CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
Kokapet (Village), Gandipet, Hyderabad, Telangana-500075. www.cbit.ac.in

ISO Certified 9001:2015

COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 43 years

SCHEME OF INSTRUCTION AND SYLLABI

of

B.TECH V to VIII SEMESTERS

of

FOUR YEAR DEGREE COURSE

in

B.Tech BIOTECHNOLOGY

(AICTE Model Curriculum with effect from AY 2020-21)

R-20 Regulation

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution) Affiliated to Osmania University
Kokapet Village, Gandipet Mandal, Hyderabad –500075. Telangana
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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology
Scheme of Instructions of V Semester of B. Tech Bio-Technology
as per AICTE Model Curriculum 2022-23
B. Tech (Bio-Technology)

SEMESTER V

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	20BTC18	Fluid Mechanics and Heat Transfer	3	-	-	3	40	60	3
2	20BTC19	Genetic Engineering and rDNA Technology	3	-	-	3	40	60	3
3	20BTC20	Plant Biotechnology	3	-	-	3	40	60	3
4	20MTC24	Biostatistics	3	-	-	3	40	60	3
5	20BTC21	Introduction to Anatomy and Physiology of Humans	3	-	-	3	40	60	3
6		**Open Elective-I**	3	-	-	3	40	60	3
7	20EGM02	Indian Traditional knowledge	2	-	-	2	-	50	Non-credit
PRACTICALS									
8	20BTC22	Fluid Mechanics and Heat Transfer Lab	-	-	2	3	50	50	1
9	20BTC23	Genetic Engineering Lab	-	-	2	3	50	50	1
10	20BTC24	Plant Biotechnology Lab	-	-	2	3	50	50	1
11	20BTI02	Industrial / Rural Internship -II	3-4 weeks/ 90 hours			-	-	50	2
Total			**20**	**-**	**6**				**23**
Clock Hours Per Week – 26									

L: Lecture T: Tutorial P: Practical

CIE – Continuous Internal Evaluation SEE – Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology
Scheme of Instructions of VI Semester of B. Tech Bio-Technology
as per AICTE Model Curriculum 2022-23
B.Tech (Bio-Technology)

SEMESTER VI

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	20BTC25	Bioseparation Engineering	3	-	-	3	40	60	3
2	20BTC26	Bioinformatics and Computational Biology	3	-	-	3	40	60	3
3	20MBC01	Engineering Economics and Accountancy	3	-	-	3	40	60	3
4	20BTC27	Animal Biotechnology	3	-	-	3	40	60	3
5	20BTC28	Mass transfer Operations	3	-	-	3	40	60	3
6		**Professional Elective – II**	3	-	-	3	40	60	3
	PRACTICALS								
7	20BTC29	Bioseparation Engineering Lab	-	-	2	3	50	50	1
8	20BTC30	Bioinformatics and Computational Biology Lab	-	-	2	3	50	50	1
9	20BTC31	Animal Biotechnology Lab	-	-	2	3	50	50	1
10	20EGCO3	Employability Skills	-	-	2	3	50	50	1
11	20BTC32	Mini Project	-	-	2	-	50	-	1
Total			**18**	**0**	**10**				**23**
Clock Hours Per Week – 28									

L: Lecture **T: Tutorial** **P: Practical**

CIE – Continuous Internal Evaluation **SEE – Semester End Examination**

Professional Elective-II (Medical Biotechnology)	
20BT E06	Virology
20BT E07	Medical Biotechnology
20BT E08	Pharmaceutical Biotechnology
20BT E09	Cancer biology

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology

Scheme of Instructions of VII Semester of B. Tech Bio-Technology

as per AICTE Model Curriculum 2022-23

B.Tech (Bio-Technology)

SEMESTER VII

S. No.	CourseCode	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Durationof SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1		**Professional Elective - III**	3	-	-	3	40	60	3
2		**Professional Elective - IV**	3	-	-	3	40	60	3
3		**Professional Elective - V**	3	-	-	3	40	60	3
4		**Open Elective – II**	3	-	-	3	40	60	3
5	20EGMO4	Gender sensitization	2	-	-	2	-	50	Non-Credit
PRACTICALS									
6	20BTC33	Project Part-I	-	-	4	-	50	-	2
7	20BTI03	Internship	4-6weeks/ 135hours			-	-	50	3
Total			**14**	**0**	**4**				**17**
Clock Hours Per Week – 18									

L: Lecture T: Tutorial P: Practical

CIE – Continuous Internal Evaluation SEE - Semester End Examination

Professional Elective–III (Plant and Animal Biotechnology)	
20BT E10	Tissue Engineering
20BT E11	Genome Editing
20BT E12	Photochemical and Herbal Products
20BT E13	Developmental Biology

Professional Elective–IV (Industrial applications of Biotechnology)	
20BT E14	Food Biotechnology
20BT E15	Nanobiotechnology
20BT E16	Good Manufacturing Laboratory Practice
20BT E17	Regulatory Affairs and Clinical Trials

Professional Elective–V (Computational Biology)	
20BT E18	Rational Drug Discovery
20BT E19	Molecular Modeling and drug design
20BT E20	Structural Biology
20BT E21	Genomics and Proteomics

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology
Scheme of Instructions of VIII Semester of B. Tech Bio-Technology
as per AICTE Model Curriculum 2022-23
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		**Professional Elective-VI**	3	-	-	3	40	60	3
2		**Open Elective –III**	3	-	-	3	40	60	3
PRACTICALS									
3	20BTC34	Technical Seminar	-	-	2	-	50	-	1
4	20BTC35	Project Part-II	4-6 weeks of industry Internship (180hours)/ 12hours			-	100	100	4
		Total	**6**	**0**	**14**				**11**
Clock Hours Per Week –20									

L: Lecture T: Tutorial P: Practical

CIE – Continuous Internal Evaluation SEE - Semester End Examination

Professional elective-VI (Advanced applications of Biotechnology)	
20BT E22	Immunodiagnostics
20BT E23	Biomaterials
20BT E24	Metabolic Engineering
20BT E25	Bio similar Technology

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology
Scheme of Instructions of V Semester of B. Tech Bio-Technology
as per AICTE Model Curriculum 2022-23
B. Tech (Bio-Technology)

SEMESTER V

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	20BTC18	Fluid Mechanics and Heat Transfer	3	-	-	3	40	60	3
2	20BTC19	Genetic Engineering and rDNA Technology	3	-	-	3	40	60	3
3	20BTC20	Plant Biotechnology	3	-	-	3	40	60	3
4	20MTC24	Biostatistics	3	-	-	3	40	60	3
5	20BTC21	Introduction to Anatomy and Physiology of Humans	3	-	-	3	40	60	3
6		**Open Elective-I**	3	-	-	3	40	60	3
7	20EGM02	Indian Traditional knowledge	2	-	-	2	-	50	Non-credit
PRACTICALS									
8	20BTC22	Fluid Mechanics and Heat Transfer Lab	-	-	2	3	50	50	1
9	20BTC23	Genetic Engineering Lab	-	-	2	3	50	50	1
10	20BTC24	Plant Biotechnology Lab	-	-	2	3	50	50	1
11	20BTI02	Industrial / Rural Internship -II	3-4 weeks/ 90 hours				-	50	2
Total			**20**	**-**	**6**				**23**
Clock Hours Per Week – 26									

L: Lecture T: Tutorial P: Practical

CIE – Continuous Internal Evaluation SEE – Semester End Examination

FLUID MECHANICS AND HEAT TRANSFER

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

Course Objectives:

1. This course aims at providing knowledge on basic concepts in flow of fluids, flow field, flow past immersed bodies.
2. The course is designed to give an understanding on measurement of viscosity, flow measuring devices.
3. The course also deals with basic concepts in heat transfer, evaporation and condensation.

Course Outcomes:

At the end of the course students will be able to

1. Measure the viscosity of different fluids in bio processing.
2. Derive a relation between pressure drop and viscosity.
3. Compare and contrast the merits and demerits of different flow measuring devices.
4. Calculate the rate of heat transfer through various geometries.
5. Calculate the overall heat transfer coefficient in different evaporators and condensers.

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	PSO1	PSO2
CO1	2	2	0	1	2	0	2	0	0	0	0	1	3	3
CO2	2	1	0	1	0	0	0	0	0	0	0	1	3	3
CO3	2	2	0	1	2	2	2	0	0	0	0	1	3	3
CO4	2	1	0	1	2	2	2	0	0	1	0	3	3	3
CO5	2	1	1	1	2	2	2	0	0	1	0	3	3	3

UNIT-I

Basic Concepts in Flow of Fluids: Introduction, Nature of fluid, Rheology of fluids -Newton's law of viscosity; Concept of Newtonian and non-Newtonian fluids-Different types of non-Newtonian fluids with examples in bioprocessing; Measurement of viscosity using impeller viscometer, plate and cone viscometer, coaxial cylinder viscometer etc.

UNIT-II

Flow Field: Friction losses in laminar flow through a circular tube (Hagen-Poiseuille equation), Friction losses in turbulent flow (Fanning equation), Pumping of fluids flow through pipes, average velocity, flow regimes, boundary layer concept. Laminar and turbulent flow – characterization by Reynold's number, pressure drop due to skin friction and form friction, friction factor chart, Hagen - Poiseuille equation.

UNIT-III

Flow Past Immersed Bodies: Definition of drag and drag coefficient; Friction in flow through beds of solids(Ergun Equation); Brief introduction to flow of compressible fluids; Flow measuring and monitoring systems- valves, bends, elbows, prevention of leaks, mechanical seals, stuffing box; Flow measuring devices-manometers, orifice-meter, venturimeter and rotameter; Brief description of Pumps(principal of centrifugal and positive displacement pumps) and Blowers.

UNIT-IV

Basic Concepts in Heat Transfer: Introduction and Mechanisms of heat transfer; Conduction heat transfer (through slab, cylinder & Sphere); Conduction through solids in series, Forced convection heat transfer inside pipes, Introduction to radiation heat transfer, Chilling and freezing of food and Biological materials; Heat transfer correlations and calculations, basic heat exchange equipment.

UNIT-V

Basic Concepts in Evaporation and Condensation: Introduction, Types of evaporation equipment and operation methods; Overall heat transfer coefficients in evaporators; simple material balances; Calculation methods for single effect evaporators, Evaporation of biological materials; Types of condensation, numerical problems and condensation equipment.

Text books:

1. W L McCabe and JC Smith, "Unit operations in Chemical Engineering", 6th edition, cGraw Hill Intl. Ed, 2005.
2. Christie J. Geankoplis, "Transport Processes and Unit Operations", 3rd edition, Prentice Hall India Pvt. Ltd. 1993

Suggested Reading:

1. Kothandaraman CP, Rudramoorthy R, "Basic Fluid Mechanics", New Age International Publishers, New Delhi,1998.
2. Sachdeva RC, "Fundamentals of Engineering Heat and Mass Transfer", New Age International Publishers, New Delhi, 1996.
3. Pauline M. Doran, "Bioprocess Engineering Principles", Academic press, 1995.

GENETIC ENGINEERING AND rDNA TECHNOLOGY

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

Course Objectives:

1. To provide theoretical concepts, basic principles and tools used in rDNA technology.
2. To learn essential features and various vectors used in gene cloning and rDNA technology.
3. To learn the principle, methodology and applications of PCR and molecular markers.
4. To learn the range of cloning strategies those are employed to clone a DNA sequence.
5. To know how rDNA technology is used to produce proteins.

Course Outcomes:

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

1. Explain the basic principles and tools used in rDNA research starting from the isolation of nucleic acid, enzymes etc.
2. Compare various types of cloning vectors and expression vectors and their use in rDNA technology.
3. Discuss the principle, types and applications of PCR and molecular markers.
4. Describe the cloning strategies and sequencing methods.
5. Summarize the high-level expression of proteins in different hosts and production of recombinant proteins for the human welfare

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	PSO1	PSO2
CO1	1	0	0	0	1	0	0	0	0	1	0	1	1	2
CO2	1	1	0	0	1	0	0	0	0	1	0	1	1	2
CO3	1	1	0	0	1	2	0	0	0	1	0	1	1	2
CO4	1	1	0	0	1	2	0	0	0	1	0	1	1	2
CO5	1	1	1	0	1	2	1	3	0	1	0	1	1	2

UNIT-I

Isolation and Purification of DNA and Enzymes Used in Cloning: Isolation and purification of nucleic acids (genomic/plasmid DNA& RNA), quantification and storage of nucleic acids; Agarose gel electrophoresis; Enzymes used in genetic engineering - Restriction enzymes – Exo and Endo nucleases, Methylases, Polymerases, Ligase, Phosphatase, Kinase, DNase, RNase; Homopolymer tailing, Linkers & Adaptors; Restriction mapping; Blotting techniques – Southern, Northern and Western Blotting.

UNIT-II

Cloning Vehicles: Essential features of cloning vectors; Cloning vectors - Plasmid vectors - pBR 322, pUC 18/19; Phage vectors – λZAP, λEMBL4; M13 derived vectors –M13mp18; Phagemid- Blue script vectors; Cosmid- pJB8; Artificial chromosomes - BAC, YAC; Viral Vectors – SV40, Baculovirus, Retrovirus; Ti-Plasmid; Expression vectors - pET vectors.

UNIT-III

Polymerase Chain Reaction and Molecular Markers: PCR – Principle, Designing of primers, PCR Methodology, RT-PCR, Multiplex PCR, PCR for site-directed mutagenesis, Applications of PCR; Molecular marker – RFLP, RAPD, AFLP.

UNIT-IV

Cloning Strategies and DNA sequencing: Construction of cDNA and Genomic library; Gene transfer techniques: biological methods, chemical methods, physical or mechanical methods, Agrobacterium- mediated gene transfer in plants; Detection o clones with the desired gene; DNA Sequencing-Chain termination DNA Sequencing, Pyro sequencing, automation of DNA sequencing.

UNIT-V

Expression of Recombinant Proteins and Applications of rDNA Technology: High-level expression of proteins in different host systems in E. coli, yeast, insect and mammalian cells; Applications of rDNA Technology - Recombinant Insulin, Recombinant Factor VIII, Golden rice. Introduction to Gene therapy (Ex vivo & In vivo), case study of ADA as an example. Safety guidelines for rDNA research.

Text Books:

1. Brown, T.A., "Gene Cloning and DNA Analysis: An Introduction", 7th edition. Wiley Blackwell, 2016.
2. Primrose, S.B., Twyman, R.M., "Principles of Gene manipulation and Genomics", 7th edition, John Wiley & Sons,2013.
3. Glick, B.R., Patten, C.L, "Molecular Biotechnology: Principles and applications of Recombinant DNA", 6th edition, ASM Press,2022

Suggested Reading:

1. Desmond S T Nicholl, "An Introduction to Genetic Engineering", 3rd edition, Cambridge End Press, 2008.
2. Richard J. Reece, "Analysis of Genes and Genomes", Wiley, 2004.

PLANT BIOTECHNOLOGY

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

Course Objectives: The course aims to

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 the production of secondary metabolites in vitro using plant cell and tissue culture.
4. To understand the methods of gene transfer in plants for the 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 the 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 a commercial scale.
4. Analyze the appropriate vectors and gene transfer methods for the production of Transgenics.
5. Outline the strategies for the production of transgenics for crop improvement and environmental concerns.

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	PSO1	PSO2
CO1	1	0	0	1	1	0	2	1	0	0	0	1	2	1
CO2	1	0	0	1	1	2	1	1	0	0	0	1	2	2
CO3	1	1	0	0	1	2	1	1	0	0	1	1	3	3
CO4	1	0	0	1	1	2	1	1	0	0	0	1	3	3
CO5	1	0	0	0	1	2	1	1	0	0	1	1	3	3

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; Genetic fidelity of plants raised through tissue culture; 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; 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. Marker-free transgenics and environmental, social and legal issues associated with transgenic plants.

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, and longer shelf life. Edible vaccines and Nutraceuticals; 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.

BIOSTASTICS
(For Bio-Technology only)

Instruction	3 L +1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 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. Use basic counting techniques to compute probability
2. Compute conditional probabilities using Bayes Theorem
3. Analyze the probability function using statistical averages
4. Distinguishing the data using different methods of hypothesis
5. Analyze the data using analysis of variance technique

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	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	2	2	1	-	2	-	-	-	-	-	-	1	1	-
CO4	2	2	1	-	2	-	-	-	-	-	-	1	1	-
CO5	2	2	1	-	-	-	-	-	-	-	-	1	1	-

UNIT-I

Basic 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.

UNIT-II

Probability: Classical approach- Axiomatic approach of probability, Basic theorems addition and product theorem, conditional probability, Baye's theorem.

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) Discrete Distributions- Binomial distribution, Poison distribution-their Expectation, variance, mgf, cgf Continuous distributions: Normal Distribution- mean, variance, m.g.f and c.g.f. Properties of Normal curve. Exponential Distribution, Expectation variance, m.g.f and c.g.f.

UNIT- IV

Inferencial Statistics: Parameter and Statistic, Tests of significance, tests of significance for large samples. Tests of significance for single proportion, and difference of proportions. Tests of significance for single mean and difference of means. Small sample test, t-test for single mean and differences of Means. F-test for equality of two population variances.

UNIT-V

Hypothesis Testing: Testing of many proportions-$\chi^2 -$ test independent of attributes-r x c-tables. Analysis of variance-CRD.

Text Books:

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

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.Kapoor,“Fundamentals of Mathematical Statistics: A Modern Approach”, tenth edition, Publishers: Sultan Chand & Sons,2005.

INTRODUCTION TO ANATOMY AND PHYSIOLOGY OF HUMANS

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

Course Objectives:

1. Student gets an overview of the human body tissues and endocrine system.
2. The various organs associated with skeletal, muscular, digestion and excretion is taught.
3. Heart structure and functioning is detailed, including the gaseous exchange occurring through the respiratory system.
4. Knowledge of Spinal cord, the associated nerves and the different sense organs are imparted.
5. Reproductive anatomy and physiology is explained.

Course Outcomes:

At the end of the course the students are able to

1. Outline the structure of Human body and explain the structure and function of endocrine glands
2. Discuss the anatomical structures and the physiological functions of Skeletal, Muscular and digestive systems.
3. Explain the anatomical structures and the physiological functions of excretory, circulatory and respiratory system.
4. Describe the anatomical structures and the physiological functions of nervous system and other sensory systems.
5. Discuss the anatomical structures and the physiological functions of reproductive system and physiology of blood

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	PSO1	PSO2
CO1	1	0	0	0	0	2	0	0	0	1	0	1	1	1
CO2	1	0	0	0	0	2	0	0	0	1	0	1	1	1
CO3	1	0	0	0	0	2	0	0	0	1	0	1	1	1
CO4	1	0	0	0	0	2	0	0	0	1	0	1	1	1
CO5	1	0	0	0	0	2	0	0	0	1	0	1	1	1

UNIT-I

Introduction to Anatomical Terms and Endocrine Glands: Definition of Anatomy and Physiology; Major types of Human tissues. Various systems of human body and their general roles; Homeostasis; Types of endocrine glands, Anatomy and physiological of pituitary, thyroid, pancreas.

UNIT-II

Anatomy and Physiology of Skeletal, Muscular and Digestive System: Structure and function of bones, Bone cells - osteoblasts, osteocytes, and osteoclasts; Structure and function of muscles, Histology of Muscle Fibers, Sarcomere; Digestive system- organs and functions; role of liver and pancreas.

UNIT- III

Anatomy and Physiology of Excretory Systems, Circulatory and Respiratory Systems: Excretory system-kidney and urinary bladder, physiology of excretory system- urine formation; Circulatory system- anatomy of heart, heartbeat, blood circulation Anatomy of blood vessels- arteries and veins. Respiratory system-anatomy of lungs and mechanism of respiration.

UNIT-IV

Anatomy and Physiology of Nervous System and Other Sensory Systems: Nervous system- peripheral and autonomous nervous system; Spinal nerves and Cranial nerves, transmission of nerve impulse, reflex arc. Special senses- eye, ear, tongue and nose.

UNIT-V

Anatomy and Physiology of Reproductive System and Blood Physiology: Mechanism of blood oxygenation, Blood pressure recording and regulating techniques, Reproductive system- male and female reproductive organs and physiology. Menstrual cycle

Text Books:

1. Cinnamon VanPutte, Jennifer Regan, Andrew Russo, Rod Seeley Trent Stephens, Philip Tate "Seeley's Anatomy and Physiology" 12th edition, McGraw Hill education
2. Elaine N. Marieb "Essentials of Human Anatomy and Physiology", 8th Edition, Pearson Education, New Delhi 2006

Suggested Reading:

1. Eric Widmaier, Hershel Raff, Kevin "Vander's Human Physiology: The Mechanisms of Body Function" McGraw-Hill Science/Engineering/Math; 13th edition2013.
2. Anthony A. Goodman – "Understanding the Human Body_ An Introduction to Anatomy and Physiology"-The Teaching Company (2004)

20EG M02 **With effect from the Academic year 2022-23**

INDIAN TRADITIONAL KNOWLEDGE

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	No credit

Prerequisite: Knowledge on Indian Culture

Course Objectives:

1. To get a knowledge in Indian Culture
2. To Know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India

Course Outcomes: After completion of this course, students will be able to:

1. Understand philosophy of Indian culture
2. Distinguish the Indian languages and literature
3. Learn the philosophy of ancient, medieval and modern India
4. Acquire the information about the fine arts in India
5. Know the contribution of scientists of different eras.

UNIT-I

Culture and Civilization: Culture, civilization and heritage, general characteristics of culture, importance of culture in human life, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian cuisine, Martial arts

UNIT-II

Education System: Education in ancient, medieval and modern India, aims of education, subjects, Languages, Science and Scientists of ancient, medieval and modern India

UNIT-III

Linguistic Wealth: Indian Languages and Literature: the role of Sanskrit, Paleography, Significance of scriptures to current society, Indian semantics and lexicography, Bhakti literature, Darsanas

UNIT-IV

Art, Technology & Engineering: Sculpture, Painting and Handicrafts, Indian Music, Dance Drama and Theatre, Introduction to Mayamatam, Iron and steel technology, Use of metals in medicinal preparations

UNIT-V

Science and Logic: Helio-centic system, Sulbasutras, Katapayadi, Hindu calendar, 6 pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka – Induction &Deduction, Ayurvedic biology, Definition of health

Text Books:

1. Kapil Kapoor, **Text and Interpretation: The Indian Tradition,** ISBN: 81246033375, 2005
2. Samskrita Bharati, **Science in Samskrit**, ISBN-13: 978-8187276333, 2007
3. Satya Prakash, **Founders of sciences in Ancient Indi**a, GovindramHasanand, ISBN-10: 8170770009, 1989
4. Brajendranath Seal, **The Positive Sciences of the Ancient Hindus**, MotilalBanarasidass, ISBN-10: 8120809254, 1915
5. KanchaIlaiah, Turning the Pot, Tilling the Land: Dignity of Labour in Our Times

Suggested Readings:

1. Swami Vivekananda, Caste, Culture and Socialism, AdvaitaAshrama, Kolkata ISBN-9788175050280
2. Swami Lokeswarananda, Religion and Culture, AdvaitaAshrama, Kolkata ISBN-9788185843384
3. Kapil Kapoor,Language, Linguistics and Literature: The Indian Perspective, ISBN-10: 8171880649, 1994.
4. Karan Singh, A Treasury of Indian Wisdom: An Anthology of Spiritual Learn,ISBN: 978-0143426158, 2016
5. Swami Vivekananda, The East and the West, AdvaitaAshrama, Kolkata 9788185301860
6. Srivastava R.N., Studies in Languages and Linguistics, Kalinga Publications ISBN-13: 978-8185163475
7. SubhashKak and T.R.N. Rao, Computation in Ancient India, Mount Meru Publishing ISBN-1988207126
8. R.N Misra, Outlines of Indian Arts Architecture, Painting, Sculpture, Dance and Drama, IIAS, Shimla & Aryan Books International, ISBN 8173055149
9. Examinations in ancient India, Arya Book Depot, 1993
10. M. Hiriyanna, Essentials of Indian Philosophy, Motilal Banarsi dass Publishers, ISBN-13: 978-8120810990, 2014
11. Ravi Prakash Arya, Engineering and Technology in Ancient India, Indian Foundation for Vedic Science, ISBN-10: 1947593072020
12. Shashi Tharoor, The Hindu Way
13. Amartya Sen, Argumentative Indian

SWAYAM/Nptel:

1. History of Indian Science and Technology - https://onlinecourses.swayam2.ac.in/arp20_ap35/preview
2. Introduction to Ancient Indian Technology – https://onlinecourses.nptel.ac.in/noc19_ae07/preview
3. Indian Culture & Heritage - https://onlinecourses.swayam2.ac.in/nos21_sc11/preview
4. Language and Society - https://nptel.ac.in/courses/109/106/109106091/
5. Science, Technology & Society - https://nptel.ac.in/courses/109/103/109103024/
6. Introduction to Indian Philosophy - https://nptel.ac.in/courses/109/106/109106059/
7. Introduction to Indian Art - An appreciation - https://onlinecourses.nptel.ac.in/noc20_hs09/preview

FLUID MECHANICS AND HEAT TRANSFER LAB

Instruction	2P Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. This lab course is designed to understand the mechanics of fluid flow, analysis of various processes viz., Flow measuring devices (Venturimeter, Mouthpiece, and Triangular notch.) and heat exchangers.

Course Outcomes:

At the end of the course the students are able to

1. Calculate the coefficient of discharge of different flow measuring devices and Reynold's Number based on the distinction between the types of flow.
2. Determine the friction losses in pipe fittings & verify Bernoulli's Theorem.
3. Predict the Thermal conductivity of homogeneous wall insulating powder under steady stat e conditions.
4. Determine the heat transfer coefficient in Natural and Forced convection using PIN FIN apparatus.
5. Predict the emissivity of a non -black surface.
6. Calculate the overall heat transfer coefficient for parallel flow and counter flow in a Double pipe heat exchanger.

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	PSO1	PSO2
CO1	2	1	1	2	2	0	1	0	0	2	0	3	3	3
CO2	2	1	1	2	2	2	1	0	0	2	0	3	2	3
CO3	2	1	1	2	1	0	0	0	0	2	0	2	2	1
CO4	2	1	1	2	1	2	1	0	0	2	0	3	2	1
CO5	2	1	1	2	1	2	1	0	0	2	0	3	3	3
CO6	2	1	1	2	2	2	1	0	0	2	0	3	3	2

Atleast 10 experiments to be conducted from the following list of experiments.

LIST OF EXPERIMENTS

1. Determination of discharge coefficient for orifice meter and venturimeter and their variation with Reynolds number.(CO1)
2. Determination of discharge coefficient for Mouth piece for constant head method and time of fall method(CO 1)
3. Determination of weir meter constant K for v-notch and rectangular notch (CO 1)
4. Calibration of rotameter and study of variation of flow rate with tube to float diameter (CO 1)
5. Determination of viscosity of different fluids (CO 1)
6. Determination of friction losses in pipe fittings (CO 2)
7. Determination of Reynold's Number based on the types of flow. (CO 2)
8. Verification of Bernoulli's Theorem (CO 2)
9. Determination of Thermal conductivity of homogeneous wall insulating powder under steady state conditions. (CO 3)
10. Determination of heat transfer coefficient in Natural convection.(CO 4)
11. Determination of heat transfer coefficient in forced convection.(CO 4)
12. Determination of emissivity of non black surface.(CO 5)
13. Determination of Overall heat transfer coefficient for parallel flow in a double pipe heat exchanger.(CO 6)
14. Determination of Overall heat transfer coefficient for counter flow in a double pipe heat exchanger.(CO 6)

Suggested Reading:

1. WLMcCabeandJCSmith,"UnitoperationsinChemicalEngineering",6thedition,McGrawHillIntl.Ed, 2005

20BT C23 **With effect from the Academic year 2022-23**

GENETIC ENGINEERING LAB

Instruction	2P Hoursper week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To know the isolation and analysis of DNA.
2. To know the incision of DNA by using the restriction endonucleases.
3. To learn the amplification DNA by polymerase chain reaction
4. To understand the cloning strategies of DNA.
5. To know about DNA sequencing and expression of recombinant protein from transformed bacterial cultures.

Course Outcomes:

At the end of the course the students are able to

1. Demonstrate the isolation and visualization of nucleic acids. (Expt. 1,2,3)
2. Characterize the DNA by restriction digestion and restriction mapping. (Expt. 4,5)
3. Plan different steps involved in cloning strategies of DNA (Expt. 6,7,8,9,10)
4. Perform the polymerase chain reaction. (Expt. 11)
5. Analyze the DNA Sequencing and recombinant protein by using SDS PAGE (Expt. 12,13)

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	PSO1	PSO2
CO1	1	1	0	1	1	2	1	2	2	1	0	2	2	2
CO2	1	1	0	1	1	2	1	2	2	1	0	2	2	2
CO3	1	1	0	1	1	2	1	2	2	1	0	2	2	2
CO4	1	1	0	1	1	2	1	2	2	1	0	2	2	2
CO5	1	1	0	1	1	2	1	2	2	1	0	2	2	2

Atleast 10 experiments to be conducted from the following list of experiments.

LIST OF EXPERIMENTS

1. Isolation of genomic DNA
2. Isolation of plasmid DNA
3. Visualization of Genomic and Plasmid DNA on Agarose gels
4. Restriction digestion
5. Restriction mapping(Structured Experiment)
6. Gel elution.
7. DNA ligation.
8. Preparation of competent cells.
9. Genetic transformation and screening for recombinant bacterial cells.
10. Blotting techniques- southern blotting.
11. Amplification of DNA fragments by Polymerase Chain Reaction (PCR).
12. DNA sequencing- Sanger's Method
13. Analysis of Recombinant Proteins using SDS-PAGE (Open ended experiment)

Suggested Reading:

1. Green MR and Sambrook J, "Molecular Cloning-A laboratory manual", Vol I, II and III, Cold spring \ Harbor Laboratory Press, 2012

PLANT BIOTECHNOLOGY LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. The students should be able to understand explicitly the concepts of Plant 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.(Expt 1,2)
2. Execute the protocols for Surface sterilization, Organ culture, and Callus induction using various explants.(Expt 3,4,5,10)
3. Develop in vitro techniques for micropropagation of meristem /nodal explants of horticulture and medicinal plants.(Expt. 6,7,8,9)
4. Demonstrate the Protoplast isolation from various plant tissues using enzymatic methods. (Exp.11)
5. Develop a system for genetic transformation in plants using Agrobacterium strains (Expt 12)

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	PSO1	PSO2
CO1	1	-	-	-	1	-	-	-	-	-	-	1	-	2
CO2	1	1	-	1	1	-	-	-	-	-	-	1	-	2
CO3	1	1	-	1	1		2	-	-	-	-	-	2	3
CO4	1	1	-	-	-	2	-	-	-	-	-	1	-	2
CO5	1	1	-	-	1	-	2	1	-	1	-	2	2	3

Atleast 10 experiments to be conducted from the following list of experiments.

LIST OF EXPERIMENTS

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

Text Books:

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.

INDUSTRIAL / RURAL INTERNSHIP-II

Instruction	3-4 week
Duration of Internship	90 Hours
SEE	50 Marks
Credits	2

Schedule for the internship schedules will be given in a flexible manner according to the availability opportunities. The minimum and maximum requirement regarding Internship duration and credits is given in Table-1

Table 1: Internship Frame work

Schedule	Activities	Duration	Credits
Summer / Winter vacation (4^{th}/ 5^{th} Semester)	Industrial / Govt. /NGO / MSME/ Rural Internship/ Innovation/ Entrepreneurship/ NSQF level 3, 4,5	3-4 weeks or 90 hrs	2 Credits

INTERNSHIP GUIDELINES:

a) Student's Diary/Daily Log: The students should record the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. Students shall be ready to show the diary to the Industry supervisor or the Faculty Mentor at any point of time. Failing to produce the same, Intern may be debarred for the remaining period of his/her internship. Daily diary needs to be submitted to Faculty Mentor at the end of Internship along with the attendance record and an evaluation sheet duly signed and stamped by the industry. Daily diary is evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary/log
- Adequacy & quality of information recorded
- Drawing, sketches, and data recorded.
- Thought process and recording techniques used
- Organization of the information

b) Internship Report: At the end of the internship, each student should prepare a comprehensive report to indicate what he/she observed and learned in the training/internship period. It should be signed by the internship supervisor. The report will be evaluated by the Industry Supervisor on the basis of the following criteria:

- Originality
- Adequacy and purposeful write-up
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience
- Practical applications, relationships with basic theory and concepts taught in the course

EVALUATION OF INTERNSHIP:

The industrial training/internship of the students will be evaluated in three stages:

a) Evaluation by the Industry (in the range of 1 to 10 where 1-Unsatisfactory; 10-Excellent)
b) Evaluation by faculty supervisor on the basis of site visit(s) or periodic communication (15 marks)
c) Evaluation through seminar presentation/Viva-Voce at the Institute(This can be reflected through marks assigned by Faculty Mentor (25 marks))

Evaluation through Seminar presentation/Viva-Voce at the institute: Students will give a seminar based on his/her training report, before an Expert Committee constituted by the concerned department as per the norms of the institute. The evaluation will be based on the following criteria:

- Quality of content presented
- Proper planning for presentation
- Effectiveness of presentation
- Depth of knowledge and skills
- Attendance record, daily diary, departmental reports shall be analyzed along with the internship Report

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology
Scheme of Instructions of VI Semester of B. Tech Bio-Technology as per AICTE ModelCurriculum2022-23
B.Tech (Bio-Technology)

SEMESTER VI

S.No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Durati on of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
	THEORY								
1	20BTC25	Bioseparation Engineering	3	-	-	3	40	60	3
2	20BTC26	Bioinformatics and Computational Biology	3	-	-	3	40	60	3
3	20MBC01	Engineering Economics and Accountancy	3	-	-	3	40	60	3
4	20BTC27	Animal Biotechnology	3	-	-	3	40	60	3
5	20BTC28	Mass transfer Operations	3	-	-	3	40	60	3
6		**Professional Elective – II**	3	-	-	3	40	60	3
	PRACTICALS								
7	20BTC29	Bioseparation Engineering Lab	-	-	2	3	50	50	1
8	20BTC30	Bioinformatics and Computational Biology Lab	-	-	2	3	50	50	1
9	20BTC31	Animal Biotechnology Lab	-	-	2	3	50	50	1
10	20EGCO3	Employability Skills	-	-	2	3	50	50	1
11	20BTC32	Mini Project	-	-	1				1
Total			**18**	**0**	**9**				**23**
Clock Hours Per Week – 27									

L: Lecture T: Tutorial P: Practical

CIE – Continuous Internal Evaluation SEE – Semester End Examination

Professional Elective-II (Medical Biotechnology stream)	
20BT E06	Virology
20BT E07	Medical Biotechnology
20BT E08	Pharmaceutical Biotechnology
20BT E09	Cancer biology

20BT C25 **With effect from the Academic year 2022-23**

BIOSEPARATION ENGINEERING

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

Course Outcomes:

At the end of the course the students are able to

1. Outline the key aspects of downstream processing of biotechnological process and develop process design for bio products.
2. Distinguish the various techniques of cell disruption and unit operations for separation of bio products.
3. Compare and contrast various membrane separation processes.
4. Interpret application of various chromatographic process for separation of bio products.
5. Analyze various product finishing techniques and case studies of important bio products

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	PSO1	PSO2
CO1	2	2	2	3	1	0	3	0	3	0	0	2	3	3
CO2	2	2	2	3	1	0	3	0	3	0	0	2	3	3
CO3	2	2	2	3	1	0	3	0	3	0	0	2	3	3
CO4	2	2	2	3	1	0	3	0	3	0	0	2	3	3
CO5	2	2	2	3	1	0	3	0	3	0	0	2	3	3

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; Case study from a recent literature: Process design criteria for bio products and 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: GC and HPLC; 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. Noorala bettu Krishna Prasad, Downstream Process Technology by PHI publications.

BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

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

Course Objectives:

1. To provide elementary knowledge in bioinformatics and biological information available to a biologist on the web and learn how to use these resources on their own.
2. To learn the fundamentals of biological databases and sequence alignment.
3. To learn methods for determining the order of the nucleotide and predicting gene.
4. To aid in understanding structural bioinformatics and the Human genome project.
5. To understand the evolutionary relationship among organisms.

Course Outcomes:

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

1. Explain various types of biological databases used for the retrieval and analysis of the information
2. Identify the methods used for sequence alignment and construction of the phylogenetic tree
3. Discuss genome sequencing and gene prediction tools.
4. Describe biochemical databases and protein structure prediction tools
5. Demonstrate docking methods for Identification of lead molecules

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	PSO1	PSO2
CO1	1	0	0	0	0	0	1	0	0	1	0	1	1	1
CO2	1	1	0	1	1	0	1	0	0	1	0	1	1	1
CO3	1	0	0	1	1	0	1	0	0	1	0	1	1	1
CO4	1	0	0	1	1	0	1	0	0	1	0	1	1	1
CO5	1	1	0	1	1	0	2	0	0	1	0	1	1	1

UNIT-I

Introduction to Bioinformatics and Biological Databases: Bioinformatics - Scope, and application of Bioinformatics; Biological databases - types of biological database, file formats for biological sequence (NCBI, EMBL, SWISSPROT, FASTA); Information retrieval from biological Databases. Sequence database search- FASTA, BLAST, various versions of BLAST and FASTA; Amino acid substitution matrices - PAM and BLOSUM.

UNIT-II

Sequence Alignments and Phylogenetic Analysis: Sequence Alignment - Local, Global alignment; Methods of pair-wise sequence alignment; Multiple Sequence alignment methods. Concept of evolutionary trees; Methods of Phylogenetic analysis, Tree Evaluation, Problems in Phylogenetic Analysis, Automated Tools for Phylogenetic Analysis.

UNIT-III

Genome Sequencing and Gene Prediction: DNA sequencing, Genome Mapping; Genome sequencing, cDNA sequencing, Genome Sequence Assembly and tools; Genome Annotation; Human genome project; Basis of Gene Prediction, Gene Prediction Methods in Microbial genomes and eukaryotes, Other Gene Prediction Tools.

UNIT-IV

Structural Bioinformatics and Biochemical Databases: Protein structure basics, protein structure classification, visualization and comparison, protein secondary structure prediction, and protein tertiary structure prediction; Introduction to Biochemical databases – KEGG, BRENDA, MMDB

UNIT-V

Molecular Docking: Methods of Docking – Flexible and Rigid Docking, Applications and limitations of docking, Docking algorithms – Genetic algorithm, QSAR overview and its significance in Docking,

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", 3rd edition, 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.

ENGINEERING ECONOMICS AND ACCOUNTANCY

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

Course Objectives: The Objectives of the Course are:

1. To demonstrate the importance of Managerial Economics in Decision Making.
2. To explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3. To understand the importance of Project Evaluation in achieving a firm's Objective.

Course Outcomes: After Completion of the Course, Student will be able to:

1. Apply fundamental knowledge of Managerial Economics concepts and tools.
2. Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
3. Understand Production and Cost relationships to make best use of resources available.
4. Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
5. Evaluate Capital and Capital Budgeting decision based on any technique.

UNIT-I

Introduction to Managerial Economics: Introduction to Economics and its evolution - Managerial Economics - its Nature and Scope, Importance; Relationship with other Subjects. Its usefulness to Engineers; Basic concepts of Managerial economics - Incremental, Time perspective, Discounting Principle, Opportunity Cost, Equimarginal Principle, Contribution, Negotiation Principle.

UNIT-II

Demand and Supply Analysis: Demand Analysis - Concept of Demand, Determinants, Law of demand - Assumptions and Exceptions; Elasticity of demand - Price, Income and Cross elasticity - simple numerical problems; Concept of Supply - Determinants of Supply, Law of Supply; Demand Forecasting - Methods.

UNIT-III

Production and Cost Analysis: Theory of Production - Production function - Isoquants and Isocosts, MRTS, Input-Output Relations; Laws of returns; Internal and External Economies of Scale.Cost Analysis: Cost concepts – Types of Costs, Cost-Output Relationship – Short Run and Long Run; Market structures – Types of Competition, Features, Price Output Determination under Perfect Competition, Monopoly and Monopolistic Competition; Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.

UNIT-IV

Accountancy: Book-keeping, Principles and Significance of Double Entry Book-Keeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments. Ratio Analysis.

UNIT-V

Capital and Capital Budgeting: Capital and its Significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance. Capital Budgeting, Methods: Traditional and Discounted Cash Flow Methods - Numerical problems.

Text Books:

1. Mehta P.L.,"Managerial Economics: Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2016.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 11th Edition, 2013.

Suggested Readings:

1. Panday I.M. "Financial Management", 11th edition, VikasPublishing House, 2015.
2. Varshney and K L Maheswari, Managerial Economics, Sultan Chand, 2014.
3. M. Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of a.India Pvt Ltd, 2007.
4. A. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2013.

ANIMAL BIOTECHNOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 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 the 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 the generation of transgenic animals and their 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 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.

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	PSO1	PSO2
CO1	1	1		2	1	2	1	2		2	1	3	3	3
CO2	1	1	1	2	1	2	1	1		2	1	3	2	3
CO3	1		1	3	1	3	1	3		2	1	3	3	2
CO4	1			2	1	3	1	2		2	1	3	2	3
CO5	2	1	1	3	1	3	2	3	1	2	1	3	3	3

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.

20BT C28 **With effect from the Academic year 2022-23**

MASS TRANSFER OPERATIONS

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

Course Objectives:

1. To provide the students with knowledge about various unit operations such as absorption, distillation, extraction, leaching.
2. To give insight about various membrane separation processes such as adsorption, Ion-exchange, dialysis and the application of these unit operations in commercial aspects of biotechnology.

Course Outcomes:

At the end of the course the students are able to

1. Predict the rate of molecular diffusion in solids, liquids and gases.
2. Determine the number of trays needed for separation by Distillation.
3. Determine the number of trays needed for separation by Extraction and Leaching.
4. Calculate the rate and time of drying in constant head and falling rate methods.
5. Write the principles and application of membrane separation processes and understand the types of adsorbents.

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	PSO1	PSO2
CO1	2	2	1	2	2	0	2	0	0	2	0	3	3	3
CO2	2	2	1	2	2	3	2	0	0	2	1	3	2	3
CO3	2	2	1	2	2	3	2	0	0	2	1	2	2	1
CO4	2	2	1	2	2	3	2	0	0	2	0	3	2	1
CO5	2	2	1	2	2	3	2	0	0	2	0	3	2	3

UNIT-I

Principles of Mass Transfer: Introduction to Mass transfer and Diffusion, Molecular diffusion in Gases, Molecular diffusion in Liquids, Molecular diffusion in Biological solutions and gels, Molecular diffusion in Solids, Inter phase mass transfer and Mass transfer coefficients. **Gas-Liquid operations:** Equilibrium relations between phases, Mass transfer between phases, Choice of solvent for absorption, Single stage and multi stage co current and counter current operations, Estimation of Mass transfer coefficient, packed columns and plate columns.

UNIT-II

Principles of VLE for Binary System: Phase rule and Raoul's law, Boiling point diagrams and x-y plots, Relative volatility, Flash distillation, Differential distillation, Simple steam distillation. Distillation with reflux and McCabe - Thiele method. Special Cases for rectification using McCabe - Thiele; Stripping column distillation, Enriching Column distillation, Rectification with direct steam injection, Rectification with single side stream.

UNIT-III

Liquid-Liquid Extraction and Leaching: Introduction to Extraction process: Equilibrium relations in extraction, Analytical and graphical solutions for single and multistage operations co-current and counter current operations without reflux. Equipment for liquid-liquid extraction: mixer settlers for extraction, Plate and Agitated Tower Contactors for Extraction, Packed and spray Extraction towers. Introduction to leaching process: Equilibrium diagrams for leaching, analytical and graphical solutions for single and multi-stage counter current operations.

UNIT-IV

Basic Concepts in Drying of Process Materials: Methods of drying, Equipment for drying; Free moisture content of materials; Concept of bound and unbound moisture content of biological materials; Rate of drying curves; Calculation methods for constant-rate & falling rate drying methods; Freeze drying of biological materials.

UNIT-V

Adsorption And Membrane Separation Process: Theory of adsorption, Industrial adsorbents, Adsorption equilibria, Frendlich equation-single and multiple operations- processing variables and adsorption cycles; Introduction and Types of Membrane separation process: Principles of ion exchange. Dialysis, Gas permeation membrane processes, types of membranes and permeability's for separation of gases, Introduction to types of flow in gas permeation.

Text Books:

1. C J Geankoplis, "Transport Processes in chemical Operations", 4th edition, Prentice Hall India, 2004
2. Robert E Treybal, "Mass Transfer operations", 3rd edition. McGraw-Hill, 1981
3. W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", 7th Edn., McGraw Hill Book Co., New York, 2004.

Suggested Reading:

1. Jaime Benitez, "Principles and Modern Applications of Mass Transfer Operations", 2nd edition, 2009.
2. J M Coulson and J F Richardson, "Chemical Engineering", Vol-II, 3rd edition, Pergamom Press.

VIROLOGY
(Professional Elective -II)

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

Course objectives:

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

1. To learn the morphology and genetics of viruses.
2. To recognize the procedures for cultivation of plant & animal viruses.
3. To be aware of the characterization of viruses.
4. To elaborate the detailed features of plant viruses and bacteriophages.
5. To earn the lifecycles of animal viruses and development of vaccines.

Course out comes:

By the end of the course the students are able to

1. Explain classification, morphology of viruses.
2. Compare the techniques for cultivation of plant & animal viruses.
3. Outline various characterization techniques for detection of viruses.
4. Illustrate the structural, functional and disease control measures of plant viruses.
5. Describe the classification, pathogenesis of animal viruses and therapeutic strategy for vaccine development.

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	PSO1	PSO2
CO1	1	2	1	2	2	3	3	2	0	2	1	2	3	3
CO2	1	1	1	2	2	0	2	2	0	2	0	2	3	3
CO3	1	1	2	2	2	3	2	2	0	1	0	2	3	3
CO4	1	1	1	2	2	3	2	1	0	1	0	2	3	3
CO5	1	2	2	2	3	3	3	2	0	2	1	2	3	3

UNIT-I

Introduction to Virology: Brief outline of discovery of Viruses; Properties of Viruses; Morphology of Viruses- Structure, Capsid Architecture, Envelopes and peplomers; Chemistry of Viruses- Viral Proteins, Genome- Structure and Types; Study of sub viral agents- Brief account on Diseases caused by Viroids- PSTV,Cadang- cadang; Prions-Scrape, Creutzfeld t-jakob; Satellite viruses.

UNIT-II

Cultivation of Viruses: General methods of cultivation of viruses- in embryonated eggs, cultivation of animal and plant viruses; cultivation of bacteriophages, Isolation and purification of viruses- plant viruses, animal viruses; Criteria of purity, Maintenance and preservation of infectivity.

UNIT-III

Characterization of viruses: Characterization of viruses-Electron microscopy, X-ray crystallography, sedimentation analysis. Enumeration of viruses By electron microscopy, plaqueassay,acid end point method, Haemagglutininassay; Detection of viruses-By serological characterization, detection of viral antigen, detection of viral nucleic acid; chemical determination, UltrastructureandlifecyclesofBacteriophages-Ml3,T4andlambda.

UNIT-IV

Plant Viruses: Taxonomy; Symptoms of diseases caused by plant viruses (Morphological, Physiological and Histological); Ultra structure and life cycles of TMV; transmission of plant viruses- Mechanical and biological (vector and non-vector); Basic control measures of plant diseases- vector and chemical control, bio pesticides with examples.

UNIT-V

Animal viruses: Taxonomy; Detailed structure and brief account on life cycles of RNA viruses- Polio, Influenza, Rotavirus, Corona viruses: Covid 19andHIV;Ultrastructureandbrief account on lifecycles of DNA viruses- Vaccina,SV40 and Hepatitis Virus; Viral vaccines-types and preparation of conventional vaccines.

Text Books:

1. Dimmock NJ and Primrose SB, "Introduction to Modern Virology", 4th edition, Blackwell Scientific Publications, 1994.
2. Matthews REF"Fundamentals of Plant Virology". Academic Press, San Diego, 1992.

Suggested Readings:

1. CarterJ and SaundersV "Virology: Principles and Applications" John Wiley and Sons ltd, 2007.
2. Morag C,TimburyM,Chrchill Livingstone, "Medical Virology", London,1994.

20BT E07 **With effect from the Academic year 2022-23**

MEDICAL BIOTECHNOLOGY
(Professional Elective -II)

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

Course Objectives:

1. To understand the scope and importance of medical biotechnology
2. To understand the differences between the normal cells and cancer cells and various diagnostic methods used in cancer detection.
3. To gain the in-depth knowledge about the clinical applications of stems cells & tissue engineering.
4. The course aims at providing knowledge about the working principles and types of advanced materials used in medical field.
5. To learn current molecular therapies and bio ethical issues.

Course Outcomes:

At the end of the course the students are able to

1. Outline the various diagnosis and treatment of Cancer.
2. Explain the concepts of Stem cell therapy and Tissue engineering.
3. Discuss the principle and applications of biomedical devices and molecular diagnostics.
4. Classify the molecular therapies and bioethical issues.
5. Classify the molecular therapies and bioethical issues.

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	PSO1	PSO2
CO1	1	0	1	1	2	0	1	2	0	1	0	3	3	3
CO2	1	1	2	2	2	2	1	3	0	2	0	3	3	3
CO3	1	1	1	1	2	3	1	3	0	2	0	2	3	3
CO4	1	1	1	2	2	0	1	0	0	2	0	1	3	3
CO5	1	0	0	2	2	3	0	3	0	2	0	2	3	3

UNIT-I

Introduction to Medical Biotechnology: Introduction, scope and importance of medical biotechnology; The genetic basis of the disease; chromosomal disorders; single gene disorders-modes of inheritance, Thalassemia,sicklecellanaemia,cysticfibrosis,Taysachsdisease,Fragile–X-syndrome;polygeneticdisorders;Alzheimersdisease, Type-1diabetisandmitochondrialdisorders (neurological disorders).

UNIT-II

Medical Oncology: Cancer types; Normal cells vs. cancer cells; cancer genetics; oncogenes and their proteins; tumor suppressor genes and their functions, diagnosis of cancer, Treatment of cancer; Radiation therapy, chemotherapy.

UNIT-III

Stem Cell Treatment and Tissue Engineering: Cellular therapy, stem cells- definition, types, properties and uses of stem cells; sources of embryonic and adult stem cells; Induced Pluripotent Stem cells, concept of tissue engineering; role of scaffolds;clinicalapplicationsofstemcells;stemcellbankingandethical issues.

UNIT-IV

Biomedical Instrumentation, Molecular Diagnostics and Biomarkers: Concepts in Biomaterials; principle, properties of Biomaterials and applications of different types of biomedical devices; pacemakers, drug coated stents, knee replacement implants, dental implants, prosthetics), molecular diagnostics by DNA approaches(Taq MAN approach, RT-PCR, Applications of biosensors in medicine. Cellular imaging, in vivo imaging of the biomarkers of the disease, epigenetic markers, fluid-based biomarkers, imaging-based biomarkers (PET, MRI).

UNIT-V

Molecular Therapeutics and Bioethical Issues: Types of molecular therapies; protein therapy by recombinant Monoclonal Antibodies, Enzymes (DNase-1,Alpha-1antitrypsin), Lactic acid bacteria by Leptin, antisense therapy, recombinant vaccines; Bioethical issues in IVF, surrogacy and cloning technologies.

Text Books:

1. JudithPongracz, MaryKeen, "MedicalBiotechnology", illustratededition, Elseiverhealthsciences, 2009.
2. BernardRGlick, CherylL.Patton, TerryL.Delovitch,"Medicalbiotechnology",1st edition,ASMpress, 2013.

Suggested Readings:

1. Truepenny, Emerys"ElementalMedicalGenetics", 14thedition, ChurchillLivingstone,2012.
2. R.J.B.King, Robins,"Cancerbiology",3rd edition,PrenticeHall, 2006.

PHARMACEUTICAL BIOTECHNOLOGY
(Professional Elective -II)

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

Course Objectives:

1. To understand the origin, scope, and importance of pharmaceutical biotechnology.
2. To learn ADME properties of drugs, pharmacokinetics, pharmacodynamics, and drug deliverysystems.
3. To understand the materials and formulations of pharmaceuticals.
4. To learn the collection, processing, and storage of blood and plasma substitutes
5. To gain knowledge about pharmaceutical products and their use in the treatment of infectiousdiseases.

Course Outcomes:

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

1. Summarize the fundamentals of biopharmaceuticals.
2. Explain the ADME properties of drugs, pharmacokinetics, pharmacodynamics, and drug deliverysystems.
3. Outline the different manufacturing procedures of drugs.
4. Discuss the blood and plasma substitutes.
5. Describe the therapeutic activity of drugs used for treating diseases

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	PSO1	PSO2
CO1	1	2	1	2	2	2	1		1	1	1	2	3	1
CO2	2	2	1	2	2	2	1		1	1	1	2	3	2
CO3	2	2	3	3	3	2	1		1	1	1	3	3	3
CO4	2	2	1	2	2	2	1		1	1	1	2	3	3
CO5	2	2	2	3	2	2	1		1	1	1	3	3	2

UNIT-I

Fundamentals of Biopharmaceuticals: Pharmaceutical Biotechnology: Definition, Scope, and Importance. Human protein replacements, Biosimilar (insulin analog), Therapeutic agents for human diseases: Tissue Plasminogen activator, Interferon, Recombinant vaccines, Clinical Trails and Regulations (Basic), History and development of Pharma covigilance.

UNIT-II

Biopharmaceutics and Pharmacokinetics: ADME properties- Physiochemical properties of Drug Absorption, Distribution, metabolism (Biotransformation), bioavailability, and Excretion. Pharmacokinetics and Pharmacodynamics. Basic considerations: Drug receptors, Drug interactions, Surgical supplies, Oral, Parenteral, Transdermal, Ophthalmic, Intravaginal, and Intrauterine Drug Delivery systems.

UNIT-III

The Drug Manufacturing Practices: Good manufacturing practices and facilities for drug production. Types of Tablets and capsules. Materials and Formulations for Manufacture of Tablets, Capsules. Excipients and its ideal properties, Parenteral solutions, Oral liquids, Emulsions, Ointments, Suppositories, Aerosols.

UNIT-IV

Blood and Plasma Substitutes: Collection, processing, and storage of whole human blood, concentrated human RBC, dried human plasma, Human plasma protein fraction, Dried human serum, Human fibrinogen, Human thrombin, Human Normal Immunoglobulin, Plasma substitutes- Ideal requirements, PVP, Dextran 40,controlofBloodproducts,Transfusionproducts, Blood and Plasma based bioproducts, Blood based and plasma-based Biomarkers.

UNIT-V

Pharmaceutical Products: Fundamentals of Therapeutic categories such as Analgesics, Antipyretic, Anti-inflammatory drugs, Anesthetics, Antacids, Alkaloids, Glycosides, Anti-neoclassic drugs, Biologicals (Immunizing agents and allergenic extracts), Anti-histamines, Electrolytes, and Diuretics, Chemotherapy of Tuberculosis and Urinary tract infections.

Text Books:

1. Purohit SS, Kakrani HN, and Saluja AK., "Pharmaceutical Biotechnology", Student Edition Jodhpur,2003.
2. Brahmankar, D.M., Sunil, B. Jaiswals - Biopharmaceutics & Pharmacokinetics a Treatise, 2nd edition, M.K. Jain Publication, Delhi,2009.
3. Cooper and Guns, "Pharmaceutics", CBS publishers, 1989.

Suggested Reading:

1. David B Troy and Paul Beringer, "Remington's: The Science and Practice of Pharmacy", Vol 1 and 2, Lippincott Williams & Wilkins Publications, 2006.
2. Tripathi, K.D. "Essentials of Medical pharmacology", Jaypee Brothers Medical Publishers 6th Edition, John Wiley, New

20BT E09 **With effect from the Academic year 2022-23**

CANCER BIOLOGY
(Professional Elective -II)

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

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	PSO1	PSO2
CO1	1	0	0	0	0	2	0	0	0	2	0	1	3	2
CO2	1	0	0	0	0	2	0	0	0	2	0	1	3	2
CO3	1	0	0	0	0	2	0	0	0	2	0	2	2	1
CO4	1	1	0	0	1	2	1	0	0	2	0	2	3	3
CO5	1	1	0	0	1	2	1	0	0	1	0	2	3	2

UNIT-I

Fundamentals of Cancer Biology: Introduction to cancer, origin and classification of different cancers, Hall marks of cancer, Cell cycle control, Regulation of the cell cycle by cyclins, cyclin-dependent kinases, cdk inhibitor. Two-Hit Hypothesis, Tumor suppressor genes. Case studies for carcinoma ex: breast cancer and stomach cancer, Diet and cancer.

UNIT-II

Principles of Carcinogenesis: Classical theory of Carcinogenesis, Types of Carcinogenesis, Chemical Carcinogenesis, Metabolism of Carcinogenesis, Laboratory chemicals induces 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: Retroviruses and Oncogenes, Activation of proto-oncogenes to oncogenes. Identification of Oncogenes, Growth factor and Growth factor receptors (RTK's) that are oncogenes, signalling pathways in cancer (MAPK, WNT pathway).

UNIT-IV

Cancer Metastasis and Diagnosis: Seed & Soil theory, heterogeneity of metastatic phenotype, Metastatic cascade, clinical significance of invasion: angiogenesis and EMT, Three-step theory of invasion (Basement Membrane disruption, role of Proteinases in tumor invasion and tumor cell locomotion), cancer stem cells. Diagnosis of cancers, Advances in Cancer detection (Biomarkers technology and nanotechnology).

UNIT-V

Principles of Cancer Therapy: Different forms therapy- conventional therapy-Chemotherapy, Radiation therapy and immunotherapy, Advances in Cancer therapy – personalized, targeted therapies and Thermo therapy. Classification of antineoplastic 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. Introduction to cell and Molecular biology of cancer, Franks and Teich, Oxford medical Publications,2002.
2. Introduction to Cancer Biology, Robin Hesketh, Cambridge University Press, 2012.
3. King, Roger J B, Robins, Mike W, "Cancer Biology", 3rdedition, Prentice Hall, USA. 2003.
4. Molecular Biology of Cancer. Lauren Pecorina, 4th edition. Oxford University Press – 2016

Suggested Reading:

1. Robert A. Weinberg, "The Biology of Cancer", 5th edition, Garland Science. 2013
2. Fiona Macdonald, Christopher Ford, Alan Casson, "Molecular Biology of Cancer", 2nd Edition, Taylor & Francis, 2004.Molecular biology of the cell. Bruce Alberts, 6th Edition
3. Textbook readings; primary literature; in-class discussion. The Molecular Biology of Cancer: A Bridge from Bench to Bedside. Stella Pelengaris, Mike Khan -2nd Edition - 2013

BIOSEPARATION ENGINEERING LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

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. Evaluate various techniques for cell disruption, filtration and separation of bioproducts. (Expt: 1-8,13)
2. Analyze the optimum protein precipitation technique. (Expt: 9)
3. Demonstrate chromatographic separation process for a given compound. (Expt: 10,11,12)
4. Apply a strategy for final product purification/ polishing of a bioproduct. (Expt: 14)
5. Develop methods for determining enzyme activity. (Expt: 15)

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	PSO1	PSO2
CO1	2	2	1	2	1	0	2	0	2	0	0	2	3	3
CO2	2	2	1	2	1	3	2	0	2	0	0	2	3	3
CO3	2	2	1	2	1	0	2	0	2	0	0	2	3	3
CO4	2	2	1	2	1	0	2	0	2	0	0	2	3	3
CO5	1	2	1	2	1	0	2	0	2	0	0	2	3	3

At least 10 experiments to be conducted from the following list of experiments.

List of Experiments:

1. Cell Disruption of microorganism by Enzymatic method
2. Cell Disruption of plant cells / animal cells by Physical methods (Temperature or Osmolysis)
3. Cell Disruption of microorganism by Ultrasonication method
4. Separation of biomolecules by Aqueous two-phase extraction.
5. Separation of solids from liquid by Sedimentation and Centrifugation
6. Separation of microorganisms from fermentation broth by Microfiltration or ultra-filtration.
7. Separation of solute particles by Dialysis.
8. Separation of protein by Ammonium Sulphate Precipitation (Structured expt)
9. Isolation and quantification of protein from milk by Isoelectric Precipitation.
10. Separation of biomolecules by Gel Exclusion Chromatography.
11. Purification of lysozyme from chicken egg white extract by Ion Exchange Chromatography.
12. Purification of proteins by Affinity Chromatography.
13. Separation of a binary mixture by simple distillation.
14. Purification of bio products by drying or crystallization
15. Estimation of 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

BIOINFORMATICS AND COMPUTATIONAL BIOLOGY LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objective:

1. To provide practical instructions to the students on using the specific databases and learn how to use these resources on their own and analyze the output.

Course Outcomes:

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

1. Retrieve the information from biological databases (Expt. 1,2)
2. Utilize BLAST, FASTA and other online tools (Expt. 3, 4)
3. Use online sequence alignment tools and construction of evolutionary tree by phylogenetic analysis (Expt. 5,6,7)
4. Predict gene and protein structure and design primers and construct restriction map. (Expt. 8, 9, 10, 11)
5. Retrieve macromolecular structures and perform docking of a ligand to its target (Expt 12, 13)

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	PSO1	PSO2
CO1	1	1	0	1	1	0	0	0	0	1	0	2	1	1
CO2	1	1	0	1	1	0	0	0	0	1	0	2	1	1
CO3	1	1	0	1	1	0	0	0	0	1	0	2	1	1
CO4	1	1	0	2	1	0	0	0	0	1	0	2	1	1
CO5	1	1	0	2	2	0	0	0	0	1	0	2	1	1

Atleast 10 experiments to be conducted from the following list of experiments.

List of Experiments:

1. Searching Bibliographic databases for relevant information.
2. Sequence retrieval from DNA and protein databases.
3. BLAST services.
4. FASTA services.
5. Pair-wise comparison of sequences (Local and global alignment).
6. Multiple Sequence Alignment.
7. Evolutionary studies/ Phylogenetic Analysis.
8. Identification of Genes in Genomes.
9. NCBI ORF Finder.
10. Restriction Mapping (Structured enquiry)
11. Primer Design (Open-ended experiment)
12. Protein Databank retrieval and visualization.
13. Molecular docking with Auto docking Vina

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.

ANIMAL BIOTECHNOLOGY LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. Students are expected to understand the sterility and aseptic conditions necessary for animal cell culture.
2. Students will learn various steps involved in maintenance and culture of animal cells.
3. Students will know about measurement of cell viability & cytotoxicity and cell death.

Course Outcomes:

At the end of the course the students are able to

1. Demonstrate aseptic culture techniques and preparation of animal cell culture media. (Expt. 1, 3, 4)
2. Identify and enumerate animal cells by using microscopic techniques. (Expt. 2, 8)
3. Apply animal cell culture techniques to the establishment of primary culture. (Expt. 5, 6, 7)
4. Evaluate cell viability and cytotoxicity of animal cell culture. (Expt. 9, 10)
5. Perform the maintenance and preservation of animal cells. (Expt.11, 12, 13)

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	PSO1	PSO2
CO1	1	1	1	3	2	3	1	3	-	3	1	3	2	3
CO2	2	1	-	2	2	3	1	3	-	3	1	3	3	3
CO3	2	1	-	3	2	-	1	1	-	3	1	3	2	3
CO4	1	-	-	2	2	3	1	3	-	1	1	2	3	3
CO5	1	1	-	3	2	3	1	3	-	3	1	3	3	3

Atleast 10 experiments to be conducted from the following list of experiments".

List of Experiments

1. Maintaining sterility and aseptic techniques within the animal biotechnology lab.
2. Microscopic visualization of Human Buccal Epithelial cells. (structured enquiry)
3. Separation of serum from whole blood.
4. Preparation of cell culture growth media
5. Primary culture of chicken embryo fibroblast culture.
6. Isolation of Hepatocytes from Chicken liver cells
7. Enumeration and counting of animal cells using a Haemocytometer.
8. Staining and microscopic visualization of adherent animal cells.
9. Evaluation of cell viability/cytotoxicity in animal cells.
10. Cell viability of cells using trypan blue dye. (Open ended experiment)
11. Trypsinization or subculture of the adherent cell line.
12. Cryopreservation of animal cells
13. Monitoring and trouble shooting of microbial contamination in animal biotechnology lab. (Open ended experiment)

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

EMPLOYABILITY SKILLS

Instruction	2 P Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives: To help the students

1. Learn the art of communication; participate in group discussions and case studies with confidence and to make effective presentations.
2. With- resume packaging, preparing them to face interviews.
3. Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

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

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals, learn to mange time effectively and deal with stress.
4. Make the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

UNIT–I

Verbal Aptitude: Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences-Jumbled Words/Sentences- Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word/Sentence/Text Completion- Reading Comprehension.

UNIT–II

Group Discussion & Presentation Skills: Dynamics of Group Discussion-Case Studies- Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence.

Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language -

Preparing an Effective PPT

UNIT–III

Behavioural Skills: Personal strength analysis-Effective Time Management- Goal Setting- Stress management- Corporate Culture – Grooming and etiquette-Statement of Purpose (SOP).

UNIT –IV

Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writing an Abstract –Technical Report Writing-Plagiarism-Project Seminar.

UNIT –V

Interview Skills: Cover Letter and Résumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

Suggested Reading:

1. LeenaSen, “Communication Skills”, Prentice-Hall of India, 2005
2. Dr.ShaliniVerma, “Body Language - Your Success Mantra”, S Chand, 2006
3. Edgar Thorpe and Showick Thorpe , “Objective English”, 2nd edition, Pearson Education, 2007
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, “The ACE of Soft Skills”, New Delhi: Pearson, 2010
5. Gulati and Sarvesh, “ Corporate Soft Skills”, New Delhi: Rupa and Co. , 2006
6. Van Emden, Joan, and Lucinda Becker, “Presentation Skills for Students”, New York: Palgrave Macmillan, 2004
7. A Modern Approach to Verbal & Non-Verbal Reasoning by R S Aggarwal, 2018
8. Covey and Stephen R, “The Habits of Highly Effective People”, New York: Free Press, 1989

MINI PROJECT

CIE	50 Marks
Credits	1

Dealing with a real time problem should be the focus of under graduate project.

All projects will be monitored at least four times in the II-semester through individual presentations (Project batch wise).

Every student should maintain a project dairy, wherein he/she needs to record the progress of his/her work and get it signed at least once in a week by the guide(s). If working outside and college campus, both the external and internal guides should sign the same.

Sessional marks should be based on the marks, awarded by a project monitoring committee of faculty members as well as the marks given by the guide.

Common norms are established for final documentation of the project report, the students are directed to download from the website regarding the guidelines for preparing the project report and the project report format.

The project report shall be evaluated for 50 Marks by the External Examiner.

If the project work found inadequate in the end examination, the candidate should repeat the project work with a new problem or improve the quality of work and report it again.

Break up for 50 Marks in the end examination:

1. Power point presentation 20 Marks
2. Thesis/Report preparation 30 Marks