SHIV NADAR UNIVERSITY

Prospectus B.S. Biotechnology 2014

Department of Life Sciences
School of Natural Sciences
Shiv Nadar University
Post office Shiv Nadar University
Gautam Buddha Nagar
UP-201314

B.S. BiotechnologyProgram

Biotechnology is the use of microorganisms such as bacteria, yeast or viruses which are genetically engineered to produce Bio-therapeutics, Cancer drugs, Malarial and Viral vaccines, Synthetic hormones, Drugs against Biological and Genetic disorders like Diabetes and Hemophilia, or even cleanup of oil spills using genetically modified bacteria. The Department of life sciences believes in laying the strong foundation in Biotechnology and at the same time not being orthodox, apprises the students to advanced and applied technology that will help them being good teachers, world class researchers or experts to successfully compete for the jobs in Pharma and Biotechnology companies, Academia at par with international standards or Medical industry in the fields of Bioimaging, Cellbiology,andDiagnostics. For this they will be trained by exposing them to hands on training in our state of art laboratories, the custom designed research projects to be performed in the companies.

The Teaching Experience

Besides the core courses of Biosciences, Department of Life sciences has also designed interdisciplinary courses whereby expertise of other departments from Chemistry, Mathematics, and Physics will be availed. The Department provides a teaching using modern tools by highly skillful globally trained biological researchers and educators from esteemed universities around the world. The degree is designed for students who have interest and exceptional ability to get trained and develop an aptitude in the interdisciplinary program for their overall scientific development. The course is structured to be completed in four years that will train the students to pursue their career in premiere scientific institutes like Indian Institute of Science, TIFR, CCMB, IIT, John Hopkins school of Medicine, NIH and many more institutes/universities throughout the world. The course will also be helpful for the

students to do Integrated Ph.D. saving them a year or two for the completion of the doctorate degree. The degree also qualifies them to enroll for direct Ph.D. in USA or Europe without obtaining the additional MS degree.

The Lab Journey

The department boasts the best infrastructure and state-of-the-art research laboratories that can match any progressive and modern lab of Molecular Biology. We have exclusive instruments for Live Cell Imaging, Analytical methodologies, Medical microbiology, Molecular Biology etc. supported by FACS, Confocal microscopy, Fluorescent microscope, RT PCR, HPLC, Akta Prime and many more. We have a central facility that hosts the instruments like NMR, CD, X-Ray Diffractors, LC- MS, MS-MS Next gen sequencer to name a few.

Research and Training

Shiv Nadar University being a teaching cum Research University, we lay equal emphasis on the Training and Research through our globally experienced faculty. The research project followed with thesis writing and colloquium will be conducted in the department in the fields of immunomodulation, vascular Biology, drug development and cancer genetics to name a few. For research projects, the students will be associated with the faculty who will assign the projects, guide their execution, help student write a thesis and prepare them for viva voce and the interviews. Besides, students will be required to spend their last semester in one of the premier Bio pharmaceutical companies, National research institutes or Hospitals depending upon which they will be awarded specialization in BS Biotechnology. The specialized projects may be opted from one of these:

·Industrial Biotechnology
·Medical Biotechnology
·Nanotechnology andMolecular medicine
·CancerBiology
·Infectiousand non-infectious diseases
·*In silico*and *in vivo*drug designing
·Virology
·Vascular Biology
·Biophysical Structural Analysis
·Malaria
·Neurodegenerative diseases Biomarkers

Career Building

Eligible students may use their independent research and teaching for their future career leading to integrated MS-PhD degree or finding the jobs in Pharmaceutical and Biopharmaceutical companies, Biotechnology companies, Health industry, Research institutes and Universities. On completion of the program, students will be mentored by the faculty to help them further choose their career and find the jobs in the areas of their interest. Guidance will be accorded for obtaining the admission, fellowships and research grants for pursuing higher studies in national and international institutes/universities.

Life SciencesCourseCatalog

Course Code	Name of the Course	No. of Credits
I Semester		
BIO 101	Fundamentals of computers	**2:0:1=3**
CHY111	Chemical Principles	3:1:1=**5**
MAT 020	CalculusI	**3:1:0=4**
PHY 101	Introduction to PhysicsI	**3:1:0=4**
PHY 105	Introduction to computational Physics I	**1:0:1=2**
	Total Credits for I semester	18
II Semester		
CHY 112	Structure and Bonding	3:1:1=**5**
MAT 084	Probabilityand statistics	**3:1:0=4**
PHY 102	Introduction to PhysicsII	3:1:1=**5**
BIO 102	Plant Sciences I	**2:0:1=3**
BIO 103	Animal Sciences I	**2:0:1=3**
	Total Credits for II semester	**20**

III Semester		
BIO 201	Cell biology and Genetics	**2:0:1=3**
BIO 202	Ecology and Environmental Sciences	**2:0:1=3**
BIO 203	Plant Sciences II	**2:0:1=3**
BIO 204	Animal Sciences II	**2:0:1=3**
	TotalCredits for III semester	**12**
IV Semester		
BIO 205	Bio analytical techniques	**2:0:1=3**
BIO 206	Microbiology I	**2:0:1=3**
BIO 207	Biophysics	**2:0:1=3**
BIO 208	Biochemistry I	**2:0:1=3**
	Total Credits for IV semester	**12**
V Semester		
BIO 301	Biochemistry II	**2:0:1=3**
BIO 302	Virology	**2:0:1=3**
BIO 303	Fundamentals of Molecular biology	**2:0:1=3**
BIO 304	Immunology	**2:0:1=3**
	Total Credits for V semester	**12**
VI Semester		
BIO 305	Animal Biotechnology	**2:0:1=3**
BIO 306	Plant Biotechnology	**2:0:1=3**
BIO 307	Recombinant DNA Technology	**2:0:1=3**
BIO 308	Bioinformatics	**2:0:1=3**

	Total Credits for VI semester	**12**
VII Semester		
BIO 401	Biology of infectious diseases	**2:0:1=3**
BIO 402	Industrial Biotechnology	**2:0:1=3**
Elective 1BIO 403	Biomedical engineering*	**2:1:0=3**
Elective 2BIO 404	Drug design and Drugdevelopment *	**2:1:0=3**
Elective 3Bio 405	Genomics ,Proteomics& System Biology *	**2:1:1=3**
	* any one of the elective from the above 3canbe selected	
BIO 406	Internal Project Dissertation	**6**
	Total Credits for VII semester	**15**
VIII Semester		
BIO 407	One semester Dissertation Project with Thesis presentation and VivaVoce	**15**
	Total Credits for VIII semester	**15**

BIO 101: Fundamentals of Computers

IntroductiontoComputers: Overview andfunctionsofa computersystem, Computer generations with characteristic features, computer organization, CPU, ALU,memoryhierarchy,registers,I/Odevices,storagedevices. TypesofProcessing: Batch, Real-Time, Online, Offline.**Introductionto operating systems:** Operating Systemconcept,Windows98/XP,VariantsofUnix,Linuxoperatingsystem and commandlineapplications.**ComputerNetworking**:Introduction to networking: Associated hardwaredevices, gadgets(Router, Switchetc.), NetworkTopologies and ProtocolsLAN,WANandMAN, WorldWideWeb(WWW) Networksecurity:fire walls. Concepts in text-based searching Medline, bibliographic databases.

Algorithms, Flowcharts &Programming concepts: Algorithms: Concepts & definitions,Convertingalgorithmstoflowcharts,Comparingalgorithms,flowcharts

&programs,Algorithmssolving Biologicalproblems,BasicPERLProgramming. **Computers in Biology**: Nature of Biological data, Biological Databases, pubmed, Overview of Bioinformatics, MajorBioinformatics Resources: NCBI, EBI &ExPASY

Recommended Books:

1. Fundamentals of Computers,-V Rajaraman, PHI.
2. Introduction to computers- PeterNorton
3. Computer Fundamentals– P.K. Sinha
4. Introduction to Bioinformatics- Attwood
5. Instant Notes in Bioinformatics

BIO 102: Plant Sciences I

Taxonomy: General principles of taxonomy, Hierarchy Systematics: CarolusLinnaeus Systematics.Outlinesandrelativestudiesonclassificationofangiosperms,Bentham & Hooker, Engler and Prantel andHutchinson system.

General characteristicsof cyanobacteria, algae,fungi, lichens, bryophytes and pteridophytes. Range of thallusstructure, types of reproduction. Economic importance of thallophytes. General characteristics of Gymnosperms and Angiosperms,classificationdistribution,morphologicalfeatures,developmentand reproduction. Evolution of angiosperms andgymnosperms.

RecommendedBooks:

1. Unified series for Botany
2. CellBiology,Genetics,MolecularBiology,EvolutionandEcologybyPSVerma and VK Agarwal
3.

BIO 103: Animal Sciences I

IntroductiontoInvertebrates:Generalcharactersofinvertebrates,classificationof invertebratesup todifferentphylafrom protozoato echinoderms withspecial referenceto protozoaandarthropod. Typestudyofhumanpathogens: Plasmodium vivax,Trypanosomagambiense, Entamoebahistolytica,Faciolahepatica, Teniasolium andAscarislumbricoides.Introductionto modelsystems:C.elegans, Drosophila and zebrafish.

Recommended Books:

1. Unified series forZoology
2.CellBiology,Genetics,MolecularBiology,EvolutionandEcologybyPSVermaand VK Agarwal

BIO 101: Fundamentals of Computers

Introductiontocomputers: Overview andfunctionsofa computersystem, Computer generations with characteristic features, computer organization, CPU, ALU,memoryhierarchy,registers,I/Odevices,storagedevices. TypesofProcessing: Batch, Real-Time, Online, Offline.**Introductionto operating systems:** Operating Systemconcept,Windows98/XP,VariantsofUnix,Linuxoperatingsystem and commandlineapplications.**ComputerNetworking**:Introduction to networking: Associated hardwaredevices, gadgets(Router, Switchetc.), NetworkTopologies and ProtocolsLAN,WANandMAN, WorldWideWeb(WWW) Networksecurity:fire walls. Concepts in text-based searching Medline, bibliographic databases.

Algorithms, Flowcharts &Programming concepts: Algorithms: Concepts & definitions,Convertingalgorithmstoflowcharts,Comparingalgorithms,flowcharts &programs, Algorithms solving Biological problems, Basic PERL Programming.
Computers in Biology: Natureof Biological data, Biological Databases, pubmed, Overview of Bioinformatics, MajorBioinformatics Resources: NCBI, EBI &ExPASY

Recommended Books:

6. Fundamentals of Computers,-V Rajaraman, PHI.
7. Introduction to computers- PeterNorton
8. Computer Fundamentals – P.K. Sinha
9. Introduction to Bioinformatics- Attwood
10. Instant Notes in Bioinformatics

BIO 201: Cell Biology and Genetics

Cell asabasicunitoflivingsystems:Thecell theory,pre-cellularevolution;broad classificationofcell types:archaebacteria,PPLOs,bacteria, eukaryotic microbes, plant–andanimalcells;cell, tissue,organandorganisms,different levelsof organization.

Cellorganelles:Ultrastructureofcellmembraneand function,Structureofcell organelles;Chromosomes:Structuralorganization ofchromosomes,chromatids, centromere,telomere, chromatin,nucleosomeorganization,euchromatin and heterochromatin.Celldivisionandcellcycle:Cellcycle,interphase,mitosis and meiosis,Cell–CellinteractionCelllocomotion:amoeboid,flagellar and ciliar; cell senescence anddeath:apoptosis,necrosis andautophagy,Cell differentiation, Mechanism ofcelldifferentiation(e.g.,RBC),differencebetweennormalandcancer cells.

Briefhistory,scope and significance of Genetics. Mendelian lawof inheritance. Lethality andinteractionofgene.Multiplealleleand iso-allele. Penetrance and Expressivity,Linkage andcrossingover. Mappingofgenes. Interference and coincidence. Basic microbial genetics, Conjugation, transformation, transductionand theiruseingeneticmapping.Classicalandmodernconceptofgene,pseudo-allelism,

position effect,intrageniccrossing over andcomplementation test,Benzers workon rII locus in T4 Bacteriophage.

Mutations; Chromosomal aberrations.Economic importanceofmutation. Genetic disordersinhumans. Sexdetermination inplant and animal.Nondisjunction as a proofofchromosomaltheoryof inheritance.Sexlinked,sexinfluencedandsex limitedinheritance. Extrachromosomalinheritance;cytoplasmicinheritance, Mitochondrial and Chloroplast genetic system. Population genetics; Hardy- Weinbergequilibrium law, Gene and genotypefrequencies.

Recommended Books:

EssentialCellBiology:AnIntroductionto theMolecularBiology oftheCell,B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff,K. Robert, P. Walter and K. Roberts, Garland Publishing Company

Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd. Cell and Molecular Biology-Sheelar&Bianchi, John Wiley
MolecularCell Biology,H.Lodish,A.Berk,S.L. Zipursky,P. Matsudaura,D.Baltimore and J. Danell, W.H. PreemanandCompany.

Principles of Genetics,E. J. Gardner, John Wiley &Sons Inc.

ConceptsofGenetics (SixthEdition),William S.KlugandMichael R,Cummings, Pearson Education.

BIO 202: Ecology and Environmental Sciences

IntroductiontoEcology,Communityand Ecosystem (Inter-relationships between livingworldandenvironment,Biosphere,biomes,ecosystemand itscomponents (abioticandbiotic).Environmentrelatedconcepts and laws(theoryoftolerance, laws oflimitingfactors).Communitycharacteristics-organization andconceptof habitatsand niche. Bioenergetics. Biogeochemical cycles, Hydrologic cycle. Concept of habitatand niche.

Populationand CommunityEcologyPopulation attributes,density, natality, mortality,ageratio,sexratio,dispersalanddispersionofpopulation,exponential andlogistic growth,lifehistorystrategies,populationinteractions,predation-types, predator-prey system, functional and numerical response, host-parasite interactions, social parasitism, symbiosis

BiogeographyPhytogeography,Phytogeographicrealms,majorplantcommunities oftheworld,VegetationofIndia, Zoogeography:Zoogeographicrealms,Threatened species ofanimals

BioresourcemanagementBiodiversity and regional conservationstrategiessuccess stories with reference to India and sustainable utilization. Principles of wildlife

management, wildlife sanctuaries, parks and biosphere reserves in India, endangered and threatened species of plants and animals in India, germplasm banks.

EnvironmentalIssues,Policies andRegulation Impactofurbanizationand industrialization, EIA-Environmental ImpactAssessment(Global, National and Local), restoration of degraded ecosystems, bioremediation, environmental pollution, global climatic change.

Recommended Books:

1.Mishra, A.Environmental StudiesSelective and ScientificBooks, New Delhi

2.Allaby, M. Basics of Environmental Science Routledge

3.Smith, T.M. and Smith, R.C.Elements ofEcology Istediton Pearson Publications

4.Miller, G.TEnvironmental Science 11thedition Brooks/Cole

BIO 203: Plant Sciences II

Structural organizationofflower, initiation and differentiation offloral organs, structure and development of anther, microsporogenesis, structure and type of ovule, megasporogenesis, types ofembryo sac.

Plantwaterrelationship,mineralnutrition,Solutetransport, Roleofgrowth regulators. Photosynthesis-lightanddarkphasesofphotosynthesis.RoleofATPand NADPHin carbondioxideassimilation, factors influencing photosynthesis, photosynthesisofCAMplants. Roleofplants inconvertingradiant energy into chemicalenergy.Respirationof chlorophylloustissuesin C3and C4plants. Regulation of photorespiration, photo periodism and flowering.

Plant development: structure of plant body; fundamental differences between animaland plantdevelopment;embryogenesis–classicalandmodernviewsusing FucusandArabidopsisasmodels;axisspecification andpatternformationin angiosperm embryos; organization and homeostasis in the shoot and root meristems; patterning invegetativeand flowermeristems;growth andtissue differentiation in plants; evolutionof developmental mechanisms inplants.

Recommended books:

1.HopkinsWG &HunerPA introduction to plant physiology

2.Dickinson WC integrativeplantanatomy

3. Introductory Plant Physiology 2nd Edition, G.RayNoggle&George J. Fritz, learning Pvt. Ltd., NewDelhi.
4.Developmental Biology: A VeryShort Introduction by LewisWolpert

5.Principlesof Developmentby Lewis WolpertandCheryll Tickle

6.Principlesof Developmental Biology by Sarah Hake andFred Wilt

BIO 204: Animal Sciences II

Chordate classification up tophyla,with special referencetopisces, amphibians, reptiles, birdsand mammals.Comparativedevelopmentofheartand respiratory organsinchordates. Composition ofblood,coagulation ofbloodandfibrinolysis. Physiology ofheartandneurohumoral regulation ofcardiovascularfunction. Gastrointestinal system– digestion and absorption of foods in GIT. Physiology of kidneyanditsroleintheregulationofelectrolyte,waterandacidbasebalancein the body. Structure and organization of muscle cells. Biochemical changes associated withmusclecontractionandrelaxation.Structureofnervecell,originof membrane potential, mechanism of propagation of nerve impulsein unmyelinated and myelinatednerve fibres. Neurotransmitters.

Reproductivephysiology-maleandfemale reproductive systems andsexhormones. Spermotogenesis,oogenesis,menstrulcycle. Placenta andits functions.Pregnancy and lactation.

Animal development: Introduction, historyand conceptsof developmental biology; thecurrentunderstandingonthemechanismsofdevelopmentoforganismsusing vertebrate(mouse,chick,frog,fish)andinvertebrate(fly,worm)models;howdoes acomplex,multicellularorganismarisefrom asinglecell;thebeginningofa new organism (fertilization),thecreationofmulticellularity(cellularization,cleavage), reorganizationintogerm layers(gastrulation),cell typedetermination;creation of specificorgans(organogenesis); molecularmechanismsunderlyingmorphogenesis and differentiationduringdevelopment;stem cells and regeneration;evolution of developmental mechanisms.

*Drosophila*Development, Development of Other Invertebrates, Plant Development, ModelOrganismsandtheHumanConnection, SignalTransduction,GermCellsand Sex, Regeneration and Growth, Post-Embryonic Development,Evolutionand Development.

Recommended books:

1.TextbookofMedicalPhysiology11theditionEd.AGGuyton&HallJEHarcourt, Asia.
2. Medical Physiology, Shambulingam
3. HumanPhysiology Roase& Wilson
4. Text book of MedicalBiochemistry Chaterjee. Jaypee
5. Biochemistry by Harper.

BIO 205: Bio-analytical Techniques

Instruments,basicprinciplesandusagepHmeter, absorptionandemission spectroscopy,Principleand lawofabsorption,fluorimetry,colorimetry, spectrophotometry(visible,UV, infra-red), polarography,centrifugation, atomic absorption,NMR, X-ray crystallography.

Chromatographytechniques:Paperchromatography, thinlayerchromatography, columnchromatography, HPLC,gaschromatography,gel filtration and ion exchange chromatography,

Electrophoresis Agarose gel electrophoresis, SDS polyacrylamide gel electrophoresis, immunoelectrophoresis,Isoelectric focussing.Radioisotope tracer techniquesand autoradiography.

Recommended Books:

Practical Biochemistry, Principles and Techniques, Keith Wilson and John WalkerBioinstrumentation, Webster

Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic

Crystal Structure Analysis, J.P. Gluskerand K.N. Trueblood, Oxford University Press

ModernSpectroscopy, J.M. Hollas, John Wiley and Son Ltd.

NMR Spectroscopy:BasicPrinciples,ConceptsandApplicationsinChemistry,H. Gunther, John Wiley and Sons Ltd.

Principles of Physical Biochemistry, K.E. VanHolde, Prentice Hall. Principles and Practiceof Bioanalysis, RichardF. Venn Microscopic Techniques in Biotechnology, Michael Hoppert Principles of Fermentation Technology, P.F. Stanbury, A. Whitaker, S.J. Hall

BIO 206: Microbiology

History,evolutionanddevelopmentofmicrobiology.Diversityofmicroorganisms- scopeand importance.Characterizationand identificationofbacteriabased on morphology,physiology,biochemistry,ecology,chemotaxonomy andmolecular systematics. Bergey'smanual– classificationof bacteria,fungi, algaeand archea.

Thestudy ofmicrobialstructurebyuseoflight,phase,fluorescentandelectron microscopy.Preparationandstainingof specimens.Microbialnutrition,nutritional types, requirements, designandtypesofnutrient media, microbialgrowth-principles,kineticsandmethods.Theinfluenceofenvironmentalfactorsongrowth.

Microbial control- definition, methods of sterilization, physical methods and chemical agents. Isolation of pure cultures- spread plate, streak plate and pour plate.

Classificationofgeneralfeaturesofcyanobacteriaand importanceofSpirulina, Rickettsia, Chlamydia,Mycoplasma,Archaebacteria.MethanogenicandHalophilic bacteria.Generalaccountand economicimportanceofalgaeand fungi. Clinically important bacteria andprotozoans.Distribution ofmicrobes innature.

Historyand developmentofviruses.Nature,origin and evolution ofviruses. Nomenclature,recentclassification(ICTV)structureandcharacteristicsofviruses. Isolation, cultivation and identification of viruses. Biological and chemical properties ofviruses. Animal,plantandbacterial virusesandtheirinteractions with hosts.Virus replication andgenomeexpression.Processofinfection- animal,plant andbacterialcells.Molecularmechanisms ofviralpathogenesiswithrespectto poliovirus, rotavirus, herpes virus,retroviruses.

Transmissionofviruses(DirectandIndirect)persistenceofvirusesand their mechanism. Purificationand inactivationofviruses- physical and chemical methods. Virusecologyand epidemiology,scopeand concepts ofepidemiology.Bacterial recombination,transformation, conjugationand transduction.Mappingof prokaryoticgenomeandtetrad analysis,insertionsequences,transposonsand mechanism of transposition,retrotransposons, plasmids.

Recommended Books:

1. Microbiology- Pelczar, Chan andKrieg
2. Brock Biology of microorganisms (9th edition) by Madigan, Martinko and Parker.
3. Introduction to microbiology byRoss
4.Microbiology-PrinciplesandApplicationbyJ.G.Black,JohnWileyandSons,New york
5. Microbiology (4th edition)- Prescott, Harley,Klein
6. GeneralMicrobiology volume I and II- Power
7.Microbiology-Principlesandapplicationsby J.G.Black,JohnWileyandsons,New York.
8. Microbiology- G.J.Oortora, B.R.Funke and C.L.Case.

BIO 207: Biophysics

Thermodynamics:Lawsofthermodynamics, conceptoffreeenergy,unavailable energyandentropy,heatcontentoffood,bombcalorimetry,chemicalkinetics– rate, order, molecularityof reactionsand energyofactivation.Redoxpotential: Oxidationand reduction,redox potential and its calculationby Nernst equation, examples of redox potential in biological system. Bioenergetics: Energy requirementsincellmetabolism,roleandstructureof mitochondria,highenergy phosphate bond, electron transferphenomenon and biological transfer.

Biophysicalproperties:Surfacetension,adsorption,diffusion,osmosis,dialysisand

colloids.KineticsofBiophysics:absorptionand emissionoflight by molecules-Wave propertiesofparticles, absorptionoflight(UVandIR) bymolecules,fluorescence and phosphorescence
and biological effects of UV and visible radiation.

Optics in Biology: Light characteristics, microscopes- compound, phase contrast, interference, polarization, ultraviolet, fluorescent and electron microscopes – Transmission Electron Microscope, Scanning Electron Microscope, Electron cry microscopy and Scanning tunneling electronmicroscope.

SpectroscopicstudiesinbiologyInteractionofEMradiationwithmatterUltraviolet &Visible spectroscopy-BeerLambertslaw-spectrophotometer.Infrared spectroscopy bending, near, mid &far infrared region, instrumentation. Raman
spectra- principle and instrumentation. Fluorescence and NMR. Estimation of meltingtemperature. AnalysisofproteinstructurebyCircularDichroism.Mass Spectrometrybasedsequencingof peptides. Crystallizationofproteins.Acquisition andInterpretationofproteinNMRspectra. Estimationofprotein-ligandbinding constantsbytitrationcalorimetry.Estimationofprotein-ligandbindingconstants by Fluorescence.Analysisofcooperative andnon-cooperative phenomenaby Scatchard plot analysis,time resolved fluorescence and Atomic Force Microscopy.

RadiationBiophysics:Introduction,particles and radiationsofsignificance,physical and biological half-lives, macroscopic absorptionofradiation, activity and measurements,unitsofdose,relativebiologicaleffectivenessand actionofradiation atmolecular level.

Recommended Books:

1.IntroductoryBioPhysicsF.R.Hallet,P.A.Speight,R.H.StinsonChapman&Hall(Unit I and II)
2.BioPhysicsPrinciplesandApplicationsM.A.Subrahmaniam-MJPPublishers(Unit III)
3. Basic BioPhysics- M.Daniel Student Edition(Unit IV)
4. Bio Physics- Rodney CotterillJohn Wiley &Sons, Ltd.(Unit V)

BIO 208: Biochemistry I

Properties and importance of water, intra and intermolecular forces, non-covalent interactions- electrostatic, hydrogen bonding, Vander Waals interactions, hydrophobic and hydrophilic interactions. Disulphidebridges. pH, pK, acid base reactions and buffers.

Carbohydrates:Differentcarbohydratesand withexamplesofglucose,galactose, sucrose,starchandglycogen.Carbohydratesmetabolism:Glycolysis,Kreb'sCycle andoxidativephosphorylation, Gluconeogenesis,Pentosephosphatepathway, Glyoxylatecycle

Proteins: Classification and propertiesof amino acids, Classificationbased on structureand functions,structural organizationofproteins(primary,secondary, tertiary and quaternarystructures),biosynthesisofprotein.Enzymesandenzyme kinetics.

Nucleicacids:Structureandproperties ofnucleicacids.Different forms ofDNA-A,B, Z. Circular DNA and DNA supercoiling. Different typesof RNA- mRNA, and non codingRNA – tRNA, rRNA, scRNA, snRNA andsiRNA.

Lipids:Classification,structure,propertiesand functions offatty acids,triglycerides, phospholipids,sphingolipids,cholesteroland eicosanoids-prostaglandlins.Source, structure,biologicalroleanddeficiencydisordersof fatsolublevitamins(A,D,E and K) andwatersolublevitamins (riboflavin, niacin,thiamine,pyridoxine,biotin, folicacid, pantothenic acid, cobalamine, and ascorbic acid).

Recommended Books:

1.LehningerPrinciplesofBiochemistrybyNelson,DandCox,D.5edMacmillan Pub.

2. Biochemistry by L. Stryer 6ed (Freeman-Tappan).

3. Text Book of BiochemistrybyWest et.al., (Mac Milan).

4. Principles of Biochemistry by Smith et. al.,(Me Graw Hill).

5. Harper'sBiochemistry by Robert K. Murray et al., 27ed(Langeman).

6. Biochemistry byD.Voetand J.G.Voet3ed (John wiley).

7. Biochemistry by Mathews et. al.,(Pearson)

BIO 301: Biochemistry II

Principlesofbioenergetics–freeenergyconcept,enthalpy,entropy, redoxpotential, phosphategroup transferpotential. Coupledreactions, high energy compounds in biologicalsystems.Substratelevelphosphorylation,electron transport-oxidative phosphorylation and photophosphorylation.

Enzymes Nomenclatureand classificationof enzymes,effectofpH, temperature, metalions,substrateconcentrationand enzymeconcentrationon enzymeactivity. Enzyme assayand units of enzyme activity.Michaelis-Mentenequation,significance of Km , Vmax and Kcat.Lineweaver– Burk plot.

Glycolysisanditsregulation.Alcoholicandhomolacticfermentation. TCAcycle and itsregulation-amphibolicnatureofTCAcycle,anapleuroticreactions.significance ofgluconeogenesis, HMPshuntandglyoxylatecycle.Glycogenmetabolism- glycogenesis, glycogenolysis and regulation. Glycogen storage diseases.

Saturated and unsaturated fatty acids - synthesis, β-oxidation and regulation. Ketone bodies. Synthesis oftriacylglycerides,phospholipids,and cholesterol. Synthesis of eicosanoids - prostaglandlins, leukotrienesand thromboxanes. Synthesisofsphingolipidsandstoragedisorders.Proteinturnover, transamination andoxidativedeamination,ureacycle.Biosynthesisanddegradationofaromatic andbranchedchain aminoacids. Inbornerrorsofamino acidmetabolism. Synthesis and regulationofpurinenucleotides by denovopathway.Salvageofpurine nucleotides. Synthesis and regulation ofpyramidine nucleotides. Formationof deoxyribonucleotides andtheir regulation. Degradationofpurinesandpyrimidine nucleotides, disorders of nucleotide metabolism

Recommended Books:

1.LehningerPrinciplesofBiochemistrybyNelson,DandCox,D.5edMacmillan Pub.

2. Biochemistry by L. Stryer 6ed (Freeman-Tappan).

3. Harper'sBiochemistry by Robert K. Murray et al., 27ed(Langeman).

4. Biochemistry by D.Voetand J.G.Voet3ed (John wiley).

5. Biochemistry by Mathews et. al.,(Pearson)

BIO 302: Virology

General aspects: Classification and nomenclature of viruses in general, their properties,morphologyandultrastructuretypical bacteriophage, animalvirusand plant virus, types of envelope, their composition, Viroidsand Prions. Animal Viruses: Classificationofanimalviruses,lifecycleandpathogenicityofimportant viruses, genomeorganizationandreplicationofDNAviruses,RNA viruses, Adeno virus, Poxvirus,SV40,Vaccinia,Lentivirus. Clinical diagnosisandtreatmentofHIV, Influenza and Hepatitis. Plant Viruses: Classification plant viruses, life cycle and pathogenicity of important viruses. Genome organization and replication of common plantviruses,suchas;TMVCaMV,Potato XVirus,GeminiVirus. Transmissionofplantvirusesby vectorsand othermeans. Diagnostictechniquesin seed, seed stocks and diseased plants.

Bacteriophages:Structureandorganizationofbacteriophages,lyticandlysogenic life cycles –T4 and lambda. Genetic switch for control of lytic and lysogenyof lambdaphage. Genomeorganization,infectionandmultiplicationofToddandT evenphages. Lambdaphage,M13,Muphage. VirologyMethods:Cultivationand purificationofviruses, Invivoandinvitrosystemsforvirusgrowth,estimationof yields, methods for purification of viruses with special emphasis on ultracentrifugationmethods.

DiagnosticMethods: Immunodiagnostic,haemagglutinationandhaemagglutination - inhibition tests, Complement Fixation, Neutralisation, Western Blot, RIPA, flow cytometryand immunochemistry.a) Nucleic acid based diagnosis:Nucleic acid hybridization,polymerasechainreaction,microarrayandnucleotidesequencing.b) Microscopic techniques: Fluorescence, confocal and electron microscopic techniques—principlesandapplications.c)Analyticaltechniques:Electrophoresis, chromatography, membrane filtration, NMR, X-rayCrystallography.

Recommended Books:

General Virology by S.E. Luria
Molecular Virology,pathogenesisand control,ASM Press,Washington DC Plant Virology by REF Matthews

DimmockN.J.,PrimroseS.B.1994Introductionto modernVirology,4th edition, Blackwell scientific Publications,Oxford.

MoragCandEmburyM.C.1994,MedicalVirology10th edition,ChurchilLivingston, London.

BIO 303: Fundamentals of Molecular Biology

Natureof geneticmaterial,organizationofgeneticmaterialinprokaryotesand eukaryotes. Structure ofchromatin,fine structureof thegene. Differentkinds of genes-splitgenes,overlapping, assembled,polyprotein&nestedgenes.Gene amplificationand polytenechromosome.C- Value paradox,mitochondrial &plastid genomes.

DNA replication–TypesofDNA polymerases.Mechanismof DNA replication. Enzymesandaccessoryproteinsinvolved inDNAreplication. Replicationof telomeresanditssignificance.Differencesinprokaryoticand eukaryoticDNA replicationand regulation. DNA damage and repair.

Transcriptioninprokaryotesand eukaryotes. Mechanismoftranscription,Typesof RNApolymerasesand promoter-polymeraseinteractions.Transcriptionalfactors. Processingof mRNA, tRNA and rRNA. RNA editing and transport.

Translation inprokaryotesand eukaryotes:Geneticcode,translationalmachinery, mechanismofinitiation,elongationand termination.Regulationof translation, co and post translationalmodifications. Leader sequences &protein targeting.

Regulation ofgeneexpressionin prokaryotes and eukaryotes- the operonconcept, negative& positivecontrol and attenuation. Roleofenhancers,cis-trans elements, DNAmethylationand chromatin remodelingingene expression.Environmental regulation ofgene expression. RNAiand gene silencing.

Recommended Books:

1. Biochemistry by L.Stryer5 Ed. (freeman-Toppan)
2. GenesVIII by B.lewin (Oxford)

3. Cell andMolecular Biology by E,D.P.DeRoberties (International edition)
4. Molecular Biology by David Frefielder.
5. Molecular Biology of the Gene by J.D. Watson*et. al*., (Benjamin).
6. Molecular Biology by Robert F. Weaver(McGraw-Hill)

BIO 304: Immunology

Concepts ofimmuneresponse. Innate immunity– barriersand roleof toll like receptors ininnate immunity.Cellsofthe immunesystem, Adaptiveimmunity– organizationandstructureoflymphoidorgans. Antigens–immunogenicity, antigenicity,factorsinfluencing theimmunogenicity,haptens,adjuvantsand mitogens. Superantigens, B &T cell epitopes.

TypesofB cells, BCR,developmental stages ofB cells,regulationofimmune response. Classification,finestructureandfunctionsofantibodies.Antigenic determinantsonimmunoglobulins–isotypes,allotypesand idiotypes. The generationofantibodydiversity.Effectorcellmechanismofhumoralresponse.T cell ontogeny – Types of T cells, T cell development. T-cell maturation and activation. Structure of TCR. T-cell differentiation, Effector cell mechanism. Cell death and T-cell populations, Types of cell mediated immunity.

Cytokines– classesandtheirbiologicalactivities.Therapeuticusesofcytokinesand theirreceptors.Complementsystem–modeofactivation,classical,alternate and mannose bindingpathway,biologicalfunctions andregulation.Major histocompatibilitycomplex(MHC). Humanleukocyteantigens(HLA),MHC restriction.MHCanddiseasesusceptibility,regulationofMHCexpression.APC's and antigenprocessingandpresentation.

Immunological techniques: Principle conceptsof antigen–antibodyinteractions: Agglutination,precipitation,geldiffusion:Ouchterlonydoubleimmunodiffusion and Mancini's radial immunodiffusion,immunoelectrophoresisandcomplement fixation test. ELISA, RIA, Western Blot and FACS.

Recommended Books:
1.KubyImmunologybyKindt,Goldsby,Osborne6thEdition(W.H.Freemanand Company)
2. Roitt'sEssentialImmunology,byPeterJ.Delves,SeamusJ.Martin,DennisR. Burton, Ivan M. Roitt 12th edition(Wiley- Blackwell)
3. Janeway'sImmunobiology by KennethMurphy 8th edition (GarlandScience)
4. Fundamental Immunology by William E. Paul, Paul, 6th Edition (Lippincott Williams &Wilkins publishers)

BIO 305: Animal Biotechnology

Basictechniquesofcell,tissueandorganculture.Primarycultureandsubcultureof cells.kineticsofcellgrowth.Propertiesofnormalandtransformedcells.Roleof

carbondioxide,serumand other supplements in cell culture. Different types of culturemedia-naturalmedia,BSS,MEM,serumfreemedia.Differentmethodsfor theestimationofcellviabilityandcytotoxicity.Applicationsofcellculture.Stem cells–Embryonic and adultstem cells.Isolationand cultureofstem cells.Induced pluripotencyofstemcells.Stemcellmarkers.Stemcellplasticityand differentiation. Application ofstem cells inmedicine.Apoptosis-mechanismandsignificancewith reference to degenerativediseases – Parkinson's disease,stroke anddiabetes.

Organcultureand tissueengineering: Organcultures,histolytic cultures,three dimensionalcultures,organotypiccultures.Productionofbio-artificialskin,liver andpancreas.Tissue engineering-cell sourceandculture,cultureofcells,design engineeringof tissues, tissue modeling. Embryonic stem cell engineering.

Production ofmonoclonalantibodies,Productionof TransgenicAnimals-Mouse, sheep,cattleandfish by microinjection,retroviral vectormethodandembryonic stemcellmethod.Animalcloning-Somaticcellnucleartransferand embryonicstem cell nuclear transfer methods. Bio pharming and gene knockout.

Recommended books:

1.CultureofAnimal cells;AmanualofBasictechniquesbyR.IanFreshney6th edition (Wiley-Blackwell)
2. Molecular Biotechnology by Bernard R. Glick and Jack. J. Pasternak
3. Elementsof Biotechnology by PKGupta(Rastogi& Co).
4. Biotechnology by U.Satyanarayana
5. Conceptsof Biotechnology by Balasubrahmanian etal., (Universitypress)
6. Principles and practices of aquaculture byTVR Pillay.
7. Coastal aquaculture by Santhanam.
8. Fisheries of India by CBLSrivatsava.
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BIO 306: Plant Biotechnology

Planttissueculturemedia,phytohormones,invitrocultures-initiation and maintenanceofcallus,suspensionculturesand singlecell clones-organogenesis, somaticembryogenesis, citedifferentiation and morphogenesis.Embryoculture, embryorescueafterwidehybridization,anditsapplications.Endospermculture andproductionoftriploids. Introductiontotheprocessesofembryogenesis and organogenesis andtheir practical applications.

Micropropagation, axillary bud, shoot-tip and meristem culture. Haploids and their applications. Somaclonal variationsandapplications. Introductiontoprotoplast isolation,Principlesof protoplastisolationandapplications.Testingofviabilityof isolatedprotoplasts.Variousstepsintheregenerationofprotoplasts.Introduction ofsomatic hybridization.Variousmethodsforfusing protoplasts, chemicaland electrical. Cybrids-definition and application. Use of plant cell, protoplasts and

tissue culturefor genetic manipulationof plants ,Introduction to A. tumefaciens. Tumorformationon plantsusingA.tumefaciens(Monocotsvs.Dicots).Practical application of genetictransformation.

Methods of gene transferin plants- PEG,particlegunsand Agrobacterium mediated (TiandRi plasmids)genetransformation. Identificationoftransgenicplants, Molecularmarkers and their applications. RFLP, AFLP,simple sequencerepeats. RAPD for molecular mapping and crop improvement. Stress- biotic and abiotic stress.Developmentoftransgenic plants- herbicide tolerance,disease resistance, insectresistance,and stresstolerance.Proteinandoilqualitytraitsin seeds. Genetic manipulationofphotosynthetictraits for improvementofcropyield.Ediblevaccines and plantibodies.

Plantsecondarymetabolites-typesandapplications,Biofertilizers- organizationof nif genesand theirregulation,Rhizobium,Azotobacter, Azolla,cyanobacteriaand their associations, Mycorrhizalbiofertilizersand biopesticideproduction strategies.

Recommended Books:

1.PlantBiotechnologyby A.Slater,N.W.Scottand M.R. Fowler(Oxford University press).
2. Biotechnology in Agriculture by Swaminathan, M.S (Mc. Millian India ltd).
3. Biotechnology and itsapplications to Agriculture, by Copping LG and P.Rodgers (British Crop Projection).
4. PlantBiotechnology, by Kung, S.andCJ.Arntzen(Butterworths).
5. Agricultural biotechnology by Purohit.
6. Experiments in Plant Tissue Culture, J.H. Doddsand L.K. Roberts, Cambridge UniversityPress

BIO 307: Recombinant DNA Technology

Isolationof DNA, cDNAsynthesis,chemical synthesisofDNA by phosphoramidite method.IntroductionofDNAintolivingcells,Introductiontogenecloningandits uses,tools andtechniques:plasmidsand othervectors,DNA,RNA,cDNA.Enzymes used in genetic engineering. Restriction endonucleases and restriction mapping, DNAligase,DNApolymerase-I,reversetranscriptase,Sl nuclease,terminal nucleotidetransferase, alkalinephosphatase, polynucleotidekinase, polynucleotide phosphorylase.Productionofproteins from clonedgenes:genecloninginmedicine (Pharmaceutical agents such asinsulin,growth hormones, recombinant vaccines), gene therapy for genetic diseases.
Cloning vectors- salient features, plasmid vectors, phage vectors, cosmids, phagemids (LambdaandM13phages),viralvectors (SV40,Baculo andCMV), artificial chromosomes BAC, YAC and MAC.

Ligationof DNAtovectors–cohesiveend,bluntend,-homopolymertailing,linkers and adaptors. Gene transfer techniques- transformation, transfection, microinjection, electroporation,

lipofectionandbiolistics.Reportergeneassay,selectionandexpressionofr-DNA clones. Polymerase ChainReaction,PCR variations and their applications DNA sequencing- chemical, enzymatic andNGS methods.Salientfeaturesofhuman genome project.Applications ofgenetic engineering in agriculture, animal husbandry, medicine and industry.

Recommended Books:

Recombinant DNA, J.D. Watson et al, W.H. Freeman andCompany

Genecloning and DNAanalysis by T.A. Brown

PrinciplesofGeneManipulation:AnIntroductiontoGenetic Engineering,R.W. Old and S. B Primrose, Blackwell Science Inc

MolecularBiotechnology: Principles and Applications of Recombinant DNA, B.R. Grickand J.J.

Pasternak,ASM Press

Molecular Biology of geneby Watson, Baker, Bell, Gann, Levine, Losick

DNA Science by MicklosFreyer

Principles of Gene manipulation and Genomics by Primrose andTwyman

BIO 308: Bioinformatics

IntroductiontoBioinformatics,Introduction toInternet,SearchEngines(Google, Yahoo, Entrezetc). BiologicalDatabases:Biologicaldatabaseconcept, Primary, secondary and compositedatabases, NucleotideSequence databases (EMBL, GenBank, DDBJ)ProteinDatabases–(UNIPROT, PIR,TREMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam,), Metabolic &Pathway databases (KEGG, etc.), Structural databases (PDB).

Genomics:Theoriginofgenomes,AcquisitionofnewGenes, DNAsequencing-chemicalandenzymaticmethods,Theoriginsofintrons,Restrictionmapping,DNA & RNA fingerprinting,The HumanGenome, SAGE, ESTs, AFLP & RFLP analysis.

Annotation, Functional &ComparativeGenomics,BasicconceptsofMulti-omics methods,Genomeanalysis, genomeanatomy,genomerearrangements with inversions, signedinversions,gene identification,geneexpression,expression analysis, gene identification andfunctional classification.

PrimarySequenceAnalysis: Sequencealignment, Homologyconcept,pairwise sequencealignment, multiplesequencealignment, Annotation,comparisonof differentmethodsPhylogeneticAnalysis,tree buildingmethods,snip identification, ESTs–databases, clustering.

Recommended Books:

Bioinformatics – Sequence, Structure and Databanks, Des Higgins&Willie Taylor
Bioinformatics: A practical guide to the analysis of genes and proteins, A.D. Baxevanisand B.F.F. Ouellette, JohnWiley andSons Inc.
Bioinformatics:SequenceandGenomeAnalysis,D.W.Mount,ColdSpringHarbor LaboratoryPress
DNA Micro arrays: APractical Approach, M. Schlena, Oxford University Press. A PrimerofGenome Science, GregGibson andSpencer V. Muse
Database Annotationin Molecular Biology: Principles and Practice,Arthur M. Lesk
DNA : Structure and Function, Richard R. Sinden
Recombinant DNA (Second Edition), James D.Watson andMarkZoller
Gene Cloning and DNAAnalysis–Anintroduction (Fourth Edition),T.A. Brown
Structural Bioinformatics, PhilipE. Bourne, Helge Weissig2003
Introduction to Bioinformation–T.Attawoo

BIO 401: Biology of Infectious diseases

Biology of infectious diseases. History of infectious diseases, basic concepts of diseasedynamics,parasitediversity, evolution&ecologyofinfectious diseases Emergence ofdiseases:The basic reproductive number,criticalcommunitysize, epidemiccurve,zoonosis,spillover,human/wildlifeinterface, climatechange,hot zones,pathology.Spreadofdiseases:transmissiontypes (droplets,vectors,sex), superspreading,diffusion,socialnetworks,nosomicaltransmission,manipulation ofbehavior.Control ofdiseases:drugresistance,vaccination,herd immunity, quarantines,antibiotics,antivirals,healthcommunication,ethical challengesof diseasecontrol.Thefutureof infectiousdiseases:Evolutionofvirulence,emergence ofdrugresistance,eradicationofdiseases,medicine&evolution,crop diseases & foodsecurity,digitalepidemiology.Diseases indevelopingcountries:Malaria, HIV, Cholera, Dengue, Tuberculosis.

BIO 402: Industrial Biotechnology

Introductiontofermentation,thefermentationindustry,Productionprocessbatch and Continuous system of cultivation, Solid-state fermentation. Selection of industrial microorganisms,mediaforfermentation,aeration,pH,temperatureand other requirementsduringfermentation, downstream processingandproduct recovery, food industrywaste as fermentationsubstrate.

Production ofcompoundslike antibiotics,enzymes,organic acids,solvents, beverages, SCP.Productionof fermented dairyproducts,Immobilizedenzymes systems, production and applications. Industrialapplication of microbes - Wine, Beer, Cheese, Yogurt.

Primary and secondary metabolites andtheirapplications; preservation offood. Biogas;bio-fertilizersandbio-pesticides.Useofmicrobesinmining:leachingofores

by microorganisms; microorganisms and pollution control-bioremediation; biosensors.
Biologicalwastetreatmentandin-plantsanitation-principleand useofbiosensor- production of vitamins, amino acids, organic acids, enzymes and antibiotics, alcohols. Enzyme technology-production and recoveryofenzymes,enzyme immobilization- application of enzyme in industries. Biosensors.

Recommended Books:

Industrial Microbiology– Cassida

Principles of fermentation Technology, Salisbury, Whitaker and Hall

Industrial microbiology– Prescot&Duhn.
Microbiology, L.M. Prescott, J.P. Harley and D.A. Klein,7/e, 2007. McGraw Hill, McGraw Hill, Boston.
Fundamental Principles of Bacteriology, A.J. Salle, 1999. Tata McGraw - Hill Publishing Company Limited, New Delhi.

Elective 1 BIO 403: Biomedical Engineering

Introductiontofermentation:rateofmicrobialgrowthanddeath.Fermentation-types,classification, basicrequirements,designofa fermentor,factorsinvolvedin fermentordesign-basicfunctions-containmentbodyconstruction-temperature control-stirringand mixing-viscosity-NewtonianandNonNowtonianfluids. Isolation andpreservation ofindustrially important microorganisms-strain developmentmutationand recombination-upstreamprocessing.Fermentation kineticsof batch,continuousandfedbatchfermentation-cellrecycle-scaleup window- principletypesoffermentor:towerfermentor,cylindroconical, airlift fermentor, deep jetfermentor,photobioreactor,membranebioreactorandMicro carrierreactors.

Biomechanics, bio fluidics, biomedical signal processing, embeddedsystems in medicine, principles ofdiagnostic and therapeutic instruments. Biomaterials.

Elective 2 BIO 404: Drug designing and Drug Development

ConceptsofDrugandDrugTargets, importantdatabases,Methodsfortarget identification,Leadidentification,optimization andvalidationconcepts, PharmacodynamicsandPharmacokinetics,Naturalsubstancesasdrugs,Stages and costofmoderndrugdesign, Terminologies inDrugdesigningand CADD,Bioactivity ofacompound,HTSand Virtualscreening,docking methodologies,Molecular Modelingconcepts,Drugdesigningmethods:structure basedrug designing and ligandbaseddrugdesigning,MolecularDescriptors,DrugReceptor interactionand SAR/QSARmethods.BiomolecularScreeningmethods,HTS,parametersrequired

for testing the compounds, LADME approaches, Toxicity criteria, pharmacogenomics and Pharmacogenetics.

Recommended Books:

Molecular Modeling: Principlesand Applications, Andrew R. Leach. Structural Bioinformatics, PhilipE. Bourne.

Elective 3 BIO 405: Genomics, Proteomics and Systems Biology

Introductionand scopeofproteomics;Proteinseparationtechniques:ionexchange, size-exclusionand affinity chromatography techniques;Polyacrylamide gel electrophoresis;Isoelectricfocusing(IEF);TwodimensionalPAGE forproteome analysis;Imageanalysisof2Dgels;Introductiontomassspectrometry;Strategies for protein identification; Protein sequencing; Protein modifications and proteomics; Applicationsofproteomeanalysistodrug; Protein-proteininteraction (Two hybridinteraction screening); Proteinengineering; Proteinchipsand functional proteomics;Clinical and biomedical application of proteomics;Proteome database; Proteomics industry.

Methodsof preparing genomic DNA;DNAsequence analysismethods:Sanger Dideoxy method and Fluorescencemethod; Genevariation and Single Nucleotide Polymorphisms(SNPs);Expressedsequenced tags(ESTs);Genediseaseassociation; RecombinantDNAtechnology:DNAcloning basics,Polymerasechainreaction, DNA fingerprinting, Human genome project and the genetic map.

IntroductiontosystemsBiology.Termsanddefinitions.Dynamicalsystems,linear stabilityandbifurcationanalysis. Limitcycles,attractors.Geneticandbiochemical networks,chemicalkinetics,deterministic andstochasticdescriptions.Other networktypes:Regulatory(e.g.fly),Signaltransduction (e.g.MAPKinasecascadein yeast),Metabolic(E coli),Neuralnetwork. Topologyofgenetic andmetabolic networks.

Softwareforsystemsbiology.SBML,andopensourceprogramseCell,VirtualCell, StochSim, BioNets.QuantitativemodelsforEColi:lacoperonandlambdaswitch. ThechemotacticmoduleinE.Coli.Pathwaysandpathwayinference.DAVID.Gene Ontologies.§ PathwayMinerand similar Software. SNPsand complex diseases.

RecommendedBooks:

1. Cantor and Smith, Genomics. John Wiley & Sons,1999.
2.Introduction to Genomics - Arthur M Lesk, OxfordUniversity Press, 2007.
3. R.M.Twyman, Principles of Proteomics, BIOS ScientificPublishers, 2004.
4. P.MichaelConn, Handbook of Proteomic Method. HumanaPress, Totowa, New Jersey,USA, 2003.
5. L.Stryer,Biochemistry, W. H. FreemanandCo., New York, 2007

BIO 406: Internal Project

Thestudentsareadvisedtowork underthesupervision ofanyoneofthefaculty members in the department.

BIO 407: Research Project

Underthis coursethestudentsaredirectedto workinsolvingaresearchprojectin their fieldofinterestrelated tobiotechnologyexternalorinternaldepending upon choice and interestof the student.

Minor courses

Thedepartmentoflifesciencesisoffering aminordegreetostudentspursuing variousmajordegreesacrosstheuniversity. Thedepartmenthas10seatsreserved forstudentsoptingforaminordegree.Thecriteriafor selectionofstudentsfora minorwill bebasedontheoverall CGPAfollowedbyaninterviewby the departmental committee.

Forgetting aminordegreethestudentshavetocompleteaminimumof24-30 credits in life science department, which includes four compulsory and two optional*courses.

Compulsory courses

CODE	CouseName	Credits
BIO 201	**CellBiology and Genetics**	**4**
BIO 207	**Fundamentals of Molecular Biology**	**4**
BIO 208	**Microbiology I**	**4**
BIO 210	**Biochemistry I**	**4**

*All courses offered to BS Biotechnology major students in the IV, V and VI semesterswill be offered as optional courses for the minor degree.