With effect from the Academic Year 2021-22

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instructions of VII Semester of B.Tech Bio-Technology as per AICTE Model Curriculum 2021-22

B.Tech (Bio-Technology)

SEMESTER-VII

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
	THEORY								
1	18BT C26	Downstream Processing	3	-	-	3	30	70	3
2	18BT C27	Plant Biotechnology	3	-	-	3	30	70	3
3	18MT C08	Biostatistics	3	-	-	3	30	70	3
4		**Core Elective V**	3	-	-	3	30	70	3
5		**Open Elective II**	3	-	-	3	30	70	3
	PRACTICALS								
6	18BT C28	Downstream Processing Lab	-	-	3	3	25	50	1.5
7	18BT C29	Tissue Culture Lab	-	-	3	3	25	50	1.5
8	18BT C30	Project Part 1	-	-	4	-	50	-	2
Total			**15**	**-**	**10**	**-**	**250**	**450**	**20**
Clock Hours Per Week – 25									

L: Lecture T:Tutorial P:Practical
CIE – Continuous Internal Evaluation SEE - Semester End Examination

Core Elective V	
18BT E14	Animal Biotechnology
18BT E15	Cancer Biology
18BT E16	Computer Applications in Bioprocess
18BT E17	Principles of data analytics

Open Elective II	
18 CS O13	Block chain technologies
18CS O04	Basics of Data Science Using R
18EG O01	Technical Writing
18EE O05	Waste Management

18BT C26

DOWNSTREAM PROCESSING

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Student is made to understand the role and, importance of downstream processing.
2. Students are taught the various techniques of cell disruption and the principles of solid liquid separation processes, filtration and centrifugation
3. Students are made to understand the principles of membrane based separations and their applications.
4. Students are enlightened about chromatographic separations, types and their importance in product purification.
5. Students are made to study the principle of crystallization, drying and lyophilisation.

Course Outcomes:

At the end of the course the students are able to

1. Explain the key aspects of downstream processing from both a technical and economic perspective.
2. Describe the various techniques of cell disruption and unit operations for separation of insoluble.
3. Compare and contrast various membrane separation processes.
4. Interpret application of various chromatographic process for separation of bioproducts.
5. Analyze various case studies involving high throughput and low value, Low throughput and high value products.

UNIT-I

Role Of Downstream Processing In Biotechnology: Role and Importance of Downstream Processing in Biotechnological Processes; Characterization of Biomolecules and fermentation broths; Physico-Chemical basis of Bio-separations; Characteristics of Bio-separations; Process design criteria for bioproducts; Downstream process economics.

UNIT-II

Primary Separation And Recovery Processes: Cell Disruption methods for intracellular products-Mechanical, Chemical and Enzymatic Methods; Removal of Insolubles, Biomass separation techniques; Flocculation; Sedimentation; Centrifugation; Filtration: Theory, Equipment-Depth filters, Plate and frame filters, Pressure leaf filters, Continuous rotary drum filters, filter media and filter aids, Problems on specific resistance of the cake, time taken for filtration and, compressibility of cake.

UNIT-III

Product Enrichment Operations: Membrane-based separations-Types of membranes, solution diffusion model, capillary flow model; Types of flow-Cross flow, Tangential flow and mixed flow; Types of membrane based separations: Micro-filtration, Ultra-filtration, Dialysis, Electro dialysis, Reverse Osmosis; Theory, design and configuration of membrane separation equipment, Applications; Aqueous Two-phase extraction of proteins; Precipitation of proteins with salts and organic solvents; Adsorption processes.

UNIT-IV

Product Purification: Chromatographic separations- Principles, Classification, General description of column chromatography; IMAC, Bio-affinity Chromatography; Design and selection of chromatographic matrices; Design of large-scale chromatographic separation processes

UNIT-V

Finishing techniques: Pervaporation, super critical fluid extraction; Electrophoretic Separations; Final Product Polishing- Crystallization: nucleation, crystal growth, Industrial crystallizers, Drying: drying terminologies, drying curve, Industrial dryers, Lyophilization: principles and applications; Case studies (Citric acid / Penicillin and Low volume high value product like recombinant proteins).

Text Books:

1. Sivasankar B, J M Asenjo, Separation processes in Biotechnology, Marcel-Dekker, 1993.
2. Keith Wilson, John Walker, John M. Walker, Principles and Techniques of Practical Biochemistry 5th edition Cambridge University Press, 2000.

Suggested Reading:

1. Nooralabettu Krishna Prasad, Downstream Process Technology by PHI publications.

With effect from the Academic Year 2021-22

18BT C27

PLANT BIOTECHNOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Enable the students to understand explicitly the basic concepts and applications of Plant Tissue culture.
2. To understand the developmental pathways of callus induction and plant regeneration.
3. To understand the techniques for production of secondary metabolites in *in vitro* using plant cell and tissue culture.
4. To understand the methods of gene transfer in plants for production of Transgenics.
5. To understand the various strategies and sources of transgenes for crop improvement.

Course Outcomes:

At the end of the course the students are able to

1. Describe the theoretical concepts behind establishment of in vitro techniques.
2. Explain the importance and applications of various in vitro techniques.
3. Identify methods used for the production of plant secondary metabolites in in vitro at commercial scale.
4. Analyze the appropriate vectors and gene transfer methods for production of Transgenics.
5. Outline the strategies for the production of transgenics for crop improvement and safety regulations.

UNIT-I

Introduction To Plant Tissue Culture: Introduction to cell and tissue culture: History, Totipotency, Plasticity, Cell Theory, Tissue culture media (composition, preparation); Sterilization techniques; Callus and cell suspension culture; Organogenesis and Embryogenesis and their applications.

UNIT-II

Tissue Culture In Crop Improvement: Micropropagation of virus-free plants; Somaclonal variation; Haploids in plant breeding; Germplasm conservation (Cryopreservation). Protoplast isolation, culture and fusion, Somatic hybridization and its applications.

UNIT-III

Molecular Farming & Industrial Products: In vitro production of short chain and long chain fatty acids; Industrial enzymes; Edible vaccines. Production of secondary metabolites from plant cell cultures using Cell suspension cultures, Immobilized cell systems, Precursor feeding (elicitation) and hairy roots. Bioreactor systems and models for mass cultivation of plant cells.

UNIT-IV

Plant Genetic Engineering - I Techniques: Agrobacterium mediated gene transfer; Plant vectors and their use in genetic manipulation; Direct gene transfer methods: electroporation, microinjection, particle bombardment and chemical methods.

UNIT-V

Plant Genetic Engineering - II Productivity and Safety Regulations: Transgenics in crop improvement: Biotic Stress resistance: Herbicide, Insect, Disease, virus etc., Abiotic stress tolerance: Drought, Temperature, Salt. Transgenics for improved nutritional quality, storage, longer shelf life. Environmental impact and gene flow.

Text Books:

1. Bhojwani SS and Razdan, “Plant Tissue Culture Theory and Practice”, Elsevier Science, 2004.
2. Chawla HS, “Introduction to Plant Biotechnology”, 4th edition, Oxford and IBH publishers, 2002.

Suggested Reading:

1. Nigel G Halford, “Plant Biotechnology : Current and future applications of genetically modified crops”, John Wiley & Sons Ld. 2006
2. Surabh Bhatia, Kiran Sharma, RandhirDahiya and, TanmoyBera, “Modern applications of Plant Biotechnology in Pharmaceutical Sciences”, Elsevier publication, Academic press, 2015.

With effect from the Academic Year 2021-22

18MT C08

Bio-Statistics
(For Bio-Technology only)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Learn the language and core concepts of probability theory.
2. Understand basic principles of Random variable and probability distributions
3. Understand the concept of Statistical Inference
4. Understand the construction of fitting of linear curves.
5. Learn the methods for analyzing one way classification of data.

Course Outcomes: On the successful completion of this course, the student shall be able to

1. Compute counting techniques to Statistical Methods
2. Recite conditional probabilities using Bayes Theorem
3. Define and classify discrete and continuous Random Variables and Probability Distributions
4. Calculate confidence intervals and illustrate parameter estimation
5. Test the classification for analyzing the data

UNIT-I: DISCRIPTIVE STATISTICS: Types of data – Methods of collection of data-Graphical representation of data-Histogram-frequency polygon-Pie chart. Frequency distribution, Measures of central tendencies, Measures of dispersion (mean deviation and standard deviation) coefficient of variation and its significance, Measures of dispersion, Skewness, Kurtosis-Boweyls coefficient, Karl Pearson's coefficient of skewness- correlation-Lines of regression- applications of Bio-technology.

UNIT-II: PROBABILITY: Classical approach- Axiomatic approach of probability, Basic theorems addition and product theorem, conditional probability, Baye's theorem- applications to Biotechnology.

UNIT-III: PROBABILITY DISTRIBUTIONS: Random variable- types of Random variable-probability mass function-probability density functions-Expectation, variance, co variance and their properties. Probability function-Moment generating function (mgf), Cumulant generating function(cgf) and Characteristic function C(t).Discrete Distributions- Binomial distribution, Poison distribution-their expectation, mgf, cgf and C(t) Continuous distributions: Normal Distribution- mean, variance, m.g.f and c.g.f. Properties of Normal distribution.

UNIT- IV: INFERENCIAL STITISTICS -I: Estimation-Hypothesis-Testing of Hypothesis-Types of Errors. Testing the single sample mean (σ-known), Testing of single sample mean (σunknown), Testing the single sample proportion, single sample variance, Testing the differences between two means, two proportions and two variances. Testing of n-proportions- 2-test.

UNIT-V: INFERENCIAL STITISTICS –II: Testing of many proportions-2-test independent of attributes-r x c-tables. Analysis of variance-CRD.

Text Books:

1. P.S.S Sunder Rao and J.Richard, "Introduction to Bio-Statistics and Research Methods" fifth edition, PHI Learning Pvt. Ltd.2012.
2. S.C.Gupta and Dr.V.K.Kapoor, "Fundamentals of Applied Statistics", tenth edition, Publishers: Sultan Chand & Sons,2005

Suggested Reading:

1. Mahajan, "Methods in Bio-Statistics",Japee Brothers Publishers, 2002.
2. A.K.Sharma ,"Text Book of Bio-Statistics"; Discovery Publishing House, 2005.
3. S.C.Gupta and Dr.V.K.Kapor, "Fundamentals of Mathematical Statistics: A Modern Approach", tenth edition, Publishers: Sultan Chand & Sons, 2005.

18BT E14

ANIMAL BIOTECHNOLOGY
(Core Elective - V)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Students are expected to understand the techniques used for animal cell culture.
2. Students will learn various steps involved in the establishment of primary culture, maintenance and scale up of animal cells.
3. Students will know about measurement of cell viability & cytotoxicity and cell death.
4. Students are expected to know about stem cells and their applications.
5. Students will know about IVF and embryo transfer, cloning and gene transfer methods for generation of transgenic animals and its applications.

Course Outcomes:

At the end of the course the students are able to

1. Explain the animal cell culture requirements and techniques.
2. Outline the establishment maintenance and scale up of animal cell culture.
3. Discuss about Stem cells and their applications and procedure for measurement of cell viability and cytotoxicity and cell death.
4. Explain various methods for IVF and embryo transfer, cloning and generation of transgenic animals and their applications.
5. Outline various applications of animal biotechnology.

UNIT-I

Animal Cell Tissue Culture: History and scope of animal cell tissue culture, advantages and disadvantages of tissue culture; Laboratory facilities for animal tissue culture; Aseptic techniques; the substrate on which cells grow; Treatment of substrate surfaces; Culture media for cells and tissues.

UNIT-II

Primary Culture and Cell Lines: Disaggregation (Enzymatic and Mechanical) of tissue and Primary culture. Culture cells and evolution of cell lines. Maintenance of cultures- Cell lines, Cell separation, Cell synchronization; Cloning of cell lines; Cell transformation; Bioreactors for animal cell culture; Scaling-up of animal cell culture.

UNIT-III

Stem Cells, Cell Viability and Toxicity: Stem cells, types of stem cells, embryonic stem cells and their applications; Measurement of cell viability and cytotoxicity, Measurement of cell death; Senescence, Apoptosis, Necrosis.

UNIT-IV

Embryo Transfer, Cloning and Transgenic Animals: Artificial insemination, in vitro fertilization and embryo transfer; Cloning of animals - Reproductive cloning, Therapeutic cloning; Gene transfer or Transfection methods; Transgenic animals- Mice, Sheep, Pig, Rabbit, Goat, Cow and fish.

UNIT-V

Applications of Animal Biotechnology: Application of animal cell culture; Mammalian cell products; viral vaccines produced from animal cell cultures. Three dimensional culture; Tissue engineering.

Text Books:

1. Ian Freshney, R., "Culture of Animal Cells: A manual of basic technique and specialized applications" Seventh edition, John Wiley and Sons,2016.
2. John Masters, "Animal Cell culture: A practical approach" OUP Oxford,2000.
3. Gupta P.K., "Biotechnology and Genomics" Rastogi Publications, 1st edition, 6th reprint,2013.

Suggested Reading:

1. Srivastava, A.K., Singh, R.K., Yadav, M.P., "Animal Biotechnology" Oxford & IBH Publishing Co. Pvt. Ltd.,2005.
2. Ranga, M.M., "Animal Biotechnology", 3 reprint, Agrobios, India,2010.

With effect from the Academic Year 2021-22

18BT E15

CANCER BIOLOGY
(Core Elective - V)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To understand the fundamentals of cancer biology.
2. To know the importance of physical and chemical carcinogens and their effects on cell cycle.
3. To learn the Molecular aspects of cell cycle control.
4. To learn the theories of metastasis, diagnosis and treatment of cancer.
5. To understand the principles of cancer pharmacology

Course Outcomes:

At the end of the course the students are able to

1. Summarize the etiology of cancer.
2. Explain the principles and mode of action of physical and chemical carcinogens.
3. Discuss the molecular genetics of cancer.
4. Outline the cancer metastasis, diagnosis and different forms of therapy
5. Describe the principles of cancer pharmacology.

UNIT-I

Fundamentals Of Cancer Biology: Definition and hall marks of cancer, Cell cycle control, regulation of the cell cycle by cyclins, cyclin-dependent kinases, cdk inhibitors, Mutations that cause changes in signal molecules, Effects on receptor, Tumor suppressor genes, Different forms of cancer(Case studies for carcinoma ex: breast cancer and stomach cancer), Diet and cancer.

UNIT-II

Principles Of Carcinogenesis: Natural History of Carcinogenesis, Types of Carcinogenesis, Chemical Carcinogenesis, Metabolism of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, Ionizing radiation and UV radiation mechanism of Carcinogenesis.

UNIT-III

Principles Of Molecular Cell Biology Of Cancer: Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, Detection of Oncogenes, Growth factor and Growth factor receptors that are Oncogenes, Activation of protooncogens to oncogens.

UNIT-IV

Cancer Metastasis And Treatment: Metastasis, Classic theory of tumor Metastasis, Clinical significance of invasion, Three-step theory of invasion (Basement Membrane disruption, role of Proteinases in tumor invasion and tumor cell locomotion). Diagnosis of cancers, Advances in Cancer detection (Biomarkers technology and nanotechnology), Different forms of therapy- Chemotherapy, Radiation therapy and immunotherapy. , Advances in Cancer therapy

UNIT-V

Principles Of Cancer Pharmacology: Pharmacokinetics and pharmacodynamics of antineoplastic drugs. Metabolism of anticancer drugs, inter individual differences in response to anticancer drugs, mechanisms of anticancer drug resistance, mechanism of gene silencing (antisense, ribozymes, RNAi) and chemoprevention studies.

Text Books:

1. FranksLM and N.M.Teich, "Introduction to Cellular and Molecular Biology of Cancer", 2nd edition, Oxford Medical Publications, 1991.
2. Raymond W. Ruddon "Cancer Biology", 3rd edition, Oxford University Press, USA1995.
3. King, Roger J B, Robins, Mike W, "Cancer Biology", 3rd edition, Prentice Hall, USA. 2003.

Suggested Reading:

1. Fiona Macdonald, Christopher Ford, Alan Casson, "Molecular Biology of Cancer", 2nd Edition, Taylor & Francis, 2004.
2. Robert A. Weinberg, "The Biology of Cancer", 5th edition, Garlan

With effect from the Academic Year 2021-22

18BT E16

COMPUTER APPLICATIONS IN BIOPROCESS
(Core Elective - V)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. This course aims at providing knowledge on basic concepts in software development processes, Algorithm design and Process Models.
2. The course is designed to give an understanding on obtaining. solutions of differential equations by Euler`s, Modified Euler`s, Runge-Kutta methods
3. This course aims at providing an insight into the solution of set of simultaneous equations by Gauss elimination, Gauss Jordan and Gauss Seidel methods.
4. The aim of the course is also to give the students an understanding of obtaining solutions of numerical methods.

Course Outcomes:

At the end of the course student are able to

1. Distinguish between different process models
2. Formulate process models leading to set of ordinary differential equations and solution procedures numerical methods.
3. Formulate process models leading to set of linear simultaneous equations and solution procedures.
4. Formulate process models leading to transcendental and polynomial equations and solution procedures.
5. Understand the steps involved in optimization that are a prerequisite for the development of process flow sheets and optimize biochemical process.

The Programs are to be written in C only

UNIT-I

Computers and Software: Computing environments, the software development processes, Algorithm design, Program composition, Quality Control, Documentation, Storage and •Maintenance, Software strategy. Process Models: Uses, Distributed & Lumped parameter models, Linear and Nonlinear models, Steady state and Dynamic models, Continuous and Discrete models, Empirical models. Formulation of Process Models: Momentum, mass and energy balances, constitutive rate equations, transport rate equations, biochemical kinetic rate expressions, thermodynamic relations. Review on "C" Language Fundamentals.

UNIT-II

Function Approximation: Function Approximations by Linear and nonlinear least square analysis, Formulation Process Models leading to set of ordinary differential equations and solution procedures by Eulers, Modified Eulers and RungeKutta methods.

UNIT-III

Formulation of Process Models : Formulation of Process Models leading to set of linear simultaneous equations and solution procedures by Method of determinants, Gauss Elimination, Gauss Jordan, Jacobi and Gauss-Seidel methods.

UNIT-IV

Process Models Leading to Transcendental and Polynomial Equations:

Formulation of Process Models leading to transcendental and polynomial equations and solution procedures by Bisection, Reguli-falsi, Newton Raphson, Richmond, Muller's and Bairstow methods

UNIT-V

Process Optimization : Nature and organization, basic concepts and elements of Optimization, Scope and hierarchy of optimization, Essential features and general procedure of optimization problems and applications of optimization , single variable functions, direct, indirect and random search methods – with and without acceleration Elimination methods for unrestricted and exhaustive search, Fibonacci search, Dichotomous search, Golden-section (gradient) search methods.

Text Books:

1. DR. B.S. Grewal, Higher engineering mathematics Khanna publishers, 1998.
2. Steven C. Chapra and Raymond P Canale, Numerical methods for Engineers 2nd edition, MCGraw Hill International edition,1988.

Suggested books:

1. Henry R. Bungay Computer Applications in Bioprocessing Volume 70 Springer, 2000.
2. Edger T.E., and Himmelbau D.M., "Optimization of chemical processes", McGraw Hill international edition, 1988 3. Bioprocess engineering Enrique Galindo and Octavio T. Ramírez Volume 16, Issue 7, 1998.

With effect from the Academic Year 2021-22

18BT E17

PRINCIPLES OF DATA ANALYTICS
(Core Elective - V)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Students were made to understand about the concepts of Statistical methods for designing experiments, collection of data and estimating the probability
2. Students were taught about design of experiments, about null and alternate hypothesis and decision making
3. Students were made aware of how to understand the relationship between the given data and predictive analytics
4. Students were taught the concepts of identification of differences in given data by analysis of variance and multivariate analysis
5. Students are enlightened about the concepts of clustering of the biological data, dimensionality reduction to represent entire data

Course Outcomes

At the end of the course, the students are able to

1. Students gains knowledge how to collect data and also apply appropriate method for statistical analysis.
2. Students would learn how to make proper decisions by understanding the results derived out of the statistical analysis performed.
3. Students would learn how to build relationships between the parameters in the given data and also would learn how to predict the future outcomes.
4. Students would learn the basic differences between the obtained data and can judge about the possible causative factors responsible for the given cause.
5. Students can use these concepts such as clustering and PCA in handling the data obtained from next generation sequencing and can learn about the genotypes and phenotypes.

Unit I

Introduction: Scientific method; Experiments and other tests; Data, observations and variables; Probability; Probability distributions

Estimation: Samples and populations; Common parameters and statistics; Standard errors and confidence intervals for the mean; Methods for estimating parameters; Resampling methods for estimation; Bayesian inference – estimation.

Unit II

Hypothesis testing: Statistical hypothesis testing; Decision errors; Multiple testing; Combining results from statistical tests; Bayesian hypothesis testing

Graphical exploration of data: Exploratory data analysis; Analysis with graphs; Transforming data; Standardizations; Outliers; Censored and missing data;

Unit III

Correlation and regression: Correlation analysis; Linear models; Linear regression analysis; Smoothing; Power of tests in correlation and regression; Multiple linear regression analysis; Regression trees; Nonlinear models

Design and power analysis: Sampling; Experimental design; Power analysis; Analysis of variance- Single factor (one way) designs, Factor effects, ANOVA diagnostics and Robust ANOVA

Unit IV

Analyzing frequencies: Single variable goodness-of-fit tests; Contingency tables; Log-linear models;

Multivariate analyses: Multivariate data; Distributions and associations; Linear combinations, eigenvectors and eigen values; Multivariate distance and dissimilarity measures; Multivariate graphics; Multivariate analysis of variance (MANOVA); Discriminant function analysis

Unit V

Principal components and correspondence analysis-Principal components analysis; Factor analysis; Correspondence analysis; Canonical correlation analysis; Redundancy analysis

Multidimensional scaling and cluster analysis: Multidimensional scaling; Classification; Scaling (ordination) and clustering for biological data

Presentation of results: Presentation of analyses; Layout of tables; Displaying summaries of the data; Error bars

Text Books:

1. Experimental Design and Data Analysis for Biologists; Gerry P. Quinn & Michael J. Keough; Cambridge University Press
2. Beckerman, Childs & Petchey (2017) Getting started with R: An introduction for Biologists (2nd edition).Oxford University press.

With effect from the Academic Year 2021-22

18CS O13

BLOCKCHAIN TECHNOLOGIES
(Open Elective - II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Outcome

1. Student is made to understand about the concept of distributed systems, block chain technology
2. Student will understand about the what is cryptocurrency, its components and use
3. Student will understand the importance of bitcoin as an alternate for real currency, about its nature of transfer and other concepts
4. Student will understand the way to use hyperledger and its importance
5. Student will understand how implementation of blockchain technology will improve science and health sector

Unit I:

Introduction: Overview of distributed system; introduction to Blockchain; Properties of Blockchain; Evolution of Blockchain

Cryptocurrency And Blockchain: Anonymity and Pseudonymity in Cryptocurrency; Programmable Money; Hash Functions and MerkleTrees; Components of Blockchain Ecosystem; Cryptography and Consensus Algorithms; Types of Blockchain; Side Chains: another type of Blockchain; Blockchain Implementations; Blockchain Platforms

Unit II:

Bitcoin Platform: Bitcoin and its uses; Bitcoin Trading: Buying, selling and storing Bitcoins; Bitcoin Ecosystem; Structure of a Bitcoin Transaction; Scripting language in Bitcoin; Applications of Bitcoin script; Nodes in a Bitcoin Network

Bitcoin Mining: Bitcoin Economics; Bitcoin Mining and Types of Mining; Mining and Consensus; Assembling and selecting chains of blocks; Mining and the hashing race; Mining Pools

Unit III:

Introduction To Ethereum: What is Ethereum; Introducing Smart Contracts; Cryptocurrency in Ethereum; Mining in Ethereum; Consensus Mechanism in Ethereum; Platform Functions used in Ethereum; Technologies that support Ethereum; Ethereum Programming Language; Components for development of Ethereum DApps; Editors and tools; Frontend Development; Ethereum Test Networks; ERC Tokens

Basic Solidity : Introducing Solidity; Sample Code; Layout of Source File; Structure of a Contract; State Variables; Functions Types; Reference Types; Units; Special Variables and Functions; Expressions and Control Structures; Function Calls; Error Handling; Visibility for Functions and State Variables

Unit IV:

Hyperledger: Introduction to Hyperledger; Hyperledger architecture; Consensus; Hyperledger API and Application Model; Network Topology; Exploring Hyperledger frameworks; Business Network Deployment on Hyperledger Composer Playground; Setting up Development Environment using Hyperledger Composer; Introduction to Hyperledger Fabric; Creating Hyperledger Fabric Blockchain Network

Deploying Private Blockchain On MultiChain : What Is MultiChain; Privacy and Permissions in MultiChain; Mining in MultiChain; Multiple configurable Blockchains using MultiChain; Setting up a Private Blockchain

Unit V:

Blockchain in Science: Reproducibility Crisis; Clinical Trials; Reputation System; Pharmaceutical Drug Tracking-Prediction Markets and Augar

Blockchain in Health Care: Payer–Providers–Patient Model; Workflow-Hot Switching; Waste Management: Capital One, Ark Invest, and Gem

Text Books:

1. Mastering Bitcoin. Programming the Open Blockchain; Andreas M. Antonopoulos; O'Reilly, 2017
2. Bitcoin and Blockchain Security**;** Ghassan Karame, Elli Androulaki; Artech House, 2016.
3. Blockchainand Clinical Trial; Hamid Jahankhani et.al. Springer (2019)
4. Blockchain Enabled Applications; Vikram Dhillon et al, Apress (2019)

18CS O04

BASICS OF DATA SCIENCE USING R
(Open Elective - II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Pre-requisites: Probability and Statistics, basics of programming languages.

Course Objectives:

1. Understand R programming language.
2. Explore the programming skills needed to use R tool for statistical analysis of Biological data.
3. Analyze biological data.

Course Outcomes:

At the end of the course, the students are able to

1. Summarize the basics of R and in-built data visualization packages.
2. Describe the data analysis using Bayesian and stochastic modeling.
3. Relate Gibbs, Z- sampling distributions and compare the binomial, chi-square, Wilcoxon and Fisher's exact tests in hypothesis testing.
4. Explore the ANOVA in Regression analysis and classify the multivariate data.
5. Experiment with the biological data using R tool and apply clustering algorithms to biological data.
6. Identify R commands for data manipulation and database technologies for datasets of bioinformatics.

UNIT - I

Basics of R: Introduction, R features, setting up and exploring R environment, loading packages, types of data objects in R, working with R data objects, Controlling work space, importing files. Programming with R: Variables and assignment, operators, control structures, Functions-built-in, writing own functions, package creation.

UNIT - II

Data Analysis and Graphics: Data summary functions in R, Graphics technology in R, saving graphics, additional graphics packages. Bayesian Data Analysis: Need of Bayesian approach, Application of Bayes rule, Priors, Likelihood functions, evaluating the posterior, Applications of Bayesial Statistics in Bioinformatics. Stochastic Modeling: Stochastic process and Markov Processes, Classification of Stochastic processes, modeling a DNA sequence with Markov Chain, Characteristics of Markov Chain.

UNIT - III

MCMC using Brugs: ABO blood type example. Gibbs sampling. Statistical Inference: Sampling distributions, Parameter estimation, interval estimation, bootstrapping, R packages for bootstrapping. Hypothesis Testing: Package ctest, Binomial test, comparing variances, Wilcoxon tests, Chi-Square test, Fisher's Exact tests, Likelihood Ratio tests.

UNIT - IV

ANOVA and Regression: ANOVA table, perforating ANOVA using R, graphical analysis of ANOVA comparison, Regression: Correlations, linear regression model, fitting and testing of regression model, generalization of the model. Working with Multivariate Data: Multivariate data, sample statistics, display of multivariate data, outliers and principal components. Classification of discriminate analysis- classification with two population and more than two populations, cross validation classification trees.

UNIT - V

Clustering methods: measures of dissimilarities, K-means clustering, K-Medoid clustering, Hierarchical clustering-Agglomerate and divisive. R Packages: Bio-conductor and Seqin R.

Data Technologies: R for Data manipulation, example, Database technologies, Bioinformatics resources on the

WWW.

Text Books:

1. Kim Seefeld, Ernest Linder, "Statistics using R with Biological examples", 2007 (https://cran.r-project.org/doc/contrib/Seefeld_StatsRBio.pdf).
2. Robert Gentleman, "R Programming for Bioinformatics", 1st Edition, CRC Press, 2008.

Suggested Reading:

1. Arvil Cohhlan "A Little Book of R for Bioinformatics", Release 1.0, CC ver 3.0

Online Resources:

1. https://epdf.tips/r-programming-for-bioinformatics.html
2. https://epdf.tips/r-programming-for-bioinformatics.htmlhttps://www.cyclismo.org/tutorial/R/objectOriented.html
3. https://www.w3schools.in/r/object-oriented/

With effect from the Academic Year 2021-22

18EG O01

TECHNICAL WRITING SKILLS
(Open Elective - II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Process of communication and channels of communication in general and technical writing.
2. Technical Writing and also contextual use of technology specific words.
3. Business letters and technical articles.
4. Technical reports and technical proposals.
5. Transferring data from verbal to graphic and vice versa and making technical presentations.

Course Outcomes:

At the end of the course, the students are able to

1. Understand the channels of communication and define nature and aspects of Technical communication
2. Compare and contrast technical communication to that of general communication while constructing error free sentences applying features of technical writing.
3. Analyze data, draw inferences to write Journal articles and conference papers and to compose business letters.
4. Evaluate data to draft technical reports and technical proposals.
5. Design a technical presentation by understanding the nuances of presentation skills and also transfer data from verbal to graphic and vice versa.

Unit I

Communication – Nature and process.

Channels of Communication – Downward, upward and horizontal and lateral communication. Barriers to communication.

Technical Communication – Definition; oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

Unit II

Technical Writing – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

Unit III

Business correspondence – Sales letters, letters of Quotation, Claim and Adjustment letters.

Technical Articles: Nature significance and types of technical articles. Writing an abstract. Journal articles and Conference papers. Elements of technical articles.

Unit IV

Technical Reports: Types, significance, structure, style and writing of reports. Routine reports, Project reports.

Technical Proposals: Definition, types, characteristics, structure and significance.

Unit V

Information Transfer – Graphic to verbal (written) and verbal to graphic.

Technical Presentations: Important aspects of oral and visual presentations.

Text Books:

1. Meenakshi Raman & Sangeeta Sharma, **"Technical Communications-Principles and Practice",** Oxford University Press, Second Edition, 2012.
2. 1.M Ashraf Rizvi, **"Effective Technical Communication",** Tata McGraw Hill Education Pvt Ltd, 2012.

Suggested Reading:.

1. .Kavita Tyagi & Padma Misra, **"Basic Technical Communication",** PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, **"Business Correspondence and Report Writing",** Tata McGraw Hill, 2003

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. https://www.technical-writing-training-and-certification.com/
3. https://academy.whatfix.com/technical-writing-skills

With effect from the Academic Year 2021-22

18EE O05

WASTE MANAGEMENT
(Open Elective - II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To imbibe the concept of effective utilization of any scrap
2. To become familiar with the processes of all disciplines of engineering.
3. To learn the technique of connectivity from waste to utility.

Course Outcomes:

At the end of the course, the students are able to

1. Understand the various processes involved in allied disciplines of engineering
2. Infer the regulations of governance in managing the waste
3. Distinguish the nature of waste materials concerned to the particular branch of engineering
4. Explore the ways and means of disposal of waste material
5. Identify the remedies for the disposal of a selected hazardous waste material

UNIT-I

Introduction to waste management: Relevant Regulations Municipal solid waste (management and handling) rules; hazardous waste (management and handling) rules; biomedical waste handling rules; fly ash rules; recycled plastics usage rules; batteries (management and handling) rules. Municipal Solid Waste Management – Fundamentals Sources; composition; generation rates; collection of waste; separation, transfer and transport of waste; treatment and disposal options.

UNIT-II

Hazardous Waste Management : Fundamentals Characterization of waste; compatibility and flammability of chemicals; fate and transport of chemicals; health effects, Radioactive Waste Management – Fundamentals Sources, measures and health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options.

UNIT-III

Environmental Risk Assessment: Defining risk and environmental risk; methods of risk assessment; case studies, Physicochemical Treatment of Solid and Hazardous Waste Chemical treatment processes for MSW (combustion, stabilization and solidification of hazardous wastes); physicochemical processes for hazardous wastes (soil vapor extraction, air stripping, chemical oxidation); ground water contamination and remediation

UNIT-IV

Biological Treatment: Solid and Hazardous Waste Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation.

UNIT-V

Landfill design aspects: Landfill design for solid and hazardous wastes; leachate collection and removal; landfill covers; incineration

Text Books:

1. John Pichtel Waste Management Practices CRC Press, Taylor and Francis Group 2005.
2. LaGrega, M.D.Buckingham,P.L. and Evans, J.C. Hazardous Waste Management, McGraw Hill International Editions, New York, 1994
3. Richard J. Watts, Hazardous Wastes - Sources, Pathways, Receptors John Wiley and Sons, New York, 1997

Suggested Readings:

1. Basics of Solid and Hazardous Waste Mgmt. Tech. by Kanti L.Shah 1999, Prentice Hall.
2. Solid and Hazardous Waste Management 2007 by S.C.Bhatia Atlantic Publishers & dist.

18BT C28

DOWNSTREAM PROCESSING LAB

Instruction	3 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	1.5

Course Objectives:

1. To provide an opportunity to experimentally verify the theoretical concepts studied.
2. To give extensive exposure to various unit operations of downstream processing.
3. To design protocol for separation of bioproduct based on characteristics

Course Outcomes:

At the end of the course the students are able to

1. Demonstrate chromatographic separation process for a given compound.
2. Apply a strategy for final product purification/ polishing of a bioproduct.
3. Analyze the optimum protein precipitation technique.
4. Evaluate various techniques for cell disruption and filtration.
5. Develop methods for determining enzyme activity.

List of Experiments:

1. Cell Disruption of microorganism using enzymatic method
2. Cell Disruption of plant cells / animal cells using physical methods
3. Liquid-liquid extraction.
4. Separation of solids from liquid by Sedimentation
5. Separation of microorganisms from fermentation broth by Microfiltration.
6. Separation of solute particles by Dialysis.
7. Separation of protein by Ammonium Sulphate Precipitation.(Structured expt)
8. Isolation and quantification of protein from milk by Isoelectric Precipitation.
9. Separation of biomolecules by Gel Exclusion Chromatography.
10. Purification of lysozyme from chicken egg white extract by Ion Exchange Chromatography.
11. Purification of proteins by Affinity Chromatography.
12. Simple distillation- vapor liquid equilibrium.
13. Solid liquid extraction./Drying technique
14. Alpha amylase activity (open ended expt)

Suggested Readings:

1. David Plummer, "An introduction to Practical Biochemistry" 3rd edition, John Wiley &Sons
2. Principles and Techniques of Biochemistry and Molecular Biology by Keith John Walker John Walker, Cambridge University Press; 6 edition (2005).
3. Laboratory Manual in Biochemistry By J. Jayaraman, Kunthala Jayaramanj, New Age International

18BT C29

TISSUE CULTURE LAB

Instruction	3 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	1.5

Course Objectives:

1. The students should be able to understand explicitly the concepts of Plant Tissue culture and Animal tissue culture.
2. Develop their skills in plant tissues culture techniques in horticultural/medicinally important plants.
3. Get extensive exposure to various techniques of plant cell and tissue culture.
4. To develop a protocol for genetic transformation using Agrobacterium strains.

Course Outcomes:

At the end of the course the students are able to

1. Prepare plant tissue culture medium for in vitro studies.
2. Execute the protocols for various plant tissue culture applications using cell suspension cultures.
3. Develop in vitro techniques for micropropagation of horticulture and medicinal plants.
4. Demonstrate the Protoplast isolation from various plant tissues using enzymatic method.
5. Develop a system for genetic transformation in plants using Agrobacterium strains

List of Experiments

1. Preparation of Plant tissue Culture Media
    - Preparation of MS stock solutions
    - Preparation of MS callus induction media
2. Surface sterilization
3. Callus induction from mature embryo.
4. Cell suspension cultures initiation and establishment
5. Organogenesis and Embryogenesis
6. Meristem tip culture for production of virus free plants
7. Micropropagation of horticultural/medicinally important plants (Open ended experiment)
8. Root induction and acclimatization of in vitro plantlets
9. Production of synthetic seeds. (Structured enquiry)
10. Protoplast isolation(demo)
11. Agrobacterium mediated gene transfer: induction of Hairy roots

Suggested Readings:

1. H. Jones and John M. Walker, "Plant Gene Transfer and Expression Protocols: Methods in Molecular Biology, 49, Humana Press, 1996.
2. J. G. Chirikjian, Biotechnology: Theory and Techniques (Plant Biotechnology, Animal Cell Culture and Immunobiotechnology), Jones & Bartlett Publishers, U.K., 1996.

With effect from the Academic Year 2021-22

18BT C30

PROJECT: PART-1

Instruction	3 Hours per week
CIE	50 Marks
Credits	2

The objective of Project Part -1 is to enable the student take up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D.

The work shall include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminaryAnalysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental Committee.

Guidelines for the award of Marks: Max. Marks: 50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Department Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

With effect from the Academic Year 2021-22

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instructions of VIII Semester of B.Tech Bio-Technology as per AICTE Model Curriculum 2021-22

B.Tech (Bio-Technology)

SEMESTER-VIII

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
	THEORY								
1		**Core Elective VI**	3	-	-	3	30	70	3
2		**Open Elective III**	3	-	-	3	30	70	3
	PRACTICALS								
3	18BT C31	Technical Seminar (On the latest trends and other than project)	-	-	2	-	50	-	1
4	18BT C32	Project Part II	-	-	20	Viva	100	100	10
Total			**6**	**-**	**22**	**-**	**210**	**240**	**17**
Clock Hours Per Week – 28									

L: Lecture T:Tutorial P: Practical

CIE – Continuous Internal Evaluation SEE - Semester End Examination

Core Elective VI	
18BT E18	Tissue Engineering
18BT E19	Immunodiagnostics
18BT E20	Genomics and Proteomics

Open Elective III	
18ME O04	Entrepreneurship
18CS O08	Open Source Technology
18CS O01	Python for Bioinformatics

Credit Summary for B. Tech Biotechnology									TOTAL CREDITS
Semester	I	II	III	IV	V	VI	VII	VIII	
Credits	20.5	21.5	20	20	21	20	20	17	**160**

18BT E18

TISSUE ENGINEERING
(Core Elective-VI)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. To provide fundamental principles and elements of tissue engineering.
2. To get insight about the roles of cells, tissue organization and matrix in tissue engineering.
3. To learn the tissue culture techniques and scale up designs.
4. To learn the different biomaterials used for the fabrication of scaffolds.
5. To gain knowledge about the therapeutic applications of tissue engineering.

Course Outcomes:

At the end of the course students will be able to

1. Outline the concepts of tissue engineering, ethical issues, and future prospects
2. Illustrate the molecular mechanisms at tissue level and in cell matrix in tissue engineering.
3. Identify in vitro culturing techniques and scale up designs.
4. Classify the compatible biomaterials used for fabrication of scaffolds in Tissue engineering.
5. Summarize the therapeutic applications of tissue engineering.

UNIT-I

Introduction to Tissue Engineering: Basic definition of Tissue engineering; origin and history of Tissue Engineering, overview of its basic steps and its applications; General scientific issues, Ethical issues; current challenges and future prospective.

UNIT-II

Cells and Tissue Organization: Cells- cell growth and death; cell differentiation; Cells in tissues and organs. Cell to cell interactions; cell adhesion molecules (CAM) Organization of cells into higher ordered structures- Mesenchymal cells; EMT, Molecular mechanisms and control of EMT process. Tissues- Vascularity; angiogenesis; wound healing. Extra cellular matrix (ECM) –components.

UNIT-III

Functional Tissue Engineering: Cell and tissue culture- media; culture initiation; transformation and immortalization; validation; differentiation; maintenance of cells in vitro; cryopreservation. Stem cells in tissue engineering Bioreactors for tissue engineering- Bioreactor design requirements; Spinner flask bioreactors. Rotating-wall bioreactors, Compression bioreactors, Strain bioreactors, Hydrostatic pressure bioreactors, Flow perfusion bioreactors, Combined bioreactors

UNIT-IV

Biomaterials of Tissue Engineering: Scaffolds- fabrication; 3D scaffolds Biodegradable polymers; synthetic polymers; hybrid of synthetic and biological polymers; prosthetic devices. Engineering biomaterials for tissue engineering.

UNIT-V

Applications of Tissue Engineering: Tissue replacement –crucial factors Skin grafting Bone tissue engineering; Cardiac tissue engineering; Neural tissue engineering; Vascular tissueengineering;

Text Books:

1. Robert.P.Lanza, Robert Langer & Vacanti, Principles of tissue engineering. Academic Press. 2nd edition2000.
2. B. Palsson, J.A. Hubbell, R. Plonsey& J.D. Bronzino. Tissue engineering. CRC Taylor & Francis 2000.

Suggested Readings:

1. Bernard Prish, Tissue engineering- Design, practice & reporting, Woodhead Publishing Ltd. Cambridge. UK 2009.
2. Atala O.P &Lanza.L, Methods of tissue engineering. Woodhead Publishing Ltd. Cambridge. UK. 2009.

With effect from the Academic Year 2021-22

18BT E19

IMMUNODIAGNOSTICS
(Core Elective - VI)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To learn the basic principles, procedures and applications of immunodiagnostic tests.
2. To understand the principles and applications of immunodiagnostic test.
3. To learn the steps involved in the production, diagnosis and applications of monoclonal antibody.
4. To learn the development of prophylactic agents such as vaccines.
5. To learn the novel methods used for immunodiagnostics.

Course Outcomes:

At the end of the course students will be able to

1. Outline the principle, importance, scope, classification of immunodiagnostic tests and antigen antibody reaction
2. Explain the principles and application of immunodiagnostics tests for diagnosing various diseases
3. Discuss about the production of monoclonal antibodies for diagnosis, treatment and prevention of disease.
4. Describe various methods used for vaccine development.
5. Summarize the various novel techniques used in immunodiagnostics.

UNIT-I

Introduction to Immunodiagnostics: Principles of immunodiagnostic tests and their development; classification of immunodiagnostic tests; Immunodiagnostics importance and scope; the antigen antibody reaction; Selection and preparation of reagents; Assay design; Antibody engineering; Catalytic antibodies.

UNIT-II

Immunodiagnostics Techniques: Immunodiagnostics techniques – Precipitation, Immunoelctrophoresis, Agglutination, RIA, ELISA, Fluoroimmunoassay, Luminescent immunoassay, Immunofluorescence, Cell separation techniques, Western blotting.

UNIT-III

Hybridoma Technology: Hybridoma technique - choice of host for immunization and myeloma cells, choice of immunogen, preparation of antigen for immunization, growth of myeloma cell lines, preparation of cells for fusion, cell fusion, selection and screening of hybridoma, purification and application (biochemical research, clinical diagnosis and treatment) of monoclonal antibodies.

UNIT-IV

Vaccines: Whole organism Vaccines; Subunit vaccines - Herpes Simplex virus, Foot and Mouth disease; Peptide vaccines - Foot and Mouth disease, Malaria; Live recombinant vaccines- Cholera, Salmonella; Vector vaccines - directed against viruses and bacteria; Purified vaccines, Conjugate polysaccharide vaccines; DNA vaccines; Antifertility vaccines.

UNIT-V

Novel Techniques in Immunodiagnostics: Imaging as an Immunodiagnostic Tool; Multicolor Flow Cytometry; Immunoglobulin and Free-light Chain Detection; Methods for Autoantibody Detection; Immunodiagnostic of Allergy; Multiplex Analysis of Cytokines; Immunomonitoring of Clinical Trials; Immunological Assays Used in Vaccine ClinicalTrials.

Text books:

1. Edwards R, “Immunodiagnostics: A practical approach” Oxford University Press, 1999.
2. Rastogi SC, “Immunodiagnostics Principles and Practice” New Age Publishers, 1996.

Suggested Readings:

1. Shepherd, P., Dean C., “Monoclonal Antibodies: A Practical Approach” Oxford University Press, 2000.
2. Jenni Punt, Sharon Stranford, Patricia Jones, Judith A Owen., “Kuby Immunology” 8thedition, Macillan learning, 2018.
3. Ralph M Aloisi Lea, Principles of Immunology and Immunodiagnostics, Lea &Febiger, 1988.

With effect from the Academic Year 2021-22

18BT E20

GENOMICS AND PROTEOMICS
(Core Elective - VI)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Student is made to understand the fundamentals of genome
2. Students are made to understand DNA sequencing and various DNA sequencing methods.
3. Students are enlightened about construction and screening of cDNA libraries.
4. Students are enlightened about the current methods existing in the field of genomics.
5. Students are made to understand the basics of proteomics, tools for proteomics and protein modifications

Course Outcomes:

At the end of the course the students are able to

1. Describe about genomes, types of genomes and the advanced techniques used for analyzing genome.
2. Explain about the methods of functional genomics.
3. Discuss about the various sequencing technology in genomics.
4. Describe the tools used for the characterization of proteins
5. Explain the about personalized medicines their uptake, action and metabolism

UNIT-I

Structural Genomics: Overview of Genome - Types, analysis of genomes; comparative homologies; evolutionary changes; Genetic analysis: Linkage mapping and analysis, High resolution chromosome maps, Physical mapping, Hybrid mapping strategies, Sequence specific tags(SST), Sequence tagged sites(STS), FISH.

UNIT-II

Functional Genomics: Gene disruption and methods; DNA microarray and its Applications; Serial analysis of gene expression (SAGE); Genome wide association studies; Chip-Seq; RNA-Seq; Metagenomics.

UNIT-III

Next Generation Sequencing: Next generation sequencing - importance; Different sequencer platforms available; Methods of Sequencing; File formats; Data generation tools; Preprocessing of data and analysis.

UNIT-IV

Proteomics: Protein arrays: basic principles. Computational methods for identification of polypeptides from mass spectrometry. Protein arrays: bioinformatics-based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); databases (such as InterPro) and analysis tools. Protein-protein interactions: databases such as DIP, PPI server and tools for analysis of protein-protein interactions

UNIT-V

Metabolomics And Pharmacogenomics: Metabolomics - Basics; Pharmacogenomics - Basics, Diseased genes and their identification; Drug uptake and metabolism; Drug targets; Designer medicine; Genomics perspective of bioterrorism; Ethical and legal implications.

Text Books:

1. Sahai S, "Genomics and Proteomics-Functional and Computational Aspects", Plenum Publications, 1999.
2. Rastogi SC, Mendiratta N, Rastogi P, "Bioinformatics-Methods and Application, Genomics, Proteomics,and drug discovery", 2nd edition, Prentice Hall of India, New Delhi,2003.
3. Hunt SP, Levessy FJ, "Functional genomics" Oxford University Press, UK, 2000.

Suggested Readings:

1. Lieber DC, "Introduction to Proteomics, Tools for the new biology", Humana Press, UK, 2000.
2. CendricGondro, "Primer to Analysis of Genomic Data Using R", Springer, 2015.

18ME O04

ENTREPRENEURSHIP
(Open Elective - III)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:
Student will understand

1. Concept and procedure of idea generation.
2. The nature of industry and related opportunities and challenges.
3. Elements of business plan and its procedure.
4. Project management and its techniques.
5. Behavioral issues and Time management.

Course Outcomes:
At the end of the course, students will be able to:

1. Understand the concept and essence of entrepreneurship.
2. Identify business opportunities and nature of enterprise.
3. Analyze the feasibility of new business plan.
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects.
5. Use behavioral, leadership and time management aspects in entrepreneurial journey.

UNIT-I
Entrepreneurship: Definition, functions of entrepreneurship, qualities of entrepreneurs, Identification and characteristics of Entrepreneurs, Entrepreneur vs intrapreneur, First generation entrepreneurs, women entrepreneurs, Conception and evaluation of ideas and their sources.

UNIT-II
Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries, Types of enterprises, Corporate Social Responsibility.

UNIT-III
Business Plan: Introduction, Elements of Business Plan and its salient features, Business model canvas, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary, Selection of Technology and Collaborative interactions.

UNIT-IV
Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden.

UNIT-V
Behavioral Aspects of Entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects, Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Readings:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5/e, Tata Me Graw Hill Publishing Company Ltd., 2005
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.
3. G.S. Sudha, "Organizational Behavior", National Publishing House, 1996.

18CS O08

OPEN SOURCE TECHNOLOGIES
(Open Elective - III)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Familiarity with Open Source Technologies.
2. Examples of OSS Projects, Advantages of Open Source.
3. Understand the principles, methodologies of OSS.
4. Understand the policies, licensing procedures and ethics of OSS.

Course Outcomes:

At the end of the course, students will be able to:

1. Able to differentiate between Open Source and Proprietary software and Licensing.
2. Recognize the applications, benefits and features of Open Source Technologies.
3. Understand and demonstrate Version Control System along with its commands.
4. Gain knowledge to start, manage open source projects.
5. Understand and practice the Open Source Ethics.

UNIT – I

Introduction to Open Source: Open Source, need of Open Source, Open Source Principles, Open Source Standards Requirements for Software, OSS success, Free Software, Examples, Licensing, Free Software Vs. Proprietary Software, Public Domain software, History of free software, Proprietary Vs Open Source Licensing Model, use of Open Source Software.

UNIT – II

Fault Tolerant Design: Principles and Open Source Methodology- History, Open Source Initiatives, Open Standards Principles, Methodologies, Philosophy, Software freedom, Open Source Software Development, Licenses, Copyright vs. Copyleft, Patents, zero marginal cost, income-generation Opportunities, Internationalization.

UNIT – III

Case Studies: Apache, BSD, Linux, Mozilla Firefox, Wikipedia, Git, GNU CC, Libre Office.

UNIT – IV

Open Source Project: Starting and Maintaining an Open Source Project, Open Source Hardware, Open Source Design, Open Source Teaching (OST), Open Source Media, What Is A License, How to create your own Licenses. Important FOSS Licenses (Apache, BSD, PL, LGPL), copyrights and copy lefts, Patent.

UNIT – V

Open Source Ethics: Open Source Vs. Closed Source, Open Source Government, Ethics of Open Source, Social and Financial Impact of Open Source Technology, Shared Software, Shared Source, Open Source as a Business Strategy.

Text Books:

1. Kailash Vadera, Bjhavesh Gandhi "Open Source Technology", University Science Press, 1st Edition, 2009.
2. Fadi P. Deek and James A. M. McHugh, "Open Source Technology and Policy", Cambridge University Press.

Suggested Readings:

1. Wale Soyinka, "Linux Administration- A beginner's Guide", Tata McGraw Hills.
2. Andrew M. St. Laurent, "Understanding Open Source and Free Software Licensing", O'Reilly Media.
3. Dan Woods, Gautam Guliani, "Open Source for the Enterprise", O'Reilly Media.
4. Bernard Golden, "Succeeding with Open Source", Addison-Wesley Professional.
5. Clay Shirky and Michael Cusumano, "Perspectives on Free and Open Source Software", MIT press.

18CS O01

PYTHON FOR BIOINFORMATICS
(Open Elective - III)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:
1. Introduce Python with reference to bioinformatics.
2. Understanding of various algorithms useful for biological sequences.
3. Identification Python modules useful to analyze gene and Biological sequences

Course Outcomes:
At the end of the course, students will be able to:
1. Understand the basics of Python Programming.
2. Develop applications using Python to solve problems.
3. Identify and use Python modules related to Biology.
4. Analyze biological and gene sequences using Python.
5. Understand advanced analysis techniques.
6. Formulate step-wise implementation of a python script for a given problem in bioinformatics

UNIT - I
Introduction to Python: Basics of Python, Python IDEs, Running Python programs, types and operations, Functions, modules, classes, Exceptions.

UNIT - II
Object-Oriented Programming, Modules: Object Oriented Programming, Threads, process, synchronization, databases and persistence, NumPy, SciPy, Image manipulation, Akando and Dancer modules.

UNIT - III
Biological Sequence Analysis: Biopython: Parsing DNA data files, Sequence Analysis, Dynamic Programming, Hidden Markov Model, Genetic Algorithms, Multiple Sequence Alignment, gapped alignment.

UNIT - IV
Advanced Analysis Techniques: Trees, Text Mining, Clustering, Self-Organizing Map, Principal Component Analysis and Numerical Sequence Alignment.

UNIT - V
Expression Analysis: Gene expression array analysis, Spot finding and Measurement, Spreadsheet Arrays and Data Displays, Applications with expression Alignment.

Text Books:
1. Jason Kinser, "Python for Bioinformatics", Jones & Bartlett Publishers, 2nd Edition, 2013.
2. Reema Thareja "Python Programming", Oxford Press, 2017.

Suggested Reading:
1. Mark Lutz, "Learning Python", 3rd edition, O'Reilly, 2007.
2. Alex Martelli, David Ascher, "Python cookbook", O'Reilly, 2002.

Online Resources:
1. http://www.biopython.org

With effect from the Academic Year 2021 - 2022

18BT C31

TECHNICAL SEMINAR

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall be preferably from any peer reviewed recent journal publications.

Guidelines for awarding marks		
Sl No.	Description	Max Marks
1.	Contents and relevance	10
2.	Presentation skills	10
3.	Preparation of PPT slides	05
4.	Questions and answers	05
5.	Report in a prescribed format	20

With effect from the Academic Year 2021-22

18BT C32

PROJECT: PART-II

Instruction	10 Hours per week
CIE	100 Marks
SEE	100 Marks
Credits	10

The object of 'Project: Part-2' is to enable the student extend further the investigative study taken up, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including teamwork;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for the award of marks in CIE: (Max. Marks: 100)

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Department Review Committee	10	Review 1
	15	Review 2
	25	Submission
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Report Preparation
	10	Analytical / Programming / Experimental Skills

Guidelines for awarding marks in SEE: (Max. Marks: 100)

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
External and Internal Examiners together	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study • Application to society
	20	Viva-Voce