CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology
AICTE Model Curriculum R20 regulations

B.Tech (Bio-Technology)

List of Open Electives offered by Department of Biotechnology

S.No	Subject Code	Subject Name	Sem
1	20BT C36	Biology For Engineers	Odd for CSE
2	20BT O01	Biology For Engineers	Even for all other branches
3	20BT O02	Biomaterials For Engineers	Odd
4	20BT O03	Bioterrorism And National Security	Odd
5	20BT O04	Bioinformatics	even
6	20BT O05	Cognitive Neuroscience	even

20BT C36/20BT O01

BIOLOGY FOR ENGINEERS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: The school level basic knowledge in Fundamental science is required

Course Objectives: The objectives of this course are

1. Understand the milestones reached by human in the field of biology.
2. Understand the human body and its parts.
3. Understand the human anatomy and medical devices.
4. Understand types of advanced therapies.
5. Understand the treatment of toxic pollutants in the environment.
6. Understand genome sequencing and NGS.

Course Outcomes: On Successful completion of the course, students will be able to

1. Appraise the values of Biology in classical and modern time
2. Develop modern instruments related to skeletal, nervous, and circulatory system
3. Apply concept of respiratory, excretory, and assisted reproductive process for developing related instruments
4. Illustrate the modern interdisciplinary tools related to medical biotechnology and bioremediation
5. Summarize the basic knowledge about nucleic acids, proteins and their sequencing

Mapping of Course Outcomes with Program Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	0	0	0	0	2	2	0	0	0	0	2
CO2	1	0	0	0	2	0	1	0	0	0	0	0
CO3	1	0	1	0	2	0	1	1	0	0	0	0
CO4	2	1	1	0	2	0	2	0	0	1	0	0
CO5	1	1	1	0	1	0	1	0	0	1	0	1

***The above table is applicable for biotechnology department. Respective departments opting for this subject may prepare similar table**

UNIT-I

Introduction to Biology: Classical Vs Modern Biology; Importance of Biological Science and Historical developments; Origin of Life, Urey Miller Experiment, Spontaneous Generation Theory; Three Domains of Life; Principle and Applications of Microscope (Light and Electron Microscope), Prokaryotic and Eukaryotic Cell- Structure and their differences.

UNIT-II

Human Anatomy and Functions-I: Human organ systems and their functions; Skeletal System-Bones, Tendon, Ligaments, principle and applications in knee replacement; Nervous System - Structure of Brain, Spinal Cord, Neuron, Neurotransmitters, Synapse, Alzheimer's - a case study, principle and applications of Imaging Techniques (CT & MRI scans); Circulatory System - Heart structure and functions, principle and applications of cardiac devices (Stent and Pacemaker), Artificial heart, blood components and typing, haemocytometer.

UNIT-III

Human Anatomy and Functions-II: Respiratory Systems - Lung structure and function, principle and applications of Peak Flow Meter, ECMO (Extra Corporeal Membrane Oxygenation); Excretory Systems-Kidney structure and function, principle and applications of Dialysis; Prenatal diagnosis; Assisted reproductive techniques- IVF, Surrogacy.

UNIT-IV

Medical Biotechnology and Bioremediation: Cells of Immune System, Etiology of cancer, Cancer treatment (Radiation Therapy); Stem Cells and its Clinical applications; Scaffolds and 3D printing of organs; Bio sensors and their applications; Parts of bioreactor and its types; Bioremediation.

UNIT - V

Bioinformatics: Nucleic acid composition, Genetic Code, Amino acid, Polypeptide, Levels of protein structure, Homolog, Ortholog and Paralog, Phylogenetics, Genome Sequencing, Human Genome Project, Next generation sequencing.

Text Books:

1. Champbell, N.A., Reece, J.B., Urry, Lisa, Cain, M,L., Wasserman, S.A., Minorsky, P.V., Jackson, R.B., "Biology: A global approach", Pearson Education Ltd, Edition 11, 2017.
2. Shier, David, Butler, Jackie, Lewis, Ricki., "Hole's Human Anatomy & Physiology"., McGraw Hill 2012.

Suggested Reading:

1. Bernard R. Glick, T. L. Delovitch, Cheryl L. Patten, "Medical Biotechnology", ASM Press, 2014.

20BT O02

BIOMATERIALS FOR ENGINEERS
(Open Elective)

Instruction	3LHoursperweek
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

Prerequisites: Undergraduate First year basic concepts of physics and chemistry are required

Course Objectives:

Students are made to understand the following concepts during their course of time:

1) To learn the types and trends of Biomaterials.
2) To recognize the procedures for manufacturing of Metallic Biomaterials.
3) To be aware of the types of ceramic Biomaterials.
4) To elaborate the detailed features of polymer and composite Biomaterials.
5) To learn the applications of Biomaterials.

Course outcomes:

By the end of the course the students are able to

1) Explain types and properties of Biomaterials.
2) Compare the techniques for manufacture of metallic Biomaterials and their use in health care industry.
3) Outline the physiological properties and various techniques for manufacture of ceramic biomaterials.
4) Illustrate the preparation of polymer and composite Biomaterials.
5) Apply the different type of Biomaterials in health industry.

Mapping of Course Outcomes with Program Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	2	2	1	-	1	-	3
CO2	1	1	2	1	-	2	2	1	-	-	-	3
CO3	1	1	2	2	-	2	1	2	-	-	-	3
CO4	1	2	2	2	-	1	1	1	1	1	-	3
CO5	1	1	2	2	-	1	2	1	1	1	-	3

***The above table is applicable for biotechnology department. Respective departments opting for this subject may prepare similar table**

UNIT-I

Introduction to Biomaterials: Introduction andimportance of biomaterials;Types of biomaterials: metallic, ceramic, polymeric and composite biomaterials; Future trends in biomaterials.

UNIT-II

Metallic Biomaterials: Properties of metallic biomaterials;Stainless steels; CoCr alloys; Ti alloys;Corrosion of metallic implants;Manufacturing of implants. Dental implant and their biocompatibility

UNIT-III

Ceramic Biomaterials: Properties of ceramic biomaterials;Classification according to physiological response of ceramic biomaterials: bioinert, bioactive and bioresorbable ceramics;Deterioration of ceramics;Bio ceramicmanufacturing techniques

UNIT-IV

Polymeric and composite biomaterials: Polymerization and basic structure;Polymers used as biomaterials; Properties of polymeric and composite biomaterials; Sterilization;Surface modifications for improving biocompatibility;Surface-protein interactions.

UNIT-V

Applications of Biomaterials: Applications of biomaterials in tissue engineering; Drug delivery; Biosensing; Diagnostics.

Text Books:

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E An Introduction to Materials in Medicine, (Elsevier Academic Press, ISBN: 0-12-582463-7),2002.
2. 2.J.B. Park and J.D. Bronzino. Biomaterials: Principles and Applications. CRC Press. 2002. ISBN: 0849314917
3. K.C. Dee, D.A. Puleo and R. Bizios. An Introduction to Tissue-Biomaterial Interactions. Wiley 2002. ISBN: 0-471-25394-4.

Reference Books

1. T.S. Hin (Ed.) Engineering Materials for Biomedical Applications. World Scientific. 2004. ISBN 981-256-061-0
2. B. Rolando (Ed.) Integrated Biomaterials Science. Springer. 2002. ISBN: 0-306-46678-3.

20BT O03

BIOTERRORISM AND NATIONAL SECURITY

(Open Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: The school level basic knowledge in Fundamental science is required

Course Objectives:

1. Familiarization of issues involved and threats facing society due to bioterrorism and approaches to tackle it effectively.
2. To provide students an in-depth characterization of different forms of bioterrorism, agroterrorism, and surveillance.
3. To define bioterrorism and forensics, the law and bioterrorism, and to present a sociological perspective on biodefense and bioterrorism
4. To provide students with contacts with faculty members, health care providers, and industrial experts as a resource for information on biological threats.

Course Outcomes: Exposure to threats for national security, methods to tackle them and support law enforcement & health agencies to handle them.

1. Evaluate different types of bioterrorism challenges.
2. Assess various categories of agents for bioterrorism.
3. Illustrate the various aspects of bioweapon and associated case studies.
4. Apply the techniques for detection of bioterrorism.
5. Summarize key national and international legal principles and sources that address bioterrorism

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	0	0	1	1	2	2	1	0	0	0	0
CO2	1	0	0	0	1	3	1	0	0	0	0	0
CO3	1	0	0	1	1	2	1	2	0	0	0	0
CO4	2	1	0	1	1	2	2	0	0	0	0	0
CO5	1	0	0	0	0	3	2	1	0	0	0	2

***The above table is applicable for biotechnology department. Respective departments opting for this subject may prepare similar table**

UNIT-I

Terrorism and Bioterrorism: Definition and Historical perspective of Bioterrorism, Traditional terrorists & New terrorists (Nuclear, chemical and radiological weapons), Agroterrorism, Bio surveillance & Bio diagnostics.

UNIT-II

Types of Bioterrorism Agents: Primary classes of Microbes-bacteria, virus, and other Agents. and their mechanism as terrorist in living systems. High-priority agents (Ebola virus), Moderate-priority agents (Brucellosis, Q fever), Low-priority agents (Yellow fever virus, Hantavirus)

UNIT-III

Bio-weapons and Techniques: Characteristics of microbes and the reasons for their Use-Symptoms-Pathogenicity- Epidemiology-natural and targeted release-The biological, techniques of dispersal, and case studies of Anthrax, Plague-Botulism, Smallpox, and Tularemia and VHF. Genetically Engineered Microbes

UNIT-IV

Prevention and Control of Bioterrorism: Surveillance and detection, Detection equipment and sensors, Novel Detections Methods for Bioagents, Industrialized Production of a Vaccine for a Bioagent, Biosecurity in the Food Industry

UNIT-V

Bioterrorism Management: Ethical issues: personal, national, the need to inform the public without creating fear, cost-benefit Rations-Information Management-Government control and industry Support-Microbial forensics. Role of National and International Organizations in prevention and control of bioterrorism

Text Books:

1. Bioterrorism: Guidelines for Medical and Public Health Management, Henderson, Donald, American Medical Association, 1st Edition, 2002.
2. Biological Weapons: Limiting the Threat (BCSIA Studies in International Security), Lederberg, Joshua (Editor), MIT Press, 1999.
3. Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century (Emerging Infectious Diseases of the 21st Century), I.W. Fong and Kenneth Alibek, Springer, 2005.

Reference Books:

1. The Demon in the Freezer: A True Story, Preston, Richard, Fawcett Books, 2003.
2. The Anthrax Letters: A Medical Detective Story, Cole, Leonard A., Joseph Henry Press, 2003.
3. Biotechnology research in an age of terrorism: confronting the dual use dilemma, National Academies of Science, 2003.

20BT O04

Bioinformatics
(Open Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: The school level basic knowledge in Fundamental science is required

Course Objectives:

The objectives of this course are

1. To provide elementary knowledge in biology and bioinformatics and biological information available to a biologist on the web and learn how to use these resources on theirown.
2. To learn the fundamentals of biological databases, Sequence analysis, data mining, sequencealignment and phylogenetics
3. To learn methods for determining the predictinggene and protein

Course Outcomes:

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

1. Explain the basic concepts of biology and bioinformatics
2. Identify various types of biological databases used for the retrieval and analysis of the information
3. Explain the sequence analysis and data mining
4. Discuss the methods used for sequence alignment and construction of the phylogenetic tree
5. Describe the methods used for gene and protein structure prediction

Mapping of Course Outcomes with Program Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	0	0	0	0	0	0	0	0	1	0	1
CO2	1	1	0	1	1	0	0	0	0	1	0	1
CO3	2	0	0	1	1	0	0	0	0	1	0	1
CO4	2	0	0	1	1	0	0	0	0	1	0	1
CO5	2	1	0	1	1	0	0	0	0	1	0	1

***The above table is applicable for biotechnology department. Respective departments opting for this subject may prepare similar table**

UNIT-I

Introduction And Basic Biology: Bioinformatics- Introduction, Scope and Applications of Bioinformatics; Basics of DNA, RNA, Gene and its structure, Protein and metabolic pathway; Central dogma of molecular biology; Genome sequencing, Human Genome Project.

UNIT-II

Biological Databases: Introduction to Genomic Data and Data Organization, types of databases, biological databases and their classification, Biological Databases - NCBI, SWISS PROT/Uniport, Protein Data Bank, Sequence formats; Information retrieval from biological databases; Data mining of biological databases

UNIT-III

Sequence Analysis and Data Mining: Scoring matrices, Amino acid substitution matrices- PAM and BLOSUM; Gap, Gap penalty; Database similarity searching - BLAST, FASTA algorithms to analyze sequence data, FASTA and BLAST algorithms comparison; Data Mining- Selection and Sampling, Pre-processing and Cleaning, Transformation and Reduction, Data Mining Methods, Evaluation, Visualization, Designing new queries, Pattern Recognition and Discovery, Text MiningTools

UNIT-IV

Sequence Alignment And Phylogentics: Sequence Alignment – Local and Global alignment; Pairwise sequence alignment – Dynamic Programming method for sequence alignment - Needleman and Wunsch algorithm and Smith Waterman algorithm. Multiple sequence alignment - Methods of multiple sequence alignment, evaluating multiple alignments, applications of multiple sequence alignment. Concept of tree, terminology, Methods of phylogenetic analysis, tree evaluation – bootstrapping, jackknifing

UNIT-V.

Macromolecular Structure Prediction:

Gene prediction, - neural networks method, pattern discrimination methods, conserved domain analysis; Protein structure basics, protein structure visualization, Secondary Structure predictions; prediction algorithms; Chou-Fasman and GOR method, Neural Network models, nearest neighbor methods, Hidden-Markov model, Tertiary Structure predictions; prediction algorithms; homology modeling, threading and fold recognition, ab initio prediction.

Text Books:

1. David Mount, "Bioinformatics Sequence and Genome Analysis", 2nd edition, CBS Publishers and Distributors Pvt. Ltd., 2005
2. Rastogi SC, Mendiratta N and Rastogi P, "Bioinformatics: Methods and Applications Genomics, Proteomics and Drug discovery", 3rdedition, PHI Learning Private Limited, New Delhi, 2010

Suggested Reading:

1. Baxebanis AD and Francis Ouellette BF, "Bioinformatics a practical guide the analysis of genes and proteins", 2nd edition, John Wiley and Sons, Inc., Publication, 2001
2. Vittal R Srinivas, "Bioinformatics: A modern approach. PHI Learning Private Limited", New Delhi, 2009
3. JiXiong, "Essential Bioinfomatics", Cambridge University Press, 2006

20BT O05

COGNITIVE NEUROSCIENCE

(Open Elective-II)

Instruction	2 L-1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: The school level basic knowledge in Fundamental science is required

Course Objectives: The main objectives of this course are to:

1. Understanding the brain effects that give rise to our abilities to perceive, act and think
2. Gain skills on the way that cognition is associated with neural activity
3. Compare and contrast the organization and function of numerous systems within the brain

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

1. Gain familiarity and basic knowledge about brain systems and functions.
2. Understand brain's neuro-transimitter system.
3. Understanding the brain's methods gives rise to behaviour whether we engage in any activity (e.g., walking, talking, etc.).
4. Identify the patterns of varied activities in neurons that correspond to a person's attempts to move in particular ways.
5. Understand the feedback system and brain disorders.

Mapping of Course Outcomes with Program Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	0	2	0	0	0	2	0	3
CO2	1	1	1	1	0	2	0	0	0	2	0	3
CO3	1	1	1	1	0	2	0	0	0	2	0	3
CO4	1	2	2	3	3	3	0	3	1	3	0	3
CO5	1	1	2	3	3	3	0	3	1	3	0	3

***The above table is applicable for biotechnology department. Respective departments opting for this subject may prepare similar table**

UNIT-I

Introduction to neuroscience: Outline of neuroanatomical; Neurogenesis, migration Axon path-finding; cell death; Role of neural activity in development; Membranes and membrane potentials.

UNIT-II

Action potential: Conductance mechanisms; Chemical and electrical transmission; Postsynaptic potentials; neural integration; Energy consumption in the brain; Attention; Methods jigsaw; Executive Control; Evolution/development; Sheep's brain dissection.

UNIT-III

Neurotransmitter systems: Visual information processing; Visual cortex; Visual plasticity; critical periods; Somatosensory system; Pain; Chemoreception; Auditory system; Spinal mechanisms; Brain mechanisms.

UNIT-IV

Human and Animal Memory: Pattern completion and separation; LTP and synapses; Spatial cognition; Social cognition; Cellular mechanisms of neural plasticity.

UNIT-V

Feedback System and Brain Disorders: Endocrine systems; feeding behaviour, Stress, Addiction, Depression, Schizophrenia, Alzheimer's, Huntington's disease, Parkinson's disease.

Textbooks:

1. Principles of Neural Science, 6th Edition (2021) Eric R. Kandel, James Harris Schwartz, Thomas M. Jessell, McGraw Hill.
2. Principles of Cognitive Neuroscience, 2nd Edition (2013) Dale Purves, Roberto Cabeza, Scott A. Huettel, Kevin S. LaBar, Michael L. Platt, and Marty G. Woldorff. Sinauer Associates, Inc.
3. Mark Bear, Brian Connors, and Michael Paradiso (2007) Neuroscience: Exploring the Brain. 3rd ed. Baltimore: Lippincott, Williams & Wilkins.