KANNUR UNIVERSITY

(Abstract)

MSc Computational Biology Programme (CBCSS)- Credit of Elective Courses reduced from 3 to 2 in the third semester- Modified Scheme and Syllabus implemented in the University Department - w.e.f. 2021 Admission - Orders issued.

ACADEMIC C SECTION

Acad/C4/7627/2021 Dated: 29.12.2022

Read:-1. U.O. No. Acad/C4/7627/2021 dated 27.04.2021
2. Minutes of the meeting of the IQAC, held on 27.07.2022
3. The Minutes of the meeting of the Department Council, Dept of Biotechnology and Microbiology dated 07.10.2022
4. Email from HoD, Dept of Biotechnology and Microbiology forwarding the modified Scheme and Syllabus dated 26.12.2022

ORDER

1. As per paper read (1) above, the Scheme & Syllabus of MSc Computational Biology Programme (CBCSS) was implemented in the University Department - w.e.f 2020 admission.

2. Meeting of Internal Quality Assurance Cell held on 27.07.2022 as per paper read (2) above, resolved that all the Teaching Departments should offer Open Elective Courses, compulsorily in the third semester.

3. As per paper read (3) above, the Department Council, Dept. of Biotechnology and Microbiology resolved to opt one Elective with 2 Credits, and one Open Elective with 4 Credits from other Department, and also to reduce the Credit of Elective Courses from 3 to 2, so as to keep total credits 80, in the third semester. The Department Council further resolved not to offer any Open Elective Course for other Departments.

4. As per paper read (4) above, HoD, Dept. of Biotechnology and Microbiology submitted the modified Scheme and Syllabus of MSc Computational Biology Programme (CBCSS) for implementation with effect from 2021 admission.

5. The Vice Chancellor after considering the matter in detail and in exercise of the powers of the Academic Council conferred under section 11 (1) Chapter III of Kannur University Act 1996, accorded sanction to implement the modified Scheme and Syllabus of MSc Computational Biology Programme (CBCSS) in the Dept of Biotechnology and Microbiology, Dr. Janaki Ammal Campus, Palayad as detailed in para (3) above, with effect from 2021 admission, and to report to the Academic Council.

6.The modified Scheme & Syllabus of MSc Computational Biology Programme (CBCSS) implemented with effect from 2021 admission are appended and uploaded on the University Website.(www.kannuruniversity.ac.in).

7.The UO read (1) above stand modified to this effect

Orders are issued accordingly.

Sd/-
BALACHANDRAN V K
DEPUTY REGISTRAR (ACAD)
For REGISTRAR

To: 1.The Head, Dept. of Biotechnology and Microbiology
Dr. Janaki Ammal Campus, Palayad

Copy To: 1. The Examination Branch (through PA to CE).
2. PS to VC / PA to PVC / PA to R
3. DR / AR 1/ AR II (Acad), EXCI, EPIV
4. The Web Manager (for uploading in the Website), Computer Programmer
5. SF / DF /FC

KANNUR UNIVERSITY CIVIL STATION P.O. KANNUR Pin-670 002 THAVAKKARA

Forwarded / By Order

SECTION OFFICER

KANNUR UNIVERSITY

DEPARTMENT OF BIOTECHNOLOGY AND MICROBIOLOGY

SCHEME AND SYLLABUS

M Sc COMPUTATIONAL BIOLOGY

2021 ADMISSION ONWARDS

SchemeandSyllabusof
MScComputationalBiologyProgrammeUnderthe
ChoiceBasedCreditSemesterSystemwith
effectfrom2021Admission

SCHEMEANDSYLLABUSOFM.Sc.COMPUTATIONALBIOLOGYPROGRAMME

(UndertheChoiceBasedCreditSemesterSystem witheffectfrom2020Admission)

AbouttheDepartment

The DepartmentofBiotechnology andMicrobiology of KannurUniversity established in theyear2000atPalayad,ThalasseryoffersM.Sc.,Ph.D.andPost-doctoralprogramsinBiotechnology and Microbiology.The Department is a Centre of Excellence in Biosciences,receiving research funds from state, national and international agencies. Our vision is to improvequality of life through research and molding future scientists and individuals who will be a workforceto makeabetter tomorrow.

ProgramSpecificOutcomes(PSOs):

Apost-graduatestudentinthefrontierandmultidisciplinaryareasofComputationalBiologyuponcompletion oftheprogrammeis expectedtogain the following attributes:

- Capabilitytobecome futurescientists,teachers,andentrepreneurs.
- Competencefor researchandinnovationinComputationalBiology
- TechnicalskillsforthebettermentofplanetEarth
- Criticalthinkingabilitytoreviewscientificliteratureassteppingstonetoresearch
- Confidenceforcareerchoice.
- Abilitytoworkindependentlyinchosenresearchtopicsaswellasbepartofteamworkwithcollaborativeskills.
- Confidenceinscientificconversationandwritingskillsandknowingethicalbehavior

DURATIONANDOTHERDETAILS OFTHEPROGRAMME

- Thewholeprogramisdivided intofoursemesters (twoyears)
- Thenumberofstudents"intake(anticipated)is12(Twelve)
- Feestructureof theprogram is sameas that of M.Sc. BiotechnologyandMicrobiology

ELIGIBILITYFORADMISSION

1. The student is required to obtain at least 50% in his/her Bachelor's programme with notlessthan 50%marks in aggregate(excludinglanguages).
2. Bachelor"s degree in any branch of science/technology/medicine (with degrees such asBSc,BE,BTech,BPharm,MBBS, BDS,BVScandBAMS)
3. Theeligiblesubjectareasinclude:Lifesciences(botany,zoology,genetics,humanbiology,generallifesciences,ecology,environmentalbiology),bioinformatics,microbiology,biotechnology,chemistry,physics,mathematics,computerscience/informationtechnology,statistics,any branchofengineering,pharmaceuticalsciences,agriculture,medicine,dentistry,horticulture,forestry,andveterinarysciences.
4. Those who are awaiting final year results of their bachelor"s degree also can apply, buttheymust fulfill the eligibilitycriteria beforethe admission.
5. Eligible relaxation in the percentage of marks will be given to candidates belonging to SCandST.ReservationpoliciesoftheUniversity/Statearefollowedforadmission.

ADMISSIONPROCEDURE

Admissions are notified in national newspapers inviting applications for the M.Sc. programmeofferedbythe Department.

All the eligible applicants must appear for a written entrance test. Duration of the entrance testwill be 120 minutes with 200 objective type multiple choice questions for 100 marks. Questionswill be focused on thebiology, chemistry, physics, mathematics, and computer science at thebasic level.Therewill be25%negativemarks forthewronganswers.Arank listwill be preparedbased on the entrance test.The admission will be as per the rank in the list and reservationpolicy.

CURRICULUM

The MSc curriculum of Computational Biology closely follows the level and extent as conceivedbythenationalcurriculadevelopmentcentersofUGC/DBT.TheChoiceBasedCreditSemester

System (CBCSS) provides an opportunity for the students to choose courses from the prescribedcourses comprising core and elective courses. The evaluation of the courses will be throughgrading system evaluation and computation of the Cumulative Grade Point Average (CGPA)basedonstudent"sperformanceininternalandexternalexaminations.

COURSESANDCREDITS

Definitions:

I. „**AcademicProgramme'**meanstheentire course of study includingitsprogrammestructure,detailsofthecourse,evaluationmethodsetc. Thiswillbecarriedoutbyteaching and evaluation process in the parent department / centre or jointly under morethanonesuchDepartment/ Centre

II. **'Course'**meansisasubjectthatispartofanAcademicProgramme

III. **'Programme Structure'** includes the list of courses (Core, Elective, Open Elective) thatforms an Academic Programme which specifies the syllabus, credits, hours of teaching,evaluationprocessandexaminationschemes,theminimumcreditsrequiredforsuccessful completion of the programme etc. prepared in conformity to University Rulesandeligibilitycriteriafor admission

IV. **'Core Course'** means a course that a student admitted to a particular programme mustsuccessfullycompletecompulsorilytoreceivethedegreeandthatwhichcannotbesubstituted byanyother course

V. **'Elective Course'** means an optional course to be selected by a student out of suchcoursesoffered in thesame oranyother Department/Centre

VI. „**Open Elective'** means an elective course which is available from recognized onlineresources like Swayam/ MOOCS or offered by other departments within the frame workofthe subject.

VII. **'Credit'** is the value assigned to a course which indicates the level of instruction; 1lectureper weekequals 1 Credit,3 hourspractical class perweek equals1 credit.

VIII. „**SGPA'**meansGradePointAverageofthesemestercalculatedforindividualsemester.

IX. **'CGPA'** is Cumulative Grade Points Average calculated for all courses completed by thestudents at the end of the programme. A formula for conversion of CGPA into percentagemarkswill be given in themark sheet.

Aminimumof 80 creditsaremandatoryfor thesuccessful completion oftheprogramme.

Students can opt for one elective (open elective) course relevant to Computational Biologyprogramfromonlinesourcesapprovedbytheuniversity(SwayamPlatformorsimilarplatforms) or other Departmentsduring second and third semester. The choice of the studentmust be reported to the Head of the Department and approved by the Department Council. Theminimum credits per semester is 16 and the maximum credits per semester (core and electiveinclusive) cannotcross24. Allstudentshave tooptfor equalnumberof electivesineachsemester.

If the student does not earn the required credits by not appearing for the exam or due to otherreasons, the course will have to be repeated along with the concurrent semester of the next batchafterthe approval bytheDC.

PROJECTWORK

Students have to take up a research project of 5 months duration in the fourth semester for whichtheyareencouragedtogotonationalresearchinstitutes.Thestudentsmayalsogetopportunitytoun dergo 1-2 weekstrainingin industrial/ research institutionsin the field.

EVALUATION

The marks for Continuous Evaluation and End Semester Examination will be in the ratio 40:60.Allocation of marks for each component under continuous evaluation of theory courses shall beasgivenbelow.

ContinuousEvaluation:TheoryPaper(40Marks)

Assignment	Testpapers	Seminar	Total
8	16	16	40

ContinuousEvaluation:Practical(40 Marks)

Mid-semester test/viva	Record	Total

30	10	40

EndSemesterExaminationPractical:(60Marks)

The teacher conducting the practical examination will decide the components of the examEndSemesterExaminationTheory:Written examinationfor 60Marks

ATTENDANCE:

The minimum attendance required for each course in a semester shall be 60% of the total numberof classes conducted for the course. Only those who secure the minimum attendance requirementinthesemesterwill beallowed to register for theEnd Semester Examination.

TENURE

Astudentmustcompletethe entireprogram within fouryears fromthe dateofregistration

CoursesofferedintheM.Sc.ComputationalBiologyProgrammeTotalcredits80

SemesterI

Core:6(Theory:4Practical:2)Electives:2
Credits:Core:16Elective:6Total:22Credits

Sl. No	Course Code	Titleofthecourse	Contacthours /week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
	CoreCourses								
1	MSCPB01C01	Biochemistry	3	2		60	40	100	3
2	MSCPB01C02	Biologicaldatabasemanagementsystems	3	2		60	40	100	3
3	MSCPB01C03	Basicsofcomputing	3	2		60	40	100	3
4	MSCPB01C04	Biostatistics	3	2		60	40	100	3
5	MSCPB01C05	Practical1:BiochemistryandBiological Databases			3+3	60	40	100	2
6	MSCPB01C06	Practical2:ProgramminglabI–Basic ComputingandApplicationofRpr ogramming			3+3	60	40	100	2
	ElectiveCourses								
7	MSCPB01E01	CellBiologyandGenetics	3	2		60	40	100	3
8	MSCPB01E02	Instrumentation	3	2		60	40	100	3
	Total Credits								

SemesterII

Courses:Core:3(Theory:2,Practical:1)Electives:4(Students must choose 4 elective courses from 5)Credits:Core:8,Elective:12,Total=20

Sl. No.	Course Code	Titleofthecourse	Contact hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
	Corecourses								
9	MSCPB02C07	SequenceAnalysis	3	2		60	40	100	3
10	MSCPB02C08	PythonprogramingandBiomolecular simulations	3	2		60	40	100	3
11	MSCPB02C09	Practical3:ProgramingLabII– PythonprogramingandBiomolecularsimulations			3+3	60	40	100	2
	Electivecourses(4/5)								
12	MSCPB02E03	StructuralBiology	3	2		60	40	100	3
13	MSCPB02E04	AdvancedAlgorithmsin ComputationalBiology	3	2		60	40	100	3
14	MSCPB02E05	MolecularBiology	3	2		60	40	100	3
15	MSCPB02E06	Immunology	3	2		60	40	100	3

16	MSCPB02E07	Ethics,PatencyandIntellectual PropertyRights	3	2		60	40	100	3
	Total Credits								20

SemesterIII
Core(Theory:4 Practical:2)Electives:2
Credits:Core:16Elective:6Total:22CreditsStude ntshavetochooseTwoElectivesfromFour

Sl. No.	Course Code	Titleofthecourse	Contact hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
	Corecourses								
17	MSCPB03C10	GenomicsandProteomics	3	2		60	40	100	3
18	MSCPB03C11	SystemsBiology	3	2		60	40	100	3
19	MSCPB03C12	CheminformaticsandComputerAided DrugDesign	3	2		60	40	100	3
20	MSCPB03C13	ProgramminginJavaandBiojava	3	2		60	40	100	3
21	MSCPB03C14	Practical4:Genomics,Proteomics andCheminformatics			3+3	60	40	100	2
22	MSCPB03C15	Practical 5: Programming lab III– JavaandBiojava			3+3	60	40	100	2
	Electivecourses(1/4)								
23	MSCPB03E08	Enzymology	2	2	0	60	40	100	2
24	MSCPB03E09	BiotechnologyinMedicine,Health, AgricultureandEnvironment	2	2	0	60	40	100	2
25	MSCPB03E10	RecombinantDNATechnology	2	2	0	60	40	100	2
26	MSCPB03E11	EnvironmentalMicrobiology	2	2	0	60	40	100	2
27		Open elective	4	2		60	40	100	4
	Total Credits								22
Students have to select one elective from the above list and one open elective from other departments.									

Semester
IVCourses:Core:1Credits:16

Sl. No.	Course Code	Titleofthecourse	Contact hours/week			Marks			Credits
		Core	L	T/S	P	ESE	CE	Total	
27	MSCPB04C16	ResearchandDissertation		5	25	60	40	100	**16**

The continuous evaluation of the project work shall be done by the research supervisor based onthe performance of the student in the lab. The end semester evaluation consists of a presentationandaviva vocebased onthe project.

SEMESTERI

(TotalCreditsRequired:22)

MSCPB01C01:
BIOCHEMISTRY
3CREDITS(48 Hours)

CourseObjectives:

1. Understandstructureandfunctionofbiological macromolecules.
2. UnderstandChemicalchanges takingplaceinthelivingcells.
3. Understandtransportacrossbiologicalmembranes.
4. Understandthe roleof smallmoleculesinthebiologicalsystem.

CourseOutcome:

Upon completion of this course, students will be able to explain and demonstrate the structure,function and dispersal of the basic building blocks of life-the chemical components of livingorganisms

CourseContent:

ModuleI

Introduction:Molecularlogicoflivingsystem,Biologicalmacromolecules.ImportanceofBiochemistryincontemporarymedicineanditsperspectives.Membranes:Structureandfunctionsofdifferentmembranesandreasonsfortheircomposition.Membranetransport:Passive transport, co-transport, anti-port, active transport, secondary active transport, Pumps andchannelsand their significance, Membraneproteins. **(10 Hrs)**

ModuleII

Carbohydrates:Definitionandclassification,Structure,conformationandfunctionsofmonosaccharides,disaccharides,polysaccharides.Starch,glycogen,dextrin,cellulose,aminosugars, Glycoproteins, Glycolipids, Mucopolysaccharides. Lipids: Definition and classification,structure, function, physical and chemical properties –Fatty acids, Fats, Waxes, Phospholipids,Sphingolipids,Cerebrosides,Gangliosides,Sterols,lipoproteins.Eicosanoids-Formationofprostaglandins;prostacyclinandthromboxanefromunsaturatedfattyacids,Saponificationnumber,acid number andiodinenumberof fats.**(14Hrs)**

ModuleIII

Proteins:Propertiesofpeptidesandproteins,Aminoacids,theirproperties,andtheirclassificationaccordingtothepolarityoftheirsidechainsandaccordingtotheacid-baseproperties. Essential and non-essential amino acids, Structure of peptides and proteins, theirprimary structure, structures of higher order and their meaning for the function of peptides andproteins.Protein-proteininteraction.Nucleicacids:Definitionandclassification,structure,function, physical and chemical properties -Purines and pyrimidines, base pairing, Hoogsteenbasepairing. **(12Hrs)**

ModuleIV

Vitaminsandminerals:chemistry,sourceandfunctionsofwatersolubleandfat-solublevitamins. Role of vitamins as cofactors. Source and functions of macro elements and traceelements,Hormones&RelatedMolecules:Chemistry,synthesisandfunctionsofvarioushormones(Plant&Animal),pigments(Plant&Animal),Pheromonesandneurotransmitters**(12Hrs)**

References

1. Lehninger"sPrincipleofBiochemistry.NelsonLDandMMCox.
2. Biochemistry.JeremyM.BergJohnandTymoczkoLubertStryer.
3. BiochemistrywithClinicalCorrelation.Thomas MDevlin.Wiley- Liss
4. Biochemistry.DonaldVoet,JudithGVoet,Charlottewpratt.JohnWiley
5. Biochemistry.JeoffreryZubay.WmCBrownPub.
6. Biochemistry.MathewsCKandKE.vanHolde.BenjaminCummingPub.
7. Biochemistry.Vol1&2DavidMetzler.

MSCPB01C02:BIOLOGICALDATABASEMANAGEMENTSYSTEMS
3CreditCourse(48hours)

Courseobjectives:

1. Tounderstandbasicstheoryandpracticeofdatabasemanagementsystems
2. Tounderstandrelationalmodel
3. TogiveanoverviewofSQLanddatamining
4. Understanddifferentbiologicaldatabases

Courseoutcomes:

Uponcompletionofthis curse,studentswill beabletounderstand thedatabasemanagementsystems,collectingandretrievingdata, anddifferent biological databases.

Coursecontent:

ModuleI

Introductiontodatabases:Traditionalfilesystem,dataandneedforinformation,databaseapproach, data models, Database languages, Database users, Classification of database systems,Database Design - Overview of the Design Process, Entity-Relationship Model, ER Diagrams,Data Storage and Querying, Transaction Management, Database Architecture, Database UsersandAdministrators **(11 hrs)**

ModuleII

Introduction to Relational model: Basic concepts: Domains Attributes, keys, tuples, Relations,Relational database schemas, Relational Database Design: Features of Good Relational Designs,AtomicDomainsandFirstNormalForm,DecompositionUsingFunctionalDependencies,Functional-DependencyTheory,AlgorithmsforDecomposition,DecompositionUsingMultivaluedDependencies, MoreNormal Forms,ModelingTemporal Data.**(11hrs)**

ModuleIII

Structured Query Language: Overview of the SQL Query Language, SQL Data Definition, BasicStructure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, AggregateFunctions,NestedSubqueries,ModificationoftheDatabase.IntroductiontoDatamining:Classification,Clustering, DataWarehousing, Applicationsof Data Mining.**(11 hrs)**

ModuleIV

Biological databases: Primary, secondary and composite databases. Types of Biological data:sequence:structure,function,literature,Nucleotidesequencedatabases-GenBank,EMBL,DDBJ.Genome databases, Protein Sequence Databases- UniProtKB, UniProt, TrEMBL, Swiss-Prot, UniProt, Secondary and composite databases: MMDB, SCOP, CATH, KEGG ENZYME,BRENDA,Prosite,ProDom,Pfam,InterPro;MetagenomicandEnvironmentalSequences-UniMES.LiteratureDatabases-PubMed,PLos, BioMedCentral.Databasefileformatsandretrieval system: GenBank, FASTA, ALN/ClustalW2, PIR; Text-based search engines (Entrez,DBGET/LinkDB).BiologicalDatabaseManagement-IntroductiontoBiologicalDataIntegration,challengesfaced intheintegrationofBiologicalInformation.**(15hrs)**

References

1. DatabaseSystemConceptsbyHenryF.Korth,AbrahamSilberschatz,S.Sudarshan,TataMac-Graw Hill.
2. An Introductionto DatabaseSystems byC.J. Date,Addison-Wesley.
3. IntroductiontoDatabaseSystems,ItlEducationSolutionsLimited,PearsonEducation

4. Introduction toDatabase Management Systems,AtulKahate,Pearson EducationIndia
5. N.Gautham;Bioinformatics:DatabasesandAlgorithms;AlphaScience.
6. D.W.Mount;BioinformaticsSequenceandGenomeAnalysis;ColdSpringLaboratoryPress.
7. F.JBurkowski;StructuralBioinformatics:AnAlgorithmicApproach;CRCPress.
8. A.MLesk;Introduction toBioinformatics;OxfordUniversityPress.
9. J.Bedell,I.KorfandM.Yandell;BLAST;O'ReillyPress.
10. J. M. Keith; Bioinformatics Vol. 1, Data, sequence analysis & evolution; HumanaPress.
11. R.Durbin;Biologicalsequenceanalysis;CambridgeUniversityPress.
12. R.M.Holmes;Acellbiologists'guidetomodelingandbioinformatics;WileyInterscience.

MSCPB01C03:BASICS OFCOMPUTING
3CreditsCourse(48hours)

Courseobjectives:

1. Understandthehardwareorganizationofdigitalcomputersandoperatingsystems
2. Understandbasicsofcomputernetworking
3. Understandbasics of HTML
4. Understandbasicsofcomputerprograming

Courseoutcome:

Studentsshall beable to

1. Explainthefunctioningofcomputerhardwareandoperatingsystem
2. Explainthefunctioningofnetworkinganddatacommunication
3. Understandthebasicswebdesigning
4. WritesimplecomputerprogramsusingR

Coursecontent:

ModuleI

FundamentalsofComputing:Introductiontocomputer,Operationofprocessor;NumberSystemsandDigitalCircuits;ALU;MemoryChips(ROM,RAM,DRAM),StorageDevices,

Memory Hierarchy; I/O Devices; Moore's Law, Classification of computers (Notebook, PersonalComputers,Workstation,Mainframes,Minicomputers,Microcomputers,Supercomputers).I ntroduction to operating systems: Characteristics and Types of Operating system like DOS,windowsXP, Window-NT,LINUX.Introductionto ComputerViruses.**(10hrs)**

ModuleII

ComputerNetworking:OSIreferencemodel,NetworkTopologies,Router,Switch,Networkcards, Data Communication (ISDN, Cable Modem, Wireless Modem),Concept of Wirelessnetworking, LAN, WAN, MAN, Security of the network, Firewalls, TCP/IP family of protocols,Concepts of client Server Architecture, Concept of search Engine - Database search engines.Introduction to Internet, World Wide Web, Advantages of Web, Web Terminology, Concepts ofDomain,Conceptof WebBrowser, Internet Services,InternetTools. Telnet,FTP.**(12hrs)**

ModuleIII

HTML:Introduction,commontags,creatinghyperlinks,incorporationofimages;Tables;Frames; Formatting of text with fonts; Dynamic HTML; cascading style sheets; Creation ofBackground images, HTML object models; dynamic positioning; direct animation path control.**(12 hrs)**

ModuleIV

Introductiontoprogramming:Thebasicmodelofcomputing,algorithmandflowcharts,programmingla nguages,compilation,linking,testing,debugginganddocumentation.Introductionto R programing.**(14 hrs)**

References

1. GurvinderSingh,RachhpalSingh.ATextbookonWindowsBasedComputerCourses,Kaly ani Publishers, Jalandhar
2. RachhpalSingh,MamtaVerma,SoniaMahindru.A TextbookofScriptingLanguageandWeb Designing,Kalyani Publishers,Jalandhar
3. KapilaH.PCComputingWindowBasedComputerSystem.DineshPublishers,Jalandhar.
4. Norton"sP.IntroductiontoComputing.McGrawHillEducation,NewDelhi.
5. SinhaP.K.FundamentalofComputers.BPBPublication,NewDelhi.
6. E.Siever;LinuxinaNutshell;O'ReillyPublication,6thedition,2009.
7. L.Robert;LinuxSystemProgramming;ShroffPublishersandDistributorsPrivateLtd, 2ndrevisededition,2014.
8. M.J.Bach;TheDesignoftheUNIXOperatingSystem;PearsonEducationIndia,1steditio n,2015.

MSCPB01C04:BIOSTATISTICS
3Credits(48Hours)

Courseobjectives:

1. Understanddatatypesanddatapresentations.
2. Understandthe conceptsofaveragesanddispersionofmeasurement values.
3. Understand theconcept of probabilityand probabilitydistributions.
4. Understandthemethodoftestingstatisticalhypotheses.

Courseoutcomes:

Studentsshall beable to

1. Makegraphical/diagrammaticrepresentationofgivenstatisticaldata.
2. Calculatemeasuresof centraltendenciesandmeasuresofdispersionofa givensetofvalues.
3. Explain differentprobabilitydistributions.
4. Testhypothesisusingnormal, students-t,chisquareandFdistributions.

Coursecontent:

ModuleI

Collection,classificationanddiagrammaticrepresentationofstatisticaldata:Variablesandconstants, Different types of numerical data, Collection of data, Sampling techniques, Randomsampling,Stratifiedrandomsampling.Classificationandtabulationofdata,frequencydistribution.Graphical/diagrammatic representation of data: line charts, Bar charts, Pie-chart,Histograms,frequencypolygons, ogives.**(12 hrs)**

ModuleII

Measures of central tendency: Arithmetic mean, Median, Mode, Geometric and Harmonic mean.Measuresofdispersion:Range,Inter-quartilerange,VarianceandStandardDeviation,coefficient of variation. Correlation and Regression: Relation between two variables, scatterdiagram, definition of correlations, Pearson"s correlation coefficient, Spearman Rank correlationcoefficient. Definition of regression: regression lines. Fitting lines using method of least squares.(**14hrs)**

ModuleIII

Probabilityandprobabilitydistributions:Permutationandcombination,typesofevents,Definitionofprobability,additionandmultiplicationtheoremsofprobability.Probabilitydistributions: Binomial, Poisson and Normal distributions. Skewness and Kurtosis: Definitions,KarlPearsonscoefficients of Skewness and Kurtosis,moments.**(10 hrs)**

ModuleIV

Normal distribution and statistical inference: Central Limit Theorem, Concept of confidenceinterval:Estimation,confidencelimit,levelofsignificance,standarderror.Statisticalhypotheses,Testsofsignificanceofmeans,differencebetweentwomeansandproportion.Student"st-distributionandtestingofhypothesisforsmallsamples.Chi-squaredistribution,Chi-

squaredtestsforindependenceandforgoodnessoffit,F-distributionandAnalysisofvariance.**(12hrs)**

References

1. PrinciplesofBiostatistics-PaganoM.&KimberleeG.DuxburyPress
2. ProbabilityandStatisticalInference-HoggR. V.Tanis E.A.,PrenticeHall,New Jersey
3. Experimental Design Data Analysis for Biologists-QuinnG. P. &KeoughM. J. CambridgeUniversity7Press
4. StatisticalMethodsinBiology-3rdedition,BaileyN.T.J.,CambridgeUniversityPress
5. Biostatisticalanalysis -4th edition,Zar,J.H.PearsonEducation.
6. FundamentalsofBiostatistics – P.HanmanthRaoandK.Janardhan,I.K.InternationalPublishingHouse, NewDelhi.
7. Introduction to Biostatistics and Research Methods-P.S.S. SundarRaoandJ.Richard, PHIlearningPvtLtd, New Delhi.

MSCPB01C05: Practical1BiochemistryandBiologicalDatabases2Credits (96 Hours)

Biochemistry

1. Qualitativeanalysisofcarbohydrates.
2. Qualitativeanalysisofproteins.
3. Qualitativeanalysisoflipids.
4. Estimationof protein.
5. Estimationoflipids(cholesterol,phospholipids,triacylglycerols).
6. Estimationofcarbohydrates(glucose,fructose,lactose,starch).
7. Denaturationstudiesonproteins.
8. Extractionoftotalnucleicacidsfromplanttissue.
9. PreparationofbuffersofrequiredpH.
10. Purificationofproteinsusingdialysis.
11. Separationofaminoacidsusingpaperchromatography.

References

1. DavidPlummer,AnIntroductiontoPracticalBiochemistry,McGrawHill
2. HaroldVarley,PracticalClinicalBiochemistry,byGowenlockA.H.,CBS.
3. HansBisswanger,PracticalEnzymology.WileyVCH.
4. RobertEisenthal,EnzymeAssays:APractical Approach,OxfordUniversityPress
5. Sadasivam&Manickam,BiochemicalMethods,NewAge International
6. DMVasudevan&SubirKumarDas,PracticalTextbookOfBiochemistry,JaypeeBrothers
7. SK.Sawhney,RandhirSingh,IntroductoryPracticalBiochemistry.AlphaScienceInternational

BiologicalDatabase

1. Makelistof Biologicaldatabasesfor DNA andprotein bybrowsingsearchengines.
2. Visit NCBI, EMBL, and DDBJ. Explore them, List out the salient features of thesedatabases. Retrieve the gene sequences by exploring and querying the nucleic aciddatabases,Retrievetheproteinsequencesbyexploringandqueryingtheproteindatabases, Find the chromosomal location of gene sequence and basic experiments inNCBImapviewer
3. Exercises to understand DBMS: Creating and working with databases, creating tables,droppingtables,primaryandsecondarykeys,datavalidation,cursors,storedprocedures.Oracle/PosGreSQL-Usageofimportant commands/instructions.

References

1. DatabaseSystemConceptsbyHenryF.Korth,AbrahamSilberschatz,S.Sudarshan,TataMac-Graw Hill.
2. An Introductionto DatabaseSystems byC.J. Date,Addison-Wesley.
3. IntroductiontoDatabaseSystems,ItlEducationSolutionsLimited,PearsonEducation
4. Introduction toDatabase Management Systems,AtulKahate, PearsonEducationIndia
5. N.Gautham;Bioinformatics:DatabasesandAlgorithms;AlphaScience.
6. D.W.Mount;BioinformaticsSequenceandGenomeAnalysis;ColdSpringLaboratoryPress.
7. F.JBurkowski;StructuralBioinformatics:AnAlgorithmicApproach;CRCPress.
8. A.MLesk;Introduction toBioinformatics;OxfordUniversityPress.
9. J.Bedell,I.KorfandM.Yandell;BLAST;O'ReillyPress.
10. J.M.Keith;BioinformaticsVol.1,Data,sequenceanalysis&evolution;HumanaPress.
11. R.Durbin;Biologicalsequenceanalysis;CambridgeUniversityPress.
12. R.M.Holmes;Acellbiologists'guidetomodelingandbioinformatics;WileyInterscience.

MSCPB01C06:Practical2
ProgramminglabI–
BasicComputingandApplicationofRProgramming2Credits (96 hours)

BasicComputing

1. Introductiontooperatingsystems(DOS,Windows, Linux etc)andtheirinstallation.

2. BasicDOScommands,Basicof LinuxcommandsandShellscripting
3. Network configuration in windows and Linux through Network Interface Card (NIC),WorkingwithTelnetandFTP
4. Exercises on HTML - Design a simple web page using basic tags, Design a simpleweb page using frameset, Design a simple web page using Image tag with attributes,Design simple login page using form with attributes, Design simple registration formusingall form tags, Design simplewebsiteusinghyperlink

References

1. GurvinderSingh,RachhpalSingh.ATextbookonWindowsBasedComputerCourses,Kalyani Publishers, Jalandhar
2. RachhpalSingh,MamtaVerma,SoniaMahindru.A TextbookofScriptingLanguageandWeb Designing,Kalyani Publishers,Jalandhar
3. KapilaH.PCComputingWindowBasedComputerSystem.DineshPublishers,Jalandhar.
4. Norton"sP.IntroductiontoComputing.McGrawHillEducation,NewDelhi.
5. SinhaP.K.FundamentalofComputers.BPBPublication,NewDelhi.
6. E.Siever;LinuxinaNutshell;O'ReillyPublication,6thedition, 2009.
7. L.Robert;LinuxSystemProgramming;ShroffPublishersandDistributorsPrivate Ltd, 2ndrevisededition,2014.
8. M.J.Bach;TheDesignoftheUNIXOperatingSystem;PearsonEducationIndia,1st edition,2015.

Applicationsof RProgramming

1. RsoftwareinstallationandbasicRusage
2. Mathematicaloperationsandstringmanipulation
3. Basicdatastructures:Vectors,dataframes,listsandmatrices
4. Logicalstatementsandloops:IF-elsestatements,forandwhileloops,break
5. Writinguserdefinedfunctions andpackages
6. Readingandwritingtablesandfiles
7. Rgraphicslibrary:Lineplots,histograms,piecharts,barplotsandotherplots
8. Computationofstatisticalparameters

References

1. BioinformaticswithRCookbook.PaurushPraveenSinha,PacktPublishing.2014
2. AndriedeVries,JorisMeys.RForDummies.Wiley.2015
3. JohnVerzani.UsingRforIntroductoryStatistics.CRCPress2018
4. RobertGentleman.RProgrammingforBioinformatics.CRCPress2018
5. Edward Curry. Introduction to Bioinformatics with R - A Practical Guide forBiologists.CRC Press 2020
6. Dr.MarkGardener:BeginningR-TheStatisticalProgrammingLanguage.Wiley2012
7. DanMacLean.RBioinformaticsCookbook.PacktPublishing2019

MSCPB01E01:CELLBIOLOGYAND GENETICS

3CreditCourse(48hours)

Courseobjectives:

1. Understandtheorganizationoflivingcellsanditsorganelles
2. Understandthestructureand replicationofDNA
3. Understandthe flowofgeneticinformation through generations
4. Understandthe functionofgenes

Courseoutcomes:

1. Students will understand the molecular mechanisms in a cell2.Studentswillappreciatethe geneticbasisofexistenceand evolution

Coursecontent:

ModuleI

Generalorganizationofprokaryoticandeukaryoticcells.Differentiationofthecellsurface,Constituents oftheExtra-cellularmatrix.Celljunctions.Cytoskeleton.Cellcommunication:generalprinciples,signalingpathways.CellularOrganelles,processingandtraffickingofbiomolecules,posttranslational modification ofproteins. (**10 Hrs)**

ModuleII

Nucleus: Nuclear envelope, nuclear matrix. Organization of chromatin: nucleosomes, higherorder folding of chromatin. Replication of prokaryotic, eukaryotic DNA.Enzymes and proteins ofreplication.DNA repair. Cell cycle: Phases of cell cycle. Apoptosis and Introduction to Cancerbiology.(**14 Hrs)**

ModuleIII

Introduction,conceptsandtheoriesofMendeliangenetics.Multiplealleles.Geneinteractions.Essential andlethalgenes.Environmentalimpactongene.chromosome theory ofinheritance, Non-MendelianInheritance,Geneticlinkage.Chromosomalexchange.Geneticmaps.Tetradanalysis,Mitoticrecombination.Chromosomalandgenemutations.Mitosis& Meiosis–anoverview. Chromosome theory of inheritance.Sexdetermination.Analysis of sex-linked traits inhumans.**(8 Hrs)**

ModuleIV

Cellularbasisofdifferentiation,Geneticbasisofcelldifferentiation.Geneexpressioncontrol.Oncogenes and tumor suppressor genes.Mapping of genes in bacteria.Mapping of genesinbacteriophages.Bacterialtransposons.EukaryoticTransposableelementsCytosomicinheritance,Inheritancethroughmitochondriaandchloroplastsandtheirmapping.Geneticvariationinpopulationsandmeasuring.Hardy-WeinbergEquilibrium,Inbreeding.GeneticDrift.Geneflow.Naturalselection.Molecular evolution.**(16 Hrs)**

References

1. MolecularCellBiologyGeraldKarp9th EditionWiley2020
2. MolecularBiologyofTheCellAlberts6thEdition2014 Garland Science

3. MolecularCellBiologyLodish8thEdition.W.H.Freeman 2016
4. GenesXIBenjamin LewinJonesandBartlettLearning2014
5. MolecularBiologyoftheGeneWatson7thEditionPearson India2017.
6. Genetics byStrickBerger
7. Plant breedingbyBD Singh
8. AtextbookofGeneticsbyVeer BalaRastogi
9. GeneticsbyGardner,Simmons and Snustad
10. GeneticsbyUrsulaGoodenough
11. BasicGenetics.Robert F. Weaver IIedn.Philip W.C.B1995.
12. AnIntroductiontogeneticAnalysisGriffith *etal.*

MSCPB01E02:INSTRUMENTATION
3Credits(48Hours)

Courseobjectives:

8. Understand basic principles and applications of biomolecular separationtechniques.
9. Understandbasicprinciplesandapplicationsofspectrophotometric,colorimetricandradioactivitybased analytical techniques.
10. Understandspectroscopictechniquesforcharacterizationofbiologicalmolecules.
11. Understandvariousanalyticaltechniquesbasedonintermolecularinteractions

Courseoutcomes:

Studentsshall beable to

1. Explain working principles and applications of biomolecular separation techniquessuchaschromatography,electrophoresis,centrifugationanddensitygradientsedimentation.
2. Explaintheprinciplesandapplicationsofcolorimetry,fluorometry,flamephotometry,radioimmunoassayand autoradiography.
3. ExplaintheprinciplesandapplicationsofUV,IR,ORD,CD,NMR,ESR,Microwave,Raman andMass spectroscopic techniques.
4. Explain the principles and applications of Surface Plasmon Resonance, IsothermalTitration Calorimetry, Differential Scanning Calorimetry, Atomic force microscopy,ELISA and ion selectiveelectrodes.

Coursecontent:

ModuleI

Centrifugationanddensitygradientsedimentation:Basicprinciplesandapplications.Chromatography : Basic principles and applications, partition coefficient and relative mobility,Types of chromatography: paper, thin layer, size exclusion, ion exchange, affinity, GLC, HPLC,HPTLC. Electrophoresis: Basic principles and application. Various types of electrophoresis,PAGE, Specialized electrophoresis techniques, Isoelectric focusing, Capillary electrophoresis.Immunoelectrophoresis,PFGE. **(14 hrs)**

ModuleII

Spectrophotometry and colourimetry: Absorption and emission spectrum, Beer-Lambert law,qualitativeandquantitativespectrophotometricassays,Fluorescenceandfluorometry,flamephotometry,Radioimmunoassayand Autoradiography.**(10 hrs)**

ModuleIII

Spectroscopic techniques: Basic principles and biological applications of UV, IR, ORD, CD,NMR,ESR,MicrowaveandRaman spectroscopies.Massspectrometric techniques:variousmodesofionization principlesandapplications.GCMS,LCMS,MALDI.(**12hrs)**

ModuleIV

Principles and applications of Surface Plasmon Resonance, Isothermal Titration Calorimetry,DifferentialScanningCalorimetry,Atomicforcemicroscopy,ELISA,Lightscatteringexperiments.Ion selectiveelectrodes andpH meter.**(12 hrs)**

References

1. Physicalbiochemistry- DavidSeeshan
2. Chromatography-Brown D.R., IvyPublishingHouse,Delhi.
3. Encyclopediaof SeparationTechnology-RuthrenD.M. (Ed), JohnWiley&Sons
4. ExperimentalBiochemistry-3rdedition,Switzer,R. L. &Garrity,L. F.W.H.Freeman&Company
5. FoundationsofSpectroscopy- Duckett, S.&Gilbert,B., OxfordUniversityPress.

SEMESTERII
(TotalCreditsRequired:20)

MSCPB02C07:SEQUENCEANALYSIS
3CreditCourse(48hours)

Courseobjectives:

1. Understanddifferent formatsof DNAandprotein sequences,their submission andretrieval
2. Understandthetheoryand applicationsofdynamicprogramming
3. Understandthemethod ofsequencealignments
4. Understand thegeneandprotein prediction fromDNAsequences

Courseoutcomes:
Onsuccessfulcompletionofthecourse,thestudents shallbeableto
1. Explaindifferentsequencesandtheir formats, searchandalignusingonlinetools.
2. ExplainthemethodofDynamicProgramming
3. Explainprincipleofdifferentsequencealignment methods
4. Usedifferentmultiplesequencealignmenttoolsforanalysisofsequences.

Coursecontent:

ModuleI
Collecting and Storing Sequence Data: Genomic Sequencing; Sequence assembly; Submission ofSequences; Sequence accuracy; Sequence databases; Sequence formats; Conversion betweenformats; Database browsers; EST databases; SNP databases; Annotation and Archival, DatabaseSearching-FASTA,BLAST.**(11hrs)**

ModuleII
DynamicProgramming-Overviewandstructure,examples,shortestpath,DynamicProgramming in Computational Biology applications – longest common sub-sequence, Pairwisesequence alignment: Identity and Similarity, Basic concepts of sequence alignment, local andglobalalignment,NeedlemanandWunsch,SmithandWatermanalgorithmsforpairwisealignments .Methodsofalignment.Dotplot,scoringalignment,gappenalty.Substitution

matrices:PAMandBLOSUMseries,matrix derivationmethods andprinciples.**(13hrs)**

ModuleIII

Multiple sequence alignments (MSA) –The need for MSA, basic concepts of various approachesforMSA(e.g.progressive,hierarchicaletc.).AlgorithmofCLUSTALWandPileUpandappl ication, concept of dendrogram and its interpretation, Use of HMM-based Algorithm forMSA (e.g. SAM method). Applications of MSA in Genome sequencing, phylogenetic analysis,pattern identification, motif and domain prediction, SNP analysis, gene prediction: statistical andsimilarity based, ORF and codon usage analysis, translational and transcriptional signals; splicesiteidentification. **(13 hrs)**

ModuleIV

Nucleic Acid Sequence Analysis: Reading frames; Codon Usage analysis; Translational andtranscriptional signals; Splice site identification; Gene prediction methods; RNA fold analysis.ProteinSequence Analysis:Compositionalanalysis;Hydrophobicity profiles; Amphiphilicitydetection; Moment analysis; Transmembrane prediction methods; Secondary structure predictionmethods.**(11 hrs)**

References

1. Bioinformatics:Sequenceand GenomeAnalysisbyMount D.,Cold SpringHarborLaboratoryPress, New York. 2004
2. Bioinformatics-APracticalGuidetotheAnalysisofGenesandProteinsbyBaxevanis, A.D.andFrancisOuellellette,B.F., WileyIndiaPvtLtd.2009
3. Introduction to Bioinformatics by Teresa K. Attwood, David J. Parry-Smith. PearsonEducation.1999

MSCPB02C08:PYTHONPROGRAMMINGANDBIOMOLECULARSIMULATIONS

3Credits(48hours)

Courseobjectives:

1. UnderstandprogrammingusingPythonandBiopythonanditsapplications.
2. Understandthe parametersdeterminingthestructureand stabilitymolecules.
3. Understanddynamicsof molecularsystemsandenergyminimizationtechniques.

Courseoutcomes:

Onsuccessfulcompletion ofthecoursestudentsshallbeableto

1. WritesmallprogramsinPython
2. DodifferentbioinformaticoperationsusingBiopythonscripts
3. Explainbiomolecularsimulationtechniques

ModuleI

Introduction to Python, Print and Variables, Simple data types, Collections: Lists, Strings, Sets andDictionaries,Functions,Conditionalexecution,Loops,Files,DelimitedFiles,ModulesandPackages.

ModuleII

Object Oriented Programming Concepts, Exception Handling, Regular Expression, Biopython:Introduction, Bio.Seq and Bio.SeqRecord modules, Using Seq class, Sequences reading andWriting,Bioclassesforsequences,Bio.SwissProt.SProtandBio.WWW.ExPASy,ReadingEntries, Regular expressions in Python, Prosite, Bio.GenBank, Reading entries, Running BlastandClustalw, Runningotherbioinformatics programs under Pise

ModuleIII

Introduction - theoretical approaches to biomolecular structures. QM foundations (an overview),Born-Oppenheimer approximation, Molecular Mechanics: Force fields – Introduction, NormalModes, Potentials – bond stretching, Angle bending, Torsional terms – improper torsions, Non-bonded - Lennard-Jones, Coulomb, Hydrogen-bonding in MM, United atom force fields andreducedrepresentation.Forcefield- GROMOS87,OPLS,AMBER, CHARMM

ModuleIV

Energy minimization –Steepest Descent and Conjugate Gradient. Molecular Dynamics (MD)Simulation:Introduction,PhaseSpace,Periodicboundaryconditions,Minimumimageconvention,Newtoniandynamics,TimeIntegrators-LeapfrogandVerletalgorithm,Watermodels,Constraintdynamics,VariousMDensembles,Simulated annealing

References

1. MarkLutz,DavidAscher(2003)LearningPython.O"Reilly&Associates
2. AlanGauld(2000)LearnToprogramUsingPythonAddison–Wesley
3. AlexMartelli(2003)PythoninaNutshell,O"Reilly
4. URL:http://www.python.org
5. URL:http://www.biopython.org
6. MolecularModelingPrinciplesandApplications(2ndEd.)byAndrewR.Leach,PrenticeHall,USA. 2001
7. MolecularModellingforBeginners,(2ndEdition)byAlanHinchliffe,JohnWiley&SonsLtd.2008
8. MolecularModelingandSimulation– AninterdisciplinaryGuidebyTamarSchlick,Springerverlag.2000

MSCPB02C09:Practical 3
ProgrammingLabII-
PythonprogrammingandBiomolecularsimulations2Credits (96 Hours)

Pythonprograming

1. PrintandVariables

2. Simpledatatypes,ArithmeticandSavingcodeinfiles
3. Collections:ListsandStrings
4. Collections:Sets andDictionaries
5. Conditionalexecution
6. Loops
7. FilesandDelimitedFiles
8. Modules
9. ObjectOrientedProgrammingConcepts
10. ExceptionHandling
11. RegularExpression
12. Biopython - Handling Sequences with BioPython, Sequence Alignment, DifferenceBetweenSequenceSimilarityandSequence Identity,BLAST,Examplewithsequenceanalysisof viral DNA/RNA

References

1. MarkLutz,DavidAscher(2003)LearningPython.O"Reilly&Associates
2. AlanGauld(2000)LearnToprogramUsingPythonAddison–Wesley
3. AlexMartelli(2003)PythoninaNutshell,O"Reilly
4. URL:http://www.python.org
5. URL:http://www.biopython.org

Biomolecularsimulations

1. MolecularVisualization:PymolandVMD
2. Structurepreparation
3. Energyminimization
4. Moleculardynamics(MD)simulation –restrainedandunrestrainedMD
5. AnalysisofMDtrajectories

References

1. Molecular Modeling Principles and Applications (2nd Ed.) by Andrew R. Leach, PrenticeHall,USA. 2001
2. URL:http://www.mdtutorials.com/gmx/

MSCPB02E03:STRUCTURALBIOLOGY
3Credits(48hours)

Courseobjectives:

1. Understandthestructureand conformationsofDNA
2. UnderstandtheProteinstructureandfolding
3. Understand theoryand methodologyof protein crystallography
4. Understanddifferentmethodsofproteinstructureprediction.

Courseoutcomes:

Onsuccessfulcompletionofthecoursestudentsshall beableto

1. Explainthestructureandconformationofdifferentformsof DNA
2. Explaindifferentlevelsofproteinstructureandproteinfoldingpathways
3. Explaindifferentstepsusedtoelucidatethestructureofproteinusingcrystallography
4. Explainthe principleofproteinstructureprediction

Coursecontent:

ModuleI

Nucleicacidstructures:Conformationofnucleotides,Watson-CrickmodelofDNA,basepairing and base stacking interactions. DNA polymorphism- ADNA, BDNA and ZDNA.t-RNAstructure.**(12 hrs)**

ModuleII

Protein Structure: Primary structure, peptide bonds, Secondary structure; Alpha helices, Betasheets and turns, Ramachandran plot, motifs and domains, tertiary and quaternary structures,Membraneproteins,Virusstructure.Proteinfolding:Forcesstabilizingmacromolecularstructures,Thermodynamicsoffolding,drivingforces,foldingpathways,Moltenglobularstructures. Foldingaccessoryproteins.**(12hrs)**

ModuleIII

Protein Crystallization: Principles of protein crystallization, Crystallization techniques: vapourdiffusionmethod,liquid-liquiddiffusionmethod,batchmethod,dialysis.Elementarycrystallography: Unit cells, symmetry elements and operations, point groups and space groups,crystal systems, Bravais lattices, Bragg's law, Atomic scattering factor, structure factor, FourierTransform. Crystal diffraction and data collection Steps in crystal structure determination:Datacollection- x-ray sources, detectors.Structure solution-Phase Problem, Patterson function, Directmethods, Molecular replacement method, heavy atom method. Refinement and validation ofstructures**(12 hrs)**

ModuleIV

Proteinstructureprediction:ChouFasmanmethod,GORmethod,Threading,Homologymodeling,Abinitioprediction,Visualizationandrelatedbioinformaticstools:SwissPDBViewer,Pymol.AACompIdent,MultiDent, PeptideMass.**(12 hrs)**

References

1. Biological thermodynamics - Donald T. Haynie, Cambridge University Press,Cambridge.
2. Biopolymers-A.G.WalsonandJ.Blackwell,AssociatedPress.
3. EssentialsofBiophysics-P:Narayanan,NewAge Internationalpublishers
4. IntroductiontoProteinStructure-C.BrandenandI.Tooz.,GarlandPress,NewYork
5. PrinciplesofProteinStructure-G.E.Schulz&R.H.Schirmer,SpringerVerlag, Berlin.
6. PrinciplesofNucleicAcidStructure-W.Saenger,

7. ProteinFolding-ThomasE. Creighton(Ed),
8. StructureandMechanismin ProteinScience -AlanFersht
9. BiophysicalChemistry-PartI,II,III-CharlesR.CantorandPaulR.Schimmel,W.H.Freeman &Company, New York.

MSCPB02E04:ADVANCEDALGORITHMSINCOMPUTATIONALBIOLOGY
3Credits(48hours)

Courseobjectives:

1. Understandvarious algorithmsused incomputationalbiology
2. Understand the basics of Hidden Markov Model and its application in sequencealignment
3. UnderstandthebasicsofSupport VectorMachinesandits applicationinbioinformatics
4. Tointroducethebasics of machinelearningtechniques

Courseoutcomes:
Onsuccessful completion ofthecourse,studentsshallbeableto

1. Explaintheconceptsofvariouscomputing algorithms
2. DetailtheHiddenMarkovModel,SupportVectorMachines,andtheirapplications
3. ExplaintheconceptsofArtificialNeuronNetworksandotherconceptsinmachinelearningtechniques

Course

contentModule

I
Algorithms in Computing: Biological and Computer algorithm, Fibonacci problem, DynamicProgramming, Time and space complexity of algorithms, Laplace's Rule. Search Algorithms:Randomwalk,Hillclimbing,simulatedannealing.GeneticAlgorithm:BasicConcepts,Reproduction,Crossover,Mutation,FitnessValue,OptimizationusingGAs;ApplicationsofGA in bioinformatics. Combinatorial Pattern Matching: Hash Tables, Repeat Finding, ExactPatternMatching

ModuleII
HiddenMarkovModel:MarkovprocessesandMarkovModels,HiddenMarkovModels.ForwardandBackwardAlgorithms.Mostprobablestatepath:Viterbialgorithm,Parameter Estimation for HMMs: Baum-Welch Algorithm, Applications of profile HMMs formultiplealignment ofproteins and for findinggenes in theDNA.

ModuleIII

SupportVectorMachines:Introduction,hyperplaneseparation(maximumandsoftmarginhyperplanes),linearclassifier,Kernelfunctions,LargeMarginClassification,Optimizationproblem with SVM, Applications of SVM in bioinformatics. Bayesian network: Bayes Theorem,Inference and learningofBayesiannetwork,BN and OtherProbabilistic Models.

ModuleIV

Introduction to machine learning techniques: Artificial Neural Network concepts, Perceptron,characteristics of neural networks terminology, models of McCulloch – Pitts neuron model,Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture, singlelayer ANN, multilayer perceptron, back propagation learning, input-, hidden-, and output-layercomputation,backpropagationalgorithm,ApplicationsofANN-secondarystructureprediction

References

1. AnintroductiontobioinformaticsalgorithmsbyNeilC.Jones,PavelPevzner.MITPress.2004
2. Biologicalsequenceanalysis:ProbabilisticmodelsofproteinsandnucleicacidsbyRichardDurbin, Eddy, AndersKrogh, 1998
3. AlgorithmsforMolecularBiologybyRonShamirLecture,FallSemester,2001
4. NeuralNetworks:ASystematicIntroductionbyRaulRojas.Springer.1996
5. Bioinformatics:themachinelearningapproachbyPierreBaldi,SørenBrunak.MITPress.2001
6. BensonG. andPageR.D.M.(2003).AlgorithmsinBioinformatics.*Springer.*
7. MichaelWaterman,Chapwan&Hall/CRC,(2000).IntroductiontoComputationalBiology-Maps,sequences andgenomes.
8. PavelA.Pevzner(2000),ComputationalMolecularBiology-AnAlgorithmicApproach, *MITPress.*

MSCPB02E05:MOLECULARBIOLOGY
(3Credits)(48Hours)

CourseObjectives:

1. Understandtheorganizationofgenome.
2. Familiarizewithcellularprocesseslikетranscriptionandtranslation
3. Studythemethods to measurethe level of expression of RNAand protein.
4. Understandregulationofgeneexpression

CourseOutcome:

Familiarizethestudentwiththemechanismsandcomponentsinvolvedinexpressionofgenesinprokaryo ticandeukaryotic systems.

CourseContent

ModuleI

Thegenome:Content,Mapping(Linkage,Restrictioncleavage,Sequencing),Variations,Repetitivean dNon-repetitivesequences,OrganelleDNA–MitochondrialandChloroplast.Genome sequences and Gene numbers. Transcription in Prokaryotes-Biosynthesis of RNA,Enzymatic machinery, Promoter selection and role of RNA Polymerase and ancillary factors.**(12Hrs)**

ModuleII

Transcriptionineukaryotes:RNApolymerases,Eukaryoticpromoterstructure,enhancerelements and transcription factors, transcriptionally active chromatin, biosynthesis of ribosomal,transfer and messenger RNAs. Post transcriptional modifications, transfer and messenger RNAs,antibioticinhibitors oftranscription. Genesilencing.**(12Hrs)**

ModuleIII

Protein synthesis: Genetic code and gene protein relationships, nonsense and missense mutationsand suppressers, ribosome structure (prokaryotic and eukaryotic) mRNA structure, polycistronicv/s monocistronic, specificity of aminoacyltRNAsynthetases, polypeptide chain elongation andtermination, factors of protein synthesis (pro & eukaryotic) and their role, inhibitors of proteinsynthesis and their mechanism of action, translational regulation, post-translational modification,biosynthesisof secretoryproteins. **(12Hrs)**

ModuleIV

Regulation of gene expression, bacterialoperons (lac, gal, ara, trp, hut, etc) and viral models (T4and T7), stringent and relaxed control, regulation in eukaryotes, chromatin activity and generegulation. Methods, measurements of RNA synthesis and protein synthesis, complementarysequenceanalysis by nucleic acid hybridization including southern blotting, isolation methodsforeukaryoticmRNA,identificationoftranslationproducts(flurography,westernblotting).Genomesequencing-chemical.Next generation sequencing.**(12Hrs)**

References

1. Lodish,H.,Baltimore,D.Berk,A.,Zipursky,S.L.Matsudaira,P.andDarnell.J.1995molecularCell Biology,3rd ed, WH.Freeman& Co.
2. Stent,G.S.andCalender,R.MolecularGenetics1986.AnIntroductiveNarrative,CBSPublishersandDistributors, New Delhi.
3. Weaver,RE&Hedrick,PW.1985BasicGenetics, WMC.BrownPublishers.
4. Alberts,B., Bray,D. Lewis,Julian,RaffnM.Roberts,K.andJ.D.Watson,
5. J.D.1994.MolecularBiologyof theCell, 3rdedn,Garland PublishingInc..
6. Hayes,W.,1994.GeneticsofBacteriaandtheirviruses.2ndEdn,CBSPublishersandDistributors,New Delhi.
7. GenesXIIBenjaminLewin

MSCPB02E06:IMMUNOLOGY
3Credits(48Hours)

CourseObjectives:

1. Understandthe componentsandfunctioningoftheimmunesystem.
2. Determinethedeficienciesarisingoutoftheimmunesystem.
3. Analyzetheoverreactionoftheimmunesystem.
4. Understandthemethodsofexploitingthespecificityoftheimmunesystemforquantification,diagnosis, andimmunization protocols.

CourseOutcome:

1. Evaluateusefulnessof immunologyattheapplicationlevel.
2. Applytheirknowledgeanddesign immunologicalexperiments
3. Understandthe roleofimmuneresponsesin the settingofinfection(viralorbacterial).

CourseContent

ModuleI

History of the Immune system, Cells of the Immune system, Innate immune mechanisms, TLR,PRR,PAMPPhagocytosis,classicalandalternativepathwaysofcomplementactivation,regulation and functions of complement. Adaptive immunity: Properties of immunogens andantigens.Pathways of antigen processingand presentation. **(10Hours)**

ModuleII

Primaryandsecondarylymphoidorgans,structureandcellularorganization.Structureofimmunoglobulins.Antigenbindingsiteofantibody.Forcesinvolvedinantigen-antibodycomplex formation. Receptors, co-receptors and CD antigen on B cells, Generation of receptordiversity.Bcell development in activation and differentiation.**(15Hrs)**

ModuleIII

Tcelldevelopment,activationanddifferentiationtohelper,cytotoxicTcells.Signaltransduction in B&T cell. Role of cytokines.Humoral and cytotoxic response, MHC complex andMHCrestriction.
IntroductiontoImmunologyofinfectiousdiseases,Hypersensitivityandimmunologyoftransplantation,Immuno-deficiencies,autoimmunity,immunesuppression,tolerance.Tumorimmunology.**(15Hrs)**

ModuleIV

Factors governing immunogenicity, haptens and its applications, epitopes, adjuvants.PrincipleandapplicationsofAntigen-antibodyinteractions.Agglutination,immunodiffusion,immunoelectrophoresis,immunofluorescence,RIAandELISAandassaysforcytotoxicresponses.Monoclonal Antibodies.Vaccines.**(8Hrs)**

References

1. ImmunologyKuby2019EighthEdition|2019JenniPunt;SharonStranford;PatriciaJones;Judy OwenMacmillanLearningEighth Edition
2. ImmunobiologyJaneway20179thEditionGarlandScience.
3. Essential Immunology.Roitt201713thEdition.WileyBlackwell

MSCPB02E07
ETHICS,PATENCY ANDINTELLECTUAL PROPERTYRIGHTS
3CREDITS(48Hours)

Courseobjectives:

1. Tounderstandhowpreciouseachlifeformsare,therisksassociatedwithalteringthegeneticmake up of an organism and theirethical aspects.
2. Tostudytheimportanceofmaintainingthebiosafetymeasureswhilehandlingwithdangerousmicroorganism.
3. Tolearn the importanceofmaintainingtheguidelines whilehandlingthe rDNAproducts.Theessential steps to befollowed to get an invention patented.

CourseOutcome:
Importanceofindividuallifeforms,understandingbiosafetylevels,patentsandpatentprocedures.

CourseContent:

ModuleI
Ethicalaspectsofinterferinginnaturalprocess,Hiddendangersinalteringgeneticmake-up.**(3hrs)**

ModuleII
Patent, Objectives of Patent system and general requirement of Patent law, Patent office, PatentOffice Practices, Infringement problems, Harmonization of Patent laws, International treaties onIPR, International convention for the protection of new varieties- Strasbourg convention, UPOVconvention.**(15hrs)**

ModuleIII
Patentabilityofmicro-organism-Claims,characterizationandrepeatability,DepositionofCulture collection, Legal protection plants and animals, Transfer of Technology, TRIPS, FDA.**(15hrs)**

ModuleIV
Biosafety, Definition, Objectives, Biological Containment (BC) and Physical Containment (PC),Biosafety levels, Biosafety level1, Biosafety level 2, Biosafety level 3, Biosafety level 4.Thecontainment laboratory design and facilities. Guidelines for rDNA research, Quality control ofbiologicalsproduced byrDNA technology.**(15hrs)**

References

1. Beir,F.K,Crespi,R.SandStrausJ:1982Biotechnologyandpatentprotection-OxfordandIBH PublishingCo. New Delhi.
2. Chowdhary,N.KandAggarwalJ.C:Dunkal"sProposalsI.ImplicationsforIndiaandthethird world.
3. Chowdhary,N.KandAggarwalJ.C:Dunkal"sProposalsII.TheFinalAct.SignificanceforIndia and World trade.
4. Department of Biotechnology(1990) Recombinant DNA Safetyguidelines.Govt.of India, New Delhi.
5. Krattinger,A.FLesser,WandMudgeG:Implementationof BiosafetyRegulatoryMechanismsunder the BiodiversityConvention.
6. NarayanaswamiK: 1994 Safety and regulatory arrangementsinBiotechnologyin

SohalandSrivastava(eds)EnvironmentandBiotechnology.

SEMESTERIII
TotalCreditsRequired:22

MSCPB03C10:GENOMICSANDPROTEOMICS
3Credits(48hours)

Courseobjectives:

1. Tounderstandthegenomesequencingandtranscriptomicstechniques
2. TounderstandthefunctionalgenomicsandPharmacogenomics
3. Tounderstandtheconceptsofproteomeanalysis

Courseoutcomes:

Studentwillbeabletoexplainthevitalconceptsoftechnologiespertinenttogenomicsandproteomics,and theirapplications

Coursecontent:

ModuleI
Genomics:History,Genomeprojects,Largescalegenomesequencingstrategies.Basicprinciples, prokaryotic and eukaryotic genomes and interpretation of results. Reference genomesequence,integratedgenomicmaps, geneexpressionprofiling.**(10 hrs)**

ModuleII
Types of RNAs and the respective roles in cells.Concept of Transcriptome and techniques usedfortranscriptomics;microarray,detectingdifferentialgeneexpression,correlationofgeneexpressiondatatobiologicalprocess.RNAdatabases,RNAinterference,RNAstructurepredictiontools,RNAsequenceanalysis,RNAregulatorynetworks,Comparativetranscriptomics.**(12 hrs)**

ModuleIII

Functionalgenomics:Applicationofsequencebasedandstructure-basedapproachestoassignment of gene functions – e.g., sequence comparison, structure analysis (especially activesites, binding sites) and comparison, pattern identification, etc. Use of various derived databasesin function assignment, use of SNPs for identification of genetic traits. Pharmacogenomics:identificationofSNPs,SNPdatabase(DbSNP).Roleof SNPin Pharmacogenomics.**(14 hrs)**

ModuleIV

Proteomics:Proteomeprofilingmethods,2Delectrophoresisimagecomparisons;yeasttwohybrid system, MALDI, Tandem mass spectroscopy, peptide mass fingerprinting, Protein microarrays, protein expression analysis, pathway analysis and identifying protein-protein interactionswithmass scale expression data.**(12 hrs)**

References

1. DiscoveringGenomics,ProteomicsandBioinformatics2ndedition - byA.MalcolmCampbellandLaurie J. Heyer. byColdSpringHarbor LaboratoryPress 2006.
2. PrinciplesofGenomeAnalysisandGenomics(3rdEd.)byPrimrose,S.B.andTwyman,R.M.,B lackwell PublishingCompany, Oxford, UK. 2003
3. Introduction to Proteomics – Tools for the new biology (1st Ed.) by Liebler, D.C.,HumanaPressInc., NewJersey, USA.2002
4. BioinformaticsandFunctionalGenomics byPevsner,J., JohnWileyand Sons,NewJersey,USA. 2003
5. Bioinformatics:SequenceandGenomeAnalysisbyMount, D.,Cold SpringHarborLaboratoryPress, New York. 2004

MSCPB03C11:SYSTEMSBIOLOGY
3Credits(48hours)

Courseobjectives:

1. Understandthesystemslevelmodellingofbiologicalsystems
2. Understandthe modellingand simulationofwholecell
3. Understandthe conceptsofmetabolicpathwaymodelling

Courseoutcomes:

Familiarizethestudentswithapproachesincomputationalmodellingofvariousbiologicalsystems

Course

contentModule

I

SystemBiology:TowardsSystemlevelUnderstandingofBiologicalSystems,Propertiesof

models-
Robustness,Redundancy,Control,ModularDesign,StructureStabilty.ImpactsofSystemBiology.RapidPole-to-poleOscillationsinE.coli,ModelsforEukaryoticGradientSensing.

ModuleII

Systems Microbiology - The Cell as a Well-stirred Bioreactor: Michaelis-Menten Kinetics, AGeneticSwitchinLambaPhage,Syntheticgeneticswitches,Stabilityanalysis,ModelingEscherichia coli chemotaxis, GeneticOscillators

ModuleIII

DevelopmentalSystemsBiology:
Wholecellsimulation,ComputerSimulationoftheCell:Humanerythrocytemodel&itsapplicationsQuorumSensing,Minimalgenesetconcept.Emerging
AreasinSystemBiology:suchasFromNeuronstoBrains,ComplexDiseases,Organismsandtheirinteractions with environment.

ModuleIV

Regulation of Metabolic Pathways at Enzyme Level: Regulation of enzyme activity, overview ofenzymekinetics,allostericenzymes,feedbackinhibition.MetabolicPathwaydatabases:-KEGG, EMP,EcoCycandMetaCyc,BioCyc.Enzymes,CompoundsandReactionsdatabases;LIGAND - Biochemical Compounds and Reactions, ENZYME – Enzymes, BRENDA - ComprehensiveEnzymeInformationSystem;FullGenomeAnnotationthroughknowledgeofMetabolicPathways,OrganismSpecificMetabolicPathways,ComparisonofMetabolicPathways,Engineering of MetabolicPathways.

References

1. FoundationofSystem BiologybyHiroaki Kitano.
2. AFirst Coursein SystemBiologybyEberhard O.Voit.
3. AlbertsBruce*et al,* (2002), Molecular Biologyofthe Cell. *Garland Science, New York.*
4. MasaruTomita,(2001). Wholecellsimulation: agrandchallengeofthe21stcentury.

MSCPB03C12:CHEMINFORMATICS AND COMPUTERAIDED DRUGDESIGN
3Credits(48hours)

Courseobjectives:

1. Understanddifferentmethodsofmoleculardocking
2. Understandstepsinvolvedstructure-basedand ligand-baseddrugdesigns
3. Understandstructure-activityrelationships

Courseoutcomes:

Studentsshall beable to

1. Explainthetheoreticalaspectsofmolecular docking
2. Explaindifferentstepsincomputer-baseddrugdesign
3. ExplaintheQSARanditsapplications

ModuleI

Moleculardocking:Intermolecularinteractions,differentmethodsofdocking:shapecomplementarymethods,fragment-basedmethods,Distancegeometrymethods,scoringfunctions,rigid andflexibledocking,applications, algorithms used.**(14hrs)**

ModuleII

Drug design: Drugs and their targets, theories of drug-target interactions, affinity and efficacy,pharmacokinetics, ADME and its prediction. Structure based drug design: steps in SBDD,leaddiscovery,HTVS,denovo design,optimizationofligandgeometries.**(12hrs)**

ModuleIII

Ligandbaseddrugdesign-
Chemoinformatics,analysisoflargedatabaseofligandsusingsimilarity,ruleoffive,ruleofthreeandsub-structurebasedmethods.Pharmacophoregeneration.**(12hrs)**

ModuleIV

Introduction to QSAR, descriptors used in QSAR study, model building: regression Analysis,PartialLeastSquares,PrincipleComponentsAnalysis,modelvalidationmethodsandapplications of QSAR.**(10 hrs)**

References

1. Chemoinformatics(MethodsinMolecularBiologyVol.275Ed. ByJurgenbajorath.HumanaPress 2004
2. StructuralBioinformatics.Ed.ByP.E. BourneandH. Weissig.Wiley-Liss2003
3. J.Gasteiger"Chemoinformatics:Atextbook"JohnWileyandSons2003
4. MolecularModeling:Basicprinciples andapplications.HoltjeHD, sipplW,RognanDandFolkers G. Wiley-VFH 2nd Edition (2003)
5. Molecularmodellinganddrugdesign.Andrew VinterandMarkGardner andBocaRaton,CRC Press, 1994

MSCPB03C13:PROGRAMMINGINJAVAANDBIOJAVA
3Credits(48hours)

Courseobjectives:

1. Understandthe fundamentalsofjavalanguageconstructs
2. Understandmultithreadprogramminginjava
3. Understandthe useofbiojavain bioinformatics

Courseoutcomes:

Aftercompletionofthecourse,studentsareexpectedtounderstandthefollowing:

1. StructureofjavaprogrammingandcreatingDatatypes
2. Thewayvariousexpressionsanddatatypesareassembledinpackages
3. ImplementationofmultithreadinginJAVA.
4. Applicationofbiojavatoolsinbioinformatics

Coursecontent

ModuleI

Introduction to Java:Compilation of java programs – Java Development kit – virtual machine – bytecode – data types (int, long, char, and Boolean) – operators (arithmetic, relational, bitwise andassignment) – arrays – operator precedence– typeconversion – control statements and loops.**(10hrs)**

ModuleII

Working with java classes:Declaring classes – super and sub classes – constructors – instances ofclasses – inheritance (simple, multiple and multilevel) – overriding and overloading – exceptionhandling– file handling.**(10 hrs)**

ModuleIII

Multi-thread programming:Life cycle of a thread – creating a thread (extension of thread class andimplementingrunnable)–threadpriorities–synchronization–deadlock.Eventhandlingandapplets:Eventhandlingmechanisms–delegationeventmodel–eventclasses–eventlistenerinterfaces – mouse and keyboard events – adapter classes and inner classes. Applet basics – passingparameters to applets – applet display methods – drawing lines, ovals, rectangles and polygons –threadsand animation.**(14hrs)**

ModuleIV

Biojava:InstallingBioJava,Symbols,BasicSequenceManipulation(DNAtoRNA,ReverseComplement, motif as regular expression), Translation (DNA to Protein, Codon to amino acid, Sixframe translation), Proteomics (Calculate the mass and pI of a peptide), Sequence I/O (File Formatsconversions),LocationsandFeatures(PointLocation,RangeLocation,Featuremodifications),BLAST and FASTA (Blast and FastA Parser, extract information from parsed results), Counts andDistributions,WeightMatricesandDynamic Programming,UserInterfaces. **(14hrs)**

References

1. Java:Thecomplete Reference.(7thEd.) byHerbertSchildt,TMH.2012
2. K.Arnold,J.Gosling,D.Holmes;TheJavaProgrammingLanguage;AddisonWesley,4thedition , 2005.
3. Anonymous;CoreandAdvancedJavaBlackBook; DreamtechPress,2016.
4. U.K.Roy.AdvancedJavaProgramming;OxfordUniversityPress,2015.
5. Dr.Kaladhar.BioJava –AProgrammingGuide;LAP LAMBERTAcademicPublishing,2012.

MSCPB03C14:Practical 4
2Credits(96Hours)
GENOMICS,PROTEOMICSANDCHEMINFORMATICS

1. Genomecomparison,Genomerearrangements,Genepredictionwithbioinformaticstools
2. Translationthe sequencesandORFfinding
3. PhylogeneticReconstruction
4. PracticalswithMultiDent,AACompIdent,Protparam
5. DatabasesPDB,SCOP,CATH,Pfam
6. SecondarystructurePrediction-GOR, SOPMA

7. Protein IdentificationandAnalysisToolsontheExPASyServer
8. StructurebasedDrugDesign-MolecularDocking,DeNovoLigandDesign,VirtualScreening
9. LigandbasedDrugDesign -PharmacophoreIdentification,QSAR

References

1. G.P.QuinnandM.J.Keough;Experimentaldesignanddataanalysisforbiologists;Cambridge UniversityPress, 2002.
2. AJ.LinkandJLaBaer;Proteomics:AColdSpringHarborLaboratoryCourseManual;ColdSpringHarborLaboratoryPress; 2009.
3. Chemoinformatics(MethodsinMolecularBiologyVol.275Ed.ByJurgenbajorath.HumanaPress 2004
4. MolecularModeling:Basicprinciplesandapplications.HoltjeHD,sipplW,RognanDandFolkers G. Wiley-VFH 2nd Edition (2003)
5. Molecularmodellinganddrugdesign.AndrewVinterandMarkGardnerandBocaRaton,CRC Press, 1994

MSCPB03C15:Practical5
2 Credits (96 Hours)PROGRAMMINGLABIII–JAVAANDBIOJAVA

1. Simplejavaprogramstodemonstratedecisionmaking,andloops.
2. Handlingofarrays andworkingwithmatrices.
3. Workingwithclassesand objectsinjava.
4. Useofconstructors anddemonstrationofoverloadingofconstructors.
5. Demonstrationofsimple,multipleandmultilevelinheritances.
6. Exceptionhandling.
7. Creationofmultiplethreads.
8. Readingandwritingfiles.
9. Applets.
10. AnimationandThreads.
11. ManagingSimpleEventsandInteractivity.
12. Alignmentofsequences(biojava)

References

1. Java:Thecomplete Reference.(7th Ed.)byHerbertSchildt, TMH. 2012
2. K.Arnold,J.Gosling,D.Holmes; TheJavaProgrammingLanguage;AddisonWesley,4th edition,2005.
3. Anonymous;Core andAdvancedJava Black Book;DreamtechPress,2016.
4. U.K.Roy.Advanced JavaProgramming;OxfordUniversityPress,2015.
5. Dr.Kaladhar. BioJava–AProgrammingGuide;LAPLAMBERTAcademicPublishing,2012.

MSCPB03E08:ENZYMOLOGY
(2Credits) (48Hours)

Courseobjectives:

1. Understandthenomenclature,methodsofisolationandpurification,activityandusesofenzymes.
2. Understandthestructureandfunctionofenzymes.
3. Understandenzymekineticsandkineticparameters
4. Understandthemechanismofenzymeinhibition

Courseoutcomes:

Thestudents shall beableto

1. Explainthemethodsofisolationandpurification,measurementofactivityandusesofenzymes.
2. Explainthestructureandfunctionofenzymes.
3. Explainthekineticsofenzyme-substrateinteractions.
4. Explainthemechanismofenzymeinhibition.

CourseContent:

ModuleI

Enzymes:basic definitions, nomenclature(ECrecommended andclassical), enzyme isolationand purification, measurement of enzyme activity, specific activity, molar activity (turn overnumber),criteriaforpurity.Coenzymes.Syntheticenzymes,abzymes,isoenzymesandribozymes. Useofenzymes inmedicineand industry.Immobilized enzymes.**(12hrs)**

ModuleII

Enzyme structure and function: folding of the polypeptide chain, active site and its location,binding site. Allosteric enzymes: Subunit Interactions, regulation of enzyme activity, Jacob andMonod model of allosteric enzymes, Koshland model, detailed discussion using haemoglobin,ATPase(EffectsofATPandCTP)asexamples.KclassandVclassallostericenzymes.Structureand theirfunction in metabolism.**(12 hrs)**

ModuleIII

Enzyme kinetics: Single substrate –single intermediate, Michaelis –Menten and Briggs – Haldanekinetics, graphical analysis of kinetic data, progress curves and linear plots, determination ofVmaxand Km –experimentalaspects.Importanceof KmandVmax.**(12 hrs)**

ModuleIV

Enzymeinhibition:Mechanismsandratestudies,degreeofinhibition,competitive,non-competitive and uncompetitive inhibition, activation, graphical analysis (primary and secondarykinetic plots), two substrate reactions, sequential and Ping –Pong mechanisms, nature of rateequations, examples. Irreversible inhibition.Alteration of Km and Vmax in various types ofinhibition.Feedback inhibition.**(12 hrs)**

References

1. Enzymes-DixonandWebb
2. EnzymeKinetics-BowdenandWharton
3. ImmobilisedEnzymes-Trevan
4. HandbookofEnzyme Technology-AlanWeisman-3rdedPrentice-Hall
5. EnzymeTechnology-ChaplineandBucke–Cambridge UniversityPress
6. Biochemistry–DonaldVoet&JudithVoet1995.JohnWileyandSons,In

MSCPB03E09: BIOTECHNOLOGYINMEDICINE,HEALTH,AGRICULTUREANDENVIRONMENT

2 Credits(48Hours)

CourseObjectives:

Understand the latest application of biotechnology in the field of Medicine, Health, Agricultureand Environment forimprovement in qualityof life.

CourseOutcome:

Abilityto understand theuseof Biotechnologyfor betterliving

ModuleI

Developments in gene therapy. Molecular basis, identification, and cure of genetic disorders: likeImmunodeficiencies, Diabetes mellitus, Coronary artery disease, Neurogenetic disorders, cancer,Muscular Dystrophy, mitochondrial disease. Diagnosis based on genomic and cDNA microarray.Therapiesbased on RNAand stem cells.**(15Hrs)**

ModuleII

Bioreactors in plant production and scale up.Plants as bioreactors.Engineering for secondarymetabolites,herbicideresistanceandimprovementoffoodquality.Biofertilizers,Typesofbiofertilizers,Biopesticides**(10 Hrs)**

ModuleIII

Biotechnologicalmonitoringofairwaterandsoilpollution.Biosensors.Biologicalindicators.Strategiesfor waste management and control.**(10Hrs)**

ModuleIV

Biotechnologically produced clinical products.Nanomedicine: Nanodevices medical microbots,nanorobotics, nanomedicine, nanosurgery for cancers and neurological disorders. Nanoparticlesfor biological assays as drug delivery vehicles.Applications of Biotechnology in aquaculture,forestry,wildlifeand veterinarysciences.**(13Hrs)**

References

1. MolecularBiotechnology5thEditionBernardR.Glick,JackJ.Pasternak,CherylL.PatternASM Press 2017
2. GenecloningandDNAanalysis:AnIntroduction6thEditionT.A.Brown,WileyBlackwell2013

3. ModernBiotechnology:ConnectingInnovationsInMicrobiologyandBiochemistrytoEngineeringFundamentals, Nathan S.Mosier, Michael R.Ladisch, Wiley2009

4. Nanomedicine-DesignandApplicationofMagneticNanomaterials,NanosensorsandNanosystems.,(2008)VijayVaradan,LinfengChenand JiningXie
5. TechniquesforWildlifeInvestigationandManagement,6thEd.,C.Braun,2005.,TheWildlifeSociety,Bethesda, MD.
6. IntroductiontoForestScience.,(2006)2ndEditionbyRaymondA.Young,RonaldL.Giese(Editor)
7. IntroductiontoVeterinaryScience(2003)byJamesLawhead,MeeCeeBaker
8. BiotechnologyinAgricultureandForestry66:Editors:JackM.WidholmandToshiyukiNagata: Springer 2012
9. EnvironmentalBiotechnology:NewApproachesandProspectiveApplication:MarianPetre(Editor)2013

MSCPB03E10: RECOMBINANT DNA TECHNOLOGY2CREDITS(48 Hours)

CourseObjectives:
Tofamiliarizewiththeadvancedgeneticengineeringtechniques.Appropriateapplicationofgenetic engineering technique for the mass production of protein of interest.The technologybehindtransgenic microorganisms, plants and animals.

CourseOutcomes:
Complete understanding of genetic engineering tools such as RFLP, AFLP, RAPD, PCR, DNAfingerprintingetc.

CourseContent:

ModuleI
HistoricaleventsthatledtothemethodsofrecombinantDNAtechnology,Genecloning,Stepsof gene cloning, enzymes involved in recombinant DNA technology-Polymerases, Klenowfragment,Nucleases,Restrictionendonucleases,Ligases,Polynucleotidekinases,Terminaldeoxynucleotidyltransferases,Alkalinephosphatases. **(10Hrs)**

ModuleII
VectorsusedinRecombinantDNAtechnology,Plasmids,Cosmids,Phagemids,Artificialchromosomes,Shuttlevectors,Viralvectors,Expressionvectors.Linkers,Adapters,Homopolymer tailing. Transformation, Transfection, Transient transfection, Selectable markergeneto identifythe transfer of genes in cells. (**14Hrs**)

ModuleIII

Preparation of Gene libraries, cDNA libraries, Expression libraries, Storage of libraries andScreening of libraries, Screening by DNA hybridization, Screening by Immunological Assay,Screeningbyproteinactivity,ScreeningbyGeneticcomplementation,HybridArrestTranslation alsystems. (**10Hrs**)

ModuleIV

RFLP, AFLP, RAPD Analysis, PCR, Various types of PCR and its applications, Fluorescent in-situ hybridization, Chromosome micro dissection and micro cloning. Genetic engineering ofanimals and generation of transgenic animals. Knock out Technology and Knock-in technology,Anti-sense RNAtechnologyandits Application. (**14Hrs**)

References

1. Principlesofgenemanipulation-AnIntroductiontoGeneticEngineering.Old,RW&Primrose,S.B–19945th Edn. Blackwell Sci Pub.
2. MolecularCloning-ALaboratoryManuelSambrook,J.,Fritsch,E.F.andManiatis,T.1989..Second Edition. Cold SpringHarborLaboratoryPress.
3. RecombinantDNAtechnology-ConceptsandBiomedicalApplicationsSteinberg,M.,Guyden,J.,Calhann,D,Staiano-Coico, L.,Coico,R,1993.ElliceHorwoodPrenticeHall.
4. RecombinantDNAWatson,J.D.,Gilman,M.,Witkowski,J.andZoller,M.1992.SecondEditio n.ScientificAmerican Books, WHFreeman&Co.
5. FromGenestoClones: IntroductiontoGene-Winnacker, E. L.1987.

MSCPB03E11:ENVIRONMENTALMICROBIOLOGY
(2 Credits)(48Hours)

Courseobjectives:

Objectivesof this course areto studyand understand

1. Microbialbiodiversityindifferentenvironmentsandfactorsaffectingmicrobialpopulation
2. Environmental,agricultural,medical,andindustrialapplicationsofmicroorganisms.

Courseoutcome:

Upon completion of this course, students will be able to explain and demonstrate the dispersaland adaptability of diverse microorganisms in different environments and their beneficial roles inenvironment,agriculture,health and industry.

CourseContent:

ModuleI

Microbialbehaviorinecosystems:Microbialbiodiversity,Interactionsamongmicrobialpopulations.Animal-microbeandplant-microbeinteractions.Microbiologyofsoil:Soilashabitat for microorganisms. Soil microflora, Decomposition of organic matter -Soil as source ofindustrial strains.Biodegradation of recalcitrants by soil microbes.Geocycles of C, N, S, P. ironand sulphuroxidation.N2fixation.**(11Hrs)**

ModuleII

Microbiologyofwater:Microbialcommunitiesinaquaticenvironments,factorsaffectingmicrobial population in natural waters, Air water interface, Microbial Corrosion, Bacteriologicalanalysis of drinking water. Water purification and various steps involved. Microbiology of air:Composition of air microflora, Significance of air microflora, Airborne diseases, Hazards oflaboratorytechniques,Airsanitation.Biologicalweapons,theirregulationandprecautions.Microorganisms in extreme environments: Environmental Determinants that Govern Extremeenvironments, Extremes of pH & temperature, salinity, Hydrostatic pressure, Nutrient limitation.**(15Hrs)**

ModuleIII

Pollution and environment, Biosensors and Biological indicators, Waste water management andsewage treatment, BOD concepts, Solid waste management and land filling, Degradation ofxenobiotics, Microbes and bioremediation. Microbial Biofilms: Physiology, Morphology andBiochemistryof microbial biofilms**(11Hrs)**

ModuleIV

Production of microbial biofertilizers –cyanobacteria, Rhizobium, Azotobacter, Azospirillum,Phosphobacteria and VAM, Biopesticides, Microbes as a health food (SCP)-Spirulina and itsproductionmethods.Probiotics-useofLactobacilliandBifidobacterium-therapeuticandnutritional value, Microbial enhanced oil recovery, Microbial production of fuels. Microbialleachingof ores andbiomining, Biopolymersandbiosurfactants.**(13Hrs)**

References

1. R.M.AtlasandR.Bartha(1998)MicrobialEcology-FundamentalsandApplications.AddisonWesleyLongman,Inc.
2. BuckleyR G,Environmental Microbiologyby, CBS
3. N.S.Subbarao,BiologicalNitrogen Fixation
4. Alexanderand Martin , Microbiologyof Soil
5. SoilMicrobiology.Mark CoyneThompsonLearning
6. Ivanov,EnvironmentalMicrobiologyfor Engineers,Taylor & FrancisExclusive(Cbs)

SEMESTERIV

MSCPB04C16
TotalCredits:16

Period:5Months

Research& Dissertation