciencePublishing,USA
5. **MaierRM,PepperILandGerbaCP**.(2009).EnvironmentalMicrobiology.2ndedition, AcademicPress
6. **BartonLL&NorthupDE**(2011).MicrobialEcology.1stedition,WileyBlackwell,USA
7. **CampbellRE.**(1983).MicrobialEcology.BlackwellScientificPublication,Oxford, England.
8. **CoyneMS**.(2001).SoilMicrobiology:AnExploratoryApproach.DelmarThomsonLearning.
9. **AltmanA**(1998).AgricultureBiotechnology,Istedition,MarceldeckerInc.
10. **MahendraK.Rai**(2005).HandBookofMicrobialBiofertilizers,TheHaworthPress,Inc.NewYork.
11. **Reddy,S.M.et.al.**(2002).BioinoculantsforSustainableAgricultureandForestry, ScientificPublishers.
12. **SaleemFandShakoori**AR(2012)DevelopmentofBioinsecticide,LapLambertAcademicPublishingGmbHKG

BIOSAFETYAND INTELLECTUALPROPERTY RIGHTS (THEORY) SEMESTER–V/VI

Sr. No.	Course contents	Teaching Hours
1	Biosafety:Introduction;biosafetyissuesinbiotechnology;BiologicalSafetyCabinets&theirtypes; PrimaryContainmentforBiohazards;BiosafetyLevelsofSpecificMicroorganisms	8
2	BiosafetyGuidelines:Biosafetyguidelinesandregulations(NationalandInternational); GMOs-ConcernsandChallenges;RoleofInstitutionalBiosafetyCommittees(IBSC),RCGM, GEACetc.forGMOapplicationsinfoodandagriculture;EnvironmentalreleaseofGMOs;Risk Analysis;RiskAssessment;Riskmanagementandcommunication;OverviewofInternational Agreements-CartagenaProtocol.	12
3	AERB/RSD/RESguidelinesforusingradioisotopesinlaboratoriesandprecautions.	4
4	IntroductiontoIntellectualProperty:Patents,Types,Trademarks,Copyright&RelatedRights, IndustrialDesignandRights,TraditionalKnowledge,GeographicalIndications-importanceofIPR– patentableandnonpatentables–patentinglife–legalprotectionofbiotechnologicalinventions– WorldIntellectualPropertyRightsOrganization(WIPO).	12
5	GrantofPatentandPatentingAuthorities:Typesofpatentapplications:Ordinary,PCT,Conventional, DivisionalandPatentofAddition;AnintroductiontoPatentFilingProcedures;Patentlicensingand agreement;Patentinfringement-meaning,scope,litigation,casestudies,RightsandDutiesofpatent owner.	12
6	AgreementsandTreaties:GATT,TRIPSAgreements;RoleofMadridAgreement;HagueAgreement; WIPOTreaties;BudapestTreatyoninternationalrecognitionofthedepositofmicroorganisms; UPOV&Breneconventions;PatentCo-operationTreaty(PCT);IndianPatentAct1970&recent amendments.	12
	TOTAL	**60**

BIOSAFETYANDINTELLECTUALPROPERTYRIGHTS(PRACTICAL) SEMESTER–V/VI

S.No	Experiment
1	StudyofcomponentsanddesignofaBSL-IIIlaboratory
2	Filingapplicationsforapprovalfrombiosafetycommittee
3	Filingprimaryapplicationsforpatents
4	Studyofstepsofapatentingprocess
5	Acasestudy

SuggestedReading

1. **BareAct,2007.IndianPatentAct1970**Acts&Rules,UniversalLawPublishingCo .Pvt. Ltd.,NewDelhi.
2. **KankanalaC**(2007).GeneticPatentLaw&Strategy,1stEdition,ManupatraInformation SolutionPvt.Ltd.NewDelhi.
3. **Mittal,D.P.**(1999).IndianPatentsLaw,Taxmann,AlliedServices(p)Ltd.
4. **SinghKK**(2015).BiotechnologyandIntelectualPropertyRights:LegalandSocial Impliocations,SpringerIndia.
5. **GoelD&PrasharS**(2013).IPR,BiosafetyandBioethics.Pearson

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

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INSTRUMENTATION AND BIOTECHNIQUES
(THEORY) SEMESTER–V/VI

TOTALHOURS:60 **CREDITS:4**

Sr. No.	Course contents	Teaching Hours
1	**Microscopy:** Bright field and dark field microscopy, FluorescenceMicroscopy, Phase contrast Microscopy, ConfocalMicroscopy, ElectronMicroscopy(Scanning andTransmission ElectronMicroscopy) and Micrometry.	**10**
2	**Chromatography:**Principles andapplications ofpaper chromatography (including Descending and 2-D), Thinlayerchromatography. Column packing and fraction collection. Gel filtration chromatography, ion-exchangechromatographyandaffinitychromatography,GLC,HPLC.	**14**
3	**Electrophoresis:** Principle and applications ofnative polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2Dgelelectrophoresis, Isoelectricfocusing,ZymogrampreparationandAgarosegel electrophoresis	**14**
4	**Spectrophotometry:** Principleanduseofstudyofabsorptionspectraofbiomolecules. AnalysisofbiomoleculesusingUVandvisiblerange.Colorimetryandturbidometry.	**10**
5	**Centrifugation:** Preparative and analytical centrifugation, fixed angle and swinging bucket rotors.RCF andsedimentationcoefficient,differentialcentrifugation,density gradientcentrifugationand ultracentrifugation.	**12**

INSTRUMENTATIONANDBIOTECHNIQUES (PRACTICAL)
SEMESTER–V/VI

S.No	Experiment
1	Studyoffluorescentmicrographstovisualizebacterialcells.
2	RaydiagramsofphasecontrastmicroscopyandElectronmicroscopy.
3	Separationofmixturesbypaper/thinlayerchromatography.
4	Demonstrationofcolumnpackinginanyformofcolumnchromatography.
5	Separationofproteinmixturesbyanyformofchromatography
6	SeparationofproteinmixturesbyPolyacrylamideGelElectrophoresis(PAGE).
7	Determinationofλ_{max}foranunknownsampleandcalculationofextinctioncoefficient.
8	Separationofcomponentsofagivenmixtureusingalaboratoryscalecentrifuge.
9	Understandingdensitygradientcentrifugationwiththehelpofpictures.

SUGGESTEDREADINGS

1. **WilsonKandWalkerJ.**(2010).Principles andTechniques ofBiochemistry andMolecular Biology.7th Ed.,CambridgeUniversityPress.
2. **Nelson DL andCox MM**. (2008). LehningerPrinciples of Biochemistry, 5th Ed., W.H. FreemanandCompany.
3. **Willey MJ, SherwoodLM &WoolvertonC J**. (2013). Prescott, Harley and Klein's Microbiology.9th Ed.,McGrawHill.
4. **Karp G.**(2010) CellandMolecular Biology: Concepts andExperiments. 6th edition. JohnWiley&Sons.Inc.
5. **DeRobertisEDPandDeRobertisEMF**. (2006). CellandMolecular Biology. 8th edition.LipincottWilliamsandWilkins,Philadelphia.
6. **CooperG.M.andHausmanR.E**.(2009).TheCell:AMolecularApproach.5th Edition.ASMPress&Sunderland,WashingtonD.C.,SinauerAssociates,MA.
7. **Nigam A and AyyagariA.**2007. Lab Manual in Biochemistry, Immunology andBiotechnology.TataMcGrawHill.