

Lecture 1 - Introduction

Lecture 2 - Graphs and functions - I

Lecture 3 - Graphs and functions - II

Lecture 4 - Functions and derivatives

Lecture 5 - Calculation of derivatives

Lecture 6 - Differentiation and its application in Biology - I

Lecture 7 - Differentiation and its application in Biology - II

Lecture 8 - Differentiation and its application in Biology - III

Lecture 9 - Differentiation and its application in Biology - IV

Lecture 10 - Integration - I

Lecture 11 - Integration - II

Lecture 12 - Differential equations - I

Lecture 13 - Differential equations - II

Lecture 14 - Vectors - I

Lecture 15 - Vectors - II

Lecture 16 - Vectors - III

Lecture 17 - Nernst equation

Lecture 18 - Diffusion - I : Diffusion equation

Lecture 19 - Diffusion - II : Mean-square displacement

Lecture 20 - Diffusion - III : Einstein's relation

Lecture 21 - Statistics : Mean and variance

Lecture 22 - Statistics : Distribution function

Lecture 23 - Understanding Normal distribution

Lecture 24 - Fitting a function to experimental data

Lecture 25 - Size of a flexible protein: Simplest model

Lecture 26 - Uniform and Poisson distributions; Knudsen's analysis

Lecture 27 - Fourier Series - I

Lecture 28 - Fourier Series - II

Lecture 29 - Fourier transform

Lecture 30 - Master equation: Polymerization dynamics, Molecular motor motion

Lecture 31 - Evolution: Simplest model

[Lecture 32 - Tutorial - I](#)

[Lecture 33 - Tutorial - II](#)

[Lecture 34 - Temperature, Energy and Entropy](#)

[Lecture 35 - Partition function, Free energy](#)

[Lecture 36 - Bending fluctuations of DNA and spring-like proteins](#)

[Lecture 37 - Force-extension and looping of DNA](#)

[Lecture 38 - Thermodynamics of protein organization along DNA](#)

[Lecture 39 - Learning mathematics with the help of a computer](#)

**NPTEL : Proteomics: Principles and Techniques (Biotechnology)**

**Co-ordinators : Prof. Sanjeeva Srivastava**

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 0 - Proteins and Gel-Based Proteomics; Course Introduction](#)

[Lecture 1 - Introduction to amino acids](#)

[Lecture 2 - Introduction to proteins](#)

[Lecture 3 - Protein folding & misfolding](#)

[Lecture 4 - Protein purification techniques](#)

[Lecture 5 - Introduction to proteomics](#)

[Lecture 6 - Systems biology and proteomics](#)

[Lecture 7 - Sample preparation and pre-analytical factors](#)

[Lecture 8 - Sample preparation: Pre-analytical factors \(Continued...\)](#)

[Lecture 9 - Sample preparation: Protein extraction and quantification](#)

[Lecture 10 - One-dimensional electrophoresis](#)

[Lecture 11 - 2-DE: Rehydration, IEF & Equilibration](#)

[Lecture 12 - 2-DE: Second dimension, staining & destaining](#)

[Lecture 13 - 2-DE: Gel analysis](#)

[Lecture 14 - 2-DE: Applications](#)

[Lecture 15 - 2-DE: Applications \(Continued...\) & Challenges](#)

[Lecture 16 - 2D-DIGE: Basics](#)

[Lecture 17 - 2D-DIGE: Data analysis](#)

[Lecture 18 - 2D-DIGE: Applications](#)

[Lecture 19 - Protein identification using MALDI-TOF/TOF](#)

[Lecture 20 - Proteomics experiment data analysis & challenges](#)

Lecture 0 - Introductory lecture

Lecture 1 - Introduction to proteomics

Lecture 2 - Proteomics and sample preparation

Lecture 3 - Bacterial protein extraction

Lecture 4 - In-gel digestion

Lecture 5 - Fundamentals of mass spectrometry

Lecture 6 - Chromatography technologies

Lecture 7 - Liquid chromatography

Lecture 8 - Mass spectrometry: Ionization sources

Lecture 9 - Mass spectrometry: Mass analyzers

Lecture 10 - MALDI sample preparation and analysis

Lecture 11 - Introduction to quantitative proteomics

Lecture 12 - Hybrid mass spectrometry configurations

Lecture 13 - SILAC: In Vivo labeling

Lecture 14 - iTRAQ: In Vitro labeling

Lecture 15 - TMT: In vitro labeling

Lecture 16 - Quantitative proteomics data analysis

Lecture 17 - Proteomics and Systems biology I

Lecture 18 - Proteomics & Systems biology II

Lecture 19 - Proteomics applications

Lecture 20 - Advances and challenges in proteomics

Lecture 1 - Introduction to Interactomics

Lecture 2 - An overview of label-free technologies

Lecture 3 - An overview of surface plasmon resonance (SPR)

Lecture 4 - An overview of surface plasmon resonance imaging (SPRi)

Lecture 5 - Basics of SPR: Surface chemistry

Lecture 6 - Basics of SPR: Experimental design

Lecture 7 - Protein immobilization for protein-protein interaction studies

Lecture 8 - Protein-protein interaction study: Binding analysis

Lecture 9 - Protein-protein interaction study: Kinetic analysis

Lecture 10 - Protein-small molecule interaction study: Immobilization and binding analysis

Lecture 11 - Protein-small molecule interaction study: Kinetic analysis

Lecture 12 - SPR: Interactive Session - I

Lecture 13 - SPR: Interactive Session - II

Lecture 14 - An overview of ellipsometry and interferometry techniques

Lecture 15 - An introduction to BioLayer Interferometry (BLI) and its applications in protein research

Lecture 16 - Kinetic analysis of protein-protein interaction using BLI

Lecture 17 - Label-free quantification of proteins using BLI

Lecture 18 - Diffraction-based biosensors - I

Lecture 19 - Diffraction-based biosensors - II

Lecture 20 - Nanotechniques in proteomics - I

Lecture 21 - Nanotechniques in proteomics - II

Lecture 22 - High throughput platforms of interactomics: Protein arrays

Lecture 23 - Conventional label based detection techniques for Protein microarrays

Lecture 24 - Novel detection techniques for Protein microarrays

Lecture 25 - Recombinational cloning and its application for Protein microarrays

Lecture 26 - An introduction to Cell-free protein synthesis

Lecture 27 - Cell-free synthesis based protein microarrays: PISA and NAPPA

Lecture 28 - Cell-free synthesis based protein microarrays: MIST, DAPA and Halotag Arrays

Lecture 29 - Digging deeper into NAPPA: Basic Workflow

Lecture 30 - Digging deeper into NAPPA: Surface Chemistry, Printing and Assessment

Lecture 31 - Application of cell free expression protein microarrays in biomarker discovery

[Lecture 32 - Application of cell free expression protein microarrays in immunological studies](#)

[Lecture 33 - Basics of microarray image scanning](#)

[Lecture 34 - Software for Image scanning and data processing](#)

[Lecture 35 - Microarray Data Analysis - Part I](#)

[Lecture 36 - Microarray Data Analysis - Part II](#)

[Lecture 37 - Application of protein microarray in biomarker discovery - I](#)

[Lecture 38 - Application of protein microarray in biomarker discovery - II](#)

[Lecture 39 - Systems biology and networks](#)

[Lecture 40 - Challenges in proteomics](#)

Lecture 1 - Introduction to amino acids

Lecture 2 - Introduction to proteins

Lecture 3 - Protein folding and misfolding

Lecture 4 - Introduction to proteomics

Lecture 5 - Lab session " Protein-protein interaction using label-free biosensors

Lecture 6 - Sample preparation and pre-analytical factors

Lecture 7 - Sample preparation: Pre-analytical factors (Continued...)

Lecture 8 - Sample preparation: Protein extraction and quantification

Lecture 9 - One-dimensional electrophoresis

Lecture 10 - Introduction to 2-DE

Lecture 11 - 2-DE: Second dimension, staining and destaining

Lecture 12 - 2-DE: Gel analysis

Lecture 13 - 2-DE Applications

Lecture 14 - 2-DE Applications (Continued...) and Challenges

Lecture 15 - Lab session - Protein/peptide pre-fractionation using OFFGEL FRACTIONATOR and data analysis

Lecture 16 - 2D-DIGE: Basics

Lecture 17 - 2D-DIGE: Data analysis

Lecture 18 - 2D-DIGE: Applications

Lecture 19 - Systems biology and proteomics - I

Lecture 20 - Systems biology and proteomics - II

Lecture 21 - Fundamentals of mass spectrometry

Lecture 22 - Chromatography technologies

Lecture 23 - Liquid chromatography

Lecture 24 - Mass spectrometry: Ionization sources

Lecture 25 - Mass spectrometry: Mass analyzers

Lecture 26 - MALDI sample preparation and analysis

Lecture 27 - Hybrid mass spectrometry configurations

Lecture 28 - Lab session - Demonstration of Q-TOF MS technology

Lecture 29 - In-gel and in-solution digestion

Lecture 30 - Lab session - Sample preparation: tissue sample preservation technology

Lecture 31 - Introduction to quantitative proteomics

[Lecture 32 - SILAC: In vivo labeling](#)

[Lecture 33 - iTRAQ: In vitro labeling](#)

[Lecture 34 - TMT: In vitro labeling](#)

[Lecture 35 - Quantitative proteomics data analysis](#)

[Lecture 36 - Proteomics applications](#)

[Lecture 37 - Challenges in proteomics](#)

[Lecture 38 - OMICS and translational research](#)

[Lecture 39 - Lab session - Targeted proteomics using triple quadrupole mass spectrometry](#)

[Lecture 40 - Lab session - Targeted proteomics: multiple reaction monitoring](#)

- Lecture 1 - Introduction to the course
- Lecture 2 - Data representation and plotting
- Lecture 3 - Arithmetic mean
- Lecture 4 - Geometric mean
- Lecture 5 - Measure of Variability, Standard deviation
- Lecture 6 - SME, Z-Score, Box plot
- Lecture 7 - Moments, Skewness
- Lecture 8 - Kurtosis, R programming
- Lecture 9 - R programming
- Lecture 10 - Correlation
- Lecture 11 - Correlation and Regression - Part-I
- Lecture 12 - Correlation and Regression - Part-II
- Lecture 13 - Interpolation and extrapolation
- Lecture 14 - Nonlinear data fitting
- Lecture 15 - Concept of Probability: introduction and basics
- Lecture 16 - Counting principle, Permutations, and Combinations
- Lecture 17 - Conditional probability
- Lecture 18 - Conditional probability and Random variables
- Lecture 19 - Random variables, Probability mass function, and Probability density function
- Lecture 20 - Expectation, Variance and Covariance - Part-I
- Lecture 21 - Expectation, Variance and Covariance - Part-II
- Lecture 22 - Binomial random variables and Moment generating function
- Lecture 23 - Probability distribution: Poisson distribution and Uniform distribution Part-I
- Lecture 24 - Uniform distribution Part-II and Normal distribution Part-I
- Lecture 25 - Normal distribution Part-II and Exponential distribution
- Lecture 26 - Sampling distributions and Central limit theorem - Part-I
- Lecture 27 - Sampling distributions and Central limit theorem - Part-II
- Lecture 28 - Central limit theorem - Part-III and Sampling distributions of sample mean
- Lecture 29 - Central limit theorem - Part-IV and Confidence intervals
- Lecture 30 - Confidence intervals Part- II
- Lecture 31 - Test of Hypothesis - 1

[Lecture 32 - Test of Hypothesis - 2 \(1 tailed and 2 tailed Test of Hypothesis, p-value\)](#)

[Lecture 33 - Test of Hypothesis - 3 \(1 tailed and 2 tailed Test of Hypothesis, p-value\)](#)

[Lecture 34 - Test of Hypothesis - 4 \(Type -1 and Type -2 error\)](#)

[Lecture 35 - T-test](#)

[Lecture 36 - 1 tailed and 2 tailed T-distribution, Chi-square test](#)

[Lecture 37 - ANOVA - 1](#)

[Lecture 38 - ANOVA - 2](#)

[Lecture 39 - ANOVA - 3](#)

[Lecture 40 - ANOVA for linear regression, Block Design](#)

- Lecture 1 - Need to Study Mechanobiology
- Lecture 2 - Cell as a Tent, Individual Components
- Lecture 3 - Cell-ECM Crosstalk
- Lecture 4 - ECM Proteins: Collagen
- Lecture 5 - Measuring Properties of Collagen Networks
- Lecture 6 - Properties of Collagen Networks
- Lecture 7 - Rheology
- Lecture 8 - Rheology of Biopolymer Networks
- Lecture 9 - Atomic Force Microscopy (AFM)
- Lecture 10 - Design of Protein Constructs for AFM
- Lecture 11 - Protein Unfolding using AFM
- Lecture 12 - Protein Unfolding using AFM
- Lecture 13 - Focal Adhesions: Focal Adhesion Proteins
- Lecture 14 - Focal Adhesion Organization
- Lecture 15 - Focal Adhesions: Role of Forces
- Lecture 16 - Cytoskeleton: Actin
- Lecture 17 - Force-velocity Relationships of Actin Networks
- Lecture 18 - Mesenchymal Cell Migration
- Lecture 19 - Actin Dynamics during Mesenchymal Migration
- Lecture 20 - Actin Dynamics during Mesenchymal Migration
- Lecture 21 - Adhesion Independent Migration
- Lecture 22 - Adhesion Independent and Collective Cell Migration
- Lecture 23 - Collective Cell Migration
- Lecture 24 - Mechanobiology of Stem Cell Fate - I
- Lecture 25 - Mechanobiology of Stem Cell Fate - II
- Lecture 26 - Mechanobiology of Stem Cell Fate - III
- Lecture 27 - Mechanobiology of Diseases: Cancer - I
- Lecture 28 - Mechanobiology of Diseases: Cancer - II
- Lecture 29 - Mechanobiology of Diseases: Cancer - III
- Lecture 30 - Mechanobiology of Diseases: Atherosclerosis and Hypertension
- Lecture 31 - Mechanobiology of Diseases: Muscular Dystrophy

[Lecture 32 - Nuclear Mechanotransduction: LINC complex](#)

[Lecture 33 - Nuclear Mechanotransduction: LINC Complex in Cell Migration](#)

[Lecture 34 - Nuclear Mechanotransduction: Gene Regulation](#)

[Lecture 35 - Mechanical Forces and DNA damage](#)

[Lecture 36 - Techniques in Mechanobiology: Hydrogels](#)

[Lecture 37 - Techniques in Mechanobiology: AFM](#)

[Lecture 38 - Techniques in Mechanobiology: Traction Force Microscopy, Trypson Deadhesion and Laser Ablation](#)

[Lecture 39 - Techniques in Mechanobiology: Microfabrication](#)

[Lecture 40 - Techniques in Mechanobiology: FRET](#)

Lecture 1 - Introduction

Lecture 2 - Graphs and Functions

Lecture 3 - Equations as Graphs

Lecture 4 - Graphs : Exponential and Periodic Functions

Lecture 5 - Graphs : Logarithmic and Other Functions

Lecture 6 - Images as 2D/3D Functions

Lecture 7 - Functions and its Derivatives

Lecture 8 - Computing Derivatives of Curves

Lecture 9 - Rules for Calculating Derivatives

Lecture 10 - Understanding Derivatives

Lecture 11 - Curvature and Second Derivative

Lecture 12 - Plotting Curves

Lecture 13 - Numerical Calculation of Derivatives

Lecture 14 - Function, Derivatives and Series Expansion

Lecture 15 - L'Hopital's Rule and Partial Derivatives

Lecture 16 - Integration

Lecture 17 - Integration : Rules

Lecture 18 - Integration : Graphical Understanding

Lecture 19 - Integration : More Examples

Lecture 20 - Integration : Product of Two Functions

Lecture 21 - Exponential Growth and Decay

Lecture 22 - Scalars and Vectors

Lecture 23 - Vectors : Position and Movement in 2D

Lecture 24 - Cell Symmetry : Use of Polar Coordinates

Lecture 25 - Gradient, Forces and Flows : Part I

Lecture 26 - Gradient, Forces and Flows : Part II

Lecture 27 - Understanding Diffusion

Lecture 28 - Diffusion Constant and Einstein Relation 1905

Lecture 29 - Diffusion Equation

Lecture 30 - Diffusion vs. Active Transport

Lecture 31 - Nernst Equation

[Lecture 32 - Fourier Series : Part I](#)

[Lecture 33 - Fourier Series : Part II](#)

[Lecture 34 - Fourier Transform](#)

[Lecture 35 - Introduction to Statistics](#)

[Lecture 36 - Mean, Standard deviation and Distribution](#)

[Lecture 37 - Frequency Distribution and Probability Distribution](#)

[Lecture 38 - Binomial Distribution](#)

[Lecture 39 - Normal Distribution](#)

[Lecture 40 - Hypothesis Testing and Mathematical Modeling](#)

- Lecture 1 - Why biology for engineers - Part I
- Lecture 2 - Why biology for engineers - Part II
- Lecture 3 - Life processes and Cell
- Lecture 4 - Cell and its properties
- Lecture 5 - Clinician's Perspective - I
- Lecture 6 - Nucleic Acid and Central Dogma
- Lecture 7 - DNA Tools: Gene Cloning - I
- Lecture 8 - DNA Tools: Gene Cloning - II
- Lecture 9 - DNA Tools and Biotechnology - I
- Lecture 10 - DNA Tools and Biotechnology - II
- Lecture 11 - DNA Tools and Biotechnology - III
- Lecture 12 - DNA Tools and Biotechnology - IV
- Lecture 13 - DNA Tools and Biotechnology - V
- Lecture 14 - DNA Tools and Biotechnology - VI
- Lecture 15 - Clinician's Perspective - II
- Lecture 16 - Genetics - I
- Lecture 17 - Genetics - II
- Lecture 18 - Genetics - III
- Lecture 19 - Genetics - IV
- Lecture 20 - Clinician's Perspective - III
- Lecture 21 - Chromosomal basis of inheritance
- Lecture 22 - Linkage, chromosomal disorders
- Lecture 23 - Classical Genetics Experiments
- Lecture 24 - Bacteria and Viruses
- Lecture 25 - Clinician's Perspective - IV
- Lecture 26 - Cell cycle dysregulation and Cancer
- Lecture 27 - Developmental Biology
- Lecture 28 - Principles and application of Animal Cloning
- Lecture 29 - Evolution
- Lecture 30 - Clinician's Perspective - V
- Lecture 31 - Amino acids and proteins

[Lecture 32 - Proteins and Proteomics](#)

[Lecture 33 - Techniques to Study Protein and Proteome - I](#)

[Lecture 34 - Techniques to Study Protein and Proteome - II](#)

[Lecture 35 - Bioinformatics - I](#)

[Lecture 36 - Techniques to Study Protein and Proteome - III](#)

[Lecture 37 - Protein Interactions and Microarrays](#)

[Lecture 38 - Protein interactions and Systems biology](#)

[Lecture 39 - Bioinformatics - II](#)

[Lecture 40 - Ethics in Research and Publications](#)

Lecture 1 - Introduction to Interactomics and Protein Arrays

Lecture 2 - NAPPA Technology and Protein Arrays - I

Lecture 3 - NAPPA Technology and Protein Arrays - II

Lecture 4 - Biomarkers: Harnessing the immune system for early detection of disease - I

Lecture 5 - Biomarkers: Harnessing the immune system for early detection of disease - II

Lecture 6 - Biomarkers: Harnessing the immune system for early detection of disease - III

Lecture 7 - NAPPA and its applications in study of antibody immune response in disease and in drug Screening - I

Lecture 8 - NAPPA and its applications in study of antibody immune response in disease and in drug screening - II

Lecture 9 - NAPPA and its applications in study of antibody immune response in disease and in drug screening - III

Lecture 10 - Using functional proteomics to identify biomarkers and therapeutic targets - I

Lecture 11 - Using functional proteomics to identify biomarkers and therapeutic targets - II

Lecture 12 - Applications of protein microarrays in Malaria Research - I

Lecture 13 - Applications of protein microarrays in Malaria Research - II

Lecture 14 - Applications of protein microarrays in Cancer Research - I

Lecture 15 - Applications of protein microarrays in Cancer Research - II

Lecture 16 - Introduction to Bioprinting and Iris's Optical QC Benefits - I

Lecture 17 - Introduction to Bioprinting and Iris's Optical QC Benefits - II

Lecture 18 - Basics and Applications of Reverse Phase Protein Arrays - I

Lecture 19 - Basics and Applications of Reverse Phase Protein Arrays - II

Lecture 20 - Basics and Applications of Reverse Phase Protein Arrays - III

Lecture 21 - Antibody signatures defined by high-content peptide microarray analysis

Lecture 22 - An overview of label-free technologies - I

Lecture 23 - An overview of label-free technologies - II

Lecture 24 - Mass Spectrometry coupled Interactomics - I

Lecture 25 - Mass Spectrometry coupled Interactomics - II

Lecture 26 - Biomolecular interactions using Bio-Layer Interferometry (BLI) - I

Lecture 27 - Biomolecular interactions using Bio-Layer Interferometry (BLI) - II

Lecture 28 - Biomolecular interaction analytics using MicroScale Thermophoresis

Lecture 29 - Surface Plasmon Resonance- Principles and Assays - I

Lecture 30 - Surface Plasmon Resonance- Principles and Assays - II

Lecture 31 - Use of SPR in unravelling domain motif interactions of proteasomal assembly chaperones

[Lecture 32 - Next-Generation Sequencing Technology- Ion Torrent](#)

[Lecture 33 - NGS Technology- Bioinformatics and data analysis - I](#)

[Lecture 34 - NGS Technology- Bioinformatics and data analysis - II](#)

[Lecture 35 - Next-Generation Sequencing Technology-MiSeq System](#)

[Lecture 36 - NGS target enrichment workflow for exomes, targeted panels and beyond](#)

[Lecture 37 - The Human Pathology Atlas: A Pathology Atlas of the Human Transcriptome - I](#)

[Lecture 38 - The Human Pathology Atlas: A Pathology Atlas of the Human Transcriptome - II](#)

[Lecture 39 - Conclusions and Overview - I \(Statistical analysis - I\)](#)

[Lecture 40 - Conclusions and overview - II \(Statistical analysis - II\)](#)

- Lecture 1 - Proteogenomics overview - I
- Lecture 2 - Proteogenomics overview - II
- Lecture 3 - Introduction to Genomics - Part I : Gene sequencing and mutations
- Lecture 4 - Introduction to Genomics - Part II : Sequence Alignment
- Lecture 5 - Introduction to Genomics - Part III : Transcriptome
- Lecture 6 - Perspectives in Proteogenomics - I
- Lecture 7 - Advancement in Cancer Genomics
- Lecture 8 - Introduction to Genomics - Part IV : Epigenome
- Lecture 9 - Introduction to Genomics - cBioPortal
- Lecture 10 - Genotype, Gene expression and Phenotype - I
- Lecture 11 - Genotype, Gene expression and Phenotype - II
- Lecture 12 - An overview of NGS technology
- Lecture 13 - NGS - Sequencing by synthesis - I
- Lecture 14 - NGS - Sequencing by synthesis - II
- Lecture 15 - Introduction to Proteomics
- Lecture 16 - Proteomics: Sample Prep and Protein Quantification
- Lecture 17 - Applications of Proteomics
- Lecture 18 - Introduction to MS-based Proteomics - I
- Lecture 19 - Introduction to MS-based Proteomics - II
- Lecture 20 - Applications of NGS - IonTorrent
- Lecture 21 - Genomic Analysis using Droplet PCR - I
- Lecture 22 - Introduction to MS-based Proteomics - I (Hands-on session)
- Lecture 23 - Introduction to MS-based Proteomics - II (Hands-on session)
- Lecture 24 - Data analysis : Normalization
- Lecture 25 - Data analysis : Batch Correction and Missing values
- Lecture 26 - Data analysis : Statistical Test
- Lecture 27 - Genomic Analysis using Droplet PCR - II
- Lecture 28 - Topics in Proteogenomics : Malaria case study
- Lecture 29 - Machine learning and Clustering
- Lecture 30 - Hypothesis testing
- Lecture 31 - ProTIGY - I

- Lecture 32 - ProTIGY - II
- Lecture 33 - Proteomics Data Analysis
- Lecture 34 - Proteomics Lab Demonstration - I
- Lecture 35 - Proteomics Lab Demonstration - II
- Lecture 36 - Workflow to Automated Data Processing
- Lecture 37 - Introduction to Fire Cloud
- Lecture 38 - FireCloud and Data Model
- Lecture 39 - Bioinformatics solutions for Big Data Analysis - I
- Lecture 40 - Bioinformatics solutions for Big Data Analysis - II
- Lecture 41 - Introduction to Targeted Proteomics
- Lecture 42 - Data analysis using Skyline
- Lecture 43 - Large-scale data Science - I
- Lecture 44 - Large-scale data Science - II
- Lecture 45 - Large-scale data Science - III
- Lecture 46 - DIA-SWATH Atlas - I
- Lecture 47 - DIA-SWATH Atlas - II
- Lecture 48 - Prediction Analysis
- Lecture 49 - Pathway Enrichment and Network Analysis
- Lecture 50 - Human Protein Atlas - I
- Lecture 51 - Human Protein Atlas - II
- Lecture 52 - Affinity based proteomics & HPA
- Lecture 53 - Clinical Considerations for OMICS - I
- Lecture 54 - Clinical Considerations for OMICS - II
- Lecture 55 - Topics in Proteogenomics: Cancer case study
- Lecture 56 - Integrative Genomics Viewer (IGV)
- Lecture 57 - Introduction to Proteogenomics - I
- Lecture 58 - Introduction to Proteogenomics - II
- Lecture 59 - Sequence centric proteogenomics
- Lecture 60 - Variant Analysis
- Lecture 61 - Proteomics - Clinical Applications
- Lecture 62 - Perspectives in Proteogenomics - II
- Lecture 63 - Predictive Analysis - I
- Lecture 64 - Predictive Analysis - II

[Lecture 65 - Association/ Marker Selection](#)

[Lecture 66 - WebGestalt - I](#)

[Lecture 67 - WebGestalt - II](#)

[Lecture 68 - Perspectives in Proteogenomics - III](#)

[Lecture 69 - Network Analysis - I](#)

[Lecture 70 - Network Analysis - II](#)

[Lecture 71 - Mutations and Signaling - I](#)

[Lecture 72 - Mutations and Signaling - II](#)

[Lecture 73 - Pathway Enrichment - I](#)

[Lecture 74 - Perspectives in Proteogenomics - IV](#)

[Lecture 75 - Pathway Enrichment - II](#)

[Lecture 76 - Sequence - GSEA](#)

[Lecture 77 - Linked Omics - I](#)

[Lecture 78 - Linked Omics - II](#)

[Lecture 79 - Proteogenomics - Opportunities and Challenges](#)

[Lecture 80 - Perspectives in Proteogenomics - V](#)

Lecture 1 - Introduction to Proteomics

Lecture 2 - Introduction to Interactomics

Lecture 3 - High throughput platforms of interactomics: Protein arrays

Lecture 4 - Cell-free expression based protein microarrays

Lecture 5 - NAPPA: Recombinational Cloning, Basic workflow, Surface Chemistry, Printing and Assessment

Lecture 6 - NAPPA Technology and Protein Arrays - I

Lecture 7 - NAPPA Technology and Protein Arrays - II

Lecture 8 - Biomarkers: Harnessing the immune system for early detection of disease - I

Lecture 9 - Biomarkers: Harnessing the immune system for early detection of disease - II

Lecture 10 - Biomarkers: Harnessing the immune system for early detection of disease - III

Lecture 11 - NAPPA and its applications in study of antibody immune response in disease and in drug screening - I

Lecture 12 - NAPPA and its applications in study of antibody immune response in disease and in drug screening - II

Lecture 13 - NAPPA and its applications in study of antibody immune response in disease and in drug screening - III

Lecture 14 - Using functional proteomics to identify biomarkers and therapeutic targets - I

Lecture 15 - Using functional proteomics to identify biomarkers and therapeutic targets - II

Lecture 16 - Applications of protein microarrays in Malaria Research - I

Lecture 17 - Applications of protein microarrays in Malaria Research - II

Lecture 18 - Introduction to Bioprinting and IrisOptical QC Benefits - I

Lecture 19 - Introduction to Bioprinting and IrisOptical QC Benefits - II

Lecture 20 - Screening of autoantibody signatures in cancer patients: Lab demonstration

Lecture 21 - Basics of Image Scanning and data acquisition

Lecture 22 - Applications of protein arrays in identification of autoantibody signatures - I

Lecture 23 - Applications of protein arrays in identification of autoantibody signatures - II

Lecture 24 - Applications of protein microarrays in deciphering PTMs and biological networks

Lecture 25 - Basics and Applications of Reverse Phase Protein Arrays - I

Lecture 26 - Basics and Applications of Reverse Phase Protein Arrays - II

Lecture 27 - Basics and Applications of Reverse Phase Protein Arrays - III

Lecture 28 - An overview of label-free technologies

Lecture 29 - Surface Plasmon Resonance - Principles and Assays - I

Lecture 30 - Surface Plasmon Resonance - Principles and Assays - II

Lecture 31 - Basics of SPR: Surface chemistry

Lecture 32 - Basics of SPR: Experimental design

Lecture 33 - Protein immobilization for protein-protein interaction studies

Lecture 34 - Protein-protein interaction study: Binding analysis

Lecture 35 - Protein-protein interaction study: Kinetic analysis

Lecture 36 - Use of SPR in unravelling domain motif interactions of proteasomal assembly chaperones

Lecture 37 - Protein-small molecule interaction study: Immobilization and binding analysis

Lecture 38 - Protein-small molecule interaction study: Kinetic analysis

Lecture 39 - An introduction to biolayer interferometry (BLI) and its applications in protein research

Lecture 40 - Biomolecular interactions using Bio-Layer Interferometry (BLI) - I

Lecture 41 - Biomolecular interactions using Bio-Layer Interferometry (BLI) - II

Lecture 42 - Lab session- An introduction to BioLayer Interferometry (BLI) and its applications in protein research

Lecture 43 - Applications of label-free technologies - II

Lecture 44 - Biomolecular interaction analytics using MicroScale Thermophoresis

Lecture 45 - Mass Spectrometry coupled Interactomics - I

Lecture 46 - Mass Spectrometry coupled Interactomics - II

Lecture 47 - Next-Generation Sequencing Technology - Ion Torrent

Lecture 48 - NGS Technology - Bioinformatics and data analysis - I

Lecture 49 - NGS Technology - Bioinformatics and data analysis - II

Lecture 50 - Next-Generation Sequencing Technology- Illumina

Lecture 51 - Agilent complete NGS target enrichment workflow for exomes, targeted panels and beyond

Lecture 52 - The Human Pathology Atlas: A Pathology Atlas of the Human Transcriptome - I

Lecture 53 - The Human Pathology Atlas: A Pathology Atlas of the Human Transcriptome - II

Lecture 54 - Statistical Analysis - I

Lecture 55 - Statistical Analysis - II

Lecture 56 - Secondary Data Analysis

Lecture 57 - Pathway Enrichment and Network Analysis

Lecture 58 - Data Repositories and Databases

Lecture 59 - Application of multi-omics approach for better understanding of cancers

Lecture 60 - Integrated Omics and Systems Biology- Conclusion

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48](#)

[Lecture 49](#)

[Lecture 50](#)

[Lecture 51](#)

[Lecture 52](#)

[Lecture 53](#)

[Lecture 54](#)

[Lecture 55](#)

[Lecture 56](#)

[Lecture 57](#)

[Lecture 58](#)

[Lecture 59](#)

[Lecture 60](#)

[Lecture 61](#)







Lecture 1 - Introduction and Scope to Enzyme Science and Engineering

Lecture 2 - Characteristic Features of Enzymes

Lecture 3 - Enzymes as Biocatalysts

Lecture 4 - Enzymatic Catalysis

Lecture 5 - Specificity of Enzyme Action

Lecture 6 - Kinetics of Enzyme Catalyzed Reactions

Lecture 7 - Kinetics of Enzyme Catalyzed Reactions

Lecture 8 - Deviation from Hyperbolic Enzyme Kinetics

Lecture 9 - Role of Effector Molecules in Enzyme Kinetics

Lecture 10 - Reversible Inhibition

Lecture 11 - Effect of PH and Temperature on Enzyme

Lecture 12 - Kinetics of Bi substrate Enzyme

Lecture 13 - Kinetics of Bi substrate Enzyme

Lecture 14 - Immobilized Enzymes - I

Lecture 15 - Immobilized Enzymes - II

Lecture 16 - Immobilized Enzymes - III

Lecture 17 - Immobilization of Enzymes by Entrapment

Lecture 18 - Effect of Immobilization

Lecture 19 - Reactors for Enzyme Catalyzed Reactions

Lecture 20 - Idealized Enzyme Reactor Performance

Lecture 21 - Idealized Enzyme Reactor Performance

Lecture 22 - Kinetic Parameters for IME Systems

Lecture 23 - Steady State Analysis of Mass Transfer

Lecture 24 - Steady State Analysis of Mass Transfer

Lecture 25 - Non Ideal Flow in Continuous Immobilized Enzyme

Lecture 26 - Applications of Immobilized Enzymes in Process

Lecture 27 - Analytical Applications

Lecture 28 - Enzyme Technology Challenges

Lecture 1 - Mathematical modeling in Biology

Lecture 2 - How to Start Modeling

Lecture 3 - Modeling the spread of infectious disease

Lecture 4 - Modeling population growth

Lecture 5 - Numerical solution of ODE-1

Lecture 6 - Numerical solution of ODE-2

Lecture 7 - Simulating ODE-based models: Introduction to JSim

Lecture 8 - Simulating ODE-based models: Examples of simulation in JSim

Lecture 9 - Steady state and stability analysis: Understanding Steady State

Lecture 10 - Steady state and stability analysis: Stability of Steady States

Lecture 11 - Phase Plane Analysis - I

Lecture 12 - Phase Plane Analysis - II

Lecture 13 - Concepts of Bifurcation:Introduction

Lecture 14 - Concepts of Bifurcation:Bifurcation in Biological Systems

Lecture 15 - Modeling Molecular Processes in Cell: Introduction

Lecture 16 - Modeling Molecular Processes in Cell: Receptor-Ligand Interaction

Lecture 17 - Modeling Molecular Processes in Cell: Enzymatic Processes

Lecture 18 - Modeling Molecular Processes in Cell: Transcription and Translation

Lecture 19 - Modeling Cell Signaling: Negative Feedback Motif

Lecture 20 - Modeling Cell Signaling: Positive Feedback Motif

Lecture 21 - Modeling Cell Signaling: Incoherent Feedforward Motif

Lecture 22 - Modeling Transcriptional Circuits-1

Lecture 23 - Modeling Transcriptional Circuits-2

Lecture 24 - Online Resources for Mathematical Modeling in Biology

Lecture 1 - Cellular Structure - Part I

Lecture 2 - Cellular Structure - Part II

Lecture 3 - Cellular Structure - Part III

Lecture 4 - Metabolic Reactions in Biological System

Lecture 5 - Growth Media For Different Expression System

Lecture 6 - Microbial Growth Kinetics

Lecture 7 - Isolation of a Gene Fragment - Part I

Lecture 8 - Isolation of a Gene Fragment - Part II

Lecture 9 - Isolation of a Gene Fragment - Part III

Lecture 10 - Polymerase Chain Reaction

Lecture 11 - Molecular Tools for Cloning

Lecture 12 - Cloning Vectors - I

Lecture 13 - Cloning Vectors - II

Lecture 14 - DNA Delivery In Host - Part I

Lecture 15 - DNA Delivery In Host - Part II

Lecture 16 - Screening of Recombinant Clones

Lecture 17 - Protein Production in Host - Part 1

Lecture 18 - Protein Production in Host - Part 2

Lecture 19 - Protein Production in Host - Part 3

Lecture 20 - Product Recovery from Host Cells

Lecture 21 - Basics of Chromatography - Part 1

Lecture 22 - Basics of Chromatography - Part 2

Lecture 23 - Ion-exchange Chromatography

Lecture 24 - Hydrophobic Interaction Chromatography

Lecture 25 - Gel Filtration chromatography - Part 1

Lecture 26 - Gel Filtration chromatography - Part 2

Lecture 27 - Affinity Chromatography - Part 1

Lecture 28 - Affinity Chromatography - Part 2

Lecture 29 - Affinity Chromatography - Part 3

Lecture 30 - Affinity Chromatography - Part 4

Lecture 31 - Electrophoresis - Part 1

[Lecture 32 - Electrophoresis - Part 2](#)

[Lecture 33 - Electrophoresis - Part 3](#)

[Lecture 34 - Protein Sequencing](#)

[Lecture 35 - Spectroscopy - Part I](#)

[Lecture 36 - Spectroscopy - Part II](#)

[Lecture 37 - Biotechnology Applications - Part 1](#)

[Lecture 38 - Biotechnology Applications - Part 2](#)

[Lecture 39 - Biotechnology Applications - Part 3](#)

[Lecture 40 - Summary and Conclusions - Part 1](#)

[Lecture 41 - Summary and Conclusions - Part 2](#)

Lecture 1 - Good Lab Practices - Part 1

Lecture 2 - Good Lab Practices - Part 2

Lecture 3 - Operation of Laboratory Instruments - Part 1

Lecture 4 - Operation of Laboratory Instruments - Part 2

Lecture 5 - Operation of Laboratory Instruments - Part 3

Lecture 6 - Solution and Buffer Preparation

Lecture 7 - Basics of Electrophoresis - Part 1

Lecture 8 - Basics of Electrophoresis - Part 2

Lecture 9 - Horizontal Gel Electrophoresis

Lecture 10 - Different Variants of Gel Electrophoresis

Lecture 11 - Scientific Questions - Part 1

Lecture 12 - Scientific Questions - Part 2

Lecture 13 - Scientific Questions - Part 3

Lecture 14 - Scientific Questions - Part 4

Lecture 15 - Basics of Chromatography - Part 1

Lecture 16 - Basics of Chromatography - Part 2

Lecture 17 - Ion-Exchange Chromatography - Part 1

Lecture 18 - Ion-Exchange Chromatography - Part 2

Lecture 19 - Hydrophobic Interaction Chromatography

Lecture 20 - Gel Filtration Chromatography - Part 1

Lecture 21 - Gel Filtration Chromatography - Part 2

Lecture 22 - Gel Filtration Chromatography - Part 3

Lecture 23 - Affinity Chromatography - Part 1

Lecture 24 - Affinity Chromatography - Part 2

Lecture 25 - Affinity Chromatography - Part 3

Lecture 26 - Affinity Chromatography - Part 4

Lecture 27 - Antibody Generation

Lecture 28 - Antibody-Antigen Interaction - Part 1

Lecture 29 - Immunoassay

Lecture 30 - Antibody-Antigen Interaction - Part 2

Lecture 31 - Antibody-Antigen Interaction - Part 3

[Lecture 32 - Cell Culture Medium](#)

[Lecture 33 - Cell Fractionation](#)

[Lecture 34 - Microscopy - Part 1](#)

[Lecture 35 - Microscopy - Part 2](#)

[Lecture 36 - Cell Biology Experiments](#)

[Lecture 37 - Flow Cytometry](#)

[Lecture 38 - Polymerase Chain Reaction - Part 1](#)

[Lecture 39 - Polymerase Chain Reaction - Part 2](#)

[Lecture 40 - Polymerase Chain Reaction - Part 3](#)

[Lecture 41 - Polymerase Chain Reaction - Part 4](#)

[Lecture 42 - Sequencing Techniques](#)

[Lecture 43 - Blotting Techniques - Part 1](#)

[Lecture 44 - Blotting Techniques - Part 2](#)

[Lecture 45 - Designing Experiments](#)

Lecture 1 - Intermolecular Forces

Lecture 2 - Classification of Intermolecular Forces

Lecture 3 - Thermodynamics Aspects of Intermolecular Forces

Lecture 4 - Surface Tension and Energy

Lecture 5 - Wettability

Lecture 6 - Adhesion and Cohesion

Lecture 7 - Methods for Surface Tension Measurement

Lecture 8 - Methods for Contact Angle Measurement

Lecture 9 - Determination of Surface Tension of Solids

Lecture 10 - Protein Adsorption

Lecture 11 - Characterization of Protein Adsorption

Lecture 12 - Kinetics of Protein Adsorption

Lecture 13 - Aggregation of Proteins

Lecture 14 - Kinetics of Protein Aggregation

Lecture 15 - Effect of Surfaces on the Aggregation of Protein

Lecture 16 - Host Responses to Biomaterials

Lecture 17 - Cell Adhesion

Lecture 18 - Biocompatibility of Biomaterials

Lecture 19 - Surface Modification

Lecture 20 - Surface Modification Techniques

Lecture 21 - Coating of Calcium Phosphates on Ti-6Al-4V

Lecture 22 - Surface Characterization

Lecture 23 - Self-Assembled Monolayers

Lecture 24 - Effect of SAMs on Biointerfacial Interactions

Lecture 1 - Introduction to Living Organisms

Lecture 2 - Classification of Living Organisms - Part 1

Lecture 3 - Classification of Living Organisms - Part 2

Lecture 4 - Classification of Living Organisms - Part 3

Lecture 5 - Classification of Living Organisms - Part 4

Lecture 6 - Origin of Life - Part 1

Lecture 7 - Origin of Life - Part 2

Lecture 8 - Evolution - Part 1

Lecture 9 - Evolution - Part 2

Lecture 10 - Evolution - Part 3

Lecture 11 - Basics of Cells - Part 1

Lecture 12 - Basics of Cells - Part 2

Lecture 13 - Basics of Cells - Part 3

Lecture 14 - Cell Division and regulation

Lecture 15 - Nucleic acids

Lecture 16 - Carbohydrates - Part 1

Lecture 17 - Carbohydrates - Part 2

Lecture 18 - Carbohydrates - Part 3

Lecture 19 - Lipids

Lecture 20 - Proteins - Part 1

Lecture 21 - Proteins - Part 2

Lecture 22 - Proteins - Part 3

Lecture 23 - Proteins - Part 4

Lecture 24 - Central Dogma of Life

Lecture 25 - Replication

Lecture 26 - Polymerase chain reaction

Lecture 27 - Transcription - Part 1

Lecture 28 - Transcription - Part 2

Lecture 29 - Translation - Part 1

Lecture 30 - Translation - Part 2

Lecture 31 - Immune system - Part 1

[Lecture 32 - Immune system - Part 2](#)

[Lecture 33 - Phagocytosis](#)

[Lecture 34 - Cell Death and Apoptosis](#)

[Lecture 35 - Vesicular Transport](#)

[Lecture 36 - Digestion - Part 1](#)

[Lecture 37 - Digestion - Part 2](#)

[Lecture 38 - Digestion - Part 3](#)

[Lecture 39 - Circulatory System - Part 1](#)

[Lecture 40 - Circulatory System - Part 2](#)

[Lecture 41 - Muscular System - Part 1](#)

[Lecture 42 - Muscular System - Part 2](#)

[Lecture 43 - Nervous System - Part 1](#)

[Lecture 44 - Nervous System - Part 2](#)

[Lecture 45 - Nervous System - Part 3](#)

[Lecture 46 - Homeostasis - Part 1](#)

[Lecture 47 - Homeostasis - Part 2](#)

[Lecture 48 - Homeostasis - Part 3](#)

[Lecture 49 - Summary and Conclusions - Part 1](#)

[Lecture 50 - Summary and Conclusions - Part 2](#)

Lecture 1 - Rules of probability

Lecture 2 - Discrete probability distribution

Lecture 3 - Continuous probability distribution

Lecture 4 - Moments: mean and variance

Lecture 5 - Moments: variance and covariance

Lecture 6 - Bayes theorem and likelihood

Lecture 7 - Concept of statistical tests

Lecture 8 - Vector and vector operations

Lecture 9 - Matrix and matrix operations

Lecture 10 - Determinant and Inverse of a matrix

Lecture 11 - Eigenvalue and eigenvector

Lecture 12 - Linear system of equations

Lecture 13 - Singular value decomposition

Lecture 14 - Getting ready with R

Lecture 15 - Algebraic and logical operations in R

Lecture 16 - Reading and writing data

Lecture 17 - Statistics using R - descriptive statistics

Lecture 18 - Statistics using R - t-test and ANOVA

Lecture 19 - Linear algebra using R

Lecture 20 - Scatter plot, Line plot and Bar plot

Lecture 21 - Histogram and Box plot

Lecture 22 - Heatmap and Volcano plot

Lecture 23 - Network visualization

Lecture 24 - Data visualization using ggplot2 - I

Lecture 25 - Data visualization using ggplot2 - II

Lecture 26 - Correlations

Lecture 27 - Linear regression - I

Lecture 28 - Linear regression - II

Lecture 29 - Linear regression using R

Lecture 30 - Multiple linear regression

Lecture 31 - Multiple linear regression using R

[Lecture 32 - Nonlinear regression](#)

[Lecture 33 - Nonlinear regression using R](#)

[Lecture 34 - Clustering and classification](#)

[Lecture 35 - Logistic regression](#)

[Lecture 36 - Logistic regression using R](#)

[Lecture 37 - Distance measures for clustering](#)

[Lecture 38 - k-means clustering](#)

[Lecture 39 - k-means clustering using R](#)

[Lecture 40 - Hierarchical clustering](#)

[Lecture 41 - Hierarchical clustering using R](#)

[Lecture 42 - Decision tree classifier](#)

[Lecture 43 - Support vector machines](#)

[Lecture 44 - Higher-dimensional data in biology](#)

[Lecture 45 - Principle component analysis](#)

[Lecture 46 - Principle component analysis using R](#)

[Lecture 47 - t-SNE](#)

[Lecture 48 - t-SNE using R](#)

[Lecture 49 - Diffusion maps](#)

Lecture 1 - Introduction: Genes and Genome Organization

Lecture 2 - History and Basics of Genetic Engineering

Lecture 3 - Advantages and Limitations of Genetic Engineering

Lecture 4 - Breakage of Genomic DNA

Lecture 5 - Repair of Genomic DNA

Lecture 6 - Homologous and non homologous recombination

Lecture 7 - Site specific recombination

Lecture 8 - Targeted genetic modification - I

Lecture 9 - Targeted genetic modification - II

Lecture 10 - Basics of Zinc Finger Nucleases

Lecture 11 - Design of Zinc Finger Nucleases for genome editing

Lecture 12 - Applications of Zinc Finger Nucleases - Part A

Lecture 13 - Applications of Zinc Finger Nucleases - Part B

Lecture 14 - Basics of TALEN - Part A

Lecture 15 - Basics of TALEN - Part B

Lecture 16 - Design of TALEN for genome editing - Part A

Lecture 17 - Design of TALEN for genome editing - Part B

Lecture 18 - Application of TALEN - Part A

Lecture 19 - Application of TALEN - Part B

Lecture 20 - CRISPR system in bacteria - Part A

Lecture 21 - CRISPR system in bacteria - Part B

Lecture 22 - CRISPR/Cas9 in Genome Editing - Part A

Lecture 23 - CRISPR/Cas9 in Genome Editing - Part B

Lecture 24 - Applications of CRISPR/Cas9 - Part A

Lecture 25 - Applications of CRISPR/Cas9 - Part B

Lecture 26 - Computational Resources for CRISPR / Cas - Part A

Lecture 27 - Computational Resources for CRISPR / Cas - Part B

Lecture 28 - Human cell engineering in diseases : Thalassemia - Part A

Lecture 29 - Human cell engineering in diseases : Thalassemia - Part B

Lecture 30 - Human cell engineering in diseases : Severe combined immunodeficiency (SCID) - Part A

Lecture 31 - Human cell engineering in diseases : Severe combined immunodeficiency (SCID) - Part B

[Lecture 32 - Human cell engineering in diseases : Hemophilia - Part A](#)

[Lecture 33 - Human cell engineering in diseases : Hemophilia - Part B](#)

[Lecture 34 - Animal models - Part A](#)

[Lecture 35 - Animal models - Part B](#)

[Lecture 36 - iPSc models - Part A](#)

[Lecture 37 - iPSc models - Part B](#)

[Lecture 38 - Cancer disease models - Part A](#)

[Lecture 39 - Cancer disease models - Part B](#)

[Lecture 40 - Engineered immune cells for Cancer therapy \(I\) - Part A](#)

[Lecture 41 - Engineered immune cells for Cancer therapy \(I\) - Part B](#)

[Lecture 42 - Engineered immune cells for Cancer therapy \(II\) - Part A](#)

[Lecture 43 - Engineered immune cells for Cancer therapy \(II\) - Part B](#)

[Lecture 44 - History and Basics - Part A](#)

[Lecture 45 - History and Basics - Part B](#)

[Lecture 46 - Genome editing and personalized therapy](#)

[Lecture 47 - Bioethics and Biosafety - Part A](#)

[Lecture 48 - Bioethics and Biosafety - Part B](#)

[Lecture 49 - Regulatory issues in Genome Editing](#)

Lecture 1 - Introduction to Enzymes

Lecture 2 - Basics of Enzyme

Lecture 3 - Enzyme Classification - Part I

Lecture 4 - Enzyme Classification - Part II

Lecture 5 - Enzyme Nomenclature

Lecture 6 - Primary Structure of Enzyme

Lecture 7 - Determination of Primary Structure

Lecture 8 - Secondary Structure of Protein

Lecture 9 - Tertiary Structure of Enzyme - Part I

Lecture 10 - Tertiary Structure of Enzyme - Part II

Lecture 11 - Molecular Modelling of Enzyme Structure - Part II

Lecture 12 - Identification of Enzyme Gene - Part II

Lecture 13 - Identification of Enzyme Gene - Part II

Lecture 14 - Polymerase Chain Reaction

Lecture 15 - Enzymes in Molecular Cloning

Lecture 16 - Cloning of Enzyme Coding Gene

Lecture 17 - DNA Delivery in host - Part I

Lecture 18 - DNA Delivery in host - Part II

Lecture 19 - Screening of Recombinant Clones

Lecture 20 - Over-expression of Enzyme in host - Part I

Lecture 21 - Over-expression of Enzyme in host - Part II

Lecture 22 - Over-expression of Enzyme in host - Part III

Lecture 23 - Host Cell Disruption Methods

Lecture 24 - Basics of Chromatography

Lecture 25 - Chromatography - Part I

Lecture 26 - Chromatography - Part II

Lecture 27 - Chromatography - Part III

Lecture 28 - Carbohydrate Metabolism

Lecture 29 - Lipid Metabolism

Lecture 30 - Amino acid Metabolism and Detoxification

Lecture 31 - Enzyme-Substrate Interactions - Part I - Chromatographic Methods

[Lecture 32 - Enzyme-Substrate Interactions - Part II - Spectroscopic Methods](#)

[Lecture 33 - Enzyme-Substrate Interactions - Part III - ITC](#)

[Lecture 34 - Enzyme-Substrate Interactions - Part IV - SPR](#)

[Lecture 35 - Enzyme Assay System - Part I](#)

[Lecture 36 - Enzyme Assay System - Part II](#)

[Lecture 37 - Enzyme Assay System - Part III](#)

[Lecture 38 - Enzyme Kinetics](#)

[Lecture 39 - Inhibitor Designing - Part I - Traditional Approach](#)

[Lecture 40 - Inhibitor Designing - Part II - Modern Approach](#)

[Lecture 41 - Inhibitor Designing - Part III - Computational Approach](#)

[Lecture 42 - Enzyme Inhibition - Part I](#)

[Lecture 43 - Enzyme Inhibition - Part II](#)

[Lecture 44 - Application of Enzyme - Part I - Food Industry](#)

[Lecture 45 - Application of Enzyme - Part II - Medical Field](#)

[Lecture 46 - Enzyme in Drug Discovery](#)

[Lecture 47 - Enzymes in Environmental Field](#)

**NPTEL : Animal Physiology (Biotechnology)**

**Co-ordinators : Prof. Mainak Das**

[Lecture 1 - Animal Physiology](#)

[Lecture 2 - Animal Physiology](#)

[Lecture 3 - Animal Physiology](#)

[Lecture 4 - Animal Physiology](#)

[Lecture 5 - Animal Physiology](#)

[Lecture 6 - Animal Physiology](#)

[Lecture 7 - Animal Physiology](#)

[Lecture 8 - Animal Physiology](#)

[Lecture 9 - Animal Physiology](#)

[Lecture 10 - Animal Physiology](#)

[Lecture 11 - Animal Physiology](#)

[Lecture 12 - Animal Physiology](#)

[Lecture 13 - Animal Physiology](#)

[Lecture 14 - Animal Physiology](#)

[Lecture 15 - Animal Physiology](#)

[Lecture 16 - Animal Physiology](#)

[Lecture 17 - Animal Physiology](#)

[Lecture 18 - Animal Physiology](#)

[Lecture 19 - Animal Physiology](#)

[Lecture 20 - Animal Physiology](#)

[Lecture 21 - Animal Physiology](#)

[Lecture 22 - Animal Physiology](#)

[Lecture 23 - Animal Physiology](#)

[Lecture 24 - Animal Physiology](#)

[Lecture 25 - Animal Physiology](#)

[Lecture 26 - Animal Physiology](#)

[Lecture 27 - Animal Physiology](#)

[Lecture 28 - Animal Physiology](#)

[Lecture 29 - Animal Physiology](#)

[Lecture 30 - Animal Physiology](#)

[Lecture 31 - Animal Physiology](#)

[Lecture 32 - Animal Physiology](#)

[Lecture 33 - Animal Physiology](#)

[Lecture 34 - Animal Physiology](#)

[Lecture 35 - Animal Physiology](#)

[Lecture 36 - Animal Physiology](#)

[Lecture 37 - Animal Physiology](#)

[Lecture 38 - Animal Physiology](#)

[Lecture 39 - Animal Physiology](#)

[Lecture 40 - Animal Physiology](#)

**NPTEL : Bio electricity (Biotechnology)**

**Co-ordinators : Prof. Mainak Das**

[Lecture 1 - Bio electricity](#)

[Lecture 2 - Bio electricity](#)

[Lecture 3 - Bio electricity](#)

[Lecture 4 - Bio electricity](#)

[Lecture 5 - Bio electricity](#)

[Lecture 6 - Bio electricity](#)

[Lecture 7 - Bio electricity](#)

[Lecture 8 - Bio electricity](#)

[Lecture 9 - Bio electricity](#)

[Lecture 10 - Bio electricity](#)

[Lecture 11 - Bio electricity](#)

[Lecture 12 - Bio electricity](#)

[Lecture 13 - Bio electricity](#)

[Lecture 14 - Bio electricity](#)

[Lecture 15 - Bio electricity](#)

[Lecture 16 - Bio electricity](#)

[Lecture 17 - Bio electricity](#)

[Lecture 18 - Bio electricity](#)

[Lecture 19 - Bio electricity](#)

[Lecture 20 - Bio electricity](#)

[Lecture 21 - Bio electricity](#)

[Lecture 22 - Bio electricity](#)

[Lecture 23 - Bio electricity](#)

[Lecture 24 - Bio electricity](#)

[Lecture 25 - Bio electricity](#)

[Lecture 26 - Bio electricity](#)

[Lecture 27 - Bio electricity](#)

[Lecture 28 - Bio electricity](#)

[Lecture 29 - Bio electricity](#)

[Lecture 30 - Bio electricity](#)

[Lecture 31 - Bio electricity](#)

[Lecture 32 - Bio electricity](#)

[Lecture 33 - Bio electricity](#)

[Lecture 34 - Bio electricity](#)

[Lecture 35 - Bio electricity](#)

[Lecture 36 - Bio electricity](#)

[Lecture 37 - Bio electricity](#)

[Lecture 38 - Bio electricity](#)

[Lecture 39 - Bio electricity](#)

[Lecture 40 - Bio electricity](#)

Lecture 1 - Fundamentals of central dogma, Part 1

Lecture 2 - Fundamentals of central dogma, Part 2

Lecture 3 - Fundamentals of central dogma, Part 3

Lecture 4 - Chromosome Structure and Function

Lecture 5 - Pedigree Analysis

Lecture 6 - Complications in Mendelian Pedigree Patterns

Lecture 7 - DNA Cloning and Hybridization Techniques - Part 1

Lecture 8 - DNA Cloning and Hybridization Techniques - Part 2

Lecture 9 - Practice Session 1: Problems Related to Pedigree Analysis

Lecture 10 - Practice Session 2: Restriction Fragment Length Polymorphism and its Applications in Pedigree Analysis

Lecture 11 - Mutations and instability of human DNA (Part 1)

Lecture 12 - Mutations and instability of human DNA (Part 2)

Lecture 13 - Animal Models for Human Diseases

Lecture 14 - Positional cloning of genes for monogenic disorders

Lecture 15 - Human Genome Project and HapMap project

Lecture 1 - Introduction to Functional Genomics

Lecture 2 - The Genomics Era

Lecture 3 - Epigenetics

Lecture 4 - Forward Genetics vs Reverse Genetics

Lecture 5 - Genome Editing Approaches - Part 1

Lecture 6 - Genome Editing Approaches - Part 2

Lecture 7 - Transcriptomics - Part 1

Lecture 8 - Transcriptomics - Part 2

Lecture 9 - Genome Sequence Databases

Lecture 10 - DNA Sequencing Methods - Part 1

Lecture 11 - DNA Sequencing Methods - Part 2

Lecture 12 - Applications of Next-Generation Sequencing (NGS)

Lecture 13 - Tutorial - Session 1

Lecture 14 - Tutorial - Session 2

Lecture 15 - Genomic Insight into Evolution

Lecture 16 - Genome sequence: Different Questions, Different Comparisons

Lecture 17 - Outcome of Comparative Genomics

Lecture 18 - Laboratory - Session 1

Lecture 19 - Laboratory - Session 2

Lecture 1 - Introduction

Lecture 2 - Oil Economy of the World

Lecture 3 - Unit of Energy and Introduction of Bioenergy

Lecture 4 - How Biomass Formed on the Earth

Lecture 5 - Road Map of Bioenergy

Lecture 6 - Basic Biomass Technology (Resources and Production)

Lecture 7 - Basics of Mechanism of Light Reaction

Lecture 8 - Exploration of Photosynthesis Process

Lecture 9 - In Photosynthesis Oxygen Comes from Water Molecule

Lecture 10 - Hill Reaction

Lecture 11 - Electron Transport Process in Light Reaction

Lecture 12 - How Carbon dioxide converted in Carbohydrate

Lecture 13 - From Carbon dioxide to two Molecules of 3 - Phospho Glycerate by RUBISCO

Lecture 14 - RUBISCO enzyme

Lecture 15 - Photo respiration and Calvin Cycle

Lecture 16 - Efficiency Calculation of Photosynthesis Process

Lecture 17 - C3 and C4 Plant Structure and Photosynthesis Process

Lecture 18 - Biomass production System and their Categorization

Lecture 19 - Important Parameters for Selecting Biomass Crops

Lecture 20 - Factors Determining the Conversion Process - I

Lecture 21 - Factors Determining the Conversion Process - II

Lecture 22 - Factors Determining the Conversion Process - III

Lecture 23 - Conversion Technology

Lecture 24 - Conversion Process- (Combustion Process)

Lecture 25 - Pyrolysis Process

Lecture 26 - Classification of Pyrolysis

Lecture 27 - Bio Oil - (Solution for Thermal Instability and Corrosivity)

Lecture 28 - Spark Ignition Engine

Lecture 29 - Compression Ignition Engine

Lecture 30 - Carbonization - Graphene like material

Lecture 31 - Introduction of Gasification

[Lecture 32 - Thermo Chemical Process of Gasification](#)

[Lecture 33 - Feed Stock Treatment of Gasification](#)

[Lecture 34 - Feed Stock Property](#)

[Lecture 35 - Gasification Types - Up Drift Gasifier](#)

[Lecture 36 - Down drift and Cross Flow Gasifier](#)

[Lecture 37 - Operation and Performance of Fixed Bed Gasifier](#)

[Lecture 38 - Fluidized Bed Gasification](#)

[Lecture 39 - Operation and Performance of Fluidized Bed Gasifier](#)

[Lecture 40 - Biological Root of Gasification and Summary of Course](#)

Lecture 1 - An Introduction to Anatomy and Physiology

Lecture 2 - Organization of living system

Lecture 3 - Homeostasis and system integration

Lecture 4 - Positive feedback loop in homeostasis

Lecture 5 - Chemical basis of organization of the body

Lecture 6 - Integumentary System - I

Lecture 7 - Integumentary system - II

Lecture 8 - Integumentary System - III

Lecture 9 - Bone and Cartilage - I

Lecture 10 - Bone and Cartilage - II

Lecture 11 - Introduction of muscle

Lecture 12 - Skeletal muscle formation

Lecture 13 - Anatomy of skeletal muscle

Lecture 14 - Contraction in muscle

Lecture 15 - Function of actin and myosin

Lecture 16 - Length tension relationship of skeletal muscle

Lecture 17 - Excitation contraction coupling with nervous system

Lecture 18 - Stretch reflex phenomena

Lecture 19 - Nervous system anatomy and signaling

Lecture 20 - Structure and circuit of neurons

Lecture 21 - Origin of biological cell

Lecture 22 - Excitability in cell

Lecture 23 - Ion transportation in the cell

Lecture 24 - Signal propagation in neurons

Lecture 25 - Neurotransmitter and action potential

Lecture 26 - Spatial temporal summation of signal in mesh neurons

Lecture 27 - Anatomy of Hippo-campus

Lecture 28 - Epilepsy and memory

Lecture 29 - Long term potentiation

Lecture 30 - Long term depression

Lecture 31 - Alzheimers disease

[Lecture 32 - Parkinsons disease](#)

[Lecture 33 - Amyotrophic lateral sclerosis](#)

[Lecture 34 - Spinal cord injury](#)

[Lecture 35 - Glial cells](#)

[Lecture 36 - Stretch reflex arc circuit - I](#)

[Lecture 37 - Stretch reflex arc circuit - II](#)

[Lecture 38 - Neuro muscular junction](#)

[Lecture 39 - Hearing system](#)

[Lecture 40 - Olfaction system](#)

[Lecture 41 - Anatomy of eye](#)

[Lecture 42 - Eye lens and cataract](#)

[Lecture 43 - Structure of Retina](#)

[Lecture 44 - Image formation and processing in eyes](#)

[Lecture 45 - Mechanism of photo processing by rods](#)

[Lecture 46 - Structure and Function of Heart - I](#)

[Lecture 47 - Structure and Function of Heart - II](#)

[Lecture 48 - Conduction circuit of heart](#)

[Lecture 49 - Contractile system and Conducting system](#)

[Lecture 50 - EKG and Comparison of action potential between pace make cell and work cell](#)

[Lecture 51 - Respiratory Physiology](#)

[Lecture 52 - Anatomy and physiology of Blood vessels - I](#)

[Lecture 53 - Anatomy and Physiology of Blood vessels - II](#)

[Lecture 54 - Anatomy and physiology of blood vessels - III](#)

[Lecture 55 - Anatomy and physiology of blood vessels - IV](#)

[Lecture 56 - Endocrine system - I](#)

[Lecture 57 - Digestive system and Endocrine system - II](#)

[Lecture 58 - Blood](#)

[Lecture 59 - Kidney and immune system](#)

[Lecture 60 - Reproductive system](#)

- Lecture 1 - Introduction of Cell Culture Technology
- Lecture 2 - Philosophy and complexity in cell culture
- Lecture 3 - To grow the cell outside the body
- Lecture 4 - Cell cycle concept
- Lecture 5 - Dividing cells
- Lecture 6 - Biology of cell culture
- Lecture 7 - Layout(s) and design(s) of cell culture facility
- Lecture 8 - Precautions during designing the lab layout - I
- Lecture 9 - Precautions during designing the lab layout - II
- Lecture 10 - Precautions during designing the lab layout - III
- Lecture 11 - State of the art facility in cell culture lab - I
- Lecture 12 - State of the art facility in cell culture lab - II
- Lecture 13 - Specialized facility in cell culture lab
- Lecture 14 - Interaction of cell and glass/polycarbonate surface - I
- Lecture 15 - Interaction of cell and glass/polycarbonate surface - II
- Lecture 16 - Poly D lysine deposition
- Lecture 17 - Surface chemical analysis
- Lecture 18 - Cell growth process
- Lecture 19 - Cell surface interface
- Lecture 20 - Cell culture substrate patterning
- Lecture 21 - Introduction of define system
- Lecture 22 - Mechanical dissociation of hippocampal tissue
- Lecture 23 - Rules for mechanical dissociation of tissue
- Lecture 24 - Drug molecule testing
- Lecture 25 - Adult hippocampal neuron dissociation
- Lecture 26 - Cell separation and In vitro myelination cell culture mode - I
- Lecture 27 - Cell separation and In vitro myelination cell culture mode - II
- Lecture 28 - Cell separation and In vitro myelination cell culture mode - III
- Lecture 29 - Cell Separation and In vitro myelination cell culture mode - IV
- Lecture 30 - Cell separation and in vitro myelination cell culture mode - V
- Lecture 31 - Fluorescent assisted cell sorting

[Lecture 32 - Condition for regenerated cells](#)

[Lecture 33 - Introduction of skeletal muscle cell culture](#)

[Lecture 34 - Skeletal muscle cell culture](#)

[Lecture 35 - Cardiac muscle cell culture](#)

[Lecture 36 - Advance cell culture modules - I](#)

[Lecture 37 - Advance cell culture modules - II](#)

[Lecture 38 - Advance cell culture modules - III](#)

[Lecture 39 - Advance cell culture modules - IV](#)

[Lecture 40 - Advance cell culture modules - V](#)

Lecture 1 - Introduction

Lecture 2 - Recap of formulae: area and volume

Lecture 3 - Recap of trigonometry

Lecture 4 - Measurement of central tendency and dispersion

Lecture 5 - Graphical presentation of data

Lecture 6 - Shape of a tree: Form and Taper

Lecture 7 - Metzgers theory

Lecture 8 - Form factor and form quotients

Lecture 9 - Taper equations

Lecture 10 - Making the cuts

Lecture 11 - Cross-section of a tree

Lecture 12 - Where to measure the diameter

Lecture 13 - Callipers - Usages and Issues

Lecture 14 - Tape: Usage and issue

Lecture 15 - Measurement of bark and growth rings

Lecture 16 - Tree height: Direct and indirect measurements

Lecture 17 - Method of similar triangles: Shadow and sticks

Lecture 18 - Distance measurements: foot, tape and rangefinder

Lecture 19 - Angular measurement

Lecture 20 - LIDAR

Lecture 21 - Canopy attributes - Part I

Lecture 22 - Canopy attributes - Part II

Lecture 23 - Canopy attributes - Part III

Lecture 24 - Canopy cover and closure

Lecture 25 - Photogrammetry

Lecture 26 - Basal area of a tree and stand

Lecture 27 - Stand basal area, crop diameter and crop age

Lecture 28 - Point sampling - I

Lecture 29 - Point sampling - II

Lecture 30 - Number density and sample calculations

Lecture 31 - Volume: Direct calculations through sections

[Lecture 32 - The Quarter - girth formula](#)

[Lecture 33 - Volume computations in the field](#)

[Lecture 34 - Volume Table](#)

[Lecture 35 - Forest Sampling](#)

[Lecture 36 - Density and mass measurement](#)

[Lecture 37 - Normalized difference vegetation Index \(NDVI\)](#)

[Lecture 38 - Site quality](#)

[Lecture 39 - Recap - I](#)

[Lecture 40 - Recap - II](#)

Lecture 1 - Introduction to the topic

Lecture 2 - Where do research ideas come from?

Lecture 3 - Inductive vs Deductive Reasoning

Lecture 4 - Scientific Hypothesis

Lecture 5 - Scientific Hypothesis (Continued...)

Lecture 6 - Testing the Hypothesis

Lecture 7 - Introduction to Scientific Writing

Lecture 8 - Writing an Abstract

Lecture 9 - Title for a Research Paper

Lecture 10 - Title and Keywords

Lecture 11 - Mileposts for the Article Writing

Lecture 12 - Writing the Methods Section

Lecture 13 - Writing the Results Section

Lecture 14 - Writing Results Section (Continued...)

Lecture 15 - How to Prepare Figures

Lecture 16 - How to Prepare Schematics

Lecture 17 - How to write Introduction and Discussion Sections

Lecture 18 - Finalizing the Manuscript and Ethics in Research

Lecture 19 - Writing a Research Proposal and Preparing for a Presentation

Lecture 20 - Tutorial Session : Oral communication

Lecture 1 - Basic Concepts - I

Lecture 2 - Basic Concepts - II

Lecture 3 - Key Terms

Lecture 4 - Galvanic Cells - I

Lecture 5 - Galvanic Cells - II

Lecture 6 - Salt Bridge

Lecture 7 - Standard Potentials - I

Lecture 8 - Standard Potentials - II

Lecture 9 - Standard Potentials - III

Lecture 10 - Nernst Equation

Lecture 11 - Relationship between Standard electrode potential ( $E^{\circ}$ ) and Equilibrium constant (K)

Lecture 12 - Cell as chemical probe and Biochemist's formal potential

Lecture 13 - Concept of Concentration Cell - I

Lecture 14 - Concept of Concentration Cell - II

Lecture 15 - Bio-electrochemistry of excitable cells (nerve cells)

Lecture 16 - Types of electrodes

Lecture 17 - Critical care profile and metal electrode

Lecture 18 - pH measurement: Ion selective electrode

Lecture 19 - Redox indicators amperometry: glucose, oxygen sensors

Lecture 20 - Redox proteins, Metalloproteins and Cyclic Voltammetry

Lecture 1 - Bioenergetics of Life Processes: An Overview

Lecture 2 - Bioenergetics: Origin of life

Lecture 3 - Iron-Sulfur world

Lecture 4 - Evolution of complex cellular membranes

Lecture 5 - Charge transfer across membrane: Key terms

Lecture 6 - Biological order and energy - I

Lecture 7 - Biological order and energy - II

Lecture 8 - Biological order and energy - III

Lecture 9 - Summary of thermodynamical parameters - I

Lecture 10 - Summary of thermodynamical parameters - II

Lecture 11 - Photosynthesis - I

Lecture 12 - Photosynthesis - II

Lecture 13 - Photosynthesis - III

Lecture 14 - Photosynthesis - IV

Lecture 15 - Photosynthesis - V

Lecture 16 - Photosynthesis - VI

Lecture 17 - Photosynthesis - VII

Lecture 18 - Photosynthesis - VIII

Lecture 19 - ATP Synthesis

Lecture 20 - Mitochondria and Chemiosmotic hypothesis

- Lecture 1 - Preliminaries
- Lecture 2 - A closer look at Biodiversity
- Lecture 3 - Economics Valuation of Biodiversity
- Lecture 4 - Threats to Biodiversity
- Lecture 5 - Preliminaries
- Lecture 6 - Basics of Sampling
- Lecture 7 - Distance Sampling - I
- Lecture 8 - Distance Sampling - II
- Lecture 9 - Radio-telemetry
- Lecture 10 - Behavioural monitoring
- Lecture 11 - What is a habitat
- Lecture 12 - Habitat degradation, loss, fragmentation and displacement
- Lecture 13 - Reserve selection and design
- Lecture 14 - Habitat management and improvement
- Lecture 15 - Some terminologies
- Lecture 16 - Some common wildlife diseases
- Lecture 17 - Principles of disease management
- Lecture 18 - Preliminaries
- Lecture 19 - Mechanical capture
- Lecture 20 - Chemical capture
- Lecture 21 - Capture myopathy
- Lecture 22 - Care of immobilised animal
- Lecture 23 - Legal aspects of capture and restraint
- Lecture 24 - Other topics in capture and restraint
- Lecture 25 - Preliminaries and introduction to genetics
- Lecture 26 - Population genetics
- Lecture 27 - Chromosomal and genetic disorders, inbreeding
- Lecture 28 - Population viability analysis
- Lecture 29 - Reintroductions and outbreeding
- Lecture 30 - Fundamentals
- Lecture 31 - Zoos and their management

[Lecture 32 - Botanical gardens](#)

[Lecture 33 - Other aspects: cryopreservation, seed banks, etc.](#)

[Lecture 34 - Impacts of climate change](#)

[Lecture 35 - Plastics and biodiversity](#)

[Lecture 36 - Oil spills](#)

[Lecture 37 - Crisis and learnings: The Sariska case-study](#)

[Lecture 38 - Revision - I](#)

[Lecture 39 - Revision - II](#)

[Lecture 40 - Revision - III](#)

Lecture 1 - Introduction

Lecture 2 - What is Nanotechnology

Lecture 3 - An outline

Lecture 4 - Agriculture: Natural versus Modern

Lecture 5 - Modern Agriculture: controlled or out of control

Lecture 6 - A Restart:Utilising Our Discoveries

Lecture 7 - Classifying nanomaterials Based on Shape and Geometry

Lecture 8 - Classifying Nanomaterials Based on Chemical Nature

Lecture 9 - Physical Approaches to Nanomaterial Synthesis

Lecture 10 - Biological and Chemical Approaches to Nanomaterial Synthesis

Lecture 11 - Detailed Physical Techniques - I

Lecture 12 - Detailed Physical Techniques - II

Lecture 13 - Detailed Chemical Techniques

Lecture 14 - Detailed Biological Techniques

Lecture 15 - Basic Characterisation Techniques of Nanomaterials

Lecture 16 - Characterisation techniques for physical and chemical surface properties of a material

Lecture 17 - Nanomaterials in Agriculture

Lecture 18 - Iron pyrite and seed pre-treatment

Lecture 19 - nano-Pyrite and its lab trial with chickpea

Lecture 20 - nano-Pyrite field trial with spinach and its mechanistic details

Lecture 21 - Mechanistic details of the action of Pyrite nano-particle

Lecture 22 - Application of Pyrite nano-particle in different crops

Lecture 23 - Application of different nano-particles in Agriculture - I

Lecture 24 - Benefits of nanoparticles in Agriculture

Lecture 25 - Nanotechnology in animal production

Lecture 26 - Antioxidant nanomaterial in animal production - I

Lecture 27 - Antioxidant nanomaterial in animal production - II

Lecture 28 - Antioxidant nanomaterial in animal production - III

Lecture 29 - Antioxidant nanomaterial in skeletal muscle development - I

Lecture 30 - Antioxidant nanomaterial in skeletal muscle development - II

Lecture 31 - Skeletal muscle development and nanomaterial intervention

[Lecture 32 - Fabrication of nano-micro devices to study force generation in muscles](#)

[Lecture 33 - Summarising role of nanomaterials in animal production](#)

[Lecture 34 - Nanomaterials in food processing and preservation - I](#)

[Lecture 35 - Nanomaterials in food processing and preservation - II](#)

[Lecture 36 - Multifunctionality of nanomaterial: water purification, waste disposal, and energy](#)

[Lecture 37 - Futuristic multifunctional, sustainable and green nanomaterial](#)

[Lecture 38 - Case study of Titanium dioxide - I](#)

[Lecture 39 - Case study of Titanium dioxide - II](#)

[Lecture 40 - The future: evolving nano world](#)

- Lecture 1 - Introduction to the course
- Lecture 2 - A historical overview of Ecology
- Lecture 3 - Ecology and Evolution
- Lecture 4 - The levels of organisation
- Lecture 5 - Species abundance and composition: Biodiversity
- Lecture 6 - Biodiversity - II
- Lecture 7 - Positive Interactions
- Lecture 8 - Negative Interactions
- Lecture 9 - Study of Behaviour and Behavioral Ecology
- Lecture 10 - Food chains, Food webs and trophic levels
- Lecture 11 - Primary Production
- Lecture 12 - Nutrient Cycles
- Lecture 13 - Population parameters and demographic techniques
- Lecture 14 - Population growth and regulation
- Lecture 15 - Population studies and applications
- Lecture 16 - Community nature and parameters
- Lecture 17 - Community changes and ecological succession
- Lecture 18 - Community organisation
- Lecture 19 - Biogeography: Analysis of geographic distributions
- Lecture 20 - Why are things where they are?
- Lecture 21 - Some push and pull factors in greater detail
- Lecture 22 - Threats to species
- Lecture 23 - In-situ conservation
- Lecture 24 - Ex-situ conservation
- Lecture 25 - Introduction and impacts
- Lecture 26 - Human population growth and food requirements
- Lecture 27 - Sustainable development
- Lecture 28 - Oil spills
- Lecture 29 - Plastic and biodiversity
- Lecture 30 - Impacts of climate change
- Lecture 31 - Optimum yield problem

[Lecture 32 - Biological control](#)

[Lecture 33 - Ecotoxicology and pollution management, Restoration ecology](#)

[Lecture 34 - Revision](#)

[Lecture 35 - Revision](#)

[Lecture 36 - Revision](#)

Lecture 1 - What is a forest ?

Lecture 2 - Classification of forests

Lecture 3 - Value of forests

Lecture 4 - What is Silviculture ?

Lecture 5 - Plant Growth Factors

Lecture 6 - Ecological Succession

Lecture 7 - Soil and Soil Profile

Lecture 8 - Major Soil Types

Lecture 9 - Nutrient Cycles

Lecture 10 - Tree Form

Lecture 11 - Measurement of Tree attributes - I

Lecture 12 - Measurement of Tree attributes - II

Lecture 13 - Classical Tools

Lecture 14 - Photogrammetry

Lecture 15 - LiDAR

Lecture 16 - Kinds of Threats

Lecture 17 - Forest Fire

Lecture 18 - Forest Law

Lecture 19 - Regeneration

Lecture 20 - Silvicultural Systems

Lecture 21 - Clear Felling System

Lecture 22 - Shelterwood System - I

Lecture 23 - Shelterwood System - II

Lecture 24 - Selection System and Irregular Shelterwood System

Lecture 25 - Logging and Processing

Lecture 26 - Growing Stock and Increment

Lecture 27 - Yield and Sustained Yield

Lecture 28 - Seed Collection and Treatment

Lecture 29 - Nursery Techniques

Lecture 30 - Planting and Tending

Lecture 31 - NTFP

[Lecture 32 - Social Forestry and Tribal Welfare](#)

[Lecture 33 - Conservation of Wild Animals](#)

[Lecture 34 - Revision - Part 1](#)

[Lecture 35 - Revision - Part 2](#)

[Lecture 36 - Revision - Part 3](#)

Lecture 1 - Introduction to the Course, Making Decisions - I

Lecture 2 - Making Decisions - II and Interactions - I

Lecture 3 - Interactions-II and Working of the Economy

Lecture 4 - Conservation in the Anthropocene

Lecture 5 - Human population growth and food requirements

Lecture 6 - Unsustainable development

Lecture 7 - Climate change

Lecture 8 - Plastics

Lecture 9 - Oil spills and mining

Lecture 10 - Push and pull factors: Localisation of species

Lecture 11 - Threats to species

Lecture 12 - Developmental Hazards and Ecotoxicology

Lecture 13 - Need to understand controls

Lecture 14 - Thinking as an Economist

Lecture 15 - Interdependence and gains from trade

Lecture 16 - Demand and supply

Lecture 17 - Elasticity

Lecture 18 - Government policy

Lecture 19 - Surplus and market efficiency

Lecture 20 - Market Efficiency and Cost of Taxation

Lecture 21 - International Trade

Lecture 22 - Externalities

Lecture 23 - Public goods and common resources

Lecture 24 - The design of the tax system

Lecture 25 - The Costs of Production

Lecture 26 - Competition

Lecture 27 - Monopoly

Lecture 28 - Markets for factors of production

Lecture 29 - Earnings and discrimination

Lecture 30 - Income inequality and poverty

Lecture 31 - Consumer choice

[Lecture 32 - Asymmetric information, Politics and Behavioural Economics](#)

[Lecture 33 - Valuation of natural resources](#)

[Lecture 34 - Economics of Protected Areas](#)

[Lecture 35 - Economics of Environmental Disasters - 1](#)

[Lecture 36 - Economics of Environmental Disasters - 2](#)

- Lecture 1 - The need for conservation
- Lecture 2 - Geography and conservation
- Lecture 3 - Biogeography
- Lecture 4 - Origin and evolution of the earth
- Lecture 5 - Structure of the earth
- Lecture 6 - Features of the earth
- Lecture 7 - Rocks and minerals
- Lecture 8 - Geomorphology and processes
- Lecture 9 - Evolution of landforms
- Lecture 10 - Structure and composition
- Lecture 11 - Atmospheric circulation and weather
- Lecture 12 - Climate and climate change
- Lecture 13 - Structure and composition
- Lecture 14 - Oceans and water movement
- Lecture 15 - Hydrological cycle
- Lecture 16 - Structure and physiography of India
- Lecture 17 - Climate and habitats of India
- Lecture 18 - Drainage systems
- Lecture 19 - Soil
- Lecture 20 - Life on Earth
- Lecture 21 - Biodiversity
- Lecture 22 - Threats to species
- Lecture 23 - Ex-situ and in-situ conservation
- Lecture 24 - Benefits from conservation
- Lecture 25 - Population and population growth - I
- Lecture 26 - Population and population growth - II
- Lecture 27 - Human development and sustainable development
- Lecture 28 - Resources and Conservation
- Lecture 29 - Water Resources
- Lecture 30 - Mineral and Energy Resources
- Lecture 31 - Economic Geography and Conservation

[Lecture 32 - Trade](#)

[Lecture 33 - Settlements](#)

[Lecture 34 - Special Topics in Geography and Conservation](#)

[Lecture 35 - Disasters](#)

[Lecture 36 - Valuation of Natural Resources](#)

[Lecture 1 - L1 Module 1](#)

[Lecture 2 - L1 Module 2](#)

[Lecture 3 - L1 Module 3](#)

[Lecture 4 - L1 Module 4](#)

[Lecture 5 - L1 Module 5](#)

[Lecture 6 - L1 Module 6](#)

[Lecture 7 - L1 Module 7](#)

[Lecture 8 - L1 Module 8](#)

[Lecture 9 - L1 Module 9](#)

[Lecture 10 - L2 Module 1](#)

[Lecture 11 - L2 Module 2](#)

[Lecture 12 - L2 Module 3](#)

[Lecture 13 - L2 Module 4](#)

[Lecture 14 - L2 Module 5](#)

[Lecture 15 - L2 Module 6](#)

[Lecture 16 - L2 Module 7](#)

[Lecture 17 - L2 Module 8](#)

[Lecture 18 - L2 Module 9](#)

[Lecture 19 - L3 Module 1](#)

[Lecture 20 - L3 Module 2](#)

[Lecture 21 - L3 Module 3](#)

[Lecture 22 - L3 Module 4](#)

[Lecture 23 - L3 Module 5](#)

[Lecture 24 - L4 Module 1](#)

[Lecture 25 - L4 Module 2](#)

[Lecture 26 - L4 Module 3](#)

[Lecture 27 - L4 Module 4](#)

[Lecture 28 - L4 Module 5](#)

[Lecture 29 - L5 Module 1](#)

[Lecture 30 - L5 Module 2](#)

[Lecture 31 - L5 Module 3](#)

[Lecture 32 - L5 Module 4](#)

[Lecture 33 - L5 Module 5](#)

[Lecture 34 - L5 Module 6](#)

[Lecture 1 - Amino Acids - I](#)

[Lecture 2 - Amino Acids - II](#)

[Lecture 3 - Protein Structure - I](#)

[Lecture 4 - Protein structure - II](#)

[Lecture 5 - Protein Structure - III](#)

[Lecture 6 - Protein Structure - IV](#)

[Lecture 7 - Enzymes - I](#)

[Lecture 8 - Enzymes - II](#)

[Lecture 9 - Enzymes - III](#)

[Lecture 10 - Enzymes Mechanisms - I](#)

[Lecture 11 - Enzymes Mechanisms - II](#)

[Lecture 12 - Myoglobin and Hemoglobin](#)

[Lecture 13 - Lipids and Membranes - I](#)

[Lecture 14 - Lipids and Membranes - II](#)

[Lecture 15 - Membrane Transport](#)

[Lecture 16 - Carbohydrates - I](#)

[Lecture 17 - Carbohydrates - II](#)

[Lecture 18 - Vitamins and Coenzymes - I](#)

[Lecture 19 - Vitamins and Coenzymes - II](#)

[Lecture 20 - Nucleic Acids - I](#)

[Lecture 21 - Nucleic Acids - II](#)

[Lecture 22 - Nucleic Acids - III](#)

[Lecture 23 - Bioenergetics - I](#)

[Lecture 24 - Bioenergetics - II](#)

[Lecture 25 - Metabolism - I](#)

[Lecture 26 - Metabolism - II](#)

[Lecture 27 - Metabolism - III](#)

[Lecture 28 - Overview of the Course](#)

Lecture 1 - Industrial Biotechnology

Lecture 2 - Development of industrial strain

Lecture 3 - Medium characteristics and biochemical pathways

Lecture 4 - Chemical reaction kinetics

Lecture 5 - Chemical reaction analysis (Continued...)

Lecture 6 - Different types of reactors

Lecture 7 - Reactor analysis

Lecture 8 - Reactor analysis (Continued...)

Lecture 9 - Stoichiometry of bioprocesses

Lecture 10 - Stoichiometry of bioprocesses (Continued...)

Lecture 11 - Enzymatic reaction Kinetics

Lecture 12 - Enzymatic reaction Kinetics (Continued...)

Lecture 13 - Enzymatic reaction Kinetics (Continued...)

Lecture 14 - Immobilization techniques

Lecture 15 - Immobilization techniques (Continued...)

Lecture 16 - Life cycle of the microbial cell, Microbial growth kinetics, product formation and substrate degradation

Lecture 17 - Life cycle of the microbial cell, Microbial growth kinetics, product formation and substrate degradation (Continued...)

Lecture 18 - Life cycle of the microbial cell, Microbial growth kinetics, product formation and substrate degradation (Continued...)

Lecture 19 - Overview of the fermenter

Lecture 20 - Flow diagrams and pumps and valves used in fermentation industries

Lecture 21 - Upstream processing: Air sterilizer

Lecture 22 - Upstream processing: Medium sterilizer

Lecture 23 - Upstream processing: Medium sterilizer (Continued...)

Lecture 24 - Downstream processing: solid-liquid separators

Lecture 25 - Downstream processing: evaporator, crystallizer

Lecture 26 - Downstream processing: liquid-liquid extraction, distillation, chromatography

Lecture 27 - Ethanol fermentation

Lecture 28 - Ethanol fermentation (Continued...)

Lecture 29 - Brewing industry

Lecture 30 - Brewing industry (Continued...)

Lecture 31 - Wine industry

- [Lecture 32 - Vinegar production](#)
- [Lecture 33 - Citric acid production](#)
- [Lecture 34 - Citric acid production \(Continued...\)](#)
- [Lecture 35 - Citric acid production \(Continued...\)](#)
- [Lecture 36 - Lactic acid production](#)
- [Lecture 37 - Lactic acid production \(Continued...\)](#)
- [Lecture 38 - Glutamic acid production](#)
- [Lecture 39 - Penicillin production](#)
- [Lecture 40 - Penicillin production \(Continued...\)](#)
- [Lecture 41 - Cephalosporin production](#)
- [Lecture 42 - Streptomycin production](#)
- [Lecture 43 - Baker's yeast fermentation](#)
- [Lecture 44 - Baker's yeast fermentation \(Continued...\)](#)
- [Lecture 45 - Fodder yeast production](#)
- [Lecture 46 - Spirulina production](#)
- [Lecture 47 - Alpha amylase production](#)
- [Lecture 48 - High fructose corn syrup production](#)
- [Lecture 49 - Metal leaching](#)
- [Lecture 50 - Cheese production](#)
- [Lecture 51 - Cheese production \(Continued...\)](#)
- [Lecture 52 - Biodiesel production](#)
- [Lecture 53 - Butanol production](#)
- [Lecture 54 - Biofertilizer](#)
- [Lecture 55 - Aerobic effluent treatment process](#)
- [Lecture 56 - Aerobic effluent treatment process \(Continued...\)](#)
- [Lecture 57 - Anaerobic effluent treatment process: Biomethanation process](#)
- [Lecture 58 - Anaerobic effluent treatment process: Biomethanation process \(Continued...\)](#)
- [Lecture 59 - 10 m<sup>3</sup> Pilot Plant operation for Biohydrogen production](#)
- [Lecture 60 - Summary and conclusion](#)

Lecture 1 - Introduction

Lecture 2 - Microbiology - I

Lecture 3 - Microbiology - II

Lecture 4 - Fundamentals of Biochemistry

Lecture 5 - Bioproducts and their market values

Lecture 6 - Stoichiometry of Biochemical Processes - I

Lecture 7 - Stoichiometry of Biochemical Processes - II

Lecture 8 - Stoichiometry of Biochemical Processes - III

Lecture 9 - Reaction Thermodynamics - I

Lecture 10 - Reaction Thermodynamics - II

Lecture 11 - Kinetics of homogeneous chemical reactions - I

Lecture 12 - Kinetics of homogeneous chemical reactions - II

Lecture 13 - Kinetics of homogeneous chemical reactions - III

Lecture 14 - Kinetics of homogeneous chemical reactions - IV

Lecture 15 - Kinetics of homogeneous chemical reactions - V

Lecture 16 - Different types of reactors

Lecture 17 - Reactor analysis - I

Lecture 18 - Reactor analysis - II

Lecture 19 - Reactor analysis - III

Lecture 20 - Reactor analysis - IV

Lecture 21 - Kinetics of enzyme catalyzed reactions using free enzymes - I

Lecture 22 - Kinetics of enzyme catalyzed reactions using free enzymes - II

Lecture 23 - Kinetics of enzyme catalyzed reactions using free enzymes - III

Lecture 24 - Kinetics of enzyme catalyzed reactions using free enzymes - IV

Lecture 25 - Kinetics of enzyme catalyzed reactions using free enzymes - V

Lecture 26 - Kinetics of enzyme catalyzed reactions using free enzymes - VI

Lecture 27 - Immobilization of Enzymes - I

Lecture 28 - Immobilization of Enzymes - II

Lecture 29 - Kinetics of enzyme catalyzed reactions using immobilized enzymes - I

Lecture 30 - Kinetics of enzyme catalyzed reactions using immobilized enzymes - II

Lecture 31 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - I

- Lecture 32 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - II
- Lecture 33 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - III
- Lecture 34 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - IV
- Lecture 35 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - V
- Lecture 36 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - VI
- Lecture 37 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - VII
- Lecture 38 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - VIII
- Lecture 39 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - IX
- Lecture 40 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - X
- Lecture 41 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - XI
- Lecture 42 - Design and analysis of activated sludge process - I
- Lecture 43 - Design and analysis of activated sludge process - II
- Lecture 44 - Design and analysis of anaerobic digestion process
- Lecture 45 - Scale up of Bioreactor - I
- Lecture 46 - Scale up of Bioreactor - II
- Lecture 47 - Transport Phenomenon in Bioprocess - I
- Lecture 48 - Transport Phenomenon in Bioprocess - II
- Lecture 49 - Transport Phenomenon in Bioprocess - III
- Lecture 50 - Transport Phenomenon in Bioprocess - IV
- Lecture 51 - Air sterilization - I
- Lecture 52 - Air sterilization - II
- Lecture 53 - Medium sterilization - I
- Lecture 54 - Medium sterilization - II
- Lecture 55 - Operation of industrial fermenter and material analysis
- Lecture 56 - Process control of the biochemical processes
- Lecture 57 - Downstream processing - I
- Lecture 58 - Downstream processing - II
- Lecture 59 - Economic analysis of the biochemical processes
- Lecture 60 - Summary and Conclusion

Lecture 1 - Introduction to Biomicrofluidics

Lecture 2 - Introduction to Biomicrofluidics (Continued...)

Lecture 3 - Engineers' guide to the cell

Lecture 4 - Fluidics in living systems and mechanobiology

Lecture 5 - Pressure Driven Flows

Lecture 6 - Surface tension driven flows

Lecture 7 - Modulating surface tension

Lecture 8 - Lab on a CD

Lecture 9 - Introduction to Electrokinetics - Part I

Lecture 10 - Introduction to Electrokinetics - Part II

Lecture 11 - Microfluidic cell culture - Part I

Lecture 12 - Microfluidic cell culture - Part II

Lecture 13 - On-chip cellular assay techniques - Part I

Lecture 14 - On-chip cellular assay techniques - Part II

Lecture 15 - Microfluidics for understanding biology

Lecture 16 - Organ-on-a-chip

Lecture 17 - Lab-on-a-chip for genetic analysis

Lecture 18 - Microfluidic technology for monoclonal antibody production

Lecture 19 - Microfluidics for Healthcare

Lecture 20 - Microfluidics for Healthcare

[Lecture 1 - Basic Concepts in Immunology](#)

[Lecture 2 - Basic Concepts in Immunology \(Continued...\)](#)

[Lecture 3 - Basic Concepts in Immunology \(Continued...\)](#)

[Lecture 4 - Basic Concepts in Immunology \(Continued...\)](#)

[Lecture 5 - Basic Concepts in Immunology \(Continued...\)](#)

[Lecture 6 - Innate Immunity](#)

[Lecture 7 - Inflammatory Response](#)

[Lecture 8 - Adaptive Immunity](#)

[Lecture 9 - Adaptive Immunity \(Humoral\)](#)

[Lecture 10 - Effector Mechanisms](#)

[Lecture 11 - Structure of antibody](#)

[Lecture 12 - Structure of antibody and T-Cell Receptors](#)

[Lecture 13 - Generation of diversity \(GOD\) of lymphocyte antigen receptors \(Continued...\)](#)

[Lecture 14 - Generation of diversity \(GOD\) of lymphocyte antigen receptors \(Continued...\)](#)

[Lecture 15 - Generation of diversity \(GOD\) of lymphocyte antigen receptors \(Continued...\)](#)

[Lecture 16 - Generation of diversity \(GOD\) of lymphocyte antigen receptors \(Continued...\)](#)

[Lecture 17 - Structural variation in immunoglobulin constant regions and isotype switching](#)

[Lecture 18 - Structural variation in immunoglobulin constant regions and isotype switching \(Continued...\)](#)

[Lecture 19 - Antigen recognition by T cell : major histocompatibility complex](#)

[Lecture 20 - Antigen recognition by T cell : major histocompatibility complex \(Continued...\)](#)

[Lecture 21 - Antigen Recognition by T cell : Major Histocompatibility Complex \(Continued...\)](#)

[Lecture 22 - Antigen Recognition by T cell : Major Histocompatibility Complex \(Continued...\)](#)

[Lecture 23 - The Generation of  \$\hat{I}^{\pm}\$  :  \$\hat{I}^2\$  T - Cell receptor ligands](#)

[Lecture 24 - The Generation of  \$\hat{I}^{\pm}\$  :  \$\hat{I}^2\$  T - Cell receptor ligands \(Continued...\)](#)

[Lecture 25 - Summary of Immune system](#)

[Lecture 26 - Tools and Techniques](#)

[Lecture 27 - Tools and Techniques \(Continued...\)](#)

[Lecture 28 - Tools and Techniques \(Continued...\)](#)

[Lecture 29 - Tools and Techniques \(Continued...\)](#)

[Lecture 30 - Flow Cytometry](#)

[Lecture 31 - Development of T Lymphocytes](#)

- [Lecture 32 - Development of T Lymphocytes \(Continued...\)](#)
- [Lecture 33 - Development of T Lymphocytes \(Continued...\)](#)
- [Lecture 34 - T Cell Mediated Immunity](#)
- [Lecture 35 - T Cell Mediated Immunity \(Continued...\)](#)
- [Lecture 36 - B-Cell Maturation - I](#)
- [Lecture 37 - B-Cell Maturation - II](#)
- [Lecture 38 - B-Cell Activation](#)
- [Lecture 39 - B-Cell Activation and Differentiation](#)
- [Lecture 40 - Effector T - Cells](#)
- [Lecture 41 - Complement System Overview](#)
- [Lecture 42 - Complement System Overview \(Continued...\)](#)
- [Lecture 43 - Complement Biological Consequences](#)
- [Lecture 44 - Complement Biological Consequences \(Continued...\)](#)
- [Lecture 45 - Cytokines : Introduction](#)
- [Lecture 46 - Cytokines : Introduction \(Continued...\)](#)
- [Lecture 47 - Cytokines in Innate and Adaptive Immunity](#)
- [Lecture 48 - Interferons](#)
- [Lecture 49 - Hypersensitivity](#)
- [Lecture 50 - Hypersensitivity \(Continued...\)](#)
- [Lecture 51 - Autoimmunity](#)
- [Lecture 52 - Autoimmunity \(Continued...\)](#)
- [Lecture 53 - Autoimmunity \(Continued...\)](#)
- [Lecture 54 - Transplantation or Graft vs. Host Reaction](#)
- [Lecture 55 - Transplantation or Graft vs. Host Reaction \(Continued...\)](#)
- [Lecture 56 - Active and Passive Immunity and Vaccination](#)
- [Lecture 57 - Active and Passive Immunity and Vaccination \(Continued...\)](#)
- [Lecture 58 - Active and Passive Immunity and Vaccination \(Continued...\)](#)
- [Lecture 59 - Monoclonal Antibody](#)
- [Lecture 60 - Monoclonal Antibody \(Continued...\)](#)

- Lecture 1 - Introduction to Metabolic Engineering
- Lecture 2 - Essence of Metabolic Engineering - Part A
- Lecture 3 - Essence of Metabolic Engineering - Part B
- Lecture 4 - Essence of Metabolic Engineering - Part C
- Lecture 5 - Essence of Metabolic Engineering - Part D
- Lecture 6 - Review of Cellular Metabolism - Part A
- Lecture 7 - Review of Cellular Metabolism - Part B
- Lecture 8 - Review of Cellular Metabolism - Part C
- Lecture 9 - Review of Cellular Metabolism - Part D
- Lecture 10 - Review of Cellular Metabolism - Part E
- Lecture 11 - Review of Cellular Metabolism - Part F
- Lecture 12 - Introduction to Metabolic Networks
- Lecture 13 - Introduction to Systems Biology
- Lecture 14 - Regulatory Networks
- Lecture 15 - Reconstruction of Metabolic Networks
- Lecture 16 - The Stoichiometric Matrix: Representing Reconstructed Network Mathematically
- Lecture 17 - Flux Balance Analysis (FBA)
- Lecture 18 - Flux Variability Analysis (FVA) and Flux Coupling (FC)
- Lecture 19 - Dynamic Flux Balance Analysis (DFBA) and Gene Deletion Algorithms
- Lecture 20 - Optimization in MATLAB
- Lecture 21 - Robustness Analysis and Phenotypic Phase Planes
- Lecture 22 - Flux Sampling, Optknock and Optstrain
- Lecture 23 - Extreme Pathways and Elementary modes
- Lecture 24 -  $^{13}\text{C}$  Metabolic Flux Analysis ( $^{13}\text{C}$  MFA)
- Lecture 25 -  $^{13}\text{C}$  Metabolic Flux Analysis ( $^{13}\text{C}$  MFA)
- Lecture 26 - Advancement in  $^{13}\text{C}$  Metabolic Flux Analysis
- Lecture 27 - E.coli core metabolic Network Optimization in MATLAB
- Lecture 28 - Application of Metabolic Flux Analysis
- Lecture 29 - CRISPR-Cas system and its application in metabolic engineering - Part I
- Lecture 30 - CRISPR-Cas system and its application in metabolic engineering - Part II
- Lecture 31 - CRISPR-Cas system and its application in metabolic engineering - Part III

[Lecture 32 - CRISPR-Cas system and its application in metabolic engineering - Part IV](#)

[Lecture 33 - Examples of pathway manipulations by metabolic engineering - Biofuels](#)

[Lecture 34 - Metabolic engineering for biofuel production - Part A](#)

[Lecture 35 - Metabolic engineering for biofuel production - Part B](#)

[Lecture 36 - Metabolic engineering for biofuel production - Part C](#)

[Lecture 37 - Applications of metabolic engineering in amino acids production](#)

Lecture 1 - Acids, Bases and Salts - Part I

Lecture 2 - Acids, Bases and Salts - Part II

Lecture 3 - Acids, Bases and Salts - Part III

Lecture 4 - Acids, Bases and Salts - Part IV

Lecture 5 - Acids, Bases and Salts - Part V

Lecture 6 - Chemical Equilibrium - I

Lecture 7 - Chemical Equilibrium - II

Lecture 8 - Chemical Equilibrium - III

Lecture 9 - Chemical Equilibrium - IV

Lecture 10 - Chemical Equilibrium - V

Lecture 11 - Chemical Kinetics - I

Lecture 12 - Chemical Kinetics - II

Lecture 13 - Chemical Kinetics - III

Lecture 14 - Chemical Kinetics - IV

Lecture 15 - Chemical Kinetics - V

Lecture 16 - Chemical Kinetics - Reaction Mechanism - Part A

Lecture 17 - Chemical Kinetics - Reaction Mechanism - Part B

Lecture 18 - Chemical Kinetics - Catalysis - Part A

Lecture 19 - Chemical Kinetics - Catalysis - Part B

Lecture 20 - Chemical Kinetics - Catalysis - Part C

Lecture 21 - Nitrogen chemistry - Part A

Lecture 22 - Nitrogen chemistry - Part B

Lecture 23 - Chlorine chemistry and disinfection - Part A

Lecture 24 - Chlorine chemistry and disinfection - Part B

Lecture 25 - Chlorine chemistry and disinfection - Part C

Lecture 26 - Radioactivity - Part A

Lecture 27 - Radioactivity - Part B

Lecture 28 - Radioactivity - Part C

Lecture 29 - Radioactivity - Part D

Lecture 30 - Radioactivity - Part E

Lecture 31 - Introduction - I

[Lecture 32 - Introduction - II](#)

[Lecture 33 - Overview of microbial life - I](#)

[Lecture 34 - Overview of microbial life - II](#)

[Lecture 35 - Overview of microbial life - III](#)

[Lecture 36 - Cell chemistry - I](#)

[Lecture 37 - Cell chemistry - II](#)

[Lecture 38 - Cell Biology - I](#)

[Lecture 39 - Cell Biology - II](#)

[Lecture 40 - Cell Biology - III](#)

[Lecture 41 - Cell Biology - IV](#)

[Lecture 42 - Microscopy - I](#)

[Lecture 43 - Microscopy - II](#)

[Lecture 44 - Microbial Metabolism - I](#)

[Lecture 45 - Microbial Metabolism - II](#)

[Lecture 46 - Microbial Metabolism - III](#)

[Lecture 47 - Xenobiotics - I](#)

[Lecture 48 - Xenobiotics - II](#)

[Lecture 49 - Microbial Growth - I](#)

[Lecture 50 - Microbial Growth - II](#)

[Lecture 51 - Microbial Growth - III](#)

[Lecture 52 - Microbial Growth and Control - I](#)

[Lecture 53 - Microbial Growth and Control - II](#)

[Lecture 54 - Pathogens and diseases - I](#)

[Lecture 55 - Pathogens and diseases - II](#)

[Lecture 56 - Metabolic Diversity - I](#)

[Lecture 57 - Metabolic Diversity - II](#)

[Lecture 58 - Metabolic Diversity - III](#)

[Lecture 59 - Metabolic Diversity - IV](#)

[Lecture 60 - Metabolic Diversity - V](#)

[Lecture 61 - Metabolic Diversity - VI](#)

[Lecture 62 - Biogeochemical cycles - I](#)

[Lecture 63 - Biogeochemical cycles - II](#)

**NPTEL : NOC:Environmental Biotechnology (Biotechnology)**

**Co-ordinators : Prof. Pinaki Sar**

Lecture 1 - Introduction of Environmental Biotechnology, Scope and applications of the subject

Lecture 2 - Introduction of Environmental Biotechnology, Scope and applications of the subject

Lecture 3 - Ecosystem : Basic concepts of structure and function

Lecture 4 - Ecosystem : Basic concepts of structure and function (Continued...)

Lecture 5 - Microbial Ecology

Lecture 6 - Microbial Ecology (Continued...)

Lecture 7 - Microbial Ecosystems and Biogeochemical Cycling

Lecture 8 - Biogeochemical Cycles

Lecture 9 - Microbial ecology and environmental biotechnology - Part A

Lecture 10 - Microbial ecology and environmental biotechnology - Part B

Lecture 11 - Microbial ecology and environmental biotechnology - Part B (Continued...)

Lecture 12 - Microbial ecology and environmental biotechnology - Part B (Continued...)

Lecture 13 - Microbial ecology and environmental biotechnology - Part C

Lecture 14 - Microbial ecology and environmental biotechnology - Part C (Continued...)

Lecture 15 - Microbial ecology and environmental biotechnology - Part C (Continued...)

Lecture 16 - Microbial Ecology and Environmental Biotechnology - Part C (Continued...)

Lecture 17 - Microbiology of Environmental Engineering System

Lecture 18 - Microbiology of Environmental Engineering System

Lecture 19 - Microbiology of Environmental Engineering System

Lecture 20 - Microbiology of Environmental Engineering System (Continued...)

Lecture 21 - Physiological Ecology and Resource Exploitation by Microorganisms

Lecture 22 - Physiological ecology and Resource Exploitation by Microorganisms (Continued...)

Lecture 23 - Physiological ecology and Resource Exploitation by Microorganisms (Continued...)

Lecture 24 - Physiological ecology and Resource Exploitation by Microorganisms (Continued...)

Lecture 25 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology

Lecture 26 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

Lecture 27 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

Lecture 28 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

Lecture 29 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

Lecture 30 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

Lecture 31 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

[Lecture 32 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology \(Continued...\)](#)

[Lecture 33 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology \(Continued...\)](#)

[Lecture 34 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology \(Continued...\)](#)

[Lecture 35 - Bioremediation](#)

[Lecture 36 - Bioremediation \(Continued...\)](#)

[Lecture 37 - Bioremediation \(Continued...\)](#)

[Lecture 38 - Bioremediation \(Continued...\)](#)

[Lecture 39 - Biodegradation](#)

[Lecture 40 - Biodegradation](#)

[Lecture 41 - Biodegradation \(Continued...\)](#)

[Lecture 42 - Microbial Interactions with Heavy Metals and Metalloids](#)

[Lecture 43 - Microbial Interactions with Heavy Metals and Metalloids - Bioremediation](#)

[Lecture 44 - Biohydrometallurgy](#)

[Lecture 45 - Enhanced biological phosphorus removal process \(EBPR\)](#)

[Lecture 46 - Biological nitrogen removal](#)

[Lecture 47 - Microbially Enhanced Oil Recovery \(MEOR\)](#)

[Lecture 48 - Emerging Pollutants](#)

[Lecture 49 - Carbon capture, Carbon Sequestration and Utilization](#)

[Lecture 50 - Bioenergy and Environmental Biotechnology](#)

[Lecture 51 - Bioremediation case studies](#)

[Lecture 52 - Bioremediation case studies \(Continued...\)](#)

[Lecture 1 - Amino Acids - I](#)

[Lecture 2 - Amino Acids - II](#)

[Lecture 3 - Amino Acids - III](#)

[Lecture 4 - The Peptide Bond](#)

[Lecture 5 - Discussion Class](#)

[Lecture 6 - Primary Structure](#)

[Lecture 7 - Secondary Structure](#)

[Lecture 8 - Tertiary and Quaternary Structure](#)

[Lecture 9 - Protein Interactions](#)

[Lecture 10 - Discussion Class](#)

[Lecture 11 - Protein folding and structure](#)

[Lecture 12 - Thermodynamics of Protein Folding](#)

[Lecture 13 - Protein Structure Methods](#)

[Lecture 14 - Protein Denaturation](#)

[Lecture 15 - Discussion Class](#)

[Lecture 16 - Protein Isolation Methods](#)

[Lecture 17 - Protein Purification](#)

[Lecture 18 - Biophysical Methods - I](#)

[Lecture 19 - Biophysical Methods - II](#)

[Lecture 20 - Biophysical Methods - III](#)

[Lecture 21 - Types of Protein ligand interactions](#)

[Lecture 22 - Kinetics and Thermodynamics of protein-ligand binding](#)

[Lecture 23 - Experimental methods in protein ligand interactions](#)

[Lecture 24 - Protein ligand docking](#)

[Lecture 25 - Discussion class](#)

[Lecture 26 - Enzymes I - Classification](#)

[Lecture 27 - Enzymes - II](#)

[Lecture 28 - Enzyme Mechanisms - I](#)

[Lecture 29 - Enzyme Mechanisms - II](#)

[Lecture 30 - Enzyme mechanisms - III](#)

[Lecture 31 - Enzyme Kinetics - I](#)

Lecture 32 - Enzyme Kinetics - II  
Lecture 33 - Enzyme Inhibition - I  
Lecture 34 - Enzyme Inhibition - II  
Lecture 35 - Discussion class  
Lecture 36 - Motor Proteins - I  
Lecture 37 - Motor Proteins - II  
Lecture 38 - Metalloproteins - I  
Lecture 39 - Metalloproteins - II  
Lecture 40 - Myoglobin and Hemoglobin  
Lecture 41 - Membrane Proteins - I  
Lecture 42 - Membrane proteins - II  
Lecture 43 - Membrane Transport - I  
Lecture 44 - Membrane Transport - II  
Lecture 45 - Electron Transport Chain  
Lecture 46 - Protein Carbohydrate Interactions - I  
Lecture 47 - Protein Carbohydrate Interactions - II  
Lecture 48 - Protein Nucleic Acid Interactions - I  
Lecture 49 - Protein Nucleic Acid Interactions - II  
Lecture 50 - Protein Nucleic Acid Interactions - III  
Lecture 51 - Protein Protein Interactions - I  
Lecture 52 - Protein Protein Interactions - II  
Lecture 53 - Protein Peptide Interactions  
Lecture 54 - Chaperone proteins  
Lecture 55 - Protein Nanoparticle Interactions  
Lecture 56 - Oxidative stress in Proteins  
Lecture 57 - Enzyme action and Proteolytic cleavage  
Lecture 58 - Intrinsically disordered proteins  
Lecture 59 - Viral proteins  
Lecture 60 - Overview of Course

Lecture 1 - Introduction - 1

Lecture 2 - Introduction - 2

Lecture 3 - Signals and Systems Overview

Lecture 4 - Important Signals

Lecture 5 - System

Lecture 6 - LSI Systems

Lecture 7 - Image Quality

Lecture 8 - Local Contrast

Lecture 9 - Blurring and Noise

Lecture 10 - Physics of Radiography

Lecture 11 - Types of Ionizing Radiations

Lecture 12 - EM Radiation

Lecture 13 - Attenuation Models

Lecture 14 - Radiation Dosimetry

Lecture 15 - PR\_Instument

Lecture 16 - PR\_Instru\_CA

Lecture 17 - PR\_Image\_formation

Lecture 18 - Imaging Equation\_updated

Lecture 19 - Film screen\_Optical Density

Lecture 20 - PR\_Image Quality

Lecture 21 - CT\_Intsru

Lecture 22 - CT\_Instru\_finish

Lecture 23 - CT Back projection

Lecture 24 - CT\_BP\_finish

Lecture 25 - Fan beam\_IQ

Lecture 26 - CT\_IQ\_Artifact

Lecture 27 - Nuclear Med\_Phys

Lecture 28 - Nuclear\_Med\_Radiotracers

Lecture 29 - Planar\_Scintigraphy\_Instru

Lecture 30 - Planar\_Scintigraphy\_Im and IQ

Lecture 31 - Spect\_Pet

[Lecture 32 - Ultrasound\\_Intro\\_Phys](#)

[Lecture 33 - Ultrasound Phys\\_Interactions](#)

[Lecture 34 - US doppler and Instrumentation](#)

[Lecture 35 - US\\_Beampattern](#)

[Lecture 36 - Approximations](#)

[Lecture 37 - US\\_Imaging Equation\\_modes](#)

[Lecture 38 - Parameters of interest](#)

[Lecture 39 - Beam Steering : Phased Array](#)

[Lecture 40 - MRI\\_Intro\\_S1-S9](#)

[Lecture 41 - MRI\\_Phys\\_S10-S16](#)

[Lecture 42 - MRI\\_Phys\\_S17-S20](#)

[Lecture 43 - MRI\\_Phys\\_S21-S28](#)

[Lecture 44 - MRI\\_Phys\\_S29-S39](#)

[Lecture 45 - MRI\\_Phys\\_S40-S44](#)

[Lecture 46 - MRI\\_Phys\\_S45\\_S52](#)

[Lecture 47 - MRI\\_Instru\\_S1\\_S16](#)

[Lecture 48 - MRI\\_Instru\\_s17\\_s26](#)

[Lecture 49 - MRI\\_slice sel\\_S27\\_S41](#)

[Lecture 50 - MRI\\_Freq\\_Encode\\_S42\\_S60](#)

[Lecture 51 - MRI\\_DAQ\\_S61\\_S69](#)

[Lecture 52 - MRI\\_RECON\\_S70\\_S82](#)

[Lecture 53 - MRI\\_IQ\\_S83\\_S96](#)

Lecture 1 - Introduction

Lecture 2 - Next Generation Sequencing Technologies - 454 Sequencing

Lecture 3 - Illumina Sequencing By Synthesis (SBS)

Lecture 4 - Single Molecule Real Time (SMRT) Sequencing

Lecture 5 - Ion Torrent and Nanopore Sequencing

Lecture 6 - Sequencing Coverage, Quality Score and Experiment Design

Lecture 7 - Data Formats

Lecture 8 - Data Formats (Continued...)

Lecture 9 - Data Quality

Lecture 10 - Data QC and Trimming

Lecture 11 - Hands-on: Setting up the system

Lecture 12 - Basic Shell Commands

Lecture 13 - Data Download and Exploration

Lecture 14 - Hands-on 1 - Data exploration and QC

Lecture 15 - Hands-on 1 - Data QC and Trimming

Lecture 16 - Read Mapping

Lecture 17 - Mapping Algorithms

Lecture 18 - Suffix tree-based mapping algorithm

Lecture 19 - Burrows-Wheeler Transform (BWT)

Lecture 20 - Read Mapping with BWT

Lecture 21 - Bowtie2 tool

Lecture 22 - Mapping reads with Bowtie2

Lecture 23 - Bowtie2 output

Lecture 24 - SAM and BAM format

Lecture 25 - SAM format: Alignment section

Lecture 26 - Variant Calling

Lecture 27 - Calling SNP/SNVs and Indels

Lecture 28 - Hands-on analysis : Variant Calling

Lecture 29 - VCF Files

Lecture 30 - Variant Annotation

Lecture 31 - Analysis of CNVs and SVs

- Lecture 32 - Introduction to RNA sequencing
- Lecture 33 - RNA-seq data processing pipeline
- Lecture 34 - Transcriptome Assembly and Quantification
- Lecture 35 - Transcript Abundance Quantification
- Lecture 36 - Biases in RNA-seq experiments
- Lecture 37 - Data Normalization Methods
- Lecture 38 - Data Normalization Methods (Continued...)
- Lecture 39 - Differential Gene Expression (DGE) Analysis
- Lecture 40 - DGE analysis results and visualizations
- Lecture 41 - Multiple hypothesis testing correction
- Lecture 42 - FDR correction and interpretation of DGE analysis results
- Lecture 43 - Functional Enrichment Analysis
- Lecture 44 - RNA-seq data analysis - Hands-on 2
- Lecture 45 - Hands-on 2: Setting up the system
- Lecture 46 - Hands-on 2: Preliminary Data Analysis
- Lecture 47 - Sample Specific Bias Correction
- Lecture 48 - Differential Gene Expression Analysis I
- Lecture 49 - DGE Analysis with spike-ins
- Lecture 50 - DGE Analysis Results and Functional Enrichment Analysis
- Lecture 51 - Genome Assembly
- Lecture 52 - Shortest Common Superstring (SCS) assembly
- Lecture 53 - Overlap-Layout-Consensus (OLC) approach
- Lecture 54 - de Bruijn Graph (DBG) based assembly
- Lecture 55 - Assembly and Quality Control
- Lecture 56 - Applications of NGS in Epigenomics
- Lecture 57 - Detecting DNA Methylations
- Lecture 58 - Genome-wide Transcription Factor(TF) Binding Sites
- Lecture 59 - Chromatin Accessibility
- Lecture 60 - Genome Organization in 3D

Lecture 1 - Neuron Structure

Lecture 2 - Networks of Neurons and Synapses

Lecture 3 - Basic Structures in the Brain

Lecture 4 - Systems of neural processing

Lecture 5 - Methods of Recording Neural Activity

Lecture 6 - Membrane Potential and All or None Spike

Lecture 7 - Patch Clamp Measurements

Lecture 8 - Ion channels

Lecture 9 - Current injection: Synapses

Lecture 10 - Single Neuron Acitivity

Lecture 11 - Point and compartmental models of neurons

Lecture 12 - Hodgkin Huxley Equations - I

Lecture 13 - Hodgkin Huxley Equations - II

Lecture 14 - Reducing the HHE and Moris-Lecar Equations (MLE)

Lecture 15 - Properties of MLE

Lecture 16 - Phase Plane Analysis - I

Lecture 17 - Phase Plane Analysis - II

Lecture 18 - Phase Plane Analysis - III

Lecture 19 - Analysing HHE with Phase Plane Analysis - I

Lecture 20 - Analysing HHE with Phase Plane Analysis - II

Lecture 21 - Random variables and random process

Lecture 22 - Spike train statistics and response measure

Lecture 23 - Receptive fields and models of receptive fields

Lecture 24 - Stimulus to Response mapping (Coding) - I

Lecture 25 - Stimulus to Response mapping (Coding) - II

Lecture 26 - Stimulus to Response Mapping (Coding) - III

Lecture 27 - Response to Stimulus Mapping (Decoding)

Lecture 28 - Basics of Information Theory - I

Lecture 29 - Basics of Information Theory - II

Lecture 30 - Maximally Informative Dimensions

Lecture 31 - Intro to Discrimination based methods

[Lecture 32 - Kullback Leibler Distance](#)

[Lecture 33 - Measuring Spike Train Distances - I](#)

[Lecture 34 - Measuring Spike Train Distances - II](#)

[Lecture 35 - Signal and Noise Correlations](#)

[Lecture 36 - Statistical Methods in Discrimination](#)

[Lecture 37 - Single Cell Decoding - I: Two Alternative Forced Choice task in Monkeys](#)

[Lecture 38 - Single Cell Decoding - II: Using ROC Curves for discrimination](#)

[Lecture 39 - Single Cell Encoding - I: Operant Conditioning Task in Ferrets](#)

[Lecture 40 - Single Cell Encoding - II: Learning in avoidance and approach methods in Ferrets](#)

[Lecture 41 - Plasticity - Synaptic Transmission and Synaptic Strength](#)

[Lecture 42 - Ways of modification of Synaptic Strength](#)

[Lecture 43 - Type of Plasticity](#)

[Lecture 44 - Short Term Plasticity - I](#)

[Lecture 45 - Short Term Plasticity - II](#)

[Lecture 46 - Long Term Plasticity](#)

[Lecture 47 - Spike Time Dependent Plasticity](#)

[Lecture 48 - Hebbian Plasticity](#)

[Lecture 49 - BCM Rule](#)

[Lecture 50 - Synaptic Normalization](#)

[Lecture 51 - Adaptation](#)

[Lecture 52 - Models of Short Term Plasticity](#)

[Lecture 53 - Attention - I](#)

[Lecture 54 - Attention - II](#)

[Lecture 55 - Developmental Cicuits](#)

[Lecture 56 - Optimal Coding in Visual System](#)

[Lecture 57 - Optimal Coding in Auditory System](#)

[Lecture 58 - Optimal Coding of Deviant Stimuli in Development](#)

[Lecture 59 - Spike Timing Dependent Plasticity - a theoretical Perspective](#)

[Lecture 60 - Important Problems in Neuroscience](#)

Lecture 1 - Ionic basis of membrane potential

Lecture 2 - Physiology of voltage gated channels

Lecture 3 - Physiology of voltage gated channels

Lecture 4 - Cardiac muscle physiology

Lecture 5 - Action potential of cardiac muscle - 1

Lecture 6 - Action potential of cardiac muscle - 2

Lecture 7 - Conducting system of heart

Lecture 8 - ECG-Physiological basis

Lecture 9 - ECG-Normal, Technical aspects

Lecture 10 - ECG Interpretation

Lecture 11 - Abnormal ECG - 1

Lecture 12 - Abnormal ECG - 2

Lecture 13 - ECG and Myocardial Infarction

Lecture 14 - Heart rate and Blood pressure - Baroreflex pathway

Lecture 15 - ECG and Hypertension

Lecture 16 - Autonomic regulation of heart

Lecture 17 - Heart rate variability (HRV)

Lecture 18 - Heart rate variability-interpretation and clinical uses, Blood pressure variability

Lecture 19 - Autonomic Function Tests - 1

Lecture 20 - Autonomic Function Tests - 2

Lecture 1 - Introduction

Lecture 2 - Mass balance, Heat Balance, flow sheet

Lecture 3 - Costing

Lecture 4 - Costing (continued), Physical and chemical principles in Down stream

Lecture 5 - Problems in Mass balance, flow sheet

Lecture 6 - Cell Breakage

Lecture 7 - Cell breakage (Continued...)

Lecture 8 - Solid Liquid Separation

Lecture 9 - Solid Liquid Separation (Continued...)

Lecture 10 - Solid Liquid separation-problems

Lecture 11 - Pre-treatment and Filters

Lecture 12 - Adsorption

Lecture 13 - Adsorption

Lecture 14 - Adsorption

Lecture 15 - Adsorption

Lecture 16 - Liquid-Liquid Extraction

Lecture 17 - Liquid-Liquid Extraction

Lecture 18 - Liquid-Liquid Extraction

Lecture 19 - Liquid liquid extraction

Lecture 20 - Reversed micellar and aqueous two phase extraction

Lecture 21 - Membranes

Lecture 22 - Membranes

Lecture 23 - Membranes

Lecture 24 - Membranes

Lecture 25 - Precipitation

Lecture 26 - Chromatography

Lecture 27 - Chromatography

Lecture 28 - Chromatography

Lecture 29 - Chromatography

Lecture 30 - Chromatography

Lecture 31 - Chromatography

[Lecture 32 - Chromatography](#)

[Lecture 33 - Crystallisation](#)

[Lecture 34 - Drying](#)

[Lecture 35 - Drying and distillation](#)

[Lecture 36 - Future trends](#)

Lecture 1 - Introduction and Review

Lecture 2 - Need for Analysis Additional Thermodynamic Functions State and Path Variables

Lecture 3 - Equations for a Closed system Chemical Potential Concept Gibbs-Duhem Equation

Lecture 4 - Maxwell's relations

Lecture 5 - Inter-Relationships between Thermodynamic Variables

Lecture 6 - Some Useful Mathematical Manipulations

Lecture 7 - Thermodynamic Relations for a Closed System with 1 mole of a pure Substances

Lecture 8 - Maximum Work, Lost Work Review of Closed Systems

Lecture 9 - Open Systems

Lecture 10 - Equations of State - Virial Equations

Lecture 11 - Equations of State - Cubic Equations

Lecture 12 - Volume Estimation

Lecture 13 - Volume Estimation (Continued...) Generalized correlations

Lecture 14 - Generalized correlations (Continued...) Residual Properties

Lecture 15 - Residual Properties (Continued...)

Lecture 16 - Generalized Correlations and Residual Properties

Lecture 17 - Fugacity Coefficient Estimation

Lecture 18 - Review of Module 3

Lecture 19 - Learning Aspects Chemical Potential Formulations

Lecture 20 - Lewis and Randall rule partial Molar Properties

Lecture 21 - Partial Molar Property Estimation from Mixing Experiments

Lecture 22 - Partial Molar Property Estimation (Continued...) Excess Property

Lecture 23 - Activity Coefficient from Excess Property

Lecture 24 - Activity Coefficient from Excess Property (Continued...)

Lecture 25 - Activity Coefficient from Excess Property (Continued...) Models for Activity Coefficient in Binary Systems

Lecture 26 - Models for Activity Coefficient in Binary Systems (Continued...)

Lecture 27 - Review of Module 4

Lecture 28 - Criteria for Phase Equilibrium Phase Rule for Non-reacting Biosystems

Lecture 29 - Clausius - Clayperon Equation

Lecture 30 - Clausius - Clayperon Equation (Continued...) vapour-Liquid Equilibrium

Lecture 31 - Vapour-Liquid Equilibrium (Continued...) Estimation of Fugacity coefficient from Equilibrium P-V-T Data

[Lecture 32 - Liquid/Liquid and Solid/Liquid Equilibria](#)

[Lecture 33 - Review of Module 5](#)

[Lecture 34 - Criteria for Bio-reaction Equilibria](#)

[Lecture 35 - Phase rule for Reacting Biosystems Equilibrium constants](#)

[Lecture 36 - Effect of Temperature and Pressure on the Equilibrium constants](#)

[Lecture 37 - Reaction in Liquid or Solid Phases](#)

[Lecture 38 - Free energy Changes for some Bioreactions](#)

[Lecture 39 - Electrolytes](#)

[Lecture 40 - Course Review](#)

Lecture 1 - Introduction

Lecture 2 - Mass balance, Heat Balance, Flow sheet

Lecture 3 - Costing

Lecture 4 - Cell Breakage

Lecture 5 - Solid Liquid Separation

Lecture 6 - Pre-treatment and Filters/centrifuge

Lecture 7 - Liquid-Liquid Extraction

Lecture 8 - Liquid-Liquid extraction (Continued...)

Lecture 9 - Adsorption

Lecture 10 - Reversed micellar and aqueous two phase extraction

Lecture 11 - Membranes

Lecture 12 - Membranes (Continued...)

Lecture 13 - Product stabilization, Drying, Lyophilisation

Lecture 14 - Precipitation and crystallization

Lecture 15 - Electrophoresis / SDS PAGE

Lecture 16 - Chromatography

Lecture 17 - Chromatography (Continued...1)

Lecture 18 - Chromatography (Continued...2)

Lecture 19 - Chromatography (Continued...3)

Lecture 20 - Future trends, Other downstream operations/Summary of the course

Lecture 1 - Introduction

Lecture 2 - Experimental Design Strategy

Lecture 3 - Data types : Binomial distribution

Lecture 4 - Poisson Distribution

Lecture 5 - Normal Distribution

Lecture 6 - Standardized Normal Distribution / t-distribution

Lecture 7 - t-distribution/confidence interval

Lecture 8 - Statistical tests

Lecture 9 - t-Test

Lecture 10 - t-Tests

Lecture 11 - t-test

Lecture 12 - F-tests

Lecture 13 - F-tests

Lecture 14 - ANOVA

Lecture 15 - ANOVA

Lecture 16 - Anova

Lecture 17 - Anova

Lecture 18 - Anova

Lecture 19 - Anova

Lecture 20 - Anova

Lecture 21 - Normality test / Odds ratio

Lecture 22 - Chi square distribution

Lecture 23 - Chi square distribution / test

Lecture 24 - Chi square test

Lecture 25 - Chi square test and Weibull Distribution

Lecture 26 - Weibull Distribution

Lecture 27 - Weibull distribution.

Lecture 28 - Non-parametric test

Lecture 29 - Non parametric test/homogeneity of variance / beta distribution

Lecture 30 - Exponential / hypergeometric distributions

Lecture 31 - Hypergeometric / Log normal distribution

[Lecture 32 - Design of experiments \(DOE\) - Introduction](#)

[Lecture 33 - Factorial Design](#)

[Lecture 34 - Full factorial design](#)

[Lecture 35 - Fractional factorial design](#)

[Lecture 36 - Other designs](#)

[Lecture 37 - Second order designs](#)

[Lecture 38 - Second order design](#)

[Lecture 39 - Regression analysis](#)

[Lecture 40 - Control charts](#)

Lecture 1 - Introduction

Lecture 2 - Sterilization

Lecture 3 - Solution to PP 1.1

Lecture 4 - Some important concepts

Lecture 5 - Enzyme bioreactors, enzyme kinetics

Lecture 6 - Solution to PP 2.1

Lecture 7 - Inhibited enzyme kinetics

Lecture 8 - Solution to PP 2.2

Lecture 9 - Measurement principles and methods

Lecture 10 - Batch growth kinetics

Lecture 11 - Solution to PP 3.1

Lecture 12 - Bioreactor analysis: chemostat and fed-batch

Lecture 13 - Solution to PP 3.2

Lecture 14 - Bioreactor environment parameters

Lecture 15 - Bioreactor env. par. (DO)

Lecture 16 - Solution to PP 4.1

Lecture 17 - Shear stress, scale-up, scale-down

Lecture 18 - Cell view: stoichiometry; degree of reductance

Lecture 19 - Solution to PP 5.1

Lecture 20 - Culture status, metabolic flux analysis

Lecture 21 - Course summary

- Lecture 1 - Introduction to Biomaterials
- Lecture 2 - Background history
- Lecture 3 - History
- Lecture 4 - Properties - Mechanical and Physico-chemical
- Lecture 5 - Properties - Mechanical and Physico-chemical
- Lecture 6 - Mechanical properties
- Lecture 7 - Mechanical Properties (Continued...)
- Lecture 8 - Resorbability, biodegradation
- Lecture 9 - Resorbability, biodegradation (Continued...)
- Lecture 10 - Biofilm
- Lecture 11 - Biofilm (Continued...)
- Lecture 12 - Biofilm (Continued...)
- Lecture 13 - Biofilm (Continued...)
- Lecture 14 - Material characterization - Analytical instruments
- Lecture 15 - Analytical instruments
- Lecture 16 - Analytical instruments (Continued...)
- Lecture 17 - Analytical instruments (Continued...)
- Lecture 18 - Biological responses, compatibility, cytotoxicity
- Lecture 19 - Biological Responses
- Lecture 20 - Cell-biomaterial interaction
- Lecture 21 - Animal trials (in vivo)
- Lecture 22 - Animal trials
- Lecture 23 - Metals-types, classifications, applications
- Lecture 24 - Metals - properties
- Lecture 25 - Metals - properties (Continued...)
- Lecture 26 - Metals - properties (Continued...)
- Lecture 27 - Metals
- Lecture 28 - Polymers-types, classifications, applications
- Lecture 29 - Polymers
- Lecture 30 - Polymers (Continued...)
- Lecture 31 - Polymer blends

[Lecture 32 - Natural biopolymers](#)

[Lecture 33 - Natural biopolymers - \(Continued...\)](#)

[Lecture 34 - Biopolymers- proteins / hydrogels](#)

[Lecture 35 - Hydrogels](#)

[Lecture 36 - Experiments](#)

[Lecture 37 - surface modification-Demonstration](#)

[Lecture 38 - Ceramics](#)

[Lecture 39 - Cardiovascular and ocular biomaterials](#)

[Lecture 40 - Sterilisation/Device failure](#)

Lecture 1 - Concepts and importance of Bioinformatics

Lecture 2 - Complexities in biological systems

Lecture 3 - DNA sequence analysis

Lecture 4 - Sequence based parameters

Lecture 5 - Database

Lecture 6 - Database categories

Lecture 7 - Protein structure and function - I

Lecture 8 - Protein structure and function - II

Lecture 9 - Protein sequence databases - I

Lecture 10 - Protein sequence databases - II

Lecture 11 - Pairwise alignment - I

Lecture 12 - Pairwise alignment - II

Lecture 13 - Uniprot Demo

Lecture 14 - Sequence alignment - I

Lecture 15 - Sequence alignment - II

Lecture 16 - Sequence alignment: Online resources - I

Lecture 17 - Sequence alignment: Online resources - II

Lecture 18 - Conservation score - I

Lecture 19 - Conservation score - II

Lecture 20 - Blast Demo

Lecture 21 - Phylogenetic trees - I

Lecture 22 - Phylogenetic trees - II

Lecture 23 - Protein sequence analysis - I

Lecture 24 - Protein sequence analysis - II

Lecture 25 - Hydrophobicity profiles

Lecture 26 - Patterns and PSSM profiles

Lecture 27 - Construction of Non-redundant datasets - I

Lecture 28 - Non-redundant datasets - II

Lecture 29 - Protein secondary structure

Lecture 30 - Secondary structure prediction - I

Lecture 31 - Secondary structure prediction - II

[Lecture 32 - Secondary structure prediction - III](#)

[Lecture 33 - Protein tertiary structure - I](#)

[Lecture 34 - Protein tertiary structure - II](#)

[Lecture 35 - Protein structure analysis - I](#)

[Lecture 36 - Protein structure analysis - II](#)

[Lecture 37 - Protein structure analysis - III](#)

[Lecture 38 - Demo: PDB or Pymol or PDBParam](#)

[Lecture 39 - Protein structure analysis - IV](#)

[Lecture 40 - Protein structure prediction - I](#)

[Lecture 41 - Protein structure prediction - II](#)

[Lecture 42 - Protein stability - I](#)

[Lecture 43 - Protein stability - II](#)

[Lecture 44 - Demo: Homology Modelling](#)

[Lecture 45 - Stabilizing residues](#)

[Lecture 46 - Thermodynamic database](#)

[Lecture 47 - Stability of proteins upon mutations - I](#)

[Lecture 48 - Stability of proteins upon mutations - II](#)

[Lecture 49 - Demo: ProTherm](#)

[Lecture 50 - Protein folding rate - I](#)

[Lecture 51 - Protein folding rate - II](#)

[Lecture 52 - Protein interactions - I](#)

[Lecture 53 - Protein interactions - II](#)

[Lecture 54 - Computer aided drug design - I](#)

[Lecture 55 - Computer aided drug design - II](#)

[Lecture 56 - Virtual screening - I](#)

[Lecture 57 - Virtual screening - II](#)

[Lecture 58 - QSAR - I](#)

[Lecture 59 - QSAR - II](#)

[Lecture 60 - Demo: Autodock](#)

[Lecture 61 - awk programming - I](#)

[Lecture 62 - awk programming - II](#)

[Lecture 63 - Development of algorithms - I](#)

[Lecture 64 - Development of algorithms - II](#)

[Lecture 65 - Applications of bioinformatics - I](#)

[Lecture 66 - Applications of bioinformatics - II](#)

[Lecture 67 - Overview - I](#)

[Lecture 68 - Overview - II](#)

[Lecture 69 - Demo: Weka](#)

**NPTEL : NOC:Demystifying the Brain (Biotechnology)**

**Co-ordinators : Dr. V Srinivasa Chakravarthy**

- Lecture 1 - The Whole and Its Parts: A History of Ideas about Brain
- Lecture 2 - Understanding Brain's Shape - Segment 1 - Brain size and intelligence
- Lecture 3 - Understanding Brain's Shape - Segment 2 - Save Wire Principle
- Lecture 4 - Understanding Brain's Shape - Segment 3 - Brain Evolution
- Lecture 5 - Neurons and Neural Signaling: Outline
- Lecture 6 - Neural Signalling : Molecular and Cellular Basis
- Lecture 7 - Networks that Learn - Segment 1
- Lecture 8 - Multilayer Perceptrons Applications in Psychology and Neuroscience
- Lecture 9 - Organization of the Central Nervous System-Segment 1 - Cortex
- Lecture 10 - Organization of the Central Nervous System-Segment 2 - Subcortical Structures
- Lecture 11 - Maps in the Brain - Segment 1
- Lecture 12 - Maps in the Brain - Segment 2
- Lecture 13 - Emotions in the Brain - Segment 1
- Lecture 14 - Emotions in the Brain - Segment 2
- Lecture 15 - Memories and Holograms - Segment 1
- Lecture 16 - Memories and Holograms - Segment 2
- Lecture 17 - Consciousness - Segment 1
- Lecture 18 - Consciousness - Segment 2

[Lecture 1 - Introduction](#)

[Lecture 2 - Introduction to Modelling](#)

[Lecture 3 - Introduction to Modelling](#)

[Lecture 4 - Fundamentals of Mathematical Modelling](#)

[Lecture 5 - Fundamentals of Mathematical Modelling](#)

[Lecture 6 - Fundamentals of Mathematical Modelling](#)

[Lecture 7 - Some Example Models](#)

[Lecture 8 - Representation of Biological Networks](#)

[Lecture 9 - Lab: MATLAB Basics](#)

[Lecture 10 - Lab: MATLAB Basics](#)

[Lecture 11 - Lab: MATLAB Basics](#)

[Lecture 12 - Lab: MATLAB Basics](#)

[Lecture 13 - Introduction to Networks](#)

[Lecture 14 - Introduction to Networks](#)

[Lecture 15 - Introduction to Network Biology](#)

[Lecture 16 - Introduction to Network Biology](#)

[Lecture 17 - Introduction to Network Biology](#)

[Lecture 18 - Network Biology](#)

[Lecture 19 - Network Models](#)

[Lecture 20 - Network Models](#)

[Lecture 21 - Biological Networks](#)

[Lecture 22 - Network Perturbations](#)

[Lecture 23 - Community Detection](#)

[Lecture 24 - Network Motifs](#)

[Lecture 25 - Lab: Cytoscape](#)

[Lecture 26 - Lab: Cytoscape](#)

[Lecture 27 - Lab: Network Biology](#)

[Lecture 28 - Network Biology: Recap](#)

[Lecture 29 - Lab: Network Models and Perturbations](#)

[Lecture 30 - Lab: Network Models and Perturbations](#)

[Lecture 31 - Reconstruction of Gene Regulatory Networks](#)

- [Lecture 32 - Reconstruction of Protein Networks](#)
- [Lecture 33 - Reconstruction of Signalling Networks](#)
- [Lecture 34 - Reconstruction of Signalling Networks](#)
- [Lecture 35 - Introduction to Dynamic Modelling](#)
- [Lecture 36 - Introduction to Dynamic Modelling](#)
- [Lecture 37 - Introduction to Dynamic Modelling](#)
- [Lecture 38 - Lab: Solving ODEs in MATLAB](#)
- [Lecture 39 - Lab: Example Biological Model](#)
- [Lecture 40 - Parameter Estimation](#)
- [Lecture 41 - Parameter Estimation](#)
- [Lecture 42 - Parameter Estimation](#)
- [Lecture 43 - Methods for Parameter Estimation](#)
- [Lecture 44 - Direct Search Methods](#)
- [Lecture 45 - Genetic Algorithms](#)
- [Lecture 46 - Genetic Algorithms](#)
- [Lecture 47 - Other Evolutionary Algorithms](#)
- [Lecture 48 - PyGMO](#)
- [Lecture 49 - Dynamic Modelling Recap](#)
- [Lecture 50 - Lab: Parameter Estimation](#)
- [Lecture 51 - Guest Lecture: Modelling in Drug Development](#)
- [Lecture 52 - Guest Lecture: Modelling in Drug Development](#)
- [Lecture 53 - Guest Lecture: Quantitative Systems Pharmacology](#)
- [Lecture 54 - Guest Lecture: Quantitative Systems Pharmacology](#)
- [Lecture 55 - Guest Lecture: Quantitative Systems Pharmacology](#)
- [Lecture 56 - Constraint-based Modelling of Metabolic Networks](#)
- [Lecture 57 - Flux Balance Analysis](#)
- [Lecture 58 - Flux Balance Analysis](#)
- [Lecture 59 - Flux Balance Analysis](#)
- [Lecture 60 - Other Constraint-Based Approaches](#)
- [Lecture 61 - Other Constraint-Based Approaches](#)
- [Lecture 62 - Lab: FBA using MATLAB](#)
- [Lecture 63 - Perturbations to Metabolic Networks: Deletions](#)
- [Lecture 64 - Lab: COBRA Toolbox](#)

[Lecture 65 - Understanding FBA](#)

[Lecture 66 - Understanding FBA](#)

[Lecture 67 - Perturbations to Metabolic Networks: Over-expression](#)

[Lecture 68 - Perturbations to Metabolic Networks: Synthetic Lethals](#)

[Lecture 69 - Perturbations to Metabolic Networks: Synthetic Lethals](#)

[Lecture 70 - Constraint-based Modelling of Metabolic Networks](#)

[Lecture 71 - Lab: Gene Deletions](#)

[Lecture 72 - Integrating Regulatory Information into Constraint-Based Models](#)

[Lecture 73 - Elementary Modes](#)

[Lecture 74 - Elementary Modes](#)

[Lecture 75 - Constraint-based Modelling of Metabolic Networks: Applications](#)

[Lecture 76 - Constraint-based Modelling of Metabolic Networks: Applications](#)

[Lecture 77 - Constraint-based Modelling of Metabolic Networks: Applications](#)

[Lecture 78 - Lab: Gene Deletions](#)

[Lecture 79 - Constraint-based Modelling of Metabolic Networks: Recap](#)

[Lecture 80 - Constraint-based Modelling of Metabolic Networks: Recap](#)

[Lecture 81 - Constraint-based Modelling of Metabolic Networks: Recap](#)

[Lecture 82 - <sup>13</sup>C-Metabolic Flux Analysis using Mass Spectrometry](#)

[Lecture 83 - <sup>13</sup>C-Metabolic Flux Analysis using Mass Spectrometry](#)

[Lecture 84 - <sup>13</sup>C-Metabolic Flux Analysis using Mass Spectrometry](#)

[Lecture 85 - Lab: <sup>13</sup>C-Metabolic Flux Analysis using Mass Spectrometry](#)

[Lecture 86 - Modelling Gene Regulatory Networks](#)

[Lecture 87 - Modelling Gene Regulatory Networks](#)

[Lecture 88 - Modelling Gene Regulatory Networks](#)

[Lecture 89 - Lab: Modelling Gene Regulatory Networks](#)

[Lecture 90 - Lab: Modelling Gene Regulatory Networks](#)

[Lecture 91 - Computational Modelling of Host-Pathogen Interactions](#)

[Lecture 92 - Computational Modelling of Host-Pathogen Interactions](#)

[Lecture 93 - Robustness in Biological Systems](#)

[Lecture 94 - Robustness in Biological Systems: Mechanisms](#)

[Lecture 95 - Robustness in Biological Systems: Organising Principles](#)

[Lecture 96 - Robustness in Biological Systems: Trade-offs](#)

[Lecture 97 - Robustness and Evolvability](#)

[Lecture 98 - robustness and Evolvability](#)

[Lecture 99 - Introduction to Synthetic Biology](#)

[Lecture 100 - Advanced Topics](#)

[Lecture 101 - Advanced Topics](#)

[Lecture 102 - Advanced Topics](#)

[Lecture 103 - Course Recap](#)

- Lecture 1 - Fundamentals of Engineering Calculations
- Lecture 2 - Process Parameters and Variables
- Lecture 3 - Fundamentals of Material Balances
- Lecture 4 - Material Balance Calculations for Single Units Without Reactions - Part 1
- Lecture 5 - Material Balance Calculations for Single Units Without Reactions - Part 2
- Lecture 6 - Material Balance Calculations for Single Units Without Reactions - Part 3
- Lecture 7 - Material Balance Calculations for Single Units Without Reactions - Part 4
- Lecture 8 - Material Balance Calculations for Multiple Units Without Reactions - Part 1
- Lecture 9 - Material Balance Calculations for Multiple Units Without Reactions - Part 2
- Lecture 10 - Fundamentals of Reactive Processes
- Lecture 11 - Material Balance Calculations For Single Units With A Single Reaction
- Lecture 12 - Material Balance Calculations for Single Units with A Single Reaction (Continued...)
- Lecture 13 - Material Balance Calculations for Single Units with Multiple Reactions - Part 1
- Lecture 14 - Material Balance Calculations for Single Units with Multiple Reactions - Part 2
- Lecture 15 - Material Balance Calculations for Single Units with Multiple Reactions - Part 3
- Lecture 16 - Material Balance Calculations for Multiple Units with Reactions - Part 1
- Lecture 17 - Material Balance Calculations for Multiple Units with Reactions - Part 2
- Lecture 18 - Material Balances on Reactive Processes - Tutorials
- Lecture 19 - Combustion Reactions: An Introduction
- Lecture 20 - Material Balances for Combustion Reactions
- Lecture 21 - Biochemical Reactions: Enzyme Kinetics
- Lecture 22 - Biochemical Reactions: Cell Growth
- Lecture 23 - Recycle Without Reactions
- Lecture 24 - Recycle with Reactions
- Lecture 25 - Recycle: Tutorials
- Lecture 26 - Bypass
- Lecture 27 - Purge
- Lecture 28 - Material Balance: A Review - Part 1
- Lecture 29 - Material Balance: A Review - Part 2
- Lecture 30 - Material Balance: A Review - Part 3
- Lecture 31 - The Unreasonable Effectiveness of Material Balance

[Lecture 32 - Constraint-based modelling](#)

[Lecture 33 - Flux balance analysis - Part 1](#)

[Lecture 34 - Flux balance analysis - Part 2](#)

[Lecture 35 - Energy Balance Terminologies and Concepts](#)

[Lecture 36 - Introduction to Energy Balances - Part 1](#)

[Lecture 37 - Introduction to Energy Balances - Part 2](#)

[Lecture 38 - Introduction to Energy Balances: Tutorials](#)

[Lecture 39 - Mechanical Energy Balances](#)

[Lecture 40 - Mechanical Energy Balances: Tutorials](#)

[Lecture 41 - Energy Balance Objectives and Procedures](#)

[Lecture 42 - Introduction to Nonreactive Processes Without Phase Change](#)

[Lecture 43 - Energy Balances on Single-Phase Nonreactive Processes](#)

[Lecture 44 - Energy Balances on Single-Phase Nonreactive Processes: Tutorials](#)

[Lecture 45 - Fundamentals of Nonreactive Phase Change Processes](#)

[Lecture 46 - Estimating Latent Heats](#)

[Lecture 47 - Energy Balances on Nonreactive Processes With Phase Change](#)

[Lecture 48 - Energy Balances on Nonreactive Processes With Phase Change: Tutorials - 1](#)

[Lecture 49 - Energy Balances on Nonreactive Processes With Phase Change: Tutorials - 2](#)

[Lecture 50 - Psychrometric Charts](#)

[Lecture 51 - Energy Balances Using Psychrometric Charts](#)

[Lecture 52 - Mixing and Solution](#)

[Lecture 53 - Mixing and Solution: Tutorials - 1](#)

[Lecture 54 - Mixing and Solution: Tutorials - 2](#)

[Lecture 55 - Fundamentals for Energy Balances on Reactive Processes - Part 1](#)

[Lecture 56 - Fundamentals for Energy Balances on Reactive Processes - Part 1 and Part 2](#)

[Lecture 57 - Fundamentals for Energy Balances on Reactive Processes - Tutorials](#)

[Lecture 58 - Energy Balances on Reactive Processes - Part 1](#)

[Lecture 59 - Energy Balances on Reactive Processes - Part 2](#)

[Lecture 60 - Energy Balances on Reactive Processes - Part 3](#)

[Lecture 61 - Energy Balances on Reactive Processes - Part 4](#)

[Lecture 62 - Energy Balances on Reactive Processes - Part 5](#)

[Lecture 63 - Energy Balances on Reactive Processes - Part 6](#)

[Lecture 64 - Energy Balances: A Review - Part 1](#)

[Lecture 65 - Energy Balances: A Review - Part 2](#)

[Lecture 66 - Energy Balances: A Review - Part 3](#)

[Lecture 67 - Energy Balances: A Review - Part 4](#)

[Lecture 68 - Unsteady State Material Balances](#)

[Lecture 69 - Unsteady State Energy Balances](#)

Lecture 1 - Introduction

Lecture 2 - Drug Discovery - Issues

Lecture 3 - Target and Lead Identification

Lecture 4 - Drug And Data bases

Lecture 5 - Drug Properties

Lecture 6 - Drug - Properties / SMILES

Lecture 7 - Drug Solubility

Lecture 8 - Drug Solubility / permeability

Lecture 9 - ADME

Lecture 10 - Drug - ADME

Lecture 11 - Drug - ADME

Lecture 12 - Drug - BBB

Lecture 13 - Pgp efflux/Drug Likeness

Lecture 14 - Drug Likeness

Lecture 15 - Molecular Modelling

Lecture 16 - Molecular Mechanics / Force Field

Lecture 17 - Molecular Mechanics / Force Field

Lecture 18 - Molecular Mechanics / Force Field

Lecture 19 - Molecular Mechanics / Force Field

Lecture 20 - ODES and Numerical methods

Lecture 21 - ODES and Numerical methods

Lecture 22 - Conformational Search / MD

Lecture 23 - Quantum Mechanics

Lecture 24 - Quantum Mechanics

Lecture 25 - Quantitative Struture Activity Relationship (QSAR)

Lecture 26 - Quantitative Struture Activity Relationship (QSAR)

Lecture 27 - Quantitative Struture Activity Relationship (QSAR)

Lecture 28 - Quantitative Struture Activity Relationship (QSAR)

Lecture 29 - Quantitative Struture Activity Relationship (QSAR)

Lecture 30 - Quantitative Struture Activity Relationship (QSAR)

Lecture 31 - 3D QSAR

[Lecture 32 - Pharmacophore modelling](#)

[Lecture 33 - Target based drug design](#)

[Lecture 34 - Target based drug design](#)

[Lecture 35 - Target based drug design](#)

[Lecture 36 - Target based drug design](#)

[Lecture 37 - Docking](#)

[Lecture 38 - Docking](#)

[Lecture 39 - Pharmacokinetics / pharmacodynamics](#)

[Lecture 40 - Pharmacokinetics / pharmacodynamics](#)

- Lecture 1 - Introduction to plant cell technology
- Lecture 2 - History of plant cell and tissue culture
- Lecture 3 - Anatomy of plant cells
- Lecture 4 - Plant tissues and functions
- Lecture 5 - Photosynthesis and Photorespiration
- Lecture 6 - In-vitro culture initiation
- Lecture 7 - Nutritional requirements of plant cells
- Lecture 8 - Organogenesis and Regeneration
- Lecture 9 - Somaclonal variation and Micropropagation
- Lecture 10 - Somatic embryogenesis and Protoplast culture
- Lecture 11 - Synthetic seeds, Cryopreservation and Freezing methods
- Lecture 12 - Secondary metabolism in plant cells - Part 1
- Lecture 13 - Secondary metabolism in plant cells - Part 2
- Lecture 14 - Secondary metabolism in plant cells - Part 3
- Lecture 15 - Secondary metabolism in plant cells - Part 4
- Lecture 16 - Optimization strategies - Part 1
- Lecture 17 - Optimization strategies - Part 2
- Lecture 18 - Optimization strategies - Part 3
- Lecture 19 - Optimization strategies - Part 4
- Lecture 20 - Biotransformation in plant cultures
- Lecture 21 - Immobilization of plant cells
- Lecture 22 - Genetic transformations in plant cells - Part 1
- Lecture 23 - Genetic transformations in plant cells - Part 2
- Lecture 24 - Genetic transformations in plant cells - Part 3
- Lecture 25 - Plant Cell Bioreactors - Part 1
- Lecture 26 - Plant Cell Bioreactors - Part 2
- Lecture 27 - Bioreactors for Hairy Root cultures
- Lecture 28 - Case study - Part 1
- Lecture 29 - Case study - Part 2

- Lecture 1 - Introduction to Tissue Engineering - Part 1
- Lecture 2 - Introduction to Tissue Engineering - Part 2
- Lecture 3 - Introduction to Tissue Engineering - Part 3
- Lecture 4 - Scaffolds: Extracellular Matrix
- Lecture 5 - Scaffolds: Natural Polymers
- Lecture 6 - Scaffolds: Synthetic Polymers
- Lecture 7 - Hydrogels - Part 1
- Lecture 8 - Hydrogels - Part 2
- Lecture 9 - Bioceramics
- Lecture 10 - Scaffold fabrication strategies
- Lecture 11 - Self Assembly
- Lecture 12 - 3D Bioprinting
- Lecture 13 - Material Characterization - Part 1
- Lecture 14 - Material Characterization - Part 2
- Lecture 15 - Material Characterization - Part 3
- Lecture 16 - Cell Source
- Lecture 17 - Cell Isolation - Part 1
- Lecture 18 - Cell Isolation - Part 2
- Lecture 19 - Tissue Dynamics
- Lecture 20 - Cell Differentiation
- Lecture 21 - Cell Adhesion
- Lecture 22 - Cell Migration
- Lecture 23 - Signaling and biomolecule delivery in Tissue Engineering
- Lecture 24 - Bioreactors in Tissue Engineering
- Lecture 25 - Challenges in Tissue Engineering
- Lecture 26 - Host integration and immune responses - Part 1
- Lecture 27 - Host integration and immune responses - Part 2
- Lecture 28 - Bioethics of Tissue Engineering - Part 1
- Lecture 29 - Bioethics of Tissue Engineering - Part 2
- Lecture 30 - Skin Tissue Engineering - Part 1
- Lecture 31 - Skin Tissue Engineering - Part 2

[Lecture 32 - Bone Tissue Engineering - Part 1](#)

[Lecture 33 - Bone Tissue Engineering - Part 2](#)

[Lecture 34 - Bone Tissue Engineering - Part 3](#)

[Lecture 35 - Vascular Tissue Engineering](#)

[Lecture 36 - Corneal Tissue Engineering - Part 1](#)

[Lecture 37 - Corneal Tissue Engineering - Part 2](#)

Lecture 1 - Introduction and review

Lecture 2 - Review (Continued...)

Lecture 3 - Need for analysis

Lecture 4 - Additional Thermodynamic Functions

Lecture 5 - State and Path Variables

Lecture 6 - Equations for a Closed System

Lecture 7 - Chemical Potential

Lecture 8 - Gibbs Duhem equation

Lecture 9 - Maxwell's relations

Lecture 10 - Inter-relationships between thermodynamic variables (Continued...)

Lecture 11 - Some useful mathematical manipulations

Lecture 12 - Thermodynamic relations for a closed system with 1 mole of pure substance

Lecture 13 - Maximum work

Lecture 14 - Open systems

Lecture 15 - Equations of state - Virial equations

Lecture 16 - Equations of state - Cubic equations

Lecture 17 - Volume estimation

Lecture 18 - Volume estimation (Continued...)

Lecture 19 - Generalized correlations

Lecture 20 - Generalized correlations (Continued...)

Lecture 21 - Residual properties

Lecture 22 - Residual properties (Continued...)

Lecture 23 - Generalized correlations and residual properties

Lecture 24 - Fugacity coefficient estimation

Lecture 25 - Review of module 3

Lecture 26 - Learning aspects

Lecture 27 - Chemical potential formulations

Lecture 28 - Lewis and Randall rule

Lecture 29 - Partial molar properties

Lecture 30 - Partial molar property estimation from mixing experiments

Lecture 31 - Partial molar property estimation (Continued...)

- Lecture 32 - Activity coefficient from excess property
- Lecture 33 - Activity coefficient from excess property (Continued...)
- Lecture 34 - Models for activity coefficient in a binary system
- Lecture 35 - Models for activity coefficient for a binary system (Continued...)
- Lecture 36 - Review of module 4
- Lecture 37 - Criteria for phase equilibrium
- Lecture 38 - Phase rule for non-reacting systems
- Lecture 39 - Clausius Clayperon equation
- Lecture 40 - Clausius Clayperon equation (Continued...)
- Lecture 41 - Vapour liquid equilibrium
- Lecture 42 - Vapour liquid equilibrium (Continued...)
- Lecture 43 - Estimation of fugacity coefficient from P-V-T data at equilibrium
- Lecture 44 - Liquid-liquid and solid-liquid equilibria
- Lecture 45 - Review of module 5
- Lecture 46 - Criteria for bioreaction equilibria
- Lecture 47 - Phase rule for reacting biosystems
- Lecture 48 - Equilibrium constants
- Lecture 49 - Effect of temperature on the equilibrium constants
- Lecture 50 - Reaction in liquid or solid phases
- Lecture 51 - Free energy changes for some bioreactions
- Lecture 52 - Electrolytes
- Lecture 53 - Review of the classical thermodynamics part
- Lecture 54 - Introduction to Statistical thermodynamics
- Lecture 55 - Concepts of macro and microstates
- Lecture 56 - Thermodynamic probability
- Lecture 57 - Boltzmann distribution law
- Lecture 58 - Defining  $\hat{P}$  in Boltzmann distribution law
- Lecture 59 - Relationship between partition function and thermodynamic quantities
- Lecture 60 - Partition function of mono atomic gases
- Lecture 61 - Entropy in terms of probablity
- Lecture 62 - Gibbs paradox
- Lecture 63 - Thermodynamic probability for distinguishable particles
- Lecture 64 - Thermodynamic probability for indistinguishable particles

[Lecture 65 - Sackur - Tetrode equation](#)

[Lecture 66 - Partition function and Helmholtz and Gibbs free energy](#)

[Lecture 67 - Ensemble approach](#)

[Lecture 68 - Ensemble average, time average, Ergodic hypothesis](#)

[Lecture 69 - Partition function for classical systems](#)

[Lecture 70 - Pair potentials for atomic systems](#)

[Lecture 71 - Potential for molecular systems](#)

[Lecture 72 - Computer code for LJ potential](#)

[Lecture 73 - Introduction to computer simulations](#)

[Lecture 74 - Computer simulations of macromolecules](#)

[Lecture 75 - MD simulation examples](#)

[Lecture 76 - Link between theory and experiments](#)

[Lecture 77 - MD protocol](#)

[Lecture 78 - Computer simulation tricks](#)

[Lecture 79 - Understanding force fields](#)

[Lecture 80 - Idea of Z-matrix](#)

[Lecture 81 - Basics of MD simulations](#)

[Lecture 82 - Integration algorithms](#)

[Lecture 83 - Calculation of Columbic force](#)

[Lecture 84 - Calculation of LJ force](#)

[Lecture 85 - Monte Carlo simulations](#)

[Lecture 86 - Analysis of MD trajectory](#)

[Lecture 87 - Case study \(water\)](#)

Lecture 1 - Introduction

Lecture 2 - Mass Conservation

Lecture 3 - Mass Conservation for a Macroscopic System

Lecture 4 - Mass Conservation for a Microscopic System

Lecture 5 - Useful Derivatives

Lecture 6 - Equation of Continuity

Lecture 7 - Mass Flux

Lecture 8 - Mass and Molar Fluxes

Lecture 9 - Shell Balance Approach

Lecture 10 - Continuity Equation Approach

Lecture 11 - Steady-state Diffusion

Lecture 12 - Steady-state Diffusion across Tubular Walls

Lecture 13 - Steady-state Radial Diffusion

Lecture 14 - Steady-state Diffusion with Reaction

Lecture 15 - Unsteady-state Diffusion

Lecture 16 - Unsteady-state Diffusion (Continued...)

Lecture 17 - Pseudo Steady State Approximation (Continued...)

Lecture 18 - Pseudo Steady State Approximation (Continued...)

Lecture 19 - Review of Mass Flux

Lecture 20 - Momentum Flux - Introduction

Lecture 21 - Rheology

Lecture 22 - Fluid Flow types

Lecture 23 - Shell Momentum Balances

Lecture 24 - Shell Momentum Balances (Continued...)

Lecture 25 - Equation of Motion

Lecture 26 - Equation of Motion (Continued...)

Lecture 27 - Application of Equation of Motion to Flow Over an Inclined Plane

Lecture 28 - Laminar Flow through a Pipe

Lecture 29 - Laminar Flow through a Pipe (Continued...)

Lecture 30 - Capillary Flow

Lecture 31 - Couette Flow

[Lecture 32 - Non-dimensional Analysis](#)

[Lecture 33 - Unsteady State Flow](#)

[Lecture 34 - Unsteady State Flow \(Continued...\)](#)

[Lecture 35 - Pulsatile Flow](#)

[Lecture 36 - Turbulent Flow](#)

[Lecture 37 - Macroscopic Aspects: The Engineering Bernoulli Equation](#)

[Lecture 38 - Friction Factor for Flow through a Straight Horizontal Pipe](#)

[Lecture 39 - Application of the Engineering Bernoulli Equation to a Piping Network](#)

[Lecture 40 - Stenosis in an Artery](#)

[Lecture 41 - Friction Factor for Relative Motion between a Solid and a Liquid](#)

[Lecture 42 - Friction Factor for Packed Beds](#)

[Lecture 43 - Review of Momentum Flux](#)

[Lecture 44 - Review of Momentum Flux \(Continued...\)](#)

[Lecture 45 - Thermal Energy Flux](#)

[Lecture 46 - Equation of Energy](#)

[Lecture 47 - Temperature Profile in a Tissue](#)

[Lecture 48 - Unsteady-state Heat Conduction](#)

[Lecture 49 - Review of Heat Flux](#)

[Lecture 50 - Charge Flux](#)

[Lecture 51 - Charge Flux - Some Fundamentals](#)

[Lecture 52 - Charge Flux - Some More Fundamentals](#)

[Lecture 53 - Getting Useful Relationships through Maxwell's Equations](#)

[Lecture 54 - Charges/Ions in Solution](#)

[Lecture 55 - Charge Flux: Review](#)

[Lecture 56 - Fluxes Under Simultaneous, Multiple Driving Forces](#)

[Lecture 57 - Simultaneous Concentration Gradient and Electrical Potential Gradient](#)

[Lecture 58 - Mobility of Ions Across a Membrane](#)

[Lecture 59 - Electrical Circuit Representation of a Membrane](#)

[Lecture 60 - Action Potential and Axial Current](#)

[Lecture 61 - Electrophoresis](#)

[Lecture 62 - Simultaneous Concentration Gradient and Velocity Gradient](#)

[Lecture 63 - Simultaneous Concentration Gradient and Velocity Gradient - Bioreactor Kla](#)

[Lecture 64 - Gas-Liquid Interphase Transport](#)

- [Lecture 65 - Gas-Liquid Interphase Transport \(Continued...\)](#)
- [Lecture 66 - Bioreactor  \$K\_L a\$  Estimation](#)
- [Lecture 67 - Liquid Phase Oxygen-Supply Strategy](#)
- [Lecture 68 - LPOS and Its Mechanism](#)
- [Lecture 69 - LPOS for Mold Cultivations](#)
- [Lecture 70 - LPOS Optimization and Costs](#)
- [Lecture 71 - Couette Flow Cultivations](#)
- [Lecture 72 - Pseudo-Steady State Approximation Applied to Bio-oil Production](#)
- [Lecture 73 - Pseudo-Steady State Approximation Applied to Cancer Treatment](#)
- [Lecture 74 - Kinetics of a Process with an Enzyme Immobilized on a Non-porous Slab](#)
- [Lecture 75 - Simultaneous Temperature Gradient and Velocity Gradient](#)
- [Lecture 76 - Design of Heat Exchangers](#)
- [Lecture 77 - Design of Heat Exchangers \(Continued...\)](#)
- [Lecture 78 - Course Review - Part 1](#)
- [Lecture 79 - Course Review - Part 2](#)
- [Lecture 80 - Course Review - Part 3](#)
- [Lecture 81 - Course Review - Part 4](#)

Lecture 1 - Introduction

Lecture 2 - Life cycles and evolution of developmental patterns

Lecture 3 - Experimental embryology

Lecture 4 - Differential gene expression - Part 1

Lecture 5 - Differential gene expression - Part 2

Lecture 6 - Differential gene expression - Part 3

Lecture 7 - Differential gene expression - Part 4

Lecture 8 - Genetic basis - Part 1

Lecture 9 - Genetic basis - Part 2

Lecture 10 - Genetic basis - Part 3

Lecture 11 - Genetic basis - Part 4

Lecture 12 - Genetic basis - Part 5

Lecture 13 - Cell-cell communication - Part 1

Lecture 14 - Cell-cell communication - Part 2

Lecture 15 - Cell-cell communication - Part 3

Lecture 16 - Cell-cell communication - Part 4

Lecture 17 - Genetics of axis formation in Drosophila - Part 1

Lecture 18 - Genetics of axis formation in Drosophila - Part 2

Lecture 19 - Genetics of axis formation in Drosophila - Part 3

Lecture 20 - Genetics of axis formation in Drosophila - Part 4

Lecture 21 - Plant Development - Part 1

Lecture 22 - Plant Development - Part 2

Lecture 23 - Plant Development - Part 3

Lecture 24 - Early Mammalian Development - Part 1

Lecture 25 - Early Mammalian Development - Part 2

Lecture 26 - Evolutionary Developmental Biology - Part 1

Lecture 27 - Evolutionary Developmental Biology - Part 2

Lecture 28 - Evolutionary Developmental Biology - Part 3

- Lecture 1 - Introduction to the course - Part 1
- Lecture 2 - Introduction to the course - Part 2
- Lecture 3 - Design of Batch Bioreactors - Part 1
- Lecture 4 - Design of Batch Bioreactors - Part 2
- Lecture 5 - Design of Batch Bioreactors - Part 3
- Lecture 6 - Design of Batch Bioreactors - Part 4
- Lecture 7 - Design of Batch Bioreactors - Practice problems
- Lecture 8 - Design of Fed Batch bioreactors - Part 1
- Lecture 9 - Design of Fed Batch bioreactors - Part 2
- Lecture 10 - Design of Fed Batch bioreactors - Practice problems - Part 1
- Lecture 11 - Design of Fed Batch bioreactors - Practice Problems - Part 2
- Lecture 12 - Design of Fed Batch bioreactors - Practice Problems - Part 3
- Lecture 13 - Design of Continuous Bioreactors - Part 1
- Lecture 14 - Design of Continuous Bioreactors - Part 2
- Lecture 15 - Design of Continuous Bioreactors - Part 3
- Lecture 16 - Design of Continuous bioreactors - Practice Problems - Part 1
- Lecture 17 - Design of Continuous bioreactors - Practice Problems - Part 1
- Lecture 18 - Design of Continuous bioreactors - Practice Problems - Part 2
- Lecture 19 - Mass Transfer in Bioreactors - Part 1
- Lecture 20 - Mass Transfer in Bioreactors - Part 2
- Lecture 21 - Mass Transfer in Bioreactors - Part 3
- Lecture 22 - Rheology of fluids
- Lecture 23 - Mass Transfer in Bioreactors - Practice Problems
- Lecture 24 - Heterogeneous reactions in Bioreactors - Part 1
- Lecture 25 - Heterogeneous reactions in Bioreactors - Part 2
- Lecture 26 - Heterogeneous reactions in Bioreactors - Part 3
- Lecture 27 - Heterogeneous reactions in Bioreactors - Practice Problems
- Lecture 28 - Heat Transfer Operations in Bioreactors - Part 1
- Lecture 29 - Heat Transfer Operations in Bioreactors - Part 2
- Lecture 30 - Heat Transfer Operations in Bioreactors - Part 3
- Lecture 31 - Heat Transfer Operations in Bioreactors - Part 4

[Lecture 32 - Heat Transfer Operations in Bioreactors - Practice Problems](#)

[Lecture 33 - Scale up of Bioreactors - Part 1](#)

[Lecture 34 - Scale up of Bioreactors - Part 2](#)

[Lecture 35 - Scale up of Bioreactors - Part 3](#)

[Lecture 36 - Scale up of Bioreactors - Part 4](#)

[Lecture 37 - Scale up of Bioreactors - Practice Problems](#)

[Lecture 38 - Non-ideal reactors: design and analysis - Part 1](#)

[Lecture 39 - Non-ideal reactors: design and analysis - Part 2](#)

[Lecture 40 - Non-ideal reactors: design and analysis - Practice Problems](#)

Lecture 1 - Introduction to Biomolecules - Part 1

Lecture 2 - Introduction to Biomolecules - Part 2

Lecture 3 - Stereochemistry and Properties of Water - Part 1

Lecture 4 - Properties of Water - Part 2 and Introduction to Proteins

Lecture 5 - Characteristics of Proteins and Chromatography techniques

Lecture 6 - Electrophoresis of Proteins and Protein Sequencing

Lecture 7 - Synthesis of Polypeptides and Enzymes - Part 1

Lecture 8 - Enzymes - Part 2

Lecture 9 - Enzymes - Part 3

Lecture 10 - Enzymes - Part 4

Lecture 11 - Enzymes - Part 5 and Carbohydrates - Part 1

Lecture 12 - Carbohydrates - Part 2 and Lipids - Part 1

Lecture 13 - Lipids - Part 2

Lecture 14 - Lipids - Part 3 and Introduction to Metabolism - Part 1

Lecture 15 - Introduction to metabolism - Part 2

Lecture 16 - Bioenergetics - Part 1

Lecture 17 - Bioenergetics - Part 2

Lecture 18 - Glycolysis - Part 1

Lecture 19 - Glycolysis - Part 2

Lecture 20 - Citric Acid Cycle - Part 1

Lecture 21 - Citric Acid Cycle - Part 2

Lecture 22 - Oxidative Phosphorylation - Part 1

Lecture 23 - Oxidative Phosphorylation - Part 2

Lecture 24 - Photosynthesis and Carbon assimilation - Part 1

Lecture 25 - Photosynthesis and Carbon Assimilation - Part 2

Lecture 26 - Photosynthesis and Carbon assimilation - Part 3

Lecture 27 - Nitrogen Metabolism

Lecture 28 - Catabolism of Amino acids

Lecture 29 - Urea cycle and Fatty acid catabolism - Part 1

Lecture 30 - Fatty acid catabolism - Part 2

Lecture 31 - Fatty Acid Biosynthesis

[Lecture 32 - Cholesterol Biosynthesis and Lipid transport - Part 1](#)

[Lecture 33 - Cholesterol Biosynthesis and Lipid transport - Part 2](#)

[Lecture 34 - Hormonal Regulation and Integration of Mammalian Metabolism](#)

Lecture 1 - Introduction - Part 1

Lecture 2 - Introduction - Part 2

Lecture 3 - Introduction - Part 3

Lecture 4 - Solids vs Fluids

Lecture 5 - Viscosity

Lecture 6 - Measuring Viscosity

Lecture 7 - Tutorial - Part 1

Lecture 8 - Tutorial - Part 2

Lecture 9 - Tutorial - Part 3

Lecture 10 - Macromolecular Nature and Hydrophobicity, Structure of Ice, Pauling-Bernal-Fowler Model of Water

Lecture 11 - Entropy and Probability of Water Conformations, Boltzmann Law of Entropy

Lecture 12 - Reynolds Number

Lecture 13 - Tutorial - Part 1

Lecture 14 - Tutorial - Part 2

Lecture 15 - Tutorial - Part 3

Lecture 16 - Hagen-Poiseuille Equation

Lecture 17 - Tutorial - Part 4

Lecture 18 - Sedimentation and Centrifugation - Part 1

Lecture 19 - Sedimentation and Centrifugation - Part 2

Lecture 20 - Blood Centrifugation

Lecture 21 - Review: Paperfuge for Hematology

Lecture 22 - Biology by Numbers

Lecture 23 - Biology by Numbers: Bomb Yield Solved

Lecture 24 - Order of Magnitude Estimates and Approximations

Lecture 25 - Physical Basis of Life

Lecture 26 - Approximating Cellular and Molecular Size Scales

Lecture 27 - Quantifying DNA and Chromatin

Lecture 28 - Protein Abundance and Spacing

Lecture 29 - Model Gene

Lecture 30 - Cell-Biology by Numbers

Lecture 31 - Experimental Techniques to Quantify Cells

- Lecture 32 - Time-Scales in Cells
- Lecture 33 - Energy Scale
- Lecture 34 - Energy and Thermodynamics of Life - Part 1
- Lecture 35 - Energy and Thermodynamics of Life - Part 2
- Lecture 36 - Energy and Life- Osmotic Engine
- Lecture 37 - Energy and Life- Interconversion of Energy
- Lecture 38 - Random Walk Statistics, Stoke-Einstein - Part 1
- Lecture 39 - Random Walk Statistics, Stoke-Einstein - Part 2
- Lecture 40 - Demonstration of Diffusion of Micron Sized Particles
- Lecture 41 - Macromolecular Crowding - Part 1
- Lecture 42 - Macromolecular Crowding - Part 2
- Lecture 43 - Cytoskeleton
- Lecture 44 - Beam Theory Applied to Biopolymer
- Lecture 45 - Understanding Chromosomes as Statistical Polymers - Part 1
- Lecture 46 - Understanding Chromosomes as Statistical Polymers - Part 2
- Lecture 47 - Brownian Ratchets and Molecular Motors
- Lecture 48 - Polymerization Dynamics - Part 1
- Lecture 49 - Polymerization Dynamics - Part 2
- Lecture 50 - Polymerization Dynamics - Part 3
- Lecture 51 - Python Programming - Part 1
- Lecture 52 - Python Programming - Part 2
- Lecture 53 - Python Programming - Part 3
- Lecture 54 - Introduction to Membrane Mechanics
- Lecture 55 - Membrane Deformation
- Lecture 56 - Developmental Pattern Formation
- Lecture 57 - Turing Model
- Lecture 58 - Phyllotaxis - Part 1
- Lecture 59 - Phyllotaxis - Part 2
- Lecture 60 - Phyllotaxis - Part 3

Lecture 1 - Medical Image Analysis - Introduction

Lecture 2 - X-ray imaging

Lecture 3 - MRI Physics

Lecture 4 - Magnetic Resonance Image Acquisition

Lecture 5 - Ultrasound Imaging

Lecture 6 - Radionuclide Imaging

Lecture 7 - Basic Image Processing Methods

Lecture 8 - Contrast Enhancement

Lecture 9 - Histogram Equalization

Lecture 10 - Edge Enhancement - Laplacian

Lecture 11 - Noise Reduction

Lecture 12 - Diffusion Filtering

Lecture 13 - Bayesian Image Restoration

Lecture 14 - Registration Introduction

Lecture 15 - Framework

Lecture 16 - Image Coordinates

Lecture 17 - Transforms

Lecture 18 - Metrics

Lecture 19 - NonRigid Registration

Lecture 20 - Demons part - 1

Lecture 21 - Demons part - 2

Lecture 22 - FFDBSplines

Lecture 23 - Endoscopy - Where are we with AI ?

Lecture 24 - Computer vision and DL in the operating room

Lecture 25 - ML in intraoperative tissue identification

Lecture 26 - Basic Image Processing Techniques Using MATLAB

Lecture 27 - Image Registration Using Matlab

Lecture 28 - Basic Image Processing Techniques Using Python

Lecture 29 - Calculus of variations

Lecture 30 - Snakes - Active Contour Models

Lecture 31 - Level Sets, Geodesic Active Contours, Mumford-Shah Functional, Chan-Vese

[Lecture 32 - Mumford-Shah Functional, Chan-Vese](#)

[Lecture 33 - Segmentation Models Demo \[Snakes \(Active Contours \) Chan-Vese segmentation, Geodesic active Contour\]](#)

[Lecture 34 - Active Shape Models](#)

[Lecture 35 - Snake tutorial](#)

[Lecture 36 - Level Set Method](#)

[Lecture 37 - Chan Vese Segmentation](#)

[Lecture 38 - Neural Networks Introduction](#)

[Lecture 39 - Linear Regression](#)

[Lecture 40 - Gradient Descent Formulation](#)

[Lecture 41 - Linear Regression Demo](#)

[Lecture 42 - Feed forward neural Networks](#)

[Lecture 43 - Example with XOR](#)

[Lecture 44 - Introduction to CNNs](#)

[Lecture 45 - Max Pooling](#)

[Lecture 46 - Applications of Cnns](#)

[Lecture 47 - CNN Training](#)

[Lecture 48 - Semantic Segmentation](#)

[Lecture 49 - Classification Demo in Pytorch](#)

[Lecture 50 - Generative Models](#)

[Lecture 51 - GAN Final Demo](#)

Lecture 1 - Introduction to Organ Printing course and Content Discussion

Lecture 2 - Introduction to 3D Bioprinting

Lecture 3 - Introduction to Inkjet 3D Bioprinting

Lecture 4 - Introduction to Inkjet 3D Bioprinting (Continued...)

Lecture 5 - Introduction to Extrusion Bioprinting

Lecture 6 - Introduction to Extrusion 3D Bioprinting (Continued...)

Lecture 7 - Introduction to Laser-assisted Bioprinting

Lecture 8 - Comparison of Different Bioprinting Techniques - Part 1

Lecture 9 - Comparison of Different Bioprinting Techniques - Part 2

Lecture 10 - 3D Bioprinting in Support Bath

Lecture 11 - Introduction to Bioinks

Lecture 12 - Important material requirement for Bioink development

Lecture 13 - Crosslinking of Hydrogels for Bioprinting

Lecture 14 - Single-Material and Multimaterial Bioink Systems

Lecture 15 - Printability for Extrusion Bioprinting

Lecture 16 - What is required and how to print an organ?

Lecture 17 - Level of complexity in Tissues/Organs for Bioprinting

Lecture 18 - Design approaches in Bioprinting

Lecture 19 - Bioprinting of Vasculature

Lecture 20 - Direct printing of vasculature

Lecture 21 - Indirect printing of vasculature

Lecture 22 - Design of Cornea Tissue-Specific Bioink and 3D Bioprinting of Cornea

Lecture 23 - Design of Cornea Tissue-Specific Bioink and 3D Bioprinting of Cornea (Continued...)

Lecture 24 - Bioprinting of Heart

Lecture 25 - Bioprinting of Liver

Lecture 26 - Bioprinting of Kidney

Lecture 27 - Bioprinting of Lung

Lecture 28 - 4D Bioprinting - Part 1

Lecture 29 - 4D Bioprinting - Part 2

Lecture 30 - 4D Bioprinting - Part 3

Lecture 31 - In Situ Bioprinting

[Lecture 32 - In Situ Bioprinting \(Continued...\)](#)

[Lecture 33 - Medical Modeling for Organ Printing](#)

[Lecture 34 - Medical Modeling for Organ Printing \(Continued...\)](#)

[Lecture 35 - Next Step in Bioprinting](#)

[Lecture 36 - Next Step in Bioprinting \(Continued...\)](#)

[Lecture 37 - Ethical Issues related to Organ Printing](#)

Lecture 1 - An Overview of Central Dogma of Molecular Biology - Part 1

Lecture 2 - An Overview of Central Dogma of Molecular Biology - Part 2

Lecture 3 - Central Dogma : The DNA Structure - Part 1

Lecture 4 - Central Dogma : The DNA Structure - Part 2

Lecture 5 - Central Dogma : The DNA Structure - Part 3

Lecture 6 - Central Dogma : Replication of DNA - Part 1

Lecture 7 - Central Dogma : Replication of DNA - Part 2

Lecture 8 - Central Dogma : Transcription - Part 1

Lecture 9 - Central Dogma : Transcription - Part 2

Lecture 10 - Central Dogma : Transcription - Part 3

Lecture 11 - Central Dogma : Translation - Part 1

Lecture 12 - Central Dogma : Translation - Part 2

Lecture 13 - Central Dogma : Translation - Part 3

Lecture 14 - Protein Structure, Folding and Function - Part 1

Lecture 15 - Protein Structure, Folding and Function - Part 2

Lecture 16 - Secondary Structure of Proteins: Ramachandran Plot - Part 1

Lecture 17 - Secondary Structure of Proteins: Ramachandran Plot - Part 2

Lecture 18 - Protein Structure, Folding and Function - Part 3

Lecture 19 - Protein Structure, Folding and Function - Part 4

Lecture 20 - Protein Structure, Folding and Function - Part 5

Lecture 21 - Protein Structure, Folding and Function - Part 6

Lecture 22 - Enzymes, Carbohydrates and Lipids

Lecture 23 - Introduction to Genetics - Part 1

Lecture 24 - Introduction to Genetics - Part 2

Lecture 25 - Introduction to Genetics - Part 3

Lecture 26 - Mendelian and Non-Mendelian Genetics - Part 1

Lecture 27 - Mendelian and Non-Mendelian Genetics - Part 2

Lecture 28 - Mendelian and Non-Mendelian Genetics - Part 3

Lecture 29 - Introduction to Microscopy - Part 1

Lecture 30 - Introduction to Microscopy - Part 2

Lecture 31 - Introduction to Microscopy - Part 3

- Lecture 32 - Biology of Cells - Part 1
- Lecture 33 - Biology of Cells - Part 2
- Lecture 34 - Complexity and Compartmentalization in Cells - Part 1
- Lecture 35 - Complexity and Compartmentalization in Cells - Part 2
- Lecture 36 - Endosymbiont Theory
- Lecture 37 - Structure of the Cell: Cell Wall and Cell Membrane
- Lecture 38 - Structure of the Cell: Discussion Session
- Lecture 39 - Plasma Membrane: The Boundaries of Life
- Lecture 40 - Plasma Membrane: Discussion Session
- Lecture 41 - Introduction to Cytoskeleton - Part 1
- Lecture 42 - Cytoskeleton: Discussion Session 1
- Lecture 43 - Introduction to Cytoskeleton - Part 2
- Lecture 44 - Cytoskeleton: Discussion Session 2
- Lecture 45 - Motor Proteins in Cell
- Lecture 46 - Motor Proteins in Cell: Discussion Session
- Lecture 47 - Discussion on Directionality of Motor Protein
- Lecture 48 - Endomembrane System of Cells - Part 1
- Lecture 49 - Endomembrane System of Cells: Discussion Session 1
- Lecture 50 - Endomembrane System of Cells - Part 2
- Lecture 51 - Endomembrane System of Cells: Discussion Session 2
- Lecture 52 - Endomembrane System of Cells - Part 3
- Lecture 53 - Endomembrane System of Cells: Discussion Session 3
- Lecture 54 - Endomembrane System of Cells - Part 4
- Lecture 55 - Endomembrane System of Cells: Discussion Session 4
- Lecture 56 - Cell Division
- Lecture 57 - Cell Division: Discussion session
- Lecture 58 - Discussion Session on Organization and Function of a Cell

Lecture 1 - Introduction to RNA Biology and RNA World - The Beginning

Lecture 2 - Introduction to RNA Biology and RNA World - Evidences

Lecture 3 - Introduction to RNA Biology and RNA World - Origin of Monomers

Lecture 4 - Introduction to RNA Biology and RNA World - Shift to DNA

Lecture 5 - Introduction to RNA Biology and RNA World - RNA Self Replication

Lecture 6 - Introduction to RNA Biology and RNA World - Origin of RNA Enzymes

Lecture 7 - RNA as Enzymes: The Ribozymes

Lecture 8 - RNA as Enzymes: Structure and Functions

Lecture 9 - RNA as Enzymes: The Present and Future

Lecture 10 - RNA Transcription: The Central Dogma

Lecture 11 - RNA Transcription: Initial Steps

Lecture 12 - RNA Transcription: Different Stages

Lecture 13 - RNA Transcription: Termination and RNA Modification

Lecture 14 - RNA Transcription: Different Polymerases

Lecture 15 - RNA Processing and Life Cycle: RNA Maturation and RNPs

Lecture 16 - RNA Processing and Life Cycle: RNA Splicing

Lecture 17 - RNA Processing and Life Cycle: Post Transcriptional Processing

Lecture 18 - Alternative RNA Processing and Editing: Alternative Splicing

Lecture 19 - Alternative RNA Processing and Editing: Implications of Introns

Lecture 20 - Alternative RNA Processing and Editing: Splicing and Pathology

Lecture 21 - Alternative RNA Processing and Editing: RNA Editing in Detail

Lecture 22 - Alternative RNA Processing and Editing: Relevance of RNA Editing

Lecture 23 - Alternative RNA Processing and Editing: Relevance in Immunology

Lecture 24 - RNA Splicing, Export and Stability: Relevance of Introns

Lecture 25 - RNA Splicing, Export and Stability: Introns in RNA Splicing

Lecture 26 - RNA Splicing, Export and Stability: Different Spliceosomes

Lecture 27 - RNA Splicing, Export and Stability: SMN Complex

Lecture 28 - snRNA, rRNA, miRNA, siRNA Processing, Export and Function: Introns and Link to Splicing

Lecture 29 - snRNA, rRNA, miRNA, siRNA Processing, Export and Function: RNA Helicases

Lecture 30 - snRNA, rRNA, miRNA, siRNA Processing, Export and Function: Nucleo Cytoplasmic Transport

Lecture 31 - snRNA, rRNA, miRNA, siRNA Processing, Export and Function: Nucleoporins and miRNAs

- Lecture 32 - snRNA, rRNA, miRNA, siRNA Processing, Export and Function: RNA Export Mechanisms
- Lecture 33 - snRNA, rRNA, miRNA, siRNA Processing, Export and Function: RNA Quality Control
- Lecture 34 - Mechanisms of RNA Decay and Non Coding RNAs: Decay Pathways
- Lecture 35 - Mechanisms of RNA Decay and Non Coding RNAs: The Exosomes
- Lecture 36 - Mechanisms of RNA Decay and Non Coding RNAs: mRNA Surveillance
- Lecture 37 - Mechanisms of RNA Decay and Non Coding RNAs: Mechanisms of RNA Decay
- Lecture 38 - Mechanisms of RNA Decay and Non Coding RNAs: Autoregulation of RNAs
- Lecture 39 - Mechanisms of RNA Decay and Non Coding RNAs: Introduction to Non-Coding RNAs
- Lecture 40 - Dosage Compensation and X-Inactivation: SRP and Different Modes of Compensation
- Lecture 41 - Dosage Compensation and X-Inactivation: Dosage Compensation of X
- Lecture 42 - Dosage Compensation and X-Inactivation: Omprinted vs Random X Inactivation
- Lecture 43 - Dosage Compensation and X-Inactivation: Molecular Basis of X-Inactivation
- Lecture 44 - Dosage Compensation and X-Inactivation: ES Cells and X-Inactivation
- Lecture 45 - Dosage Compensation, Xist and ncRNA in Imprinting: The Roles of YY1
- Lecture 46 - Dosage Compensation, Xist and ncRNA in Imprinting: shRNAs and Gene Expression
- Lecture 47 - Dosage Compensation, Xist and ncRNA in Imprinting: Mechanism of RNAi in Action
- Lecture 48 - Dosage Compensation, Xist and ncRNA in Imprinting: Genomic Imprinting in Action
- Lecture 49 - Dosage Compensation, Xist and ncRNA in Imprinting: Different ncRNAs and their Roles
- Lecture 50 - Dosage Compensation, Xist and ncRNA in Imprinting: lncRNA-Induced Cancer
- Lecture 51 - Dosage Compensation, Xist and ncRNA in Imprinting: Xist and Cancer
- Lecture 52 - Telomere, Telomerase and Impact on Genomes: The Importance of Telomeres
- Lecture 53 - Telomere, Telomerase and Impact on Genomes: Telomerase and Aging
- Lecture 54 - Telomere, Telomerase and Impact on Genomes: Telomere Length as Marker of Aging
- Lecture 55 - Telomere, Telomerase and Impact on Genomes: Telomeres and Cancer
- Lecture 56 - Telomere, Telomerase and Impact on Genomes: Cell Cycle Arrest
- Lecture 57 - Telomere, Telomerase and Impact on Genomes: Maintenance and Manipulation of Telomeres
- Lecture 58 - Epitranscriptome and Protein Synthesis: Important RNA Modifications
- Lecture 59 - Epitranscriptome and Protein Synthesis: Readers, Writes and Erasers
- Lecture 60 - Epitranscriptome and Protein Synthesis: Biological Implications of RNA Modifications
- Lecture 61 - Epitranscriptome and Protein Synthesis: Roles of RNAs in Translation
- Lecture 62 - Epitranscriptome and Protein Synthesis: Mechanism of Translation

Lecture 1 - Introduction to forces - Resolving forces, principle of transmissibility

Lecture 2 - Statics FBD and EOE

Lecture 3 - Example problems on FBD and EOE

Lecture 4 - Joints in human body

Lecture 5 - Machines and mechanical advantage

Lecture 6 - Levers and types of levers

Lecture 7 - Insertion point and torque

Lecture 8 - Practice problem - 1

Lecture 9 - Practice problem - 2

Lecture 10 - Key terminologies

Lecture 11 - Anatomical planes and axis

Lecture 12 - Sagittal plane movements

Lecture 13 - Coronal plane movements

Lecture 14 - Transverse plane movements

Lecture 15 - Muscles - Muscle fascicles

Lecture 16 - Muscle fibers- Pennation angle

Lecture 17 - More on pennation angle

Lecture 18 - Excitation contraction coupling

Lecture 19 - Sliding filament theory

Lecture 20 - Force length relationship

Lecture 21 - Shoulder joints and muscles

Lecture 22 - Shoulder problem - 1

Lecture 23 - Shoulder problem - 2

Lecture 24 - Elbow theory

Lecture 25 - Elbow problem - 1

Lecture 26 - Elbow problem - 2

Lecture 27 - Elbow problem - 3

Lecture 28 - Wrist theory

Lecture 29 - Finger theory

Lecture 30 - Finger muscles

Lecture 31 - Spine anatomy and movements

[Lecture 32 - Spine muscles](#)

[Lecture 33 - Spine problem](#)

[Lecture 34 - Hip anatomy and movements](#)

[Lecture 35 - Hip muscles](#)

[Lecture 36 - Hip problem](#)

[Lecture 37 - Knee anatomy and movements](#)

[Lecture 38 - Knee muscles](#)

[Lecture 39 - Knee problem](#)

[Lecture 40 - Ankle anatomy and movements](#)

[Lecture 41 - Ankle muscles](#)

[Lecture 42 - Ankle problem](#)

[Lecture 43 - Grasping- reaching- chains](#)

[Lecture 44 - D.O.F mobility, open/closed chain](#)

[Lecture 45 - Forward kinematics and workspace](#)

[Lecture 46 - 2R inverse kinematics](#)

[Lecture 47 - 3R kinematics forward and inverse](#)

[Lecture 48 - D-H parameters](#)

[Lecture 49 - Velocity and jacobian](#)

[Lecture 50 - 3R velocity](#)

[Lecture 51 - Tissues and types of tissues](#)

[Lecture 52 - Bone microstructure and cells](#)

[Lecture 53 - Properties of bones](#)

[Lecture 54 - Wolffs Law and Hookean behavior](#)

[Lecture 55 - Elastic properties and stress strain relations](#)

[Lecture 56 - Stress strain curve and mechanical properties of biological materials](#)

[Lecture 57 - Bending of Bones](#)

[Lecture 58 - Viscoelastic modelling](#)

[Lecture 59 - Maxwell Model](#)

[Lecture 60 - Voight Model](#)

[Lecture 61 - Kelvin model](#)

[Lecture 62 - Viscoelasticity in bones](#)

[Lecture 63 - Tissues and its constituents](#)

[Lecture 64 - Cartilages, ligaments and tendons](#)

Lecture 65 - Stress strain relations in tendons

Lecture 66 - Tendon forces and factors affecting tendon property

Lecture 67 - Gliding resistance, tendon wrapping and friction forces

Lecture 68 - Enslaving - Intertendinous force transfer and motor units

Lecture 69 - Introduction to enslavement

Lecture 70 - Enslaving effects in finger force production - 1

Lecture 71 - Enslaving effects in finger force production - 2

Lecture 72 - Wrist posture and finger interdependence - 1

Lecture 73 - Wrist posture and finger interdependence - 2

Lecture 74 - Wrist posture and finger interdependence - 3

Lecture 75 - Measurement of orientation in 3D space - Devices

Lecture 76 - Rotation matrices in 2D and 3D

Lecture 77 - Animating using rotation matrices- Matlab Examples

Lecture 78 - Composite rotation matrix and relative orientations

Lecture 79 - Complex numbers and quaternions

Lecture 80 - Singularity, Gimbal Lock, Advantages and disadvantages of parameterization methods

Lecture 81 - Single finger kinematics measurement using IMU's

Lecture 82 - IMU based Full hand kinematics measurement system (HKMS)

Lecture 83 - Demonstration of the Hand Kinematics Measurement System (HKMS)

Lecture 84 - Introduction to Gait and running

Lecture 1 - Basic concepts in microscopy - 1

Lecture 2 - Basic concepts in microscopy - 2

Lecture 3 - Dark-field and phase contrast microscopy

Lecture 4 - Differential interference contrast and polarization

Lecture 5 - Fluorescence and confocal microscopy

Lecture 6 - Transmission electron microscopy

Lecture 7 - Transmission electron microscopy cont. and scanning electron microscopy

Lecture 8 - Basic concepts - 1

Lecture 9 - Basic concepts - 2

Lecture 10 - GM counting and Scintillation counting

Lecture 11 - Scintillation counting continued

Lecture 12 - Autoradiography and RIA

Lecture 13 - Safety aspects and applications

Lecture 14 - Introduction and Basic concepts in chromatography - 1

Lecture 15 - Basic concepts in chromatography - 2

Lecture 16 - Low-pressure liquid chromatography (LPLC) and high performance liquid chromatography (HPLC)

Lecture 17 - Ion-exchange chromatography

Lecture 18 - Gel-filtration chromatography

Lecture 19 - Affinity chromatography

Lecture 20 - Gas-liquid chromatography

Lecture 21 - Basic concepts in electrophoresis

Lecture 22 - Horizontal and vertical gel electrophoresis

Lecture 23 - Native gel electrophoresis and SDS-PAGE

Lecture 24 - Isoelectric focusing (IEF), 2-D gel electrophoresis and protein detection methods

Lecture 25 - Electrophoresis of nucleic acids

Lecture 26 - Immunoelectrophoresis and capillary electrophoresis

Lecture 27 - Introduction and Basic Concepts - 1

Lecture 28 - Basic concepts - 2

Lecture 29 - Types of centrifuges and analytical ultracentrifugation method

Lecture 30 - Separation methods in preparative ultracentrifuges

Lecture 31 - Types of rotors

[Lecture 32 - Types of rotors cont. and care of rotors](#)

[Lecture 33 - Introduction and basic concepts](#)

[Lecture 34 - UV-Visible spectroscopy](#)

[Lecture 35 - Infrared and fluorescence spectroscopy](#)

[Lecture 36 - Circular dichroism \(CD\) spectroscopy](#)

[Lecture 37 - Nuclear magnetic resonance \(NMR\) spectroscopy and X-ray crystallography](#)

[Lecture 38 - Atomic spectroscopy and mass spectrometry](#)

[Lecture 39 - Polymerase chain reaction\(PCR\)](#)

[Lecture 40 - DNA sequencing methods](#)

[Lecture 41 - Enzyme linked immunosorbent assay \(ELISA\)](#)

Lecture 1 - Introduction to Nano

Lecture 2 - Nano-Biomimicry

Lecture 3 - Synthesis of nanomaterials by Physical and Chemical Methods

Lecture 4 - Synthesis of nanomaterials by Biological Methods

Lecture 5 - Characterisation of Nanomaterials

Lecture 6 - DNA Nanotechnology

Lecture 7 - Protein and Glyco Nanotechnology

Lecture 8 - Lipid Nanotechnology

Lecture 9 - Bio-Nanomachines

Lecture 10 - Carbon nanotubes and Its Bio-Applications

Lecture 11 - Nanomaterials for Cancer Diagnosis

Lecture 12 - Nanomaterials for Cancer therapy

Lecture 13 - Nanotechnology in Tissue Engineering

Lecture 14 - Nano artificial cells

Lecture 15 - Nanotechnology in Organ Printing

Lecture 16 - Nanotechnology in Point-of-Care Diagnostics

Lecture 17 - Nano-Pharmacology and Drug Targeting

Lecture 18 - Cellular uptake mechanisms of nanomaterials

Lecture 19 - In vitro Methods to study antibacterial and anticancer properties of nanomaterials

Lecture 20 - Nanotoxicology

- Lecture 1 - Life Cycle of an Angiosperm
- Lecture 2 - Characteristics of Plant Growth and Development - I
- Lecture 3 - Characteristics of Plant Growth and Development - II
- Lecture 4 - Molecular Genetics of Plant Development - I
- Lecture 5 - Molecular Genetics of Plant Development - II
- Lecture 6 - Molecular Genetics of Plant Development - III
- Lecture 7 - Molecular Genetics of Plant Development - IV
- Lecture 8 - Molecular Genetics of Plant Development (Continued...) - I
- Lecture 9 - Molecular Genetics of Plant Development (Continued...) - II
- Lecture 10 - Molecular Genetics of Plant Development (Continued...) - III
- Lecture 11 - Root Development
- Lecture 12 - Root Development (Continued...)
- Lecture 13 - Root Development (Vascular Development)
- Lecture 14 - Root Branching: Lateral Root Development
- Lecture 15 - Shoot Development: SAM Maintenance
- Lecture 16 - Shoot Development: Organogenesis
- Lecture 17 - Shoot Development: Leaf Development
- Lecture 18 - Shoot Development: Flowering
- Lecture 19 - Cell-Cell Communication During Plant Development
- Lecture 20 - Techniques Used in Lab

Lecture 1 - Introduction: Why to Study Structural Biology

Lecture 2 - Introduction to Biological Macromolecules

Lecture 3 - Introduction: Decoding Biological Macromolecules

Lecture 4 - Introduction: Genome Sequencing

Lecture 5 - Introduction: Post Genomic Era

Lecture 6 - Amino acids and their properties

Lecture 7 - Protein: Protein Chemistry, Chirality, Peptide bond and Levels of protein structures

Lecture 8 - Protein: Dihedral angles, Peptide bond and Ramachandran Plot

Lecture 9 - Protein: Super Secondary Structures, Motif, Domains, Non-covalent interactions

Lecture 10 - Protein: Folding of Protein, Thermodynamics and Kinetics of protein folding, Characterization of Proteins

Lecture 11 - Introduction to Structural Biology Techniques - Part I

Lecture 12 - Introduction to Structural Biology Techniques - Part II

Lecture 13 - X-ray Crystallography: Crystallization - Part I

Lecture 14 - X-ray Crystallography: Crystallization - Part II

Lecture 15 - X-ray Crystallography: Crystal Mounting

Lecture 16 - X-ray Crystallography: Production of X-ray and its properties

Lecture 17 - X-ray Crystallography: Journey to 3D land

Lecture 18 - X-ray Crystallography: Crystal Symmetry

Lecture 19 - X-ray Crystallography: Instrumentation in X-ray Crystallography

Lecture 20 - X-ray Crystallography: Data collection and processing

Lecture 21 - X-ray Crystallography: Data Analysis - Part I

Lecture 22 - X-ray Crystallography: Data Analysis - Part II

Lecture 23 - X-ray Crystallography: Phase Problem - Part I

Lecture 24 - X-ray Crystallography: Phase Problem - Part II

Lecture 25 - X-ray Crystallography: Refinement and Structure deposition to PDB

Lecture 26 - Introduction to Spectroscopy and NMR

Lecture 27 - Basic Principles of NMR and Instrumentation

Lecture 28 - NMR Sample Preparation and Chemical Shift related concepts

Lecture 29 - Factors effecting NMR Spectra (1D and 2D)

Lecture 30 - 2D and 3D NMR Spectroscopy focusing on protein structure

Lecture 31 - Introduction to Spectroscopy

[Lecture 32 - UV-Vis and CD spectroscopy](#)

[Lecture 33 - Fluorescence Spectroscopy and Green Fluorescence Protein \(GFP\)](#)

[Lecture 34 - Infrared and Raman Spectroscopy for protein](#)

[Lecture 35 - Raman Spectroscopy, Raman Microscopy and Raman Crystallography for studying protein](#)

[Lecture 36 - Introduction to Microscopy](#)

[Lecture 37 - Functioning details of Cryo Electron Microscopy \(Cryo EM\)](#)

[Lecture 38 - Cryo Electron Microscopy: Data Collection and Analysis](#)

[Lecture 39 - A concise story of advancement Cryo-EM](#)

[Lecture 40 - Protein Data Bank](#)

[Lecture 41 - History of Molecular Visualizations of Biological Macromolecules](#)

[Lecture 42 - Description of structure related files \(.pdb, .mmCIF, .mtz, etc.\)](#)

[Lecture 43 - Demonstration of COOT](#)

[Lecture 44 - 3D visualization using Pymol](#)

[Lecture 45 - Demonstration of Pymol](#)

[Lecture 46 - Why we need MD Simulation](#)

[Lecture 47 - Molecular Dynamic Simulation Process - Part I](#)

[Lecture 48 - Molecular Dynamic Simulation Process - Part II](#)

[Lecture 49 - Molecular Dynamic Simulation Process - Part III](#)

[Lecture 50 - Application of Molecular Dynamic Simulation](#)

[Lecture 51 - What, How and Which of Protein Engineering](#)

[Lecture 52 - How to make logical Protein Engineering: Process of Rational design](#)

[Lecture 53 - Success story of Rational Protein designing: Focusing on De Novo Process](#)

[Lecture 54 - Designing Protein by mimicking nature: Process of Directed Evolution](#)

[Lecture 55 - Achievement, Challenges, and Future direction in the field of Protein Engineering](#)

[Lecture 56 - Introduction to Structure Based Drug Discovery \(SBDD\)](#)

[Lecture 57 - Rational Drug Discovery](#)

[Lecture 58 - Docking Based Virtual Screening: Progress, Challenges and Future perspective](#)

[Lecture 59 - What makes a small molecule an ideal drug: Developing in silico ADMETox Model](#)

[Lecture 60 - Structure Based Drug Discovery: Case study and Conclusion](#)

Lecture 1 - Introduction to Learning and Memory - I : Historical perspective

Lecture 2 - Introduction to Learning and Memory - II : Classification

Lecture 3 - Associative Learning I : Rules of Associative learning

Lecture 4 - Associative learning II : Garcia and Koelling's Experiment, Kamin's Blocking Experiment

Lecture 5 - Introduction to the Rescorla Wagner Model

Lecture 6 - Application of Rescorla Wagner Model - I

Lecture 7 - Application of Rescorla Wagner Model - II

Lecture 8 - Application of Rescorla Wagner Model - III

Lecture 9 - Application of Rescorla Wagner Model - IV

Lecture 10 - Limitations of Rescorla Wagner Model

Lecture 11 - Introduction of Reinforcement Learning - I : Thorndike's view, Tolman's views, Skinner Box

Lecture 12 - Introduction of Reinforcement Learning - II : Classification, Thorndike's view, Tolman's views, Skinner Box (Continued...)

Lecture 13 - Introduction of Reinforcement Learning - III : Understanding scheduling of reinforcers in operant conditioning

Lecture 14 - Sign Tracking vs Goal Oriented/Tracking; Linking complex behaviors to simple molecules

Lecture 15 - Sign Tracking vs Goal Oriented; Learning Linking complex behaviors to simple molecules - II

Lecture 16 - Memory in Molecular Terms - I : Protein synthesis in memory consolidation

Lecture 17 - Memory in Molecular Terms - II : Long term potentiation

Lecture 18 - Memory in Molecular Terms - III : Properties of a memory molecule

Lecture 19 - Memory in Molecular Terms - IV : Remote memory and its characteristics

Lecture 20 - Memory in Molecular Terms - V : Selective labelling of memory encoding neurons and their manipulation

Lecture 1 - Drug Delivery Introduction and Pharmacokinetics

Lecture 2 - Pharmacokinetics (Continued...)

Lecture 3 - Pro-drugs and Polymers Introduction

Lecture 4 - Polymers - Synthesis

Lecture 5 - Polymers - Properties

Lecture 6 - Biomedical Polymers

Lecture 7 - Biodegradable Polymers and Polymer Drug Conjugates - I

Lecture 8 - Polymer Drug Conjugates - II

Lecture 9 - Research Paper Discussion and Diffusion Controlled Systems

Lecture 10 - Controlled Release: Reservoir System - I

Lecture 11 - Controlled Release: Reservoir Systems and Non-erodible Systems

Lecture 12 - Controlled Release: Non-erodible Systems and Erodible systems

Lecture 13 - Math Exercise

Lecture 14 - Hydrogels - I

Lecture 15 - Hydrogels - II

Lecture 16 - Hydrogels - III

Lecture 17 - Hydrogels - IV

Lecture 18 - Nano and Micro-particles - I

Lecture 19 - Nano and Micro-particles - II

Lecture 20 - Nano and Micro-particles - III

Lecture 21 - Nano and Micro-particles - IV

Lecture 22 - Nano and Micro-particles - V

Lecture 23 - Nano and Micro-particles - VI

Lecture 24 - Nano and Micro-particles - VII

Lecture 25 - Protein Adsorption - I

Lecture 26 - Protein Adsorption - II

Lecture 27 - Protein Adsorption - III

Lecture 28 - Tissue Engineering - I

Lecture 29 - Tissue Engineering - II

Lecture 30 - Tissue Engineering - III

Lecture 31 - Drug Delivery in Tissue Engineering - I

- Lecture 32 - Drug Delivery in Tissue Engineering - II
- Lecture 33 - Implant Associated Infections - I
- Lecture 34 - Implant Associated Infections - II
- Lecture 35 - Route Specific Delivery: Oral Route - I
- Lecture 36 - Route Specific Delivery: Oral Route - II
- Lecture 37 - Route Specific Delivery: Oral and Subcutaneous Route
- Lecture 38 - Route Specific Delivery: Intramuscular, Transdermal - I
- Lecture 39 - Route Specific Delivery: Transdermal - II
- Lecture 40 - Route Specific Delivery: Transdermal and Inhalation Route
- Lecture 41 - Route Specific Delivery: Inhalation - II, Buccal and Rectal Administration
- Lecture 42 - Research Paper Discussion: Dry Powder Particle Delivery
- Lecture 43 - Route Specific Delivery: Intra-articular and Intravenous Administration
- Lecture 44 - Intravenous Administration: Approved Nanocarriers and Immune System
- Lecture 45 - Immune System - II
- Lecture 46 - Complement System and Blood Clotting
- Lecture 47 - Blood Clotting and Hemocompatibility of Materials; Adaptive Immune Response
- Lecture 48 - Adaptive Immune Response and Vaccine
- Lecture 49 - Vaccines
- Lecture 50 - Vaccines and Immuno-isolated Cell Therapy
- Lecture 51 - Immuno-isolated Cell Therapy
- Lecture 52 - Immuno-isolated Cell and Gene Therapy
- Lecture 53 - Gene Delivery: Vectors
- Lecture 54 - Gene Delivery: Polymers
- Lecture 55 - Genes as Vaccines
- Lecture 56 - Vaccines: Gene Delivery and Other Variants
- Lecture 57 - Cancer Vaccines
- Lecture 58 - Cancer Vaccine: Immunotherapy
- Lecture 59 - Responsive Delivery Systems - I
- Lecture 60 - Responsive Delivery Systems - II
- Lecture 61 - Targeted Drug Delivery System
- Lecture 62 - Targeted Drug Delivery System: Research Paper Discussion
- Lecture 63 - Nanotoxicology and Translation Pathways

Lecture 1 - Introduction

Lecture 2 - Substrate

Lecture 3 - Substrate (Continued...)

Lecture 4 - Introduction to cleanroom

Lecture 5 - Contamination and surface cleaning

Lecture 6 - Advanced cleaning techniques

Lecture 7 - Defects

Lecture 8 - Diffusion

Lecture 9 - Diffusion - Advanced Concepts

Lecture 10 - Ion Implantation

Lecture 11 - Ion Implantation (Continued...)

Lecture 12 - Native Films

Lecture 13 - Native Films: Advanced Concepts

Lecture 14 - Native Films: Defects at Si/SiO<sub>2</sub> interface

Lecture 15 - Methods and Some Definitions

Lecture 16 - Chemical Vapor Deposition: Basics

Lecture 17 - Chemical Vapor Deposition: Precursor Transport

Lecture 18 - Chemical Vapor Deposition: Types of CVD Equipment

Lecture 19 - Chemical Vapor Deposition: Nucleation and Growth

Lecture 20 - Chemical Vapor Deposition: Other Details

Lecture 21 - Atomic Layer Deposition

Lecture 22 - Atomic Layer Deposition (Continued...)

Lecture 23 - Physical Vapor Deposition: Basics

Lecture 24 - Physical Vapor Deposition: Evaporation

Lecture 25 - Physical Vapor Deposition: Sputtering

Lecture 26 - Metallization: Contact resistance

Lecture 27 - Metallization: Electromigration and Epilogue

Lecture 28 - Pattern Transfer Basics

Lecture 29 - Optical lithography basics: resist process - 1

Lecture 30 - Optical lithography basics: resist process - 2

Lecture 31 - Optical Lithography: Contact and Proximity printing

- [Lecture 32 - Optical Lithography: Stepper and Scanner](#)
- [Lecture 33 - Projection Lithography: Image formation basics](#)
- [Lecture 34 - Projection Lithography: Image formation in photoresist](#)
- [Lecture 35 - Optical lithography: Surface Reflection](#)
- [Lecture 36 - Optical Lithography: Mask Technology](#)
- [Lecture 37 - Lithography process technology glossary](#)
- [Lecture 38 - Optical Lithography: Resolution enhancement](#)
- [Lecture 39 - Electron beam lithography: Basics](#)
- [Lecture 40 - Electron beam lithography: Resist process](#)
- [Lecture 41 - Emerging lithography techniques](#)
- [Lecture 42 - Etching Figures of Merit](#)
- [Lecture 43 - Wet etching Basics](#)
- [Lecture 44 - Wet Etching Recipes](#)
- [Lecture 45 - Wet Etching Recipes](#)
- [Lecture 46 - Dry etch: Plasma Basics](#)
- [Lecture 47 - Dry etch: Plasma etching basics](#)
- [Lecture 48 - Dry etch: Plasma tool configuration](#)
- [Lecture 49 - Dry etch: Etch mechanism](#)
- [Lecture 50 - Dry etch: Etch chemistry](#)
- [Lecture 51 - Chemical Mechanical Polishing \(CMP\): Basics](#)
- [Lecture 52 - Chemical Mechanical Polishing \(CMP\): Tool and process](#)
- [Lecture 53 - Design for Manufacturability - 1](#)
- [Lecture 54 - Design for Manufacturability - 2](#)
- [Lecture 55 - Design for Manufacturability: Case study](#)
- [Lecture 56 - Process integration](#)
- [Lecture 57 - PV integration](#)
- [Lecture 58 - CMOS integration](#)
- [Lecture 59 - Lab demo: Silicon Nitride cantilever fabrication - 1](#)
- [Lecture 60 - Lab demo: Silicon Nitride cantilever fabrication - 2](#)
- [Lecture 61 - CMOS process for photonics application](#)

- Lecture 1 - Optical Focus and Localisation of Light
- Lecture 2 - Relating Photon's Momentum to Spot Size
- Lecture 3 - Shortest Pulse of Light: How fast can we shutter the light?
- Lecture 4 - Behaviour of light through polarizers: Introduction
- Lecture 5 - Nature of Light: Introduction to Photo Multiplier Tubes
- Lecture 6 - Revisiting Polarisation Through Ket Vectors
- Lecture 7 - Light through Polarisers: Detailed Description - I
- Lecture 8 - Light through Polarisers: Detailed Description - II
- Lecture 9 - Time Dependent Perturbation Theory (TDPT): Overview
- Lecture 10 - TDPT in Steps-1: Unperturbed and Perturbed Hamiltonian
- Lecture 11 - TDPT in Steps-2: Introducing the switch and first approximation
- Lecture 12 - TDPT in Steps-3: Finding the co-efficients
- Lecture 13 - Fermi's Golden Rule
- Lecture 14 - Beer Lambert's Law from TDPT
- Lecture 15 - Einstein's Phenomenology
- Lecture 16 - Einstein's Coefficients, Fluorescence and Lifetime
- Lecture 17 - Fock States and Photonic Treatment of Light
- Lecture 18 - Operators in Fock State Space
- Lecture 19 - Light Matter Interaction and Rudimentary Feynman Diagrams
- Lecture 20 - Emergence of Spontaneous and Stimulated Emission Processes
- Lecture 21
- Lecture 22
- Lecture 23
- Lecture 24
- Lecture 25
- Lecture 26 - Introduction to LASER
- Lecture 27 - LASER population dynamics
- Lecture 28 - LASER population dynamics - Part- 2
- Lecture 29 - Real world LASER and characteristics of LASER emission
- Lecture 30 - Temporal and Spatial Coherence

- Lecture 31 - Transverse and Longitudinal modes of LASER
- Lecture 32 - Pulsed LASER
- Lecture 33 - Q-switching in detail
- Lecture 34 - Q-switching in detail - Part 2
- Lecture 35 - Basics of mode locking
- Lecture 36 - Basics of mode locking - Part 2
- Lecture 37 - Pulse compression
- Lecture 38 - Real world system (Mode lock Part-2)
- Lecture 39 - TEM mode
- Lecture 40 - Alignment basics
- Lecture 41 - Non-Linear Optics
- Lecture 42 - Confocal Detection
- Lecture 43 - Interference Filters
- Lecture 44 - Laser Scanning System - 1
- Lecture 45 - Laser Scanning System - 2
- Lecture 46 - Alignment of Moving Beams
- Lecture 47 - Decoding an Objective Lens - 1
- Lecture 48 - Decoding an Objective Lens - 2
- Lecture 49 - Designing Lens Systems
- Lecture 50 - Astigmatism and Field Curvature
- Lecture 51 - Intro to Lab Session
- Lecture 52 - Optics in LAB: Aligning light through an optical fiber - 1
- Lecture 53 - Optics in Lab: Telescope
- Lecture 54 - Kinematic Mounts
- Lecture 55 - Alignment with out iris
- Lecture 56 - Fluorescence Spectrometer - 1
- Lecture 57 - Fluorescence Spectrometer - 2
- Lecture 58 - Ti:Sapphire Laser and Two Photon Fluorescence

Lecture 1 - Introduction to Cell Biology, Cell components, organization and processes - Part I

Lecture 2 - Introduction to Cell Biology, Cell components, organization and processes - Part II

Lecture 3 - DNA: The genetic material - Part I

Lecture 4 - DNA: The genetic material - Part II

Lecture 5 - Regulation of the cell cycle - Part I

Lecture 6 - Regulation of the cell cycle - Part II

Lecture 7 - Checkpoints: The DNA damage and DNA replication checkpoints

Lecture 8 - The Ubiquitin Proteasome system

Lecture 9 - S-phase: Regulation of entry into S-phase and DNA Replication

Lecture 10 - DNA replication - Part I

Lecture 11 - DNA Replication - Part II

Lecture 12 - DNA Replication - Part III

Lecture 13 - DNA Replication - Part IV

Lecture 14 - Mitosis - Part I

Lecture 15 - Cytokinesis

Lecture 16 - Aging and Senescence

Lecture 17 - Apoptosis - Part I

Lecture 18 - Apoptosis - Part II

Lecture 19 - Meiosis - Part I

Lecture 20 - Meiosis - Part II

Lecture 21 - Nuclear organization

Lecture 22 - SMC proteins and chromosome organization - Real-Time imaging of DNA loop-extrusion by SMC complexes

Lecture 23 - The cohesin complex and its functions - The mysterious biological function of chromosome loops

Lecture 24 - Chromatin organization

Lecture 25 - SMC proteins and chromosome organization - Introduction

Lecture 26 - Meiosis - Part III

Lecture 27 - Mitosis - Part II

Lecture 28 - Cell diversity and properties of specialized cells-Budding yeast as a model system

Lecture 29 - The Plant Cell

Lecture 30 - Stem cells - Part I Intro-SL

Lecture 31 - Stem cells - Part II

[Lecture 32 - Nerve cells](#)

[Lecture 33 - The Cancer Cell](#)