ChaitanyaBharathi Institute of Technology

Department of Biotechnology

COURSES TO BE PURSUED FOR OBTAINING MINOR ENGINEERING IN BIOCHEMICAL ENGINEERING

(Applicable for 2020 admitted students onwards)

S.No	Titleofcourse	Link	Noof weeks	Credits
1	ChemicalEngineeringThermodynamics	https://swayam.gov.in/nd1_noc20_ch34/preview	12	3
2	MechanicalUnitOperations	https://swayam.gov.in/nd1_noc20_ch27/preview	12	3
3	Chemical ReactionEngineering-I	https://swayam.gov.in/nd1_noc20_ch25/preview	12	3
4	Fluidmechanics	https://swayam.gov.in/nd1_noc20_ce59/preview	8	2
5	TechnologiesForClean AndRenewable EnergyProduction	https://swayam.gov.in/nd1_noc20_ch37/preview	8	2
6	Numericalmethodsand Simulation Techniques for Scientists and Engineers	https://nptel.ac.in/courses/115/103/115103114/	8	2
7	Chemical ProcessControl	https://swayam.gov.in/nd1_noc20_ch28/preview	8	2
8	Chemical ProcessSafety	https://swayam.gov.in/nd1_noc20_ch38/preview	12	3
9	Heat transfer	https://swayam.gov.in/nd1_noc20_ch21/preview	12	3
10	Principles OfDownstreamTechniques In Bioprocess	https://swayam.gov.in/nd1_noc20_bt25/preview	12	3
11	Industrial Biotechnology	https://swayam.gov.in/nd1_noc20_bt21/preview	12	3
12	Heatexchangers: Fundamentals and design analysis	https://swayam.gov.in/nd1_noc20_me52/preview	12	3
13	BiostatisticsandMathematicalbiology	https://swayam.gov.in/nd1_noc20_ce34/preview	12	3
14	Fundamentalsoffoodprocess Engineering	https://swayam.gov.in/nd1_noc20_ag01/preview	12	3

Note:

1. Studentscansecureminimum 3 creditsineachsemester(It is not mandatory but just for the convenience of students so that they can secure 20 credits before seventh semester)

2. Studentscannotchoosethecoursestheyhavestudiedaspartoftheregularcurriculum (160 credits).
3. Incase,any open electivematches withthesubjectsgivenintheabovelist,studentcanchoosesuch subjectonlywhenhe/she hasnot optedthatelectivein regular curriculum

4. Incase,NPTELisnotofferinganycourselistedabove,BoSchairmancansuggestanalternativecoursebeingofferedbyNPTELduringthattime.

5. The list of courses will be updated time to time based on the courses announced by NPTEL and same will be informed to the students before deadline by the concerned faculty coordinators.

6. Students of B.Tech Chemical Engineering are not eligible to pursue this minor engineering course.

ChemicalEngineeringThermodynamics

CourseDuration	12weeks
Credits	3

COURSELAYOUT

Week1: Thepostulatesofthermodynamics,ConditionofEquilibrium

Week2: ThemaximumWorkTheorem,CarnotCycleandother cycles

Week3: Generalized Thermodynamic Potential, Maxwell relation, Stability ofThermodynamic Systems

Week4: Propertiesofpurefluids

Week5: Intermolecularforces,EquationofStates

Week6: Properties of mixtures-I

Week7: Properties of mixtures-II

Week8: Vapor-liquidequilibrium

Week9: TheoriesandmodelsofVLE ofmixtures-I

Week 10: Theories and models of VLE of mixtures-II

Week11: LLEandSLE

Week12: ChemicalReactionEquilibria

Books and References

Referencebooks:

- Thermodynamics and Introduction to Thermostatistics, by Herbert B. Callen, 2nd Edition(Wiley)
- Molecular Engineering Thermodynamics by Juan J. De Pablo and Jay D. Schieber, Cambridgepress.
- IntroductiontoChemicalEngineeringThermodynamics,J.E.Elliot,C.T.Lira,PrenticeHall

Text book:

- EngineeringandChemicalThermodynamicsbyMiloD.Koresky2nd Edition(Wiley).

MechanicalUnitOperations

CourseDuration 12weeks
Credits 3

Week1:IntroductionofParticulateSizesandShapes

Week2:Screening

Week3:SizeReduction

Week4:StorageandConveyingofBulkSolids

Week5:SizeEnlargement

Week6:FlowpastBluffBodies

Week7:FlowThroughPackedandFluidizedBeds

Week8:Filtration

Week9:CrossFlow FiltrationandMembraneSeparations

Week10:GravitySedimentationProcesses

Week11:CentrifugalSeparations

Week12:Floatation

Books and References

1. E.Ortega-Rivas,Unit OperationsofParticulateSolids:TheoryandPractice,CRCPress,FL,2012.
2. W.L.McCabe,J.Smith,P.Harriot,UnitOperationsofChemicalEngineering,7thEdition,McGrawHill, 2005.
3. J.F.Richardson,J.J.Harker,CoulsonandRichardson'sChemicalEngineering,2nd Volume,5th Edition,Butterworth-Heinemann,2003.

ChemicalReactionEngineeringI

CourseDuration	12weeks
Credits	3

Week1:KineticsofHomogeneousReactions

Week2:Stoichiometry

Week3:InterpretationofBatchReactorData

Week4:IdealReactorDesign

Week 5: Design for single reactions

Week 6: Design for parallel reactions

Week7: Design forparallelreactions

Week 8: Temperature and Pressure Effects

Week 9: Temperature and Pressure Effects

Week 10: Residence Time Distribution

Week 11: Reactor modeling with RTD

Week12:Reactor modelingwithRTD

Books and References

1. O.Levenspiel,ChemicalReactionEngineering, JohnWiley,1991.
2. H.S.Fogler,ElementsofChemicalReactionEngineering,Prentice-HallIndia,2003.
3. J. M.Smith,ChemicalEngineeringKinetics,McGraw-Hill,1981

FluidMechanics

CourseDuration	8weeks
Credits	2

Week1: IntroductionandBasic Concepts

Week2: Properties ofFluids

Week3: Pressure and Fluid Statics

Week4: FluidKinematics

Week5: Mass, Bernoulli and Energy Equations

Week6 Momentum Analysis of Flow Systems

Week7: Dimensional Analysis and Modeling

Week8: Flow through Pipes

Books and References

1. Fluid Mechanics Fundamentals and Applications yunus a. Qengel and john m. Cimbalamcgrawhill publications.
2. FluidMechanicsFrankM.WhiteMcGRAWHILLPublications.
3. FluidMechanics.IrvingHShames,McGRAWHillPublication,FourthEdition
4. FluidMechanicsAnIntroduction,E.Rathakrishnan,PHI,SecondEdition
5. FluidMechanicsMITOpenCourseware

Technologies for cleaner and Renewable energy production

Course Duration 12weeks

Credits 3

Week1:Introduction,characterizationofcoalandconventionalroutesforenergyproductionfromcoal

Week2: Cleanerroutesforenergyproductionformcoal

Week3:Characterizationof crude oil andconventionalroutesfor crude oil utilization

Week4:Cleanerroutesforenergyproductionformpetroleumcrude

Week5:Cleanerenergyproductionfromgaseousfuels

Week6:Solarandwindenergyproduction

Week7:Productionofhydroandgeothermalenergy

Week8:Energy production from biomass and wastes and energy conservation

Books and References

1.Miller BruceG.,CoalEnergySystems,Elsevier Academic Press,Paris2005

2..Twidel, J. and Tony W., Renewable Energy Resources, Second Edition, Taylor & Francis2006

3.KreithF.,GoswamiD.Y.,EnergyManagementandConservation,CRCPress2008.

4. SukhatmeS.,JNayakJ.,SolarEnergy:PrinciplesofthermalCollectionandStorage,3rd Ed.,Tata McGraw-HillPublishing CompanyLtd.2008.

5. MondalPandDalaiA.,Sustainableutilizationofnaturalresources,CRCPress2017.

Numericalmethods and SimulationTechniques forScientists and Engineers

CourseDuration 8weeks
Credits 2

Week1: Introduction to Numerical analysis, Importance of error and their calculations,Examples

Week2: Root Finding Method of non-linear equations, Bisection Method, Newton RaphsonMethod, Secantmethod,Regula-Falsimethod,Practicalexamples.

Week3: Curve fitting method, linear and non-linear fitting, Linear interpolation, Lagrangeinterpolation method,NewtonInterpolationformula,Practicalexamples.

Week4: Numerical differentiation, central difference methods, higher order derivatives,errors,practical examples.

Week5: Numerical integration, Simpson's 1/3 rd rule, Simpson's 3/8 th rule, local and globalerror analysis, practical examples.

Week6: Eigenvalue problems, Heun's method, Euler's method, RungeKutta Method,Gerschgorindisc theorem,Jacobimethod,Practicalexamples

Week7: Simulation Techniques, Random numbers, Monte Carlo Method, Importance Sampling,MetropolisAlgorithm,Heat-bathalgorithm,practicalExamples

Week8: Molecular dynamics, interaction and forces in molecular systems, MD and Verletalgorithm, correlations,practicalexamples

Books and References

1. R.H.Landau,M.J.Paez,andC.C.Bordeianu,ComputationalPhysics:Problemsolving with Computers Wiley VCH(2007).
2. S.C.Chopra andR.P.Canale,NumericalMethodsforEngineers,Tata McGraw-Hill (2002).
3. M.K.Jain,S.R.K.Iyengar,andR.K.Jain,"NumericalMethodsforScientificandEngineeringComputation",NewAgePvt.Pub,NewDelhi.
4. M.E.J.NewmanandG.T.Barkema,MonteCarloMethodsinStatisticalPhysics,OxfordUniversityPress(2010).
5. J.M.Haile,Molecular DynamicsSimulations:Elementarymethods,Wiley Professional (1992).

ChemicalProcess Control

CourseDuration	12weeks
Credits	3

Week1:Introductiontoprocessdynamicsandcontrol

Week2:Firstorder dynamicalsystems

Week3:Secondandhigherorder dynamicalsystems

Week4:Introductionto feedback control

Week5:Stabilityanalysis

Week6:Designoffeedbackcontrolsystems

Week7:Advancedcontroltopics

Week8:Multivariableandbatchprocesscontrol

Books and References

- Bequette,B.W.ProcessControl:Modeling,Design,andSimulation.
- Luyben,W.L.ProcessModeling,SimulationandControlforChemicalEngineers.
- Stephanopoulos,G.Chemical ProcessControl:AnIntroductiontoTheoryandPractice.
- Seborg,D.E.andMellichamp,D.A.andEdgar,T.F.andDoyle,F.J.ProcessDynamicsandControl

ChemicalProcessSafety

CourseDuration	12weeks
Credits	3

Week1: Introduction toProcesssafety,AccidentsandLossstatistics

Week2:ToxicologicalStudies

Week3:FireandExplosion

Week 4: PreventionofFireandExplosion

Week 5: Source model and dispersion

Week6:ReliefandreliefSizing

Week7:HazardIdentification,HAZOPanalysis

Week8:RiskAssessment

Week9:QRAandLOPA

Week10:ProcessofAccidentInvestigation

Week11:ReliabilityEngineering

Week12:Economicsoflossprevention

Books and References

1. CrowlD.A.andLouvarJ.F.,ChemicalProcessSafety: FundamentalsWithApplications.
2. LeesF.P.Lee'sLossPreventioninProcessindustries:HazardIdentification,Assessmentandcontrol
3. KletzT,WhatWentWrong?CaseHistoriesofProcessPlantDisasters:HowTheyCouldHaveBeen Avoided

Heat Transfer

CourseDuration 12weeks
Credits 3

Week 1: Physical Origins and Rate Equations, Units and Dimensions, Relevance, Analysis of HeatTransfer Problems: Methodology,IntroductiontoConduction,TheConductionRateEquation,The ThermalPropertiesof Matter

Week2: The HeatDiffusionEquation, BoundaryandInitialConditions,One-Dimensional, Steady-State Conduction,thePlaneWall,RadialSystems.

Week3: ConductionwithThermalEnergyGeneration,HeatTransferfromExtendedSurfaces,Introduction toTwo-Dimensional, Steady-State Conduction

Week4: TransientConduction,TheLumpedCapacitanceMethod,ThePlaneWallwithConvection,Radial SystemswithConvection,TheSemi-InfiniteSolid

Week5: TheConvectionBoundaryLayers,Local andAverageConvectionCoefficients,LaminarAnd Turbulent Flow,ThermalBoundaryLayerEquationsand Similarity, the Normalized BoundaryLayer Equations, Boundary Layer Analogies

Week6: External Flow, ConvectionCalculations, the Flat Plate inParallel Flow, the Cylinder inCrossFlow, FlowacrossBanksofTubes.

Week7: InternalFlow,LaminarFlowinCircularTubes:ThermalAnalysisandConvectionCorrelationsfor TurbulentFlowinCircular,Non-CircularandConcentricTubeAnnulus

Week8: Free Convection, theGoverning EquationsforLaminarBoundaryLayers, LaminarFreeConvection on aVertical Surface, The Effectsof Turbulence,Empirical CorrelationsforExternalFree Convection Flows and Within Parallel Plate Channels,Combined Free and Forced Convection

Week 9: Boiling andCondensation, Boiling Modes, ForcedConvectionBoiling, Condensation-laminarand Turbulent FilminDifferent Geometries,DropwiseCondensation.

Week 10: Heat Exchangers, the Overall Heat Transfer Coefficient, Heat Exchanger Analysis: UseoftheLog MeanTemperatureDifference,HeatExchangerAnalysis:TheEffectiveness–NTUMethod,Heat ExchangerDesignandPerformanceCalculations.

Week11: Radiation, Fundamental Concepts, Blackbody Radiation, Absorption, Reflection, andTransmission byRealSurfaces,Kirchhoff'sLaw,TheGraySurface.

Week12: RadiationExchange BetweenSurfaces-TheViewFactor,BlackbodyRadiationExchange, Radiation Exchange between Opaque, Diffuse, Gray Surfaces in an Enclosure, RadiationExchange withParticipatingMedia.

Books and References

1. IntroductiontoHeatandMassTransferbyF.P.IncroperaandD.P.DeWitt (Wiley)
2. HeatTransferbyJ.P.Holman,McGraw-Hill,
3. TransportPhenomenaby Bird, StewartandLightfoot(Wiley)
4. TransportPhenomenaFundamentalsbyJ.L. Plawsky(CRCPress)

PrinciplesOfDownstreamTechniquesInBioprocess

CourseDuration 12weeks
Credits 3

COURSELAYOUT
Week1: Lec-01IntroductionLec-02 Mass balance, Heat Balance, flow sheetLec-03Costing

Week2: Lec-04 Costing (continued), Physical and chemical principles in Downs streamLec-05Problemsin Massbalance, flow sheetLec-06 Cell Breakage

Week3: Lec-07CellBreakage(continued)Lec-08SolidLiquidSeparationLec-SolidLiquidSeparation (continued)

Week4: Lec-10SolidLiquidseparation-problemsLec-11Pre-treatmentandFiltersLec-12 Adsorption

Week5: Lec-13Adsorption (continued)Lec-14Adsorption(continued)Lec15Adsorption (continued)

Week6: Lec-16 Liquid-LiquidExtractionLec-17 Liquid-Liquid extraction (continued)Lec-18Liquid-Liquid extraction(continued)

Week7: Lec-19Liquid-Liquidextraction (continued)Lec-20 Reversed micellar and aqueous two phase extractionLec-21Membranes

Week8: Lec-22Membranes(continued)Lec-23 Membranes (continued)Lec-24Membranes (continued)

Week9: Lec-25PrecipitationLec-26 ChromatographyLec-27 Chromatography (continued)

Week10: Lec-28Chromatography(continued)Lec-29 Chromatography (continued)Lec-30Chromatography (continued)

Week11: Lec-31Chromatography(continued)Lec-32 Chromatography (continued)Lec-33Crystallisation

Week12: Lec-34DryingLec-35DryingandDistillationLec-36Future trends, Summary of the course

Books and References

1. Belter,P.A.andCussler,E.L.Hu,W.S(1988),Bioseparation: DownstreamprocessingforBiotechnology,Wiley,NewYork.
2. Ladisch, M.R., (2001), BioseparationEngineering:Principles,PracticeandEconomics,Wiley,Interscience.

Industrial Biotechnology

CourseDuration 12weeks
Credits 3

Wee

k1: Introduction, Microbes and enzymes of industrial importance

Week2: DifferenttypesofbioreactorsandbioreactordesignWeek3:Microbial growth, substrate degradation and product formation kinetics, Tutorial 1

Week4: Instrumentation,Sterilizationofair,mediaandreactor

Week5: Upstreamanddownstreamprocessing

Week6: ProductionofOxyChemicals:Taxandnon-taxalcohol, Brewingindustry, Tutorial2

Week7: Production of Oxy Chemicals II: Wine making, Vinegar and citric acid production, Tutorial 3

Week8: ProductionofOxyChemicalsIIIAntibiotics:Penicillin;Streptomycin

Week9: Highfructosecornsyrup,Cheesemaking,andsinglecellproduction

Week10: VaccinesproductionandMetal leaching

Week11: Bioenergy-Gaseousfuels: Biohydrogen, Biomethane and Microbial fuel cell;Liquidfuels: Bioethanol,BiodieselandBiobutanol

Week12: Aerobicandanaerobicwastewatertreatmentprocesses, Tutorial4

Books and References

1. Industrial Microbiology by Samuel Cate Prescott and Cecil Gordon Dunn2.BiochemicalEngineeringFundamentalsbyBaileyandOlli's
2. BioprocessEngineeringPrinciplesbyDoran
3. BioprocessEngineeringBasicConceptsbyShularandKargi5.Biochemical Engineering by Blanch and Clark6.BiochemicalEngineeringbyAiba,HumphreyandMillis
4. AtextbookofIndustrialMicrobiologybyWulfCruegerandAnnelieseCruegen

Heat exchangers:Fundamentalsanddesignanalysis

CourseDuration 12weeks
Credits 3

COURSELAYOUT
Week1: Background,Application,Classification,Commonterminologies.

Week2: IntroductiontoThermalandhydraulicaspects,pressuredropandheattransfer,sizingand rating.F-LMTDand-NTUmethod.
Week3: TubularHeatExchangers:differentdesigns,briefdescriptionofShellandTubeHeatExchangers, Specialtypes.

Week4: Compactheatexchangers, enhancement ofheattransfer,extendedsurfaceorFin,fundamental ofextendedsurfaceheattransfer,Fin tubeheatexchanger.

Week5: PlateFinHeatExchangers(PFHE),types,construction,fabrication,design,application.Multi streamPFHE.

Week6: MultistreamPFHEcontinued.Directcontactheatexchangers,types,application,simpleanalysis.

Week7: Regenerators,typesofregenerators,construction,application.TheoryofRegenerator,-NTUand-method.

Week8: Heatpipes,construction,workingprinciple,application,analysis.Specialheatpipes.

Week9: MicroscaleHeat Exchangersandheatsinks;heattransferandfluidflowthroughnarrowconduits, specialdesignconsiderations

Week10: PhasechangeHEX;phasechangeheattransfer,introductiontoevaporatorsandcondensers.

Week11: PhasechangeHEX;phasechangeheattransfer,introductiontoevaporators andcondensers.

Week12: HeatExchanger testing,steadystateanddynamicmethods.

Books and References

1. FundamentalsofHeatExchangerDesignbyR.K.Shah,DusanP.Sekulic,JohnWiley&Sons,11-Aug-2003.
2. HeatExchangerDesignHandbookbyKuppanThulukkanam,Taylor&Francis,23-Feb-2000.
3. HeatExchangers:Selection,Rating,andThermalDesign,ThirdEditionbySadikKakac,HongtanLiu,CRC-Press,01-Feb-1998.
4. CryogenicHeatTransfer,SecondEditionbyRandallF.Barron,GregoryF.Nellis,CRCPress,May23,2016.

Biostatistics and Mathematical Biology

CourseDuration 12weeks
Credits 3

Week1: BiostatisticsandMathematicalBiology:An Introduction,Typesofstudies
Week2: Levels of measurements summarizing the Data: Tabular Presentation
Week3: SummarizingtheData:GraphicalPresentationChartingwithExcel
Week4: Descriptive statistics: Point Estimates Descriptive Statistics: Interval Estimates Error Bars
Week5: Moments, Normality Tests and Outliers Concepts of Population, Sample and ConfidenceInterval
Week6: Statistical Hypothesis TestingStatistical Significance and P-Values Relationship between ConfidenceIntervalsandStatisticalSignificance
Week7: StatisticalPowerandChoosingthe rightSampleSize t-Distributionandtestsofsignificance Basedon't-distributionF-distributionandtestsofsignificance basedonFdistribution
Week8: χ2 Distribution and tests of significance based on χ2 distribution Comparing Proportions Gaussian,Binomial,LognormalandPoissonDistributions
Week9: Pearson'sCorrelationSimpleLinear RegressionNon-Linear Regression
Week10: NonparametrictestsPermutationsandCombinations
Week11: ProbabilityBayesTheoremandLikelihood
Week12: Statistics with MS Excel and GraphPad Prism Key concepts of statistics Statistical Pitfalls to Avoid

Books and References

1. Motulsky, H. (2014). Intuitive biostatistics: a nonmathematical guide to statistical thinking. OxfordUniversityPress,USA.Amazonlink
2. VanBelle,G.,Fisher,L.D.,Heagerty,P.J.,&Lumley,T.(2004).Biostatistics:amethodologyforthehealthsciences(Vol.519).JohnWiley&Sons.
3. Le, C.T.,&Eberly,L.E.(2016).Introductorybiostatistics.JohnWiley&Sons.

Fundamentals of Food Process Engineering

CourseDuration 12weeks
Credits 3

Week1: ConceptofFoodRheologyanditsMeasurements

Week2: Viscoelasticfoods

Week3: Thermalprocessingandmicrobialdeathkinetics

Week4: Evaporationandconcentration

Week5: HeatExchangers

Week6: DryingTechnology

Week7: FreezingandFreezeDrying

Week8: SizeReduction

Week9: MechanicalSeparationTechniques

Week10: Mixing and agitation

Week11: Leaching and Extraction

Week12: NonThermalProcessing

Books and References

1. FundamentalofFoodProcessEngineeringbyRTToledo,2nd Ed,2000,CBSPublishers
2. Transport Process and Unit Operations by Christie. J Geankoplis,1999,Prentice-Hall International.Inc.
3. FoodProcessEngineering,D.R.HeldmanandR.P.Singh.Springer,1981edition
4. Unit Operations of Chemical Engineering. By McCabe & J CSmith, 1999. McGraw Hill.
5. EngineeringPropertiesofFoods:MARao&SSHRizvi,1986,MarcelDekkarInc.
6. Unit Operations of Chemical Engineering. By J M Coulson &J F Richardson,1999,McGraw-Hill BookCo.,ThePergamonPress

ChaitanyaBharathi Institute of Technology

Department of Biotechnology

Courses to be pursued for obtaining Minor engineering in Bioscience and Bioengineering

(Applicable for 2020 admitted students onwards)

S.No	Name of the Course	Courseofferedby	Credits
1	Animal physiology	Swayam	3
2	BiochemistryandBiomolecules	Swayam	3
3	Immunology	Swayam	3
4	Industrial Biotechnology	Swayam	3
5	Virology	Swayam	3
6	Wildlife Conservation	Swayam	2
7	Wildlife Ecology	Swayam	3
8	OrganicFarmingforSustainable Agricultural Production	Swayam	2
9	NanotechnologyinAgriculture	Swayam	2
10	Experimental Biotechnology	Swayam	3
11	GeneticEngineering:TheoryAnd Application	Swayam	3
12	Enzymology	Swayam	3
13	Human Genetics	Swayam	3
14	MicrobialPhysiologyandmetabolism	Swayam	3
15	Introductiontomechanobiology	Swayam	2
16	PlantCellBioprocessing	Swayam	2
17	Transport Phenomena in Biological Systems	Swayam	3
18	IntroductiontoBiostatistics	Swayam	2
19	DairyandFoodprocessandproducts Technology	Swayam	3
20	FundamentalsofFoodProcess Engineering	Swayam	3
21	IntroductiontoDevelopmentalBiology	Swayam	3
22	Biomaterialsforbonetissue engineering applications	Swayam	2
23	Bioengineering: An Interface with BiologyandMedicine	NPTEL	2
24	Tissue engineering	Swayam	2
25	IntroductionToProteomics	Swayam	2
26	ComputerAided DrugDesign	Swayam	2
27	Druglivery:Principlesand Engineering	Swayam	3
28	IntroductiontoProteogenomics	Swayam	3

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1. Studentscansecureminimum3creditsineachsemester(It is not mandatory but just for the convenience of students so that they can secure 20 credits before seventh semester).

2. Studentscannotchoosethecoursestheyhavestudiedaspartoftheregular curriculum (160 credits).

3. Incase,any open elective matches withthesubjectsgivenintheabovelist,studentcanchoosesuch subjectonlywhenhe/she hasnot optedthatelectivein regular curriculum.

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5. The list of courses will be updated time to time based on the courses announced by NPTEL and same will be informed to the students before deadline by the concerned faculty coordinators

Animal physiology

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/nd1_noc20_bt42/preview**

COURSELAYOUT

Week 1: Introduction

Week2: Skeletalsystem

Week 3: Neural system

Week 4: Neural system

Week 5: Endocrine system

Week6: Blood&heart

Week 7: Lymphatic and respiratory system

Week8: Digestivesystem

Week 9: Urinary system & fluid-electrolyte balance

Week 10: Reproductive system and extreme physiology

Week11: Willbeupdatedsoon

Week12: Willbeupdatedsoon

Books and References

1. Guyton and Hall Text book of Medical Physiology
2. Ganong'SRevof Med PhysiologyFundamentals of anatomy and physiology by Martini

Biochemistry and Biomolecules

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/nd2_cec20_bt12/preview**

COURSELAYOUT

Week 1
Module 01: Molecules of living systems- Part 1Module 02: Molecules of living Systems– Part 2Module03:Moleculesof livingsystems-Part3

Week 2
Module 04: Molecules of living systems Part 4Module 05: Molecules of living systems Part 5Module06:Reactionsofthebiologicalsystem

Week 3
Module07:Carbohydrates-Part1
Module08:Carbohydrtaes- Part2
Module09:Lipids

Week 4
Module10:LipidMetabolism(Part-1)Module 11: Lipid metabolism (Part 2)Module 12:Lipidmetabolism(Part-3)

Week 5
Module13:Proteins(Part-1)Module14:Proteins(Part-2)Module15:Proteins(Part-3)

Week 6
Module16:Covalentprimarystructure
Module 17:Secondarystructure
Module18:Supersecondary,tertiaryandquaternarystructure

Week 7
Module 19: Protein folding, symmetry, subunit and dynamicsModule 20:Differentshape,size ofproteinsandfibrousproteinsModule21: Quaternary structure globular protein

Week 8

Module 22:Enzyme,Characteristics,Properties&Significance
Module23:Enzyme,Activity,Purification,Assay,Unit
Module24:Enzyme,Kineticsregulation&Catalysis

Week 9
Module25:Vitamins
Module 26: Vitamin B Complex (Part-
1)Module27:VitaminBComplex(Part-2)

Week10
Module 28:Vitamin
CModule 29:Vitamin
DModule30:VitaminA,E&K

Week11
Module31:EstimationofDNAandRNAbyMeasurementofsugarModul
e32:ProteinEstimation
Module33:Estimationofglucose byGlucoseOxidaseMethod

Week12
Module 34: Estimation of serum cholesterol by cholesterol oxidase
methodModule35:Liverfunctiontests
Module36:Estimationofbilirubin

BooksandReferences

1. LehningerPrincipleofBiochemistrybyD.L.NelsonandM.M.Cox.7thedition.
2. BiochemistrybyDonaldVoetandJudithVoet.4thedition
3. Harper'sillustratedBiochemistrybyRobertK.Murray
4. MolecularBiologyoftheCell, 4th editionbyBruceAlberts,AlexanderJohnson,JulianLewis,MartinRaff,KeithRoberts,andPeterWalter.
5. Biochemistry.6thedition.ByCharlesGrisham, Reginald Garrett,StavroulaAndreopoulos, WilliamG.Willmore,ImedE.Gallouzi.

Immunology

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/nd1_noc20_bt43/preview**

COURSELAYOUT

Week1: IntroductiontoimmuneSystem,Immunecelltypes,Hematopoiesis,BandTlymphocytes,NKcells,Lymphoidorgans(primaryandsecondary)

Week2: Featuresofintroductiontoinflammation,Adaptiveimmunesystem,Innate Immune system

Week3: Antibodystructure,Generationofantibodydiversity

Week4: GenerationofantibodydiversityandTCRrearrangement

Week5: Major history compatibility complex,Antigenpresentation,APCs

Week6: T-celldevelopment,negative/positiveselection,co-stimulatorymolecules

Week7: Humoralimmunity/Cell-mediated immunity,T cell subtypes:Th1,Th2,Th17,Tregsetc

Week8: B-cellmaturation/activationBCRsignaling

Week9: Pro-inflammatory andanti-inflammatory cytokines

Week10: Cell polarization/Complement activation (classical/alternate), Vaccines, memory B andTcellresponses,activeimmunization,passiveimmunizationVaccineproduction.

Week11: Autoimmunity,hypersensitivity,hostvs graftreaction

Week12: Immuno-diffusionassay,ELISA(Sandwich),Immuno-blotting,Immuno-precipitation,polyclonalandmonoclonalantibodies

Books and References

1. Janeway'sImmunobiologybyK.Murphy,P.TraversandM.Walport,Publisher:GarlandScience.
2. KubyImmunologyPaperbackbyThomasJ.Kindt,BarbaraA.OsborneandRichardGoldsby.Publisher:W.H.Freeman.
3. CellularandMolecularImmunologybyDrs.AbulK.Abbas,AndrewH.H.Lichtman,andShivPillaiPublisher: ElsevierIndia.

Industrial Biotechnology

Duration **12weeks**
Credits **3**
URL **https://swayam.gov.in/nd1_noc20_bt21/preview**

COURSELAYOUT

Week1: Introduction,Microbesandenzymesofindustrialimportance.

Week2: Differenttypes ofbioreactors and bioreactordesign.

Week3: Microbialgrowth,substrate degradation andproductformationkinetics,Tutorial1.

Week4: Instrumentation,Sterilizationofair,mediaandreactor.

Week5: Upstream andDownstreamprocessing.

Week6: ProductionofOxyChemicalsI: Taxandnon-taxalcohol, Brewing industry,Tutorial2.

Week7: ProductionofOxyChemicalsII:Winemaking, Vinegarandcitricacidproduction,Tutorial3.

Week8: Productionof OxyChemicalsIII:Antibiotics:Penicillin;Streptomycin.

Week9: Highfructosecornsyrup,Cheesemaking,andSinglecellproduction.

Week10: VaccinesproductionandMetalleaching

Week 11: Bioenergy- Gaseous fuels: Biohydrogen, Biomethane and Microbial fuel cell;Liquidfuels:Bioethanol,BiodieselandBiobutanol

Week12: AerobicandAnaerobicwastewatertreatmentprocesses,Tutorial4

Books andReferences

1. Industrial Microbiology by Samuel Cate Prescott and Cecil Gordon Dunn2.BiochemicalEngineeringFundamentalsbyBaileyand Olli's.
2. BioprocessEngineeringPrinciplesbyDoran
3. BioprocessEngineeringBasicConceptsbyShularandKargi
4. Biochemical Engineering by Blanch and Clark
5. BiochemicalEngineeringbyAiba,HumphreyandMillis
6. Atextbookof IndustrialMicrobiologybyWulfCruegerandAnnelieseCruegen

Virology

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/nd2_cec20_bt15/preview**

COURSELAYOUT

Week1: Discovery, nature, origin and evolutionary importance of virusesStructureof VirusesIsolation, purificationandcultivationofvirusesViraltaxonomy:Classificationandnomenclatureof differentgroupsofviruses.

Week2: Diversity, classification and one step multiplication curve Lyticandlysogenic phages Regulationof Transcription inlambdaphage. Phagephenotypes,phenotypemixingandphagetherapy.

Week3: Principale vents involved in replication:Adsorption,penetrationanduncoating. Viral nucleic acid andproteinsynthesisIntracellular trafficking, assembly, maturation and releaseHostresponseto viralinfection.

Week4: TMVandBBTV Herpes, Polio and Influenza virusSV40and AdenoVirus,PoxvirusesHepatitisand Retroviruses.

Week5: Visualization and enumeration of virus particlesPhysical andbiologicalmethodsofdetectionof virusesImmunological and molecular methods detection of virusesCharacterizationof viralproduct expressedintheinfectedcells.

Week6: GeneralmethodsofpropagationofplantvirusesPurificationof plantvirusesusingcentrifugation, chromatographyandelectrophoresistechniquesMethodsemployedinidentificationof plant Virusesasbiopesticides.

Week 7: Commoncold,SARS,InfluenzaMeasles,Mumps,Rubella, Human papillomaHerpes,Polio,Rabies, SmallpoxHIV, Hepatitis, Dengue,Yellow fever

Week8: Introductiontoon congenic viruses Conceptsofoncogenesandproto-oncogenes Understanding human carcinogenesis by using tumor viruses as experimental toolsPreventionandtreatmentof virusinduced cancer.

Week9: Hostspecificand non-specific defensemechanismsinvolvedinresistancetoandrecoveryfromvirus infectionsRoleof interferon in viralinfections ViralChemotherapy:Nucleosideanalogs,reversetranscriptas inhibitors,proteaseinhibitorsHistory of vaccines especially smallpox and polio. New methods: subunit vaccines, anti -idiotype andDNAvaccines.

Week10: Use of viral vectors in cloning and expression Gene therapy and Phage display Emerging and reemerging viruses and future.

Week 11: Exam preparation and assessment of assignments.

Week12: Assessment at the end of the course, which comprises of 40% of Online or In-term assessment and 60% Proctored end term exam.

WildlifeConservation

Duration	**8 weeks**
Credits	**2**
URL	**https://swayam.gov.in/nd1_noc20_bt39/preview**

COURSELAYOUT

Week1:Introduction,Importance, Threats

Week2:Monitoringwild animals

Week 3 :Monitoring & managing habitats

Week 4 : Management of wildlife diseases

Week 5 : Capturing and restraining wild animals

Week6:Conservationgenetics

Week7:Ex-sit conservation

Week8:Managementofchanges

Books andReferences

1. Pullin, A.S.,ConservationBiology. 2002: CambridgeUniversityPress.
2. Vandyke, F., ConservationBiology: Foundations, Concepts, Applications.2008: SpringerNetherlands.Selectedarticles/papersasreferredtointhelectures.

WildlifeEcology

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/nd2_cec20_bt15/preview**

COURSE LAYOUT

Week 4: Ecological energetics

Week 5: PopulationEcology

Week 6: Community Ecology

Week7: Distribution&abundance

Week8: Managementofthreatenedspecies

Week 9: Human Ecology

Week10: Ecologyofchange

Week 11: Applied Ecology

Week12: Revision

Books and References

1. Krebs, C.J.The experimental analysis of distribution and abundance. Ecology. NewYork: HarperandRow.
2. Odum, E.P., &Barrett, G.W.Fundamentals of Ecology. Philadelphia: Saunders. Selected articles / papersas referred tointhelectures.

Organic Farming for Sustainable Agricultural Production

Duration	**8 weeks**
Credits	**2**
URL	**https://swayam.gov.in/nd1_noc20_ag05/preview**

COURSELAYOUT

Week1: OrganicFarming:Concepts andprinciples oforganicfarming.

Week2: Keyindicatorsofsustainableagriculture,organicfarmingandclimatechange.

Week3: Inputmanagement;compostproduction, vermin composting,Compostquality,Compostutilizationandmarketing.

Week4: Organiccropmanagement:fieldcrops,horticultureandplantationcrops.

Week5: Plantprotectionmeasures, bio pesticides,naturalpredators,culturalpractice.

Week6: Rotation designfororganicsystem,Transition toorganicagriculture,farmingsystem.

Week7: Qualityanalysisoforganicfoods,Antioxidantsandtheirnaturalsource,organicfoodandhumanhealth .

Week8: Standardsoforganicfood andmarketing.

NanotechnologyinAgriculture

Duration	**8 weeks**
Credits	**2**
URL	**https://swayam.gov.in/nd1_noc20_bt41/preview**

COURSELAYOUT

Week1: Historyofagricultureandtheroleofchemicalsinmodernagriculture.

Week2: Overview ofnanotechnology.

Week3: Application of nanotechnology in modern day agriculture practicesI.

Week4: Application of nanotechnology in modern day agriculture practices II.

Week5: Applicationofnanotechnologiesinanimalproduction.

Week6: Nanotechnologyand shelf life ofagriculturalandfoodproducts.

Week7: Nanotechnologies forwaterquality and availability.

Week8: Greennanotechnologyandtheroleofgoodgovernanceandpoliciesforeffective nanotechnologydevelopment

Books and References

1. E-Referencematerialswillbeprovidedduringthecourse

ExperimentalBiotechnology

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/explorer?searchText=experimental+biotechnology**

COURSELAYOUT

Week1: Basicsof LaboratoryResearch:GoodLabPractices,Conceptof bufferingandPreparationof SolutionsandReagents.

Week2: Electrophoresis (Part 1):Basic Concept of Electrophoresis, performance ofelectrophoresisanditsapplications

Week3: Electrophoresis: Horizontal Gel electrophoresis, discussion about scientificquestionsandrelatedexperimentstosolvethemutilizingelectrophoresis

Week4: Chromatography (Part I): Analytical techniques in purification of biomolecules;Columnchromatography,HPLC.

Week5: Chromatography(PartII):Analyticaltechniquesinpurificationof biomolecules;Column chromatography,HPLC.

Week6: Chromatography (Part III) : Discussion about scientific questions and relatedexperimentsto solvethemutilizingchromatography

Week7: Immunology Techniques: Immunological tools, Antibody Generation andPurification, ELISA, Radial Immuno-diffusion, Western blotting and Immuno-precipitation.

Week8: CellBiologyTechniques(Part1):Basicsofcell-culture,isolationofcellsfromtissueand fractionation.

Week9: Cell Biology Techniques (Part 2): Immuno-localization, cell sorting, and discussionaboutscientificquestionsandrelatedexperimentstosolvethemutilizingcell Biologytechniques.

Week10: Molecular Biology (Part 1):Primer designing, Polymerase chain reaction, Differentvariantsof PCRandtheirapplications.

Week11: Molecular Biology (Part 2) Blotting Techniques, DNA and protein sequencingtechniquesandtheirapplications.

Week12: SummaryandConclusions.

Books and References

1. H-PS chmauder, MSchweizer and LMSchweizer., Methods in Biotechnology,(eds), Taylor & Francis Publishers, 2002.

2. K.Wilson&J.Walker,PracticalBiochemistry:PrinciplesandTechniques.(eds)CambridgeUniversity Press,NewYork,1995.

3. DouglasA.SkoogandJamesJ.Leary,PrinciplesofInstrumentalAnalysis.4th Edition.SaundersCollege Publishing,1992.

4. C.R.Kothari,Researchmethodology:MethodsandTechniques,3rdEdn.,NewageInternational2014.

Genetic Engineering: Theory And Application

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/nd1_noc20_bt32/preview**

COURSELAYOUT

Week1: Introduction andBasicsofBiologicalSystem.

Week 2: Basics of Biological

System**Week 3**: Basics of Cloning (Part

I)**Week4**:BasicsofCloning(PartII)

Week5:RecombinantDNATechnology(PartI)

Week 6: Recombinant DNA Technology (Part II)

Week7: Product Recovery and Purification (Part I)

Week 8: Product Recovery and Purification (Part

II)**Week9**:CharacterizationofIsolatedProducts(PartI)

Week10:CharacterizationofIsolatedProducts(PartII)

Week11:Biotechnology inSocialWelfare

Week12:Summary&Conclusions

Books and References

1. J.M.Berg, J.L.TymoczkoandL.Stryer, Biochemistry, W.H.FreemanandCompany (New York), 2006.
2. D.L.NelsonandM.M.Cox, LehningerPrinciplesofBiochemistry, 5th Ed Macmillan Worth, 2007.
3. B.Alberts,A.Johnson,J.Lewis,M.Raff,K.Roberts,P.Walters,MolecularBiologyofCell,5thEd,GarlandPublishing,2007.
4. L.M.Prescott,J.P.HarleyandD.A.Klein,Microbiology,6thEd, McGraw-Hill,2005.
5. S.B.PrimroseandR.M.Twyman,PrinciplesofGeneManipulation,Black wells science, 2006.

B.Lewin,GenesIX,InternationalEdition,Pearsoneducation,2008.

Enzymology

Duration **12weeks**
Credits **3**
URL **https://swayam.gov.in/nd2_cec20_bt20/preview**

COURSELAYOUT

Week1: Enzymes Nomenclature and classification of enzymes Holoenzyme, apoenzyme , cofactors, Coenzyme,prosthetic groups ,metallo enzymes, monomeric and oligomeric enzymes Activation energy andtransition state theory, enzyme activity, specific activity, common features of active sites, enzymespecificity:typesandtheoriesFactorsaffectingenzymeactivity,E,S,tempandpH.

Week2: Role of NAD+ NADP+, Folic acid and Vit., B12 as biocatalysts FMN/FAD, Coenzyme A, Lipoic acid,biotin, tetrahydrofolateand metal ions as biocatalysts Role of thiamine pyrophosphate, pyridoxalphosphate as biocatalysts Biocatalysts from extreme thermophillic and hyperthermophilicarcheaandbacteria

Week3:Enzyme substrate complex: Concept of E-S complex, binding sites, active site, specificity, kinetics ofenzyme activity Michaelis- Menten equation and its derivation Different plots for the determinationof KM and Vmaxand their physiological significance Two substrate reactions (random, ordered and Ping-Pong mechanisms),enzymeinhibition,typesofinhibition,determinationofKi,suicideinhibitor.

Week4:Qualitative descriptionofconcertedandsequential modelsNegative cooperativityHalf sitereactivityEnzymeregulation:Productinhibition,feedbackcontrol,covalentmodification

Week5:Enzyme- enzyme interaction , protein ligand binding Measurement analysis of binding isotherm,cooperativity, HillandScatchard plots Kinetics of allosteric enzymes Allosteric enzymes with specialreferencetoaspartatetranscarbomylaseandphosphofructokinase

Week6: Mechanism of enzyme action, general mechanistic principle Techniques for studying mechanism ofaction Factors associated with catalytic efficiency, proximity, orientation and distortion of strainCollision and transition state theories, significance of activation energy and free energy Acid base.Nucleophilicand covalent catalysis.

Week7:Isolation, crystallization and purification of enzymes Test of homogeneity of enzyme preparation,methods of enzyme analysis Detailed view of techniques for studying Enzyme assay Chemicalmodification of active site groups, chymotrypsin, Lysozyme,RNase, Carboxypeptidase, GPDH,Aldolase,alcoholdehydrogenase5Subjective.

Week8: Zymogens and their activation (proteaseses and prothrombin) Isozymes :Multiple forms of enzymeswith special reference tolactate dehydrogenase Multienzyme complexes, RibozymesMultifunctionalenzymese.g.,fattyacidsynthase.

Week9: Enzyme technology: Methods for large scale production of enzymes, immobilized enzymes and theircomparison with soluble enzymes Methods of immobilization of enzymes, immobilized enzymereactors Application of immobilized and soluble enzymesin health and industry, application tofundamental studies of biochemistry, enzyme electrodes Thermal stability and catalytic efficiency ofenzyme,sitedirectedmutagenesisandenzymeengineering-selectedexamples5Subjective.

Week10: Delivery system for protein pharmaceuticals, structure function relationship in enzymes, structuralmotifsandenzymeevolutionMethodsofproteinsequencingMethodsforanalysisofsecondaryandtertiarystructureofenzymesProteinfoldinginvitroandinvivo.

Books and References

1. "Enzymes:Biochemistry,Biotechnology,ClinicalChemistry"byPalmerTandPLBonner
2. ApplicationsofEnzymeBiotechnologybyKelly,JeffreyW.,Baldwin,ThomasO.(Eds.)
3. LehningerPrinciplesof BiochemistrybyDavidL.Nelson&MichaelM.Cox
4. NatureofEnzymesbyL.Foster4.KeithWilsonandJohnWalker.2006.
5. PrinciplesandTechniquesofBiochemistryandMolecularBiology6th edition.CambridgeUniversityPress NewYork,pp.571-594.
6. LubertStryer.2007.Biochemistry6thEditionW.H.Freeman,andCompany.NewYork
7. EnzymologybyPrice
8. Internetsources.

HumanGenetics

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/nd2_cec20_bt17/preview**

COURSELAYOUT

Week1:
1 Introduction
2 Dermatoglyphics1
3 Dermatoglyphics2

Week 2:
4. Pedigreeanalysis1
5. PedigreeAnalysis26Chromosomes

Week 3:
7. Heterochromatin
8. Ultrastructure ofChromosome
9. HumanKaryotype10Ba
ndingtechniques

Week 4:
11. Euploidyandmonoploidy
12. Haploidyandpolyploidy
13. Anueploidyandnondisjunction
14. Deletionswithexamples

Week 5:
15. Duplicationswithexamples
16. Inversionswithexamples
17. Translocationswithexamples
18. Evolutionarysignificanceof Chromosomalaberrations

Week 6:
21 Genetic disease and inheritance pattern
22.a)Autosomal dominant inheritance
22.b)Auto soma recessive inheritance

Week 7:
23. X-andY-linkedinheritance
24. Multifactorial&mitodiseases
25. Oncogene tics

Week 8:

26.Tumour suppressor genes
27.Cellsof immune system
28. Genetics of immune system

Week 9:

29. Innate adaptive immunity&I response
30. Inherited Immunodeficiency
31.a)HGPs
31. b)HGPs

Week10:

32. Geneticmarkers-SNPsandapplications
33. Geneticmarkers-CNVsandInDelsandtheirimplications
34. Prenataldisgnosis-Non-invasivemethods
35. Prenataldiagnosis-Invasivemethod

Week11:

36. Technologyinreproductiveassistance
37. Genetherapy withreferencetohemophilia
38. Cordbloodbankingandstemcelltherapy

Week12:

39. Geneticcounseling
40. Eugenics-positiveandnegativeimplications

Books and References

1. Brooker,R.J.2014.*Genetics:Analysisand Principles*.5th edition.McGrawHill.
2. Cavalli-SforzaL.L.,PiazzaA.,MenozziP.(1994)*Historyandgeographyofgenes*.(PrincetonUniversityPress,Princeton,NJ).
3. Cummings. R.2014.*HumanHeredity:Principlesand Issues*. WestPublishingCompany.
4. GardnerE.J.M.J.SimmonsandD.P.Snustad.2006*PrinciplesofGenetics*.8th edition.JohnWiley&Sons.INC .NewYork.
5. GriffithsAJF,H.J.Muller,D.T.Suzuki,R.C.LewontinandW.M.Gelbart.*Anintroductiontogeneticanalysis*.2015.11th edition.W.H.Greeman.NewYork.
6. HarpendingH.,SherryS.T.,RogersA.R.,StonekingM.(1993)*Thegeneticstructureofancienthumanpopulations*.Curr.Anthropol.34:483–496.
7. SimmonsS2006,*Principlesofgenetics*,4th Edition,JohnWiley&Sons(Asia)PteLtd.NewJersey.
8. StrickbergerM.W.2012.*Genetics*.MacMillanPublishingCo.NewYork.
9. Tamarin,RH.2009.*PrinciplesofGenetics*.McGraw-Hill.

Imagesources:

- https://www.gettyimages.in/detail/news-photo/circa-400-bc-hippocrates-an-ancient-greek-physician-and-the-news-photo/51242244
- https://www.britannica.com/biography/Aristotle
- https://commons.wikimedia.org/wiki/File:William_Bateson.jpg
- https://www.researchgate.net/figure/Spectral-karyotyping-SKY-of-the-metaphase-spread-showing-derXtXq2p_fig2_281389775
- https://www.ucl.ac.uk/~ucapikr/projects/Ana_staining_LitRev.pdf
- https://www.researchgate.net/figure/Cytogenetic-analysis-G-banding-karyotype-from-a-peripheral-blood-metaphase-of-the_fig1_235520522
- https://www.ucl.ac.uk/~ucapikr/projects/Ana_staining_LitRev.pdf
- https://www.britannica.com/biography/Gregor-Mendel

Microbial Physiology and metabolism

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/nd2_cec20_bt14/preview**

COURSELAYOUT

Week1: Microbial enzymes:StructureandClassificationMechanism of Enzyme actions: Lock and key model, induced fit theoryFactorsaffectingratesof enzymemediatedreactionsTheroleof ATPinmetabolism.

Week2: DefinitionsofgrowthandgenerationtimeMeasurementofmicrobialgrowthandspecificgrowthrateBatchandContinuousculturePhasesandtypesofgrowthcurveanditsindustrialapplicationMicrobialgrowthinresponsetotemperature,pH,soluteandwateractivity,oxygen,pressureandradiation.

Week3: Classification of bacteria based on nutrientsMembranesof microorganisms, Ion channels Passiveandfacilitateddiffusion,Primaryandsecondaryactivetransport,conceptofuniport,symportandantiportGrouptranslocationandIronuptake

Week4: PhotosyntheticpigmentsandapparatusinbacteriaPhotophosphorylation C3andC4pathwaysDifferencebetweenoxygenicand an oxygenic photosynthesis

Week5: ModeofnutritioninHydrogenandNitrifyingbacteriaMode of nutrition in Purple sulfur bacteria, Non-sulfur bacteria and Green sulfur bacteriaModeof nutritioninmethylotrophsandmethanogensUtilizationoflightenergybyhalobacteria.

Week6: Concept of aerobic respiration, anaerobic respiration and fermentationSugar degradation pathways i.e., EMP, ED and Pentose phosphate pathwayTCAcycleandElectrontransportchain ComparisonofmitochondrialandbacterialETC,electrontransportphosphorylation, uncouples and Inhibitors.

Week7: Fatesof pyruvate,Pasteureffectandindustrialimportanceof fermentationAlcohol FermentationLactate fermentation (homo fermentative and hetero fermentative pathways)Conceptof Linearandbranchedfermentationpathways.

Week8: Utilization of Lactose and GalactoseUtilization of Maltose andMannitolDegradationofcellulose,starchandglycogenConversionofbiomasstoenergyusingmicroorganisms

Week9: Mechanism of nitrogen fixation Symbiotic and non-symbiotic nitrogen fixation Biosynthesis of amino acids Degradation amino acids.

Week10: Oxidative stress Thermal stress Starvation stress and stringent response Aerobic to an aerobic transition.

Week11: Exampreparationandassessmentofassignments
Assessment at the endofthecourse,whichcomprisesof40%ofOnlineorIn-termassessmentand60%Proctoredendtermexam.

BooksandReferences

1. Moat A.G., Foster J.W. and Spector M.P. 2002.*Microbial Physiology*, 4th edition. A Johan Wileyandsonsinc.,publication.
2. KimB.H.andGaddG.M.2008.*Bacterialphysiologyandmetabolism*.CambridgeUniversityPress, Cambridge.
3. GilbertH.F.2000.*Basicconceptsinbiochemistry:Astudent'ssurvivalguide*.SecondEdition. Mc-Graw-HillCompanies,healthprofessionsDivision,NewYork.
4. MadiganM.T.,MartinkoJ.M.,StahlD.A.andCalrkD.P.2012.*BrockBiologyofMicroorganisms*.13thed.PearsonEducationInc.

Introduction to Mechanobiology

Duration	**8 weeks**
Credits	**2**
URL	**https://swayam.gov.in/nd1_noc20_bt27/preview**

COURSELAYOUT

Week1
Lecture 1: Need to study echanobiology
Lecture 2: Cell as a Tent, individual componentsLecture 3:Cell-ECMcrosstalk
Lecture4:ECMproteins:Collagen
Lecture5:Measuringpropertiesof collagennetworks

Week2
Lecture 6:Properties of collagen networks
Lecture7:Rheology
Lecture8:Rheology of biopolymer networks
Lecture9:Atomic Force Microscopy (AFM)
Lecture10:Designof proteinconstructsforAFM

Week3
Lecture 11: Protein unfolding using AFM
Lecture12:ProteinunfoldingusingAFM
Lecture 13: Focal adhesions: focal adhesion proteins
Lecture14:Focaladhesionorganization
Lecture15:Focaladhesions:role offorces

Week4
Lecture 16:Cytoskeleton:Actin
Lecture 17: Force-velocity relationships of actin networks
Lecture 18:Mesenchymalcell migration
Lecture 19: Actin dynamics during mesenchymal migration
Lecture20:Actindynamicsduringmesenchymalmigration

Week5
Lecture 21:AdhesionIndependentMigration
Lecture 22: Adhesion Independent & Collective Cell MigrationLecture23:CollectiveCellMigration
Lecture 24:Mechanobiology of Stem Cell Fate - ILecture25:MechanobiologyofStemCellFate-II

Week6

Lecture 26: Mechanobiology of Stem Cell Fate – III
Lecture 27: Mechanobiology of Diseases: Cancer I
Lecture 28: Mechanobiology of Diseases: Cancer II
Lecture29:MechanobiologyofDiseases:CancerIII
Lecture 30:MechanobiologyofDiseases:Atherosclerosis&Hypertension

Week7

Lecture 31: Mechanobiologyof Diseases: Muscular Dystrophy
Lecture32:NuclearMechanotransduction:LINCcomplex
Lecture 33: Nuclear Mechanotransduction: LINC complex in cell
migrationLecture34:NuclearMechanotransduction:Generegulation
Lecture35:Mechanical Forces&DNAdamage

Week8

Lecture 36: Techniques in Mechanobiology: Hydrogels
Lecture37:TechniquesinMechanobiology:AFM
Lecture 38: Techniques in Mechanobiology: Traction Force Microscopy, TrypsinDE adhesion &LaserAblation
Lecture39:TechniquesinMechanobiology: Micro fabrication
Lecture40:TechniquesinMechanobiology:FRE

Books and References

1. Introduction to Cell mechanics and Mechanobiology, Christopher .R. Jacobs(Garland Science)
2. Cellular and biomolecular mechanics and mechanobiology, Editors: Gefen, Amit (Springer)

PlantCellBioprocessing

Duration **8 weeks**
Credits **2**
URL **https://swayam.gov.in/nd1_noc20_bt34/preview**

COURSELAYOUT

Week 1:Introduction toplantcells

Week 2: In vitro forms of plant tissue cultures for commercial applications;Cultureinitiation

Week 3:Somaticembryogenesis andculturepreservation;Secondary metabolism in plant cells: Its role and commercial applications

Week4:Secondarymetabolisminplantcells(contd.)Strategiestoenhanceyieldandproductivity of plantsecondarymetabolitesininvitrocell/tissuecultures.

Week5:Strategiestoenhanceyieldandproductivityofplantsecondarymetabolitesininvitrocell/tissuecultures(contd.)Biotransformation and Immobilization of plant cell cultures

Week6:Genetictransformationsinplantcells

Week7:Scale-upconsiderationsinplantcell/tissuecultures

Week8: Case studies on in vitro production of high-value plant secondary metabolites forcommercialapplications:A combinatorial/integratedapproachforsynergistic effect on production rates.

Books and References

1. Karl-HermannNeumann(2009)Plantcell/tissueculture-AtoolinBiotechnology:BasicsandApplication.Springer-VerlagBerlin.ISBN:978-3-540-93883-5
2. S.DuttaGupta(2008)PlantTissueCultureEngineering.Springer.ISBN:978-1-4020-3594-4
3. J.J.Zhong(2001) Plantcells.Springer.ISBN:978-3-540-41849-8
4. PlantCell,TissueandOrganCulture.Eds.,O.L.Gamborg,G.C.Phillips.Springer-VerlagBerlin.
5. PlantTissueCulture:TheoryandPractice.Eds.,BhojawaniS.S.andRazdanM.K.,PanimaPublishingCorporation,NewDelhi.
6. PlantBiotechnology,Ed.K.G.Ramawat,S.ChandandCompanyLtd.,NewDelhi.
7. MedicinalPlantBiotechnology,Ed.CiddiVeeresham,CBCPublishersandDistributors,NewDelhi
8. Chapter14,Bioprocess considerations in usingPlantCellCultures.In(eds.ShulerML&KargiF)BioprocessEngineering,Basicconcepts.pp-431-435
9. Chapter 5, CellCultivation: Plant CellCultivations. In (ed. LeeJM)BiochemicalEngineering.pp:118-123.

Transport Phenomena in Biological Systems

Duration **12weeks**
Credits **3**
URL **https://swayam.gov.in/nd2_cec20_bt14/preview**

COURSELAYOUT

Week1: Introduction;Massconservationprinciple

Week2: Massflux

Week3: Massfluxcontd.;Review

Week4: Momentumflux

Week5: Momentumfluxcontd.

Week6: Momentumfluxcontd.

Week7: Momentumfluxcontd.;Review;Energy(heat) flux

Week8: Energy(heat) flux contd;Review

Week9: Chargeflux;Review

Week10: Fluxesundersimultaneous,multipledrivingforces

Week11: Fluxesundersimultaneous,multipledrivingforcescontd.

Week12: Fluxesundersimultaneous,multipledrivingforcescontd.;Review

Books and References.

Textbook:

1. Suraishkumar GK. 2014. Continuum Analysis of Biological Systems: Conserved Quantities, Forces and Fluxes. Springer, Heidelberg (e-book available free through Springer Link if your Institution has access to it).

References:

1. Truskey, GA, YuanF, KatzDF.2009.Transport Phenomena in BiologicalSystems.IIed. PrenticeHall,NewJersey.
2. Bird,RB,Stewart,WE,Lightfoot,EN.2001.Transport Phenomena, II edition,JohnWileyandSons,NewYork.

Introduction to Biostatistics

Duration	**8 weeks**
Credits	**2**
URL	**https://swayam.gov.in/nd1_noc20_bt23/preview**

COURSELAYOUT

Week1:

Lecture1.Introductiontothe course
Lecture2.Datarepresentationandplotting
Lecture3.Arithmeticmean
Lecture4.Geometricmean
Lecture5.Measure ofVariability,Standarddeviation

Week2:

Lecture6.SME,Z-Score,Boxplot
Lecture7. Kurtosis,
Lecture8. R programming
Lecture9.Rprogramming
Lecture10.Correlation

Week3:

Lecture 11.CorrelationandRegression
Lecture12.CorrelationandRegressionPart-II
Lecture13. Interpolation and extrapolation
Lecture14.Nonlineardatafitting
Lecture15. Concept of Probability: introduction and basics

Week4:

Lecture16.countingprinciple,Permutations,andCombinations
Lecture17.Conditionalprobability
Lecture18.ConditionalprobabilityandRandomvariables
Lecture19. Random variables, Probability mass function, and Probability density functionLecture20.Expectation,VarianceandCovariance

Week5:

Lecture21.Expectation,VarianceandCovariancePart-II
Lecture22.BinomialrandomvariablesandMomentgeneratingfunction
Lecture23. ProbabilitydistributionPoissondistributionandUniformdistributionPart-ILecture24.UniformdistributionPart-IIandNormaldistributionPart-I
Lecture25.NormaldistributionPart-IIandExponentialdistribution

Week6:

Lecture26.SamplingdistributionsandCentrallimittheoremPart-I
Lecture27. SamplingdistributionsandCentrallimittheoremPart-II
Lecture28.Central limit theorem Part-III and Sampling distributions of sample mean
Lecture29.Centrallimittheorem- IVandConfidenceintervals
Lecture30.ConfidenceintervalsPart-II

Week7:

Lecture31.Testof Hypothesis- 1

Lecture32. Test of Hypothesis - 2 (1 tailed and 2 tailed Test of Hypothesis, p-value)

Lecture33.Test of Hypothesis - 3 (1 tailed and 2 tailed Test of Hypothesis, p-value)

Lecture34.Testof Hypothesis- 4(Type-1andType-2error)

Lecture35.T-test

Week 8:

Lecture36.1tailedand 2 tailed T-distribution, Chi-square test

Lecture37.ANOVA-1

Lecture38.ANOVA-2

Lecture39.ANOVA-3

Lecture40. ANOVA for linear regression, Block Design

Books and References

1. Introduction to Probability & Statistics - Medenhall, Beaver, Beaver 14th Edition Introduction to Probability and statistics for engineers and scientists, SM Ross, 3rd Edition

Dairy And Food Process And Products Technology

Duration **12weeks**

Credits **3**

URL **https://swayam.gov.in/nd1_noc20_ag02/preview**

COURSELAYOUT

Week1:Basicprinciplesandmethodsoffoodprocessingandpreservation.EmergingTechnologies infoodprocessing.Foodadditivesandpreservatives.

Week 2:Food lawsand standards. Effect of processing on acceptability and nutritive valueoffood.

Week3:Physico-chemicalpropertiesandstructureofmilkandmilkconstituents.

Week 4:Chemical and microbial spoilage of milk and milk products; Fluid milkProcessing,packaging anddistribution.

Week5:Common dairy processes – creamseparation (standardization),pasteurization,sterilizationandHomogenization.

Week6: Process technology for manufacture of evaporated milk, condensedmilk, driedmilk, malted milk, infant and baby foods, ice-cream, cheese, butter,fermentedmilkandindigenousdairyproducts.

Week7:Methodsandproceduresforsamplingandtestingofmilkandmilkproducts. Lawsandstandardsformilkandmilkproducts.

Week8:Technological processes for industrially manufactured foods of commercialimportance,fromplantandanimalorigin.

Week9:Cereals, vegetables, fruits, meats, poultry and egg products; Bakery, pasta andconfectionaryproducts, readytoeatfoods, fermentedfoods, alcoholicandnon-AlcoholicBeverages,tea,coffeeandcocoa,fabricatedfoods.

Week10:Packaging materials; Characteristics, properties and their design. PackagingrequirementforDifferentprocessedandunprocessedfoods.

Week11:WorkingPrinciplesofvarioustypeoffillers:form-fill-sealmachine.

Week12:Gas packaging and modified atmosphere Package design. Shelf life prediction offoods in packages. Quality control in Food packaging. Product safety andpackagingregulations.

Fundamentals of Food Process Engineering

Duration **12weeks**

Credits **3**

URL **https://swayam.gov.in/nd1_noc20_ag01/preview**

COURSELAYOUT

Week1: ConceptofFood Rheologyand its Measurements

Week2: Viscoelasticfoods

Week 3: Thermal processing and microbial death kinetics

Week4: Evaporationandconcentration

Week5: Heat Exchangers

Week6: DryingTechnology

Week7: FreezingandFreezeDrying**Wee**

k8: SizeReduction

Week9: MechanicalSeparation

Techniques**Week10:**Mixingandagitation

Week11: Leaching and

Extraction**Week12:**NonThermalProces

sing

Books and References

1) FundamentalofFoodProcessEngineeringbyRTToledo,2nd Ed,2000,CBSPublishers.
2) TransportProcessand UnitOperationsby Christie. J Geankoplis, 1999, Prentice-HallInternational.Inc
3) FoodProcessEngineering,D.R.HeldmanandR.P.Singh.Springer,1981edition
4) UnitOperationsofChemicalEngineering.ByMcCabe&JCSmith, 1999.McGrawHill.
5) EngineeringPropertiesofFoods:MARao&SSHRizvi, 1986, MarcelDekkarInc.
6) UnitOperationsofChemicalEngineering.ByJMCoulson&JFRichardson,1999,McGraw-Hill BookCo.,ThePergamonPress

Introduction to Developmental Biology

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/nd1_noc20_bt21/preview**

COURSELAYOUT

Week1: DevelopmentalAnatomy–lifecycle;comparativeandevolutionaryembryology;fatemapping.

Week2: Differentialgeneexpression.

Week 3: Differential gene expression; Basic concepts of genetics.

Week4: Theconceptofmodelorganisms;Coregenetictechniques.

Week5: Cell-CellcommunicationinDevelopment–basicconceptsofmorphogenesisandcellsignaling.

Week6: Cell-CellcommunicationinDevelopment–thesignalingpathways.

Week7: AxisspecificationduringDrosophilaembryogenesis.

Week8: AxisspecificationduringDrosophilaembryogenesis.**Week**

9:PlantDevelopment.

Week 10: Early mammalian development – Cleavage and gastrulation.

Week11: Earlymammaliandevelopment–Axisformation.

Week12: Developmentalmechanismsof evolutionarychange.

Books and References

DevelopmentalBiology(9thorlatereditions)Author:ScottGilbert

Biomaterials For Bone Tissue Engineering Applications

Duration	**8 weeks**
Credits	**2**
URL	**https://swayam.gov.in/nd1_noc19_mm24/preview**

COURSELAYOUT

Week 1: Introduction to Biomaterials and Biocompatibility.

Week2:Definingtissueengineeringscaffoldsandimplants.

Week 3:Structure and Properties of Proteins and Cells.

Week4:StemcellsandCellfateprocesses.

Week 5:Cell-material Interaction (in vitro and in vivo) and Clinical trials.

Week 6: Manufacturing of Biomaterials (metals, ceramics and polymers).

Week7:HA-basedcomposites.

Week8: Glass ceramicsfororthopedicanddentalapplications,acetabularsocketandfemoralhead,

Prototypedevelopment.

Books and References

1. B.Basu, D.Katti andAshokKumar;AdvancedBiomaterials:Fundamentals,Processingand Applications;JohnWiley&Sons,Inc.,USA(ISBN:978-0-470-19340-2),September,2009.
2. BiomaterialsScience:AnintroductiontoMaterialsinMedicine,EditedbyRatner,Hoffman, SchoetandLemons,SecondEdition:ElsevierAcademicPress,2004.

Bioengineering: An Interface with Biology and Medicine

Duration	**8 weeks**
Credits	**2**
URL	**https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-bt09/**

COURSELAYOUT

Week1:WhyBiologyforEngineers,cellproperties,clinicians'perspectives

Week2:DNAtoolsforBiotechnology

Week3:DNAtoolsforBiotechnology&clinicians'perspectives

Week4:Geneticsinclinicianperspective

Week5:ChromosomalDisorders in clinician perspective

Week6:Cellcycledysregulation incancer,DevelopmentalBiology,AnimalcloningEvolutionin clinicianperspective

Week7:Proteomics

Week8: Techniques inproteomicsstudyandtoolsinBioinformatics.

Tissue Engineering

Duration	**8 weeks**
Credits	**2**
URL	**https://swayam.gov.in/nd1_noc20_bt33/preview**

COURSELAYOUT

Week1: Introductiontotissueengineering

Week2: Scaffolds:extracellularmatrix, naturalandsyntheticpolymers

Week3: Hydrogels, bio ceramics,scaffoldfabrication

Week4: Materialcharacterization

Week5: Cellsource,isolation,growth,differentiation

Week6: Celladhesion,migration,signaling,bioreactorsandchallengesintissueengineering

Week7: Hostintegration,bioethics,Applications:Skintissueengineering

Week8: Applications:Bonetissueengineering,Vasculartissueengineering, andCornealtissue Engineering

Books and References

1. BernhardO.Palsson,SangeethaN.Bhatia,TissueEngineering,2004,Pearson
2. RobertABrown,ExtremeTissueEngineering:ConceptsandStrategiesforTissueFabrication,2013,WileyBlackwell
3. WMarkSaltzman,TissueEngineering:EngineeringPrinciplesfortheDesignofReplacementOrgansandTissues,2004,OxfordUniversityPress
4. JohnPFisher,AntoniosGMikos,JosephDBronzino,TissueEngineering,2006,CRCPressRobert Lanza, Robert Langer, Joseph Vacanti, Principles of Tissue Engineering, Third Edition, 2007,ElsevierAcademicPress

Introduction To Proteomics

Duration	**8 weeks**
Credits	**2**
URL	**https://swayam.gov.in/nd1_noc20_bt23/preview**

COURSELAYOUT

Week1: Basics of Proteins and Proteomics
Lecture1 : Introduction to amino acids
Lecture2:IntroductiontoProteins
Lecture3 : Protein folding &misfolding
Lecture4:IntroductiontoProteomics
Lecture5:Labsession–Protein-proteininteractionusinglabel-freebiosensors

Week2: Gel-basedproteomics
Lecture6:Sample preparation and pre-analytical factors
Lecture7:Samplepreparation:Pre-analyticalfactors(contd.)
Lecture8 :Sample preparation: Protein extraction and quantification
Lecture9:One-dimensionalelectrophoresis
Lecture10:Introductionto2-DE

Week 3: Two-dimensional gel electrophoresis (2-DE)
Lecture11 :2-DE: Second dimension, staining &destaining
Lecture12:2-DE:Gelanalysis
Lecture13:2-DEApplications
Lecture14:2-DEApplications(contd.)&Challenges
Lecture15:Labsession-Protein/peptidepre-fractionation using OFFGEL FRACTIONATOR & dataanalysis

Week4: Differenceing electrophoresis
(DIGE)&SystemsBiologyLecture16:2D-DIGE:Basics
Lecture17: 2D-DIGE: Data analysis
Lecture18:2D-DIGE:Applications
Lecture19: Systems biology and proteomics–I
Lecture20:Systemsbiologyandproteomics-II

Week5: Basicsofmassspectrometry
Lecture21:Fundamentals of mass spectrometry
Lecture22 : Chromatography technologies
Lecture23:Liquidchromatography
Lecture24: Mass spectrometry: Ionization sources
Lecture25:Massspectrometry:Massanalyzers

Week6: Basicsofmassspectrometryandsamplepreparation
Lecture26:MALDIsamplepreparationandanalysis
Lecture27:Hybrid mass spectrometryconfigurations
Lecture28:Lab session - Demonstration of Q-TOF MS technology
Lecture29:In-gel&in-solutiondigestion
Lecture30:Labsession-Samplepreparation:tissuesamplepreservationtechnology

Week7: Quantitativeproteomics
Lecture31 :Introduction to quantitative proteomics
Lecture32:SILAC:Invivolabelling
Lecture33:iTRAQ:Invitrolabelling
Lecture34:TMT:Invitrolabelling
Lecture35 :Quantitativeproteomicsdataanalysis

Week8:AdvancementinProteomicsLectu
re 36: Proteomics applications
Lecture37 :Challengesinproteomics
Lecture38:OMICSandtranslationalresearch
Lecture 39 :Lab session – Targeted proteomics using triple quadrupole mass spectrometry
Lecture40 :Labsession–Targetedproteomics:multiplereactionmonitoring

Computer Aided Drug Design

Duration	**8 weeks**
Credits	**2**
URL	**https://swayam.gov.in/nd1_noc20_bt23/preview**

COURSELAYOUT

Week1:Introductiontodrugdiscovery

Week2:Structureandproperty

Week3:ADME-rules

Week4:Forcefield/MM/QM

Week5:Boundaryconditions/Conformation

Week6:QSAR/Pharmacophore

Week7:Enzymes/proteinsstructures/docking

Week8:PK/PD

BOOKS AND REFERENCES

1. VoitE(2012) A First Course in Systems Biology. Garland Science,1/e.ISBN0815344678•KlippE(200 Stemsbiology:atextbook.Wiley-VCH,1/e.ISBN9783527318742•NewmanMEJ(2011)Networks: Introduction.OxfordUniv.Press.ISBN9780199206650.

Drug delivery: Principles and Engineering

Duration	**12weeks**
Credits	**3**
URL	**https://swayam.gov.in/nd1_noc20_bt24/preview**

COURSELAYOUT

Week1
Module01: Molecules of living systems-Part 1
Module02: Molecules of living Systems–Part 2Module03:Moleculesof livingsystems-Part3

Week2
Module04: Molecules of living systems Part 4
Module05: Molecules of living systems Part 5
Module06:Reactionsofthebiologicalsystem

Week3
Module07:Carbohydrates-Part1
Module08:Carbohydrtaes-Part2
Module09:Lipids

Week4
Module10:LipidMetabolism(Part-1)
Module 11: Lipid metabolism (Part 2)
Module12:Lipidmetabolism(Part-3)

Week5
Module13:Proteins(Part-1)
Module14:Proteins(Part-2)
Module15:Proteins(Part-3)

Week6
Module16:CovalentprimarystructureM
odule 17:Secondarystructure
Module18:Supersecondary,tertiaryandquaternarystructure

Week7
Module 19: Protein folding, symmetry, subunit and dynamicsModule 20:Differentshape,size ofproteinsandfibrousproteins
Module21: Quaternary structureglobularprotein

Week 8
Module22: Enzyme, Characteristics, Properties & Significance
Module23:Enzyme,Activity,Purification,Assay,Unit
Module24:Enzyme,Kineticsregulation&Catalysis

Week 9
Module25:Vitamins
Module 26: Vitamin B Complex (Part-
1)Module27:VitaminBComplex(Part-2)

Week10
Module 28: Vitamin
CModule 29: Vitamin
DModule30:VitaminA,E&K

Week11
Module31:EstimationofDNAandRNAbyMeasurementofsugarModul
e32:ProteinEstimation
Module33:EstimationofglucosebyGlucoseOxidase Method

Week12
Module34: Estimation of serum cholesterol by cholesterol oxidase method
Module35:Liverfunctiontests
Module36:Estimationofbilirubin

Books and References

1. LehningerPrincipleof BiochemistrybyD.L.NelsonandM.M.Cox.7th edition.
2. BiochemistrybyDonaldVoetandJudithVoet.4th edition
3. Harper'sillustratedBiochemistrybyRobertK.Murray
4. MolecularBiologyoftheCell,4th editionbyBruceAlberts,AlexanderJohnson,JulianLewis,Mar tinRaff,KeithRoberts,andPeterWalter.
5. Biochemistry.6th edition.ByCharlesGrisham,ReginaldHGarrett,StavroulaAndreopoulos,WilliamG. Willmore,ImedE.Gallouzi.

Introduction to Proteogenomics

Duration **12weeks**
Credits **3**
URL **https://swayam.gov.in/nd1_noc20_bt19/preview**

COURSELAYOUT

Week1:Proteogenomics overview- Part I, Proteogenomics overview- Part II, Introduction toGenomics- Part I : Gene Sequencing and mutations Introduction to Genomics-Part II : Sequencealignment, Introduction to Genomics-Part III :Transcript me, SL1: Advancement in Cancer Genomics,SL2:AdvancementinCancerGenomics.

Week2:Introduction to Genomics IV : Epigenome, Introduction to Genomics : cBioPortal, Genotype,Gene expression & Phenotype - Part I, Genotype, Gene expression & Phenotype- Part II, An overviewof NGStechnology,SH1: NGS-Sequencingbysynthesis,SH2:NGS- Sequencingbysynthesis.

Week3:IntroductiontoProteomics,Proteomics:SamplePrep&ProteinQuantification,Proteomics:Sample Prep &Protein Quantification (Hands-on), Introduction to MS-based Proteomics- Part I,Introduction to MS-based Proteomics- Part II, SL 3: Applications of NGS – Ion Torrent, SL4:Applicationsof NGS – IonTorrent.

Week4: Introduction to MS-based Proteomics- Part I (Hands-on), Introduction to MS-basedProteomics- Part II (Hands-on), Data analysis: Normalization, Data analysis: Batch Correction andMissing values, Data analysis:Statistical Tests, SH3: NGS- Ion Torrent, SH4: NGS-Ion Torrent.

Week5:Machine learning and Clustering, Hypothesis testing, ProTIGY- Part I, ProTIGY- Part II,Proteogenomicsapproachtounravelproteoforms,SL5:GenomicAnalysisusingDropletPCR,SL6:GenomicAnalysisusingDropletPCR.

Week6: Workflow to Automated Data Processing, Introduction to Fire Cloud, Fire Cloud and DataModel, Bioinformaticssolutions for 'Big Data' Analysis- Part I, Bioinformatics solutions for 'Big Data'Analysis-Part II, SH5: GenomicAnalysis using Droplet PCR, SH6: Genomic Analysis using Droplet PCR

Week7:Data Science infrastructure management- Part I, Data Science infrastructure management-Part II, DataScience infrastructure management- Part III, DIA-SWATH Atlas-Part I, DIA-SWATHAtlas-PartII,SL7:Introduction to Targeted Proteomics,SH7:DataAnalysisusingSkyline.

Week8: Human Protein Atlas-Part I Clinical, Human Protein Atlas-Part II, Affinity based proteomics& HPA, ClinicalConsiderations for OMICS-Part I, Considerations for OMICS- Part II, SL8: Proteomics:PTMs,SL9:ClinicalProteomics.

Week9:Introduction to Proteogenomics-Part I, Introduction to Proteogenomics-Part II, Sequencecentriproteogenomics,GeneVariantAnalysis,ProteomicsinClinicalstudies,SH8:ProTIGY

Week10:Supervised Machine learning- Predictive Analysis Part I, Supervised Machine learning- Predictive AnalysisPart II, Supervised Machine learning- Marker Selection, Gene Set Analysis usingWebGestalt- Part I, Gene Set Analysis using WebGestalt- Part II, SH9: Supervised Machine Learning.

Week11: Biological Network Analysis- Part I, Biological Network Analysis- Part II, Mutation andSignaling - Part I,Mutation and Signaling- Part II, Pathway Enrichment,SH10: Pathway EnrichmentandNetworkAnalysis.

Week 12:Gene Set Enrichment Analysis (GSEA), Pathway enrichment: GSEA, Linked Omics, LinkedOmics (Hands-on), Proteogenomics Conclusions, SL10: Topics in Proteogenomics- Malaria andCancercasestudy.

Books and References

1. Proteomics: A Cold Spring Harbor Laboratory Course Manual, A.J.Link and J.LaBaer,Cold Spring Harbor Laboratory Press, 2009. Selected papers from scientific journals.

Dr. RajasriYadavalli

(I/C Head, Biotechnology)