ANNAMALAI UNIVERSITY

211 - B.Sc. BIOTECHNOLOGY

Programme Structure and Scheme of Examination (Under CBCS)
(Applicable to the candidates admitted in Affiliated Colleges from the academic year 2022-2023 onwards)

Course code	Part	Study Components & Course Title	Hours /Week	Credit	Maximum Marks		
					CIA	ESE	Total
SEMESTER - I							
22UTAML11	I	Language Course – I : Tamil/Other Languages	5	3	25	75	100
22UENGL12	II	English Course – I : Communicative English - I	5	3	25	75	100
22UBTHC13	III	Core Course –I : Cell Biology	4	4	25	75	100
22UBTHC14		Core Course – II : Genetics	4	4	25	75	100
		Core Practical –I : Cell Biology, Genetics & Biochemistry	3	-	-	-	-
22UBTHA01		Allied – I : Paper – 1 : Biodiversity	4	4	25	75	100
		Allied Practical – I : Biodiversity	3	-	-	-	-
22UENVS18	IV	Environmental Studies	2	2	25	75	100
		Total	**30**	**20**			**600**
SEMESTER - II							
22UTAML21	I	Language Course – II : Tamil/Other Languages	5	3	25	75	100
22UENGL22	II	English Course – II : Communicative English - II	5	3	25	75	100
22UBTHC23	III	Core Course – III : Biochemistry	5	4	25	75	100
22UBTHC24		Core Practical –I : Cell Biology, Genetics & Biochemistry	4	4	40	60	100
22UBTHA02		Allied – II : Paper – 2 : Biophysics	4	4	25	75	100
22UBTHP02		Allied Practical – I : Biodiversity		3	40	60	100
22UBTHE27		Internal Elective – I	3	3	25	75	100
22UVALE27	IV	Value Education	2	1	25	75	100
22USOFS28		Soft Skill	2	1	25	75	100
		Total	**30**	**26**			**900**

Internal Elective Courses

22UBTHE27-1	Internal Elective - I	Biomaterials
22UBTHE27-2		Forensic Science
22UBTHE27-3		Drug Designing

Allied Courses offered by the Department of Biotechnology

22UBTHA01	Theory	Biodiversity
22UBTHA02	Theory	Biophysics
22UBTHP02	Practical	Biodiversity Lab

SEMESTER:I PART:III	COURSE CODE: 22UBTHC 13 COURSE TITLE: CORE COURSE – I: CELL BIOLOGY	CREDIT:4 HOURS:4

COURSE OBJECTIVES

1) To impart the basic nature of the cellular origin.
2) To understand the basic components of a cell and their functions.
3) To understand the structural organization of chromosomes.
4) To understand the process of cell division and cell cycle.
5) To impart the knowledge on cell to cell signaling.

Unit I: Origin of Cell

Cell and membrane structure – History, Cell theory. Ultrastructure of Prokaryotic and Eukaryotic Cells. Structure and functions of Plasma membrane, Cytoskeleton. Structural organization of plant and animal cells.

Unit II: Components of a Cell

Structure and function of intracellular organelles (Nucleus, Nucleolus, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Vacuole, Cytosol, Microtubules, Microfilaments, and Intermediate filaments), Extracellular matrix.

Unit III: Cytogenetics

Chromosomes: Discovery, morphology, chemical composition, structural organization of chromosomes, Specialized Chromosomes (polytene, lampbrush chromosomes). Chromosomal aberrations.

Unit IV: Life of a Cell

Cell division and Cell cycle: Mitosis and Meiosis, interphase, comparison of mitosis and meiosis, Cell cycle regulation. Cell differentiation, Cancer – Characteristics, Metastasis, Types of Cancer, Oncogenes.

Unit V: Cell Signaling and Transport

Signaling molecules and their receptor; functions of cell surface receptors. Intracellular signal transduction pathway; Molecular Transport - Active, Passive, Nuclear – Cytoplasmic Transport.

COURSE OUTCOMES

1) Understand the theories on the origin of a living cell.
2) Identify the intracellular organelles.
3) Understand the chromosomal organization of cells.
4) Understand the process of cell division and its regulation.
5) Understand the transport and signaling mechanism between cells.

Text Books

1) Gupta, P.K. (2004). *Cell and Molecular Biology*. Third Edition. Rastogi Publications.
2) Verma, P.S and Agarwal, V.K. (1993). *A Textbook of Cytology*. S. Chand & Co, New Delhi.
3) E.D.P De Robertis, E.M.F De Robertis. (1987). *Cell Biology.* Eighth edition. Lea & Febiger.

Supplementary Readings

1) Aminul Islam. (2011). *A Text Book of Cell Biology.* 1st edition. Books and Allied (P) Ltd, Kolkata.
2) Powar. C.B.(1983). *Cell Biology.* Himalaya Publishing House, New Delhi.
3) Gerald Karp. *Cell and Molecular biology, concepts and experiments*; 4th Edition.

OUTCOME MAPPING

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	2	3
CO2	2	3	3	3	2
CO3	2	3	3	3	2
CO4	3	3	3	3	3
CO5	3	3	2	3	3

1: Low; **2:** Moderate; **3:** High

SEMESTER: I PART: III	COURSE CODE: COURSE TITLE 22UBTHC14: GENETICS – CORE COURSE - II	CREDIT: 04 HOURS: 04

COURSE OBJECTIVES

1) Understand on Historical introduction to Genetics and genetic materials.
2) Understanding the concept of cell cycle and mendel's principles.
3) Knowledge about the composition of eukaryotic chromosomes.
4) To understand the linkage and crossing over of chromosomes.
5) Its expression in host and to provide an idea about gene regulations and its control.

Unit I: Principles of Genetics

Mendel's Experiments – principle of segregation – monohybrid crosses – dominance – recessiveness - lethal – principle of independent assortment – gene interaction – genetic versus environmental effects – multiple alleles.

Unit II: Sex Linkage

Mendel's principles – mechanism of sex determination – environmental factors and sex determination – sex differentiation – sex-linked inheritance

Unit III: Eukaryotic chromosomes

Chemical composition of eukaryotic chromosomes – packing the giant DNA molecules into chromosomes – euchromatin and heterochromatin – repetitive DNA and sequence organization – Satellite DNAs – telomere structure – replication of eukaryotic chromosomes

Unit IV: Linkage and crossing over

Linkage and crossing over – chromosome mapping – two factor crosses – three factor crosses – somatic-cell hybridization – molecular mechanism of crossing-over – gene conversion - Discovery of transposable elements – transposable elements in bacteria – transposable elements in eukaryotes

Unit V: Structure of chromosome

Variations in chromosome structure – duplications – inversions – translocations – position effects – variations in chromosome number – trisomy in humans – chromosomal mosaics – euploidy – induced polyploidy - applications of polyploidy.

COURSE OUTCOMES

1) Comprehend the concept of replication of genetic materials
2) Understand about regulation of gene expression and mutation
3) Demonstrate the genetic exchange mechanism in microorganisms
4) Gain knowledge on Mutation
5) Grasp the Basic of genetics and their role

Text Books

1) Eldon, J.G., Simmons, M.J., & Snustad, D.P. (2005). *Principles of Genetics*. (8th ed.). Singapore: John Wiley & Sons.
2) Robert, T.B. (1999). *Genetics: Analysis and Principles*. (2nd ed.). Wisconsin: Addison's Wesley publishers.
3) Primrose, S.B., & Twyman, R.M. (2006). *Principles of Gene Manipulation and Genomics*. (7th ed.). Australia: Blackwell Publishing.

Suggested Readings

1) Brown, TA, 1999. *Genome*. Asia: John wiley and sons.
2) Varma, P.A., & Agarwal, V.K. (2009). *Genetics*. (9th ed.). New Delhi: Schand and Company Pvt Ltd.

OUTCOME MAPPING

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	2	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

1: Low; **2:** Moderate; **3:** High

SEMESTER: I PART: III	COURSE CODE:22 UBTHP 15 COURSE TITLE: CORE PRACTICAL -I: CELL BIOLOGY & GENETICS	CREDIT:4 HOURS:3

Lab in Cell Biology &Genetics

1) Use of Micrometer and calibration, measurement of onion epidermal cells.
2) Cell division: Mitosis in onion root tips.
3) Cell division: Meiosis in flower buds of Allium cepa or grasshopper testis.
4) Blood smear preparation.
5) Identification of Barr body from buccal cavity.
6) Separation of cellular organelles by differential centrifuge.
7) Identification of cell organelles.
8) Identification and Karyotyping of Chromosomes.
9) Study of cyclosis in cells of suitable plant material.
10) Histochemical localization of starch, protein, lipid, and lignin.
11) Cell counting and viability.

SEMESTER: II PART: III	COURSE CODE: 22 UBTHC 23 COURSE TITLE: CORE COURSE – III: BIOCHEMISTRY	CREDIT:4 HOURS:4

COURSE OBJECTIVES

1) To understand the nature and significance of biomolecules.
2) To understand the structure of various carbohydrates and their functions.
3) To understand the amino acid structures, classifications, and proteins.
4) To describe the classification and structural organization of lipids.
5) To understand the structure and functions of nucleic acids and vitamins.

Unit I: Biophysical Chemistry

Acids and Bases, Buffers, Solutions, Colloidal State, Diffusion, Water and Life – Water turnover and electrolyte balance, Maintenance of blood pH, Osmosis, Isotopes-Applications of radioisotopes in biochemistry.

Unit II: Carbohydrates

Carbohydrates: Structure, Classification & Properties of carbohydrates, carbohydrate metabolism, Glycolysis, Citric acid cycle, Gluconeogenesis, Glycogenesis, Glycogenolysis, HMP Shunt, Biological Importance of Carbohydrates.

Unit III: Proteins and Amino acids

Structure and classification of amino acids, Essential and Non-Essential amino acids, Protein- Classification, Structure, Properties, and Urea cycle; Biologically important proteins (Insulin, Vasopressin, Glutathione).

Unit IV: Lipids

Lipids - Classification, and functions. Fatty acids-Essential fatty acids, Triacylglycerols, phospholipids, Glycolipids, lipoproteins, and steroids. Metabolism of Lipids: Fatty acid oxidation, Biological importance of lipids.

Unit V: Nucleic Acids and Vitamins

Nucleic Acids: Nucleotides. Structure of DNA- Watson and Crick model, Structure of RNA. Forms of DNA double helix. Vitamins: Definition, Classification, Sources, Structure, and physiological functions, antivitamins.

COURSE OUTCOMES

1) Understand the basic concepts of solutes, chemical bonding, and organic compounds.
2) Identify and interpret the structure, and classification, of carbohydrates.
3) Identify and interpret the structure, and classification, of proteins.
4) Identify and interpret the structure, and classification, of lipids.
5) Identify and interpret the structure, and classification, of nucleic acids and vitamins.

Text Books

1) U Satyanarayana. (2014). *Biochemistry***.** Elsevier Health Sciences. 812 pages.
2) J.L. Jain. (2005). *Fundamentals of Biochemistry.* S. Chand Limited. 1230 pages.
3) G.Zubay. (1998). *Biochemistry***,** Macmillan Publishing Co., New York.

Supplementary Readings

1. L.Stryer.(1994). *Biochemistry*. Freeman & Co., New York.
2. A.L.Lehninger, D.L.Nelson & M.M.Cox. (1993). *Principles of Biochemistry*. Worth Publishers, New York.
3.Voet & Voet. (2010). *Fundamentals of Biochemistry*, John Willey & Sons.

OUTCOME MAPPING

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3
CO2	2	3	3	3	2
CO3	2	3	3	3	2
CO4	3	3	3	3	3
CO5	3	3	2	2	3

1: Low; **2:** Moderate; **3:** High

SEMESTER: II PART: III	COURSE CODE: COURSE TITLE 22UBTHE27: BIOMATERIALS – INTERNAL ELECTIVE - I	CREDIT: 03 HOURS: 03

COURSE OBJECTIVES

1) The basic concepts of Biomaterials
2) The naturally occurring Biomaterials
3) About the different types of biomaterials and its application medical field.
4) Techniques involved in Biomaterial analysis.
5) Role of Proteomics in Biomaterials study.

Unit I Fundamentals of Biomaterials

Biomaterials- properties of biomaterials, Surface Properties and Surface Characterization of Biomaterials, Role of Water in Biomaterials. Applications of biomaterials in medical field.

Unit II Protein as Biomaterials

Collage and Gelatin-Alginate: Structure, Preparation and application. Fibroin (protein in silk): Production and its use

Unit III Carbohydrates as Biomaterials

Carbohydrates: Modified carbohydrates; Actin gas lubricants for biomedical applications; Bacterial Polydextrose; Carbohydrates modified from enzymes, Cellulose and Chitin-Chitosan: structure, preparation and application

Unit IV Biopolymers

Biopolymers: Synthesis from a simple biological monomer - hyaluronate polymer; Dextrans, Rubber produced by bacteria and fungi, PHB, PCL; Production of a copolymer of PHB and PHV.

Unit V Biocompatibility materials

Metallic Implant materials, Ceramic implant materials, Polymeric implant materials, Skin and Maxillofacial implant and blood interfacing implants.

COURSE OUTCOMES

1) Define Biomaterials and its applications
2) Biomaterials extracted from Protein.
3) Biomaterials extracted from Carbohydrates.
4) Biopolymers, synthesis and its uses
5) Biocompatibility materials used in medical field

Text Books

1) Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, M.D, Jack E. Lemons, 2013, "Biomaterials Science An Introduction to Materials in Medicine", 3rd Edition, Elsevier Inc.
2) Ratledge, C. and Kristiansen, B., 2001, "Basic Biotechnology", 2nd Edition, Cambridge University Press.

Supplementary Readings

1) Yoshiharu D, 1990, "Microbial polyesters", 1st Edition, VCH Weinheim Publishers.
2) Joon Park and Lakes R. S, 2007, "Biomaterials: An Introduction", 3rd Edition, Springer Verlag Publishers.
3) David Byrom, 1991, "Novel materials from biological source", 1st Edition, Macmillan Publishers Limited.
4) Masoud Mozafari, 2020, "Handbook of Biomaterials and Biocompatibility", 1st Edition, Woodhead Publishing

OUTCOME MAPPING

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	3	2
CO2	2	3	2	2	3
CO3	3	3	2	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

1: Low; **2:** Moderate; **3:** High

SEMESTER: II PART: III	COURSE CODE: COURSE TITLE 22UBTHE27: FORENSIC SCIENCE – INTERNAL ELECTIVE - I	CREDIT: 03 HOURS: 03

COURSE OBJECTIVES

1) To make students on understanding the importance of forensic principles and technology
2) Its practical applicability in identifying the candidate who convicted the crime scenery.
3) The students also gain added skills in terms tracing the victim death by means of adapting the measurable molecular approaches.
4) Acquire knowledge about the fatality forensics and art illustration.
5) To understand the applications of DNA fingerprinting technology.

Unit I: Introduction to forensic science

Introduction, definition, Scope and branches of forensic science. Central F.S.L. and State F.S.L. Biological Evidence: Nature, collection, identification, evaluation of hair and fibres.

Unit II: Fingerprinting

Definition and Classification of fingerprints (Henry system). Taking fingerprints from living and dead persons. Automatic fingerprint identification system (AFIS).

Unit III: Forensic Art Illustration

Introduction, Finding and identifying human face image. Post mortem drawing, methods of super imposition.

Unit IV: Fatality Forensics

Introduction, cause, manner and characteristics of death, Road traffic fatality (RTF) investigation. General classification of RTFs.

Unit V: DNA fingerprinting technology

DNA Fingerprinting (DFP) technology: An overview, Applications of DFP in forensic investigations, paternity disputes. DNA Profiling practice in India with reference to criminal cases.

COURSE OUTCOMES

1) Gain knowledge on forensic science laboratories across India.
2) Acquires knowledge on fingerprint identification system.
3) To understand the finding and identifying face image by forensic art illustration
4) Know where abouts on the FAI and the concepts of fatality forensics.
5) Understand the concepts of DNA finger printing technology.

Text Books

1) Richard, S. (2001). *Criminalistic: An Introduction to Forensic Science*. (7th ed.). New Jersey: Prentice Hall.
2) Chowdhri, S. (2010). *Forensic Biology*. B.P.R. &D, Govt. of India.
3) Cammins, H., & Middle, C. (1961). *Fingerprints Palms and Soles*. New York: Dover Publications.

Supplementary Readings

1) Taylor, K.T. (2000). *Forensic Art and Illustration*. (1st ed.). U.S.A: CRC Press.
2) Kirby, T.L. (1993). *DNA Fingerprinting: An Introduction*. USA: OUP.

OUTCOME MAPPING

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	3	2
CO2	2	3	2	2	3
CO3	3	3	2	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

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SEMESTER: II PART: III	COURSE CODE: COURSE TITLE 22UBTHE27: DRUG DESIGN – INTERNAL ELECTIVE - I	CREDIT: 03 HOURS: 03

COURSE OBJECTIVES

1) The study of drug design and development.
2) To know about drug delivery systems.
3) To understand Cheminformatics and its Application in Drug Development.
4) To study Computer Aided Drug Design (CADD) and its role.
5) To study various receptors for Drug design.

Unit I Introduction to Drug Design

Introduction to Drug Design and Discovery, History and Evolution of the contemporary drug discovery process. Role of organic chemistry in Drug Discovery, Design and Development.

Unit II Drug Design

Types of Drug design and Drug development, difference between drug design and drug development. Classical Targets in Drug Discovery - Enzymes, Inhibition of Enzymes, G-Protein-Coupled Receptors (GPCRs), Ion Channels and Membrane Transport Proteins (Transporters).

Unit III Cheminformatics

Cheminformatics - Introduction to pharmacophore, concepts in CADD, methods in docking simulations, Applications in ADME-tox and Limitations.Role of Cheminformaticsand Molecular Diversity in Lead Discovery. Sources of Lead Compounds, Screening, Identification, Modification and Lead Optimization.

Unit IV Computer Aided Drug Design (CADD)

Introduction and classification ofCADD. Drug design based on bioinformatics tools, Molecular docking, De novo design, Structure Based Drug Design (SBDD) and Ligand Based Drug Design (LBDD). Challenges and emerging problems inCADD, Legal & ethical considerations in drug development.

Unit V Drug Delivery & Drug Delivery Systems

Introduction to drug delivery and targeting systems. Controlled drug release, parenteral and non parenteral routes of drug delivery and targeting - Oral,buccal, sublingual, GI tract, transdermal, nasal and pulmonary drug delivery. Gene delivery systems and Vaccine delivery. Challenges and obstacles to targeted drug delivery.

COURSE OUTCOMES

1) Insight on storage and retrieval of data
2) Understanding biological databases with applications
3) Discuss and distinguish the types of protein structures and its implications in function
4) Explain the sequences and its alignment which determines several roles of biomolecules
5) Comprehend the molecular modelling and visualization for drug designing

Text Books

1) Shanmughavel P, 2006, "Trends in Bioinformatics", Pointer Publishers, Jaipur, India.
2) Lesk AM, 2003, "Introduction to Bioinformatics", Oxford University Press, New Delhi.

Suggested Readings

1) Andrew R Leach, 2001, "Molecular Modeling: Principles and Application", Pearson Publishers, United Kingdom.
2) Hans X, 2008, "Basic principles and applications", Wiley publications, United States
3) Yvonne C Martin, 1998, "Designing bioactive molecules three-dimensional techniques and applications", American Chemical Society, United States
4) Leo, Albert, Hockma, Hansch, Corwin, 1995, "Exploring QSAR", 2nd edition, American Chemical Society, United States.

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CO5	3	3	3	3	3

1: Low; **2:** Moderate; **3:** High