M.Sc. BIOTECHNOLOGY

SYLLABUS : 2012

CHOICE BASED CREDIT SYSTEM (CBCS)

St. JOSEPH'S COLLEGE (Autonomous)

Re-accredited with 'A' Grade (3rd Cycle) by NAAC

College with Potential for Excellence by UGC

TIRUCHIRAPPALLI - 620 002, INDIA.

FEATURES OF CHOICE BASED CREDIT SYSTEM

PG COURSES

The Autonomous (1978) St. Joseph's College, accredited with Five Star status in 2001, Re-accredited with **A⁺ Grade** from **NAAC (2006),** Re-accredited with **A Grade** from **NAAC (3rd cycle)**, had introduced the Choice Based Credit System **(CBCS**) for PG courses from the academic year 2001-2002. As per the guidelines of Tamil Nadu State Council of Higher Education (TANSCHE) and the Bharathidasan University, the College has reformulated the CBCS in 2008-2009 by incorporating the uniqueness and integrity of the college.

OBJECTIVES OF THE CREDIT SYSTEM

- To provide mobility and flexibility for students within and outside the parent department as well as to migrate between institutions
- To provide broad-based education
- To help students learn at their own pace
- To provide students scope for acquiring extra credits
- To impart more job oriented skills to students
- To make any course multi-disciplinary in approach

What is credit system?

Weightage to a course is given in relation to the hours assigned for the course. Generally one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The following Table shows the relation between credits and hours.

Sem.	Specification	No. of Papers	Hour	Credit	Total Credits
I – IV	Core Courses (Theory & Practical)	14	6	14 x 5	70
	Project	1	--	1 x 5	05
I – IV	3 – Core Electives 1 – Soft Skill Course (Common) (IDC-1)	3	4	3 x 4	12
	1 – Inter Dept. Courses (IDC-2)	2	4	2 x 4	08
I – IV	SHEPHERD – Extension Activity	~	70	5	05

Total Minimum Credits **100**

Other Additional Credits (Dept. Specific) **....**

However, there could be some flexibility because of practicals, field visits, tutorials and nature of project work.

For PG courses a student must earn a minimum of 100 credits. The total number of courses offered by a department is 20. However within their working hours a few departments can offer extra credit courses.

Course Pattern

The Post Graduate degree course consists of three major components. They are Core Course, Elective Course and Inter Departmental Course (IDC). Also 2 compulsory components namely Project / Project related items and SHEPHERD, the extension components are mandatory.

Core Course

A core course is the course offered by the parent department, totally related to the major subject, components like Practicals, Projects, Group Discussions, Viva, Field Visits, Library Record form part of the core course.

Elective Course

The course is also offered by the parent department. The objective is to provide choice and flexibility within the department. The student can choose his/her elective paper. Elective is related to the major subject. The difference between core course and elective course is that there is choice for the student. The department is at liberty to offer three elective courses any semester. It must be offered at least in two different semesters. The staff too may experiment with diverse courses.

Inter Departmental Course (IDC)

IDC is an inter departmental course offered by a department for the students belonging to other departments. The objective is to provide mobility and flexibility outside the parent department. This is introduced to make every course multi-disciplinary in nature. It is to be chosen from a list of courses offered by various departments. The list is given at the end of the syllabus copies. Two IDC s must be taken by students which are offered in Semester II & III. In

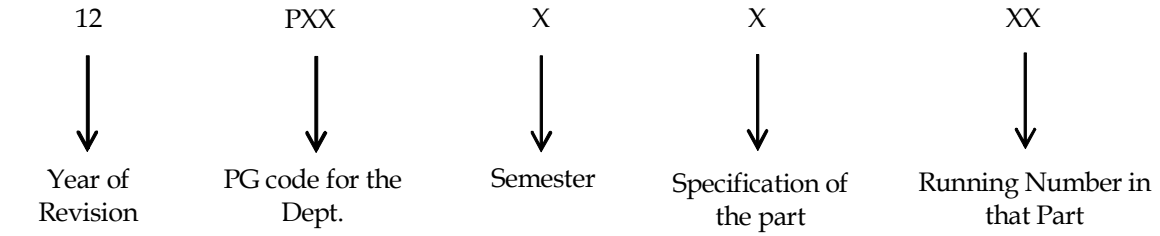
semester II, a common IDC, Soft Skills is to be offered by JASS (Joseph Academy of Soft Skills).

Day College (Shift-I) student may also take an IDC-2 from SFS (Shift-II) course and vice versa

The IDC are of application oriented and inter-disciplinary in nature.

Subject Code Fixation

The following code system (9 characters) is adopted for Post Graduate courses:



01 – Core Courses: Theory & Practical
02 – Core electives
03 – Additional Core Papers (if any)
04 – Inter Departmental Courses
05 – Project
06 – SHEPHERD

CIA Components

The CIA Components would comprise of two parts: (1) Test Components conducted by Controller of Examination (COE) and (2) Teacher specific component. The two centralized tests will be conducted by the COE (Mid-Semester Test & End-Semester Test) for 30% each administered for 2 hours duration. The remaining 40% would comprise of any three components as listed below and will be carried out by the faculty concerned for that paper.

* Assignment, Quiz (Written / Objective), Snap Test, Viva-Voce, Seminar, Listening Comprehension, Reading Comprehension, Problem Solving, Map Reading, Group Discussion, Panel Discussion, Field Visit, Creative Writing, Open Book Test, Library Record, Case Study, etc.

* As a special consideration, students who publish papers in referred journals would be exempted from one of the teacher specific internal components in one of the papers. At the beginning of each semester, the four internal components would be informed to the students and the staff will administer those components on the date specified and the marks acquired for the same will be forwarded to the Office of COE.

Evaluation

For each course there are formative continuous internal assessment (CIA) and semester examinations (SE) in the weightage ratio 50:50.

Once the marks of CIA and SE for each course are available, the Overall Percentage Mark (OPM) for a student in the programme will be calculated as shown below:

$$OPM = \frac{\sum_i C_i M_i}{\sum_i C_i}$$ where C_i is the credit earned for that course in any semester and M_i is the marks obtained in that course.

The Scheme of Over-all Results is as follows:

	PG	
Class	**Arts (OPM)**	**Science (OPM)**
SECOND	50 to 59.99	50 to 59.99
FIRST	60 to 74.99	60 to 79.99
DISTINCTION	75 & Above	80 & Above

Declaration of Result

Mr./Ms. _____ has successfully completed M.Sc./M.A. degree course in _____. The student's overall average percentage of marks is _____ and has completed the minimum 100 credits. The student has also acquired _____ (if any) additional credits from courses offered by the parent department.

M.Sc. Biotechnology - Course Pattern

Sem	Category	Code	Title of the Paper	Hrs	Cr
I	Core 1	12PBT1101	Molecular Biology	6	5
	Core 2	12PBT1102	Biochemistry	6	5
	Core 3	12PBT1103	Microbiology	6	5
	Core 4	12PBT1104	Lab course 1- Molecular biology, Genetics & Microbiology	8	5
	Core 5	12PBT1105	Lab Course 2 – Biochemistry		
	Core Elective 1	12PBT1201A	Developmental Biology (or)	4	4
		12PBT1201B	Cellular organization & cell signaling		
	Add. Core 1	12PBT1301	**15 DAYS INDUSTRIAL TRAINING** (OPTIONAL)	---	(3)
			Total Hours & Credits for Semester I	**30**	**24 + (3)**
II	Core 6	12PBT2106	Recombinant DNA Technology	6	5
	Core 7	12PBT2107	Immunology	6	5
	Core 8	12PBT2108	Lab course 3 Rdna Tech	8	5
	Core 9	12PBT2109	Lab Course 4- Immunology		
	Add. Core 2	12PBT2302	Comprehensive & Scientific writing	2	(2)
	Core Elective 2	12PBT2202A	IPR/Regulations and CGMP & Environment Biotechnology (or)	4	4
		12PBT2202B	Cellular, Molecular & Immunodiagnostics		
	IDC 1	12PSK2401	Soft Skills	4	4
	Add. Core 3	12PBT2303	**2 MONTHS INTERNSHIP** (OPTIONAL)	---	(5)
			Total Hours & Credits for Semester II	**30**	**23 + (7)**
III	Core 10	12PBT3110	Bioprocess Technology	5	5
	Core 11	12PBT3111	Bioinformatics	6	5
	Core 12	12PBT3112	Genes, Genomes, Genomics & Proteomics	5	5
	Core 13	12PBT3113	Lab course 5 Bioinformatics & Biostatistics	6	5
	Core 14	12PBT3114	Lab Course 6 - Plant Tissue culture & Bioprocess Technology		
	Core elective 3	12PBT3203A	Bioinstrumentation & Biostatistics (or)	4	4
		12PBT3203B	Drug dynamics & design		
	IDC 2	12PBT3402	Applied Biotechnology	4	4
			Total Hours & Credits for Semester III	**30**	**28**
IV	Core 15	12PBT4115	Plant & Animal Biotechnology	6	5
	Core 16	12PBT4116	Regulation of Gene Expression	6	5
	Core 17	12PBT4117	Emerging trends in Biotechnology	6	5
		12PBT4501	**PROJECT**	12	5
			Total Hours & Credits for Semester IV	30	20
		12PBT4601	SHEPHERD	--	5
			TOTAL HOURS & CREDITS FOR ALL THE SEMESTERS	**120**	**100**
			Addl. Credits		**10**

SEM: I ***Hours/Week: 6***

12PBT1101 ***Credits: 5***

MOLECULAR BIOLOGY (Core 1)

Objectives

- To understand the basic structure and functioning of the genetic materials – DNA.
- To understand the changes in the genetic material and the consequences in plants and human.

UNIT I

Introduction: Terms and definitions – DNA is the Genetic Material: Griffith's Experiment, Avery *et al*., Experiments and Hershey & chase Experiment. RNA is the Genetic Material: Conrat & Singer Experiment with TMV - Central Dogma.

Organization of Chromosome: Structural organization of Prokaryotic and Eukaryotic cells. Components of nucleic acids. Structure of nucleic acids: nucleoside, nucleotide, Dinucleotide, polynuceotide, Primary and Secondary structures of DNA, Chemical bonds & interactions responsible for the stability of DNA double helical structure - Types of DNA, C value paradox. Types and basic structure of chromosomes. Chromosomal Proteins - Histones and Protamines - nucleosomes - levels in the organization of Metaphase Chromosome. Organization of prokaryotic DNA. Special types of Chromosome: Polytene and Lamp brush chromosomes. RNA as a genetic material - viral genome - types of RNA and their role. Duplication & segregation of Chromosomes.

UNIT II

Transposons: Discovery, IS elements, Transposons in Bacteria (Tn elements), Maize (Ac/Ds and Sp/Dsp elements), Drosophila (P elements) and Yeast (Ty elements). Transposition, Genetic and evolutionary significance of transposons.

Extra chromosomal DNA: Maternal Inheritance, Structure, gene contents and functions of Chloroplast and Mitochondrial DNA

- Interaction between cpDNA and nDNA, theory of prokaryotic endosymbionts. Plasmids: Definition, Types, Structure, Properties and gene content. Use in rDNA technology.

UNIT III

DNA replication: Denaturation and renaturation of DNA. DNA replication: Models - Meselson & Stahl Experimental proof for Semiconservative replication - Rules, requirements, problems and Molecular mechanism of the replication of linear and circular(Rolling circle Model) DNA. DNA polymerases - Structure and function. Replication of RNA genome - Example HIV virus. Mismatch repair.

Recombinations: Homologous and non-homologous recombination- Site specific recombinations & transposition of DNA.

UNIT IV

Transcription: RNA types(tRNA, mRNA, rRNA, Ribozyme, snoRNA, hnRNA, RNAi, RNA-P and micro RNA), structure and functions. Transcription Mechanism in Prokaryotes and Eukaryotes - initiation, elongation and termination, Post transcriptional modifications. Antibiotic inhibitors of transcription.

Translation: Genetic code and features. Wobbling hypothesis. Machinery, initiation, elongation and termination of translation in bacteria and the differences in eukaryotes. Translational proof reading, translational inhibitors, Post translational modifications, chaperones and protein targeting.

UNIT V

Changes and consequences: Changes in the chromosome number: Euploidy, aneuploidy and related genetic disorders. Changes in the chromosome structure: addition, deletion, inversion and translocation and related genetic disorders.

Mutation: Definition, chemical basis and types**.** Mutagens: Physical and chemical. Mutant types - lethal, conditional, biochemical, loss of function, gain of function, germinal vs. somatic mutants, insertional mutagenesis. DNA repair mechanism: Thymine

dimer, Light activation repair, Excision repair, Recombinational repair and SOS repair.

Cancer Biology: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

Text Book(s)

1. David Freifelder. 2008. Molecular Biology. (Ed: 2). Narosa Publications. New Delhi.
2. Gardner, Simmons and Snustad. 2004, Principles of Genetics. (Ed: 8). John Wiley & Sons, Inc. New York.
3. Jeoffrey M. Cooper and Rober E. Hausman. 2000. The Cell: A Molecular Approach(Ed: 4). ASM Press, Washington D.C.
4. Watson J.D., *et al.* 2006. Molecular Biology of the gene (Ed. 5) Pearson Education Inc. London.

Reference(s)

1. Ajoy Paul. 2007. Textbook of Cell and Molecular Biology. Books and Allied [P] Ltd. Kolkata
2. De Robertis and De Robertis. 1990. Cell and Molecular Biology. Saunders College, Philadelphia.
3. Gerald Karp. 2008. Cell and Molecular Biology. (Ed: 5). John Wiley and Sons, New York.
4. Krebs, J.E. *et al*. 2011.Lewin's GenesX.(Ed: 10).Jones and Barlett Publishers, Sudbury, Massachusetts.
5. Tom Strachan and Andrew P Lead. 2004. Human Molecular Genetics (Ed: 3). Garland Science / Taylor & Francis Group.USA.
6. Twyman. 2003. Advanced Molecular Biology. Bios Scientific Publishers LTD. Oxford, UK.

SEM: I ***Hours/Week: 6***

12PBT1102 ***Credits: 5***

BIOCHEMISTRY (Core 2)

Objectives

- To study the fundamental principles of chemistry which forms the basis to understand the structure and function of various biomolecules.
- To study the various biochemical and biophysical processes of the cell metabolism as a whole.

UNIT - I: Elemental composition of living matter.

Chemical bondings and their biological significances (electrovalent or polar or ionic bond, covalent bond). Stabilizing interactions: Hydrogen bonds, hydrophobic and non-polar interactions), Biologically important properties of water. pH, Ionization theory and Biological buffer systems. **Bioenergetics.** Laws of thermodynamics, Gibbs free energy, Activation energy, Exergonic and endergonic reactions, coupled reaction. Biological energy transductions. Group transfer.

UNIT II: Composition, Structure & Functions of Biomolecules.

Carbohydrate-chemical properties, classification, stereo and optical isomers. Heteroglycans: N-linked glycans and O-linked glycans.

Aminoacids: structure, classification and characteristics.

Proteins: Peptide bonds. Conformation of Proteins. Ramachandran plot, primary, secondary, tertiary and quaternary structures, domains, motif & folds. Folding & Stability of protein structure. Types and function of Proteins.

Lipids: Classification (Simple, compound and derived), membrane lipids - Prostaglandins and leukotrienes. Fatty acids - saturated vs unsaturated.

Nucleic acids: structure and types, Forms and stability of nucleic acids.

UNIT III: Enzymes

Enzymes: Classification, nomenclature, principles of enzyme catalysis, rate constants, enzyme regulation, Mechanism of Enzyme catalysis. LB plots. Inhibitors and activators. MM equation. Allosteric enzymes & metabolic regulations. Abzymes and ribozymes. Zymogens-activation and their role in biological system. Isozymes.

UNIT IV: Metabolism - I

Energetics of glucose metabolism. Glycolysis, pyruvate oxidation, TCA cycle & its regulation, electron transport and oxidative phosphorylation. Gluconeogenesis. Pentosephosphate pathway.

Metabolism of Lipids –Biosynthesis and regulation of triglycerol, palmitate, membrane lipids & steroids. b-oxidation of fat.

Metabolism of amino acids – Biosynthesis and regulation of aminoacids (proline and arginine from glutamate). Amino acid degradation. Ubiquitination.

UNIT V: Metabolism - II

Metabolism of nucleotides - Biosynthesis and regulation of purine and pyrimidine nucleotides, salvage pathway, degradation of nucleotides, formation of deoxy ribonucleotide.

Intermediary metabolism: Anabolism, catabolism and amphibolism. Types of pathways: Linear, cyclic and branched. Three stages of intermediary metabolism. Central role TCA cycle in the Intermediary metabolism.

Text Book(s)

1. Jain J. L. *et al.*, 2008. Fundamentals of Biochemistry. S. Chand & company Ltd, New Delhi.
2. Michael M. Cox. *et al.*, 2008. Principles of Biochemistry (Lehninger) (Ed:8). W.H. Freeman & Company, New York.

Reference(s)

1. Metzier D.E. 2001. Biochemistry – The chemical reactions of living cells. Academic press, California, USA.
2. Murray R.K. *et al*., 2006. Harper's Illustrated Biochemistry, (Ed: 27) Edition. Mc Graw Hill, New York, USA.
3. Palmer T. 2001. Enzymes: Biochemistry, Biotechnology & Clinical Aspects Chichester. Horwood Pub., West Sussex, England.
4. Rawn D. 1989. Biochemistry. Neil Patterson, USA.
5. Stryer L. *et al*., 1995. Biochemistry. W.H. Freeman and company, New York, USA.

SEM: I ***Hours/Week: 6***

12PBT1103 ***Credits: 5***

MICROBIOLOGY (Core 3)

Objective

- To understand the microbial world and their dynamics.
- To know the importance of microbes in day-to-day life.

UNIT I

Brief history of Microbiology: Prokaryotic and Eukaryotic cells: Structure and functions. Taxonomy of microbes- definition, the concept of microbial species, Five - kingdom system of classification. Bergey's system of bacterial classification - Morphology, cell structure & cell wall chemistry of bacteria. Three groups of the kingdom fungi - the slime moulds, the flagellated lower fungi and the terrestrial fungi. Virus - structure, classification and reproduction.

UNIT II

Microbial nutrition - Elemental nutrient requirements of microbes nutritional classes of microorganisms Culturing microorganisms - Different culture media, preparation of media (liquid, semisolid and solid), obtaining pure culture and preservation of pure culture, Enumeration of bacteria, uncultivable microorganisms and their study (in general). The concept of prototrophs and auxotrophs, Growth of microorganisms: methods of microbial growth, doubling time and growth rate, exponential growth, phases of growth, continuous cultures, synchronous growth, growth of a colony.

UNIT III

Respiration (Aerobic and anaerobic) and fermentation. Metabolism of microorganisms - aerobic and anaerobic metabolism, regulation of metabolism Reproduction and life cycle of bacteria. Life cycle of T4 bacteriophages. Genetic exchange among prokaryotic and eukaryotic microbes. Nature and properties of spores: Bacterial

endospore structure, phenomenon of sporulation, biochemistry and genetics of sporulation. Germination of spores.

UNIT IV

Controlling microorganisms - fundamentals of microbial control, death rate patterns, sterilization. Physical controls on microorganisms - radiation, filtration, drying and osmotic strength. Chemical controls on microorganisms. Preserving food - temperature, pH, water and chemicals.

UNIT V

The concept of disease: Infectious disease, pathogenic microbes, properties of pathogenic microbes, Infection, pathogenesis and virulence. Virulence factore - Capsular materials, bacterial toxins - exotoxins, toxoids, endotoxins, enterotoxins. Physiology of toxin production. Extracellular enzymes of pathogenic bacteria. Microbial genetics - the genetics of antibiotics resistance, Integrons, Transposons.

Text Book(s)

1. Dubey R.C. and D.K. Maheshwari. 2010. A text book of microbiology. S. Chand & Company Ltd. New Delhi.
2. Pelczar M.J. *et al*. 2010. Microbiology. An Application Based Approach. Tata McGraw Hill Education Private Limited, New Delhi.

Reference(s)

1. EL-Mansi. *et al*., 2007. Fermentation Microbiology and Biotechnology. Taylor & Francis, Bosca Raton.
2. Mc Cane L and J. Kandel. 1996. Microbiology – Essentials and applications, McGraw Hill Inc. New York.

SEM: I ***Hours/Week: 4***

12PBT1104 ***Credits: 3***

LAB COURSE 1: MOLECULAR BIOLOGY, GENETICS & MICROBIOLOGY (Core 4)

Cell Biology

1. Isolation of organelles by Differential Centrifugation
2. Cell division – Mitosis, Meiosis
3. Isolation and Study of Polytene chromosome

Genetics

4. Mendelian and Non-Mendelian (Gene Interactions) Inheritance Patterns.
5. Linkage Mapping using three point cross (T.H. Morgan)
6. Hardy Weinberg theorem.

Microbiology

7. Baiting technique
8. Pure culture of Microorganism (Serial Dilution, Streak Plate, Pour plate and Spread plate)
9. Staining Techniques (Simple, Spore, Capsular and Gram)
10. Biochemical tests for identification of Microorganisms (IMViC).
11. Quantification of Microorganisms.
    i. Turbidity Method
    ii. Most Probable Number (MPN)
12. Bacterial growth Kinetics.

SEM: I ***Hours/Week: 4***

12PBT1105 ***Credits: 2***

LAB COURSE 2: BIOCHEMISTRY (Core 5)

Biochemistry

1. Preparation of Standard solutions (Molar & Normal) and various buffers
2. Preparation of Titration curve & determination of pKa values for weak acids and aminoacids
3. Determination of Protein content by Bradford and Lowry *et al*. methods
4. Chromatography: Column Chromatography - Separation of Photosynthetic Pigments and recording their absorption spectra in the visible range
5. Chromatography: Paper chromatography
    i. Determination of RF value of various Amino Acids
    ii. Separation and identification of amino acids by 2D paper chromatography
6. Chromatography: Thin Layer (TLC):
    i. Preparation and activation of TLC plates
    ii. Extraction of Plant (Castor seeds) and Animal lipids (Chick Brain)
    iii. Separation of different fractions by 2D TLC and identification of various types of lipids
7. Enzyme Kinetics
    i. Real time Enzyme velocity
    ii. Substrate curve, Determination of Vmax, ½Vmax and Km values
    iii. pH of the reaction medium and the Enzyme velocity
    iv. Temperature of the reaction medium and the Enzyme velocity

v. Enzyme concentration in the reaction medium and the Enzyme velocity

vi. Optimization of Enzyme assay

vii. Enzyme stability assay

viii. Kinetics of inhibition

Electrophoresis

8. SDS - PAGE: Electrophoretic separation and staining of Proteins
9. Native gel Electrophoretic separation and staining of Proteins
    i. Silver staining
    ii. Coomassie Brilliant Blue

SEM: I ***Hours / Week: 4***

12PBT1201A ***Credits: 4***

DEVELOPMENTAL BIOLOGY(Core Elective-1)

Objectives

- To study the cellular basis of development.
- To elucidate the early development process of humans.

UNIT I

Basic concepts: General concept of organisms development: Potency, commitment, specification, induction, competence, determination & differentiation; morphogenetic gradients; cell fate & cell lineages; genomic equivalence and cytoplasmic determinants; imprinting. General principles of cell-cell communication in development: cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, paracrine factors.

UNIT II

Fertilization, development and sex determination in humans: Gametogenesis - Sperm & Egg formation; ultrastructure of sperm and ovum, egg types, egg membrane. Fertilization, cleavage, Morula, Implantation, blastulation, gastrulation, formation of germ layers, axis formation - anterior and posterior. Sex determination - chromosomes and environment.

UNIT III

Organogenesis - I: Organogenesis: Central nervous system and the epidermis - Formation of neural tube, Differentiation of the neural tube, tissue architecture of the central nervous system, origin of cutaneous structures. Neural crest cells and axonal specificity - Specification, Trunk Neural Crest, Pattern generation in the nervous system.

Organogenesis - II: Plant meristem organization and differentiation - Organization of shoot apical meristem (SAM); Organization of root apical meristem (RAM); Pollen germination

and pollen tube guidance; Phloem differentiation; Self-incompatibility and its genetic control; Embryo and endosperm development; Heterosis and apomixes.

UNIT IV

Organogenesis - III: Paraxial and intermediate mesoderm - Somites formation, Osteogenesis, Urogenital system. Lateral plate mesoderm and endoderm **-** Heart formation, digestive tube and its derivatives.

UNIT V

Implications of developmental biology: Medical implications of developmental biology - genetic disorders in human development, environmental assaults on human development, Future therapies and Developmental biology, Environmental regulation of animal development - Environment as a part of normal development, Polyphenisms and plasticity, Learning system. Mechanisms of Macroevolutionary change - Heterotropy, Heterochrony, Heterometry, and Recruitment.

Text Book

Gilbert S.F. 2010. Developmental Biology, (Ed: 9) Sinauer Associates Inc. Pub., Sunderland, Massachusetts.

Reference(s)

1. Alberts B. *et al.* 2002. Molecular Biology of the Cell, (Ed: 3) Garland Science, New York.
2. Lodish, H. *et al.* 2000. Molecular Cell Biology (Ed: 4) W.H.Freeman, New York.

SEM: I ***Hours / Week: 4***

12PBT1201B ***Credits:4***

CELLULAR ORGANIZATION & CELL SIGNALLING (Core Elective 1)

Objectives

- To study the organization of cells which is the basic requirement to understand the processes taking place in a living cell.
- To understand the principles and mode of communication within and between cells and the biomolecules and factors that govern the cellular communications.

UNIT I: CELLULAR ORGANIZATION 1

Key concepts: comparison of prokaryotes and different eukaryotic cells, evolutionary basis of cellular organization, dynamic nature of cellular organization, physical properties of cells - dimensions, diffusion, biophysical properties of cells. Cell behavior - Adhesion, cell polarity, cell motility, contractility, tissues.

UNIT II: CELLULAR ORGANIZATION 2

Key concepts: properties and dynamics of cytoskeletal proteins (actin, microtubules, intermediate filaments), effects of the cytoskeleton on cellular organization, molecular motors. Structure of membrane and function, lipid bilayer and membrane protein diffusion, osmosis, ion pumps. Structure and function of nucleus, mitochondria, Golgi bodies and plastids.

UNIT III: CELL SIGNALLING 1

Introduction to signaling, Receptors and ligands, Hormones, Neurotransmitter, Transporter, Clearance of signaling molecule. G-protein coupled receptors (GPCRs) - heterotrimeric G-proteins, GPCRs: effectors, Gaseous messengers: NO and CO, Wnt and Hedgehog Signaling, Notch/Delta signaling, Tyrosine kinase - RTKs and cytokine receptors, Src kinases, ras/MAPK pathways, Mitogenic signaling, Focal adhesion signaling.

UNIT IV: CELL SIGNALLING 2

Rac/rho and the cytoskeleton, Pattern recognition receptors, Ion Channels - Gap junction, Voltage-gated, External Ligand-gated and Other Ligand-gated, TGF β-signaling, Lipid signaling - Signaling modularity, Calcium homeostasis, Calcium signaling, Seine/ Threonine phosphatases/kinases, Calcium imaging and quantification.

UNIT V: CELL SIGNALLING 3

Signaling Involved in Cell Survival & Death - Regulation of gene expression, Cell cycle regulation, Apoptosis. Cell Signaling in disease - Cancer/estrogen signaling, Inflammation/Toll-like receptors/NF-kB signaling and Diabetes/roles of ER & mitochondrial signaling. Signaling and Toxins - Bacterial pathogens and signaling, Protozoan parasites and viral pathogens signaling.

Text Book (s)

1. Robert F. Goldberger. 1980. Biological Regulation and Development Vol. 2: Molecular Organization and Cell Function. Plenum Press, New York-London.
2. Bruce Alberts *et al*., 2007. Molecular Biology of the Cell (Ed:5). Garland Science.
3. Friedrich Marks *et al*., 2009. Cellular Signal Processing: An Introduction to the Molecular Mechanisms of Signal Transduction (Ed:1). Garland Science.
4. John Nelson. 2008. Structure and Function in Cell Signaling, Wiley-Blackwell.
5. Thomas D. Pollard *et al*., 2007. Cell Biology (Ed:2): Saunders Publishers, UK.

Reference (s)

1. Brian C Goodwin. 2011. Temporal organization in cells; a dynamic theory of cellular control processes. Nabu Press.
2. Carraway K. and C. Carraway. 2000. Cytoskeleton: Signaling and Cell Regulation: A Practical Approach, Oxford University Press.
3. Sebastien Lansing and Tristan Rousseau. 2010. Cytoskeleton: Cell Movement, Cytokinesis and Organelles Organization (Ed:1). Nova Science Pub Inc.

SEM: I ***Hours/Week: –***

12PBT1301 ***Credits:(3)***

INDUSTRIAL TRAINING (ADDITIONAL CORE 1) (OPTIONAL)

Objectives

- To provide an opportunity to know the possible avenues available in the industrial sector for the Biotechnology graduates so that they could prepare themselves employable in the industry they are interested during the course period.
- To provide an opportunity to the students to have an interaction with the employer and the technology used in the Industry.
- This exercise is optional but could earn additional credits
- This exercise could be for 10 to 15 days during the winter vacation
- Students are permitted to take up the exercise only in reputed companies and Institutions shortlisted by the Department and approved by the Guide and Head of the Department.
- On their return, students should submit a report on their Industrial Visit with the following details and duly signed by the authorized signatory of the company concerned.
    i. Name & Address of the company/Institute
    ii. Division and the Name of the supervisor under whom he/she worked
    iii. Date of joining and date of relieving
    iv. Knowledge acquired
    v. Conduct of the student during this period
- On their return, he/she will present (*viva voce* examination) his experience and the knowledge acquired during this period to the review committee constituted by the guide and the HOD.
- The maximum mark for the Report will be 50 and for the *viva voce* examination 50 and the total credit will be 3.

SEM: II ***Hours / Week: 6***

12PBT2106 ***Credits: 5***

RECOMBINANT DNA TECHNOLOGY (Core 6)

Objectives

- To study the various underlying principles of genetic engineering that forms the basis of rDNA technology.
- To study the methodologies, and in brief the applications and related issues of rDNA technology.

UNIT I

Introduction to Recombinant DNA technology - Isolation (Mechanical, cDNA, Shot gun) & Purification of Nucleic acid, PCR; Enzymes in molecular biology – Restriction endonuclease, Ligases, Reverse transcriptase, Nucleases, Polymerase, Alkaline phosphatase, Terminal transferase, T4 polynucleotide kinase; Linker, Adaptors, Homopolymers.

UNIT II

Expression Cassette – Promoters (Constitutive, Inducible, Tissue specific), Terminators, Reporters, Markers (Antibiotic resistant, Herbicide resistant, Antimetabolite); Vectors in gene cloning – Plasmids (pBR322, pUC), Bacteriophages (Phage l, M13), Cosmids, Phagemids, Yeast plasmid vector, Viral vectors (Adenovirus, Adeno associated virus, Baculo virus, Herpes virus, Retrovirus, Cauliflower mosaic virus, Tobacco mosaic virus, Potato virus X), Transposons (Ac-Ds, P) Artificial chromosome (BAC, YAC, HAC), Shuttle vector, Expression vector.

UNIT III

Gene transfer Methods - Transformation - Physical method (Electroporation, Micro-injection, Particle bombardment, Liposome mediated transfer); Chemical method (PEG mediated, DEAE Dextran mediated, $CaPo_4$ mediated gene transfer); Biological method (Agrobacterium mediated gene transfer). Expression systems - Prokaryotes (Bacteria) and Eukaryotes (Yeast, Mammalian and, Insect cell lines).

UNIT IV

Screening & Selection methods - Insertional inactivation, Blue-White selection, colony - *in situ* hybridization, *In vitro* selection, *In vitro* translation, Radioactive antibody test, Immunological techniques, Rescue techniques, dot blot hybridization.

Blotting techniques - southern, northern, Western and South-western.

UNIT V

Molecular Techniques - RFLP, RAPD, AFLP, DNA Finger printing, DNA Foot printing, Microarray (DNA & Non-DNA).

Libraries - Genomic library; c-DNA library & its types; BAC library; YAC library; Methyl filtration libraries; COT fractionation based libraries.

Bioethics & Biosafety in genetic engineering; IPR & Patenting.

Text Book(s)

1. Glick R. and J.J. Pasternak. 2002. Molecular Biotechnology (Ed:3). ASM Press, Washington.
2. Old R.W. and S.B. Primrose. 1989. Principles of gene manipulation(Ed:4). Blackwell scientific publications, London.

Reference(s)

1. Brown T.A. 1988. Gene cloning –An introduction. VNR (UK) co. Ltd, England.
2. David M. Glove. 1984. Gene cloning - The mechanisms of DNA manipulations. Chapman and hall, New York.
3. Ernst L. Winnacker. 2002. From genes to clones - Introduction to gene technology. VCR Pub., Weinheim.
4. James D. Watson. *et al.* 1992. Recombinant DNA (Ed:2) WH freeman and co., New York.
5. Maniatis T. and J. Sambrook *et al*. 2003. Molecular cloning - A laboratory manual. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

SEM: II ***Hours/Week: 6***

12PBT2107 ***Credits: 5***

IMMUNOLOGY (Core 7)

Objectives

- To elucidate the immune response of humans to foreign substances.
- To study the modern techniques that help determine human protection.

UNIT I

Basics of immunology: Immunity - Types of Immunity, Innate and Acquired Immunity. Cells of the Immune System - B & T Lymphocytes; T-cell sub-sets; Antigen Presenting Cells. Organs of the immune System : Primary lymphoid organs (Bone marrow and Thymus); Secondary lymphoid organs (lymph nodes, spleen and mucosal-associated lymphoid tissue). Antigens - Immunogenecity versus Antigenicity, Factors that influence immunogenecity, Epitopes - Properties of B-cell epitopes and T-cell epitopes, Haptens and the study of Antigenicity.

UNIT II

Immunoglobulin: Structure and Functions domains, classes, Organization and expression of Immunoglobulin Light and Heavy chain genes Principles of cell signaling; Kinetics of immune response, memory; B cell maturation, activation and differentiation; Generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors.

UNIT III

Major Histocompatibility Complex (MHC): General organization and inheritance of MHC; MHC Haplotypes. The structure of MHC class-I and class-II molecules; organization of MHC class I and class II genes, peptide binding of MHC molecules. Complement system-alternate and classical pathways. HLAtyping. Polyclonal and Monoclonal antibody. Transplantation - Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy.

UNIT IV

Antigen-antibody interactions: Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT assay, Immunofluorescence, Flow cytometry and Immunoelectron Microscopy; Surface plasmon resonance, Biosensor assays for assessing ligand - receptor interaction, CMI techniques - lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptosis.

UNIT V

Clinical Immunology: Immunity to Infection: Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity - Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD^{4+} T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Tumor immunology - Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer immunotherapy; Immunodeficiency - Primary immunodeficiencies, Acquired or secondary immunodeficiencies.

Text Book(s)

1. Kuby R.A. Goldsby *et al.,* 2002. Osborne Immunology(Ed: 6) Freeman & Co., New York.
2. Roit M. Ivan. 1998. Essential Immunology (Ed: 7). Blackwell Scientific Publisher, England.

Reference(s)

1. Donald M. Weir and John Steward. 1993. Immunology (Ed: 7). ELBS, London.
2. Janeway C. 2004. Immunology VIED. Garland Science, New York
3. Janis kuby. 1992. Immunology. W.H. Freeman & Co. Ltd., USA.
4. Murphy *et al*., 2008. Janeway's Immunology the immune system in health and disease. (Ed: 7). Garland Science Publisher, New York.

SEM: II ***Hours/Week : 4***

12PBT2108 ***Credits : 3***

LAB COURSE 3: RECOMBINANT DNA TECHNOLOGY (Core 8)

1. Agarose gel electrophoresis
2. Isolation of Genomic and Plasmid DNA from Bacteria
3. Isolation of RNA - Guanidium Thiocyanate - Phenol Chloroform Extraction Method
4. Isolation of DNA from Plant tissue by CTAB method.
5. Isolation of DNA using Phase Lock Gel
6. RFLP
7. Restriction digestion of DNA
8. Ligation of DNA
9. GFP cloning
10. PCR
11. Blotting techniques – Southern, Northern & Western.

SEM: II ***Hours / Week: 4***

12PBT2109 ***Credits: 2***

LAB COURSE 4: IMMUNOLOGY (Core 7)

1. Blood typing.
2. RBC Total and differential count.
3. WBC Total and differential count.
4. Blood smear identification of leukocytes by Giemsa stain.
5. Separation of Peripheral blood mononuclear cells.
6. Isolation of peritoneal macrophage.
7. Generation and purification of chicken egg yolk antibodies
8. Isolation of DNA from leukocytes
9. WIDAL Test
10. Immuno electrophoresis-Rocket immuno electrophoresis.
11. Single radial Immuno diffusion.
12. Ouchterlony double immuno diffusion.
13. Counter current Immuno electrophoresis
14. Quantitative precipitation assay
15. Dot ELISA.

SEM: II ***Hours/Week: 2***

12PBT2302 ***Credit: (2)***

COMPREHENSIVE & SCIENTIFIC WRITING (Additional Core 2)

Objectives

- To develop the skill of comprehension of scientific matter.
- To train in writing scientific paper for given set of data and illustrations.

1. Copies of articles from reputed journal will be given without abstract and the students have to prepare a comprehensive abstract, prepare a power point on the article and make an oral presentation of the paper.

2. Hypothetical observations (data) will be given and the students need to prepare a scientific paper with illustrations using MS Excel, collect references for bibliography, submit the article and also present & defend his/her results and discussions.

SEM – II ***Hours / Week: 4***

12PBT2202A ***Credits: 4***

INTELLECTUAL PROPERTY RIGHT (IPR), CURRENT GOOD MANUFACTURING PRACTICES (CGMP) & ENVIRONMENTAL BIOTECHNOLOGY (Core Elective 2)

Objectives

- To know Patenting and protecting our Intellectual property Rights - Consequences of Globalization.
- To study the basics of Environmental concepts and be aware of the various environmental issues.

UNIT I

Introduction to intellectual property. Types of IP, patents, trademarks, copyrights - related rights, industrial design, traditional knowledge, geographical indications, & protection of GMOs. International framework for the protection of IP. Introduction to the history of GATT, WTO, WIPO & TRIPS.

UNIT II

Basics of patents – types, PCT, Budapest treaty, procedure for filing an application. Patent non/infringement. License: types and classification. Case study: basmati rice & turmeric case.

UNIT III

Regulatory concepts: Basics of good manufacturing processes & practice. Quality assurance and regulation. Current GMP practices. International versus Indian GMP regulation – a comparative study. The various regulatory bodies, eg: US – FDA. An overview on Indian GMP regulation. A brief study about quality control and assurance in pharmaceutical industry and pharmaceutical laboratories.

UNIT IV

Waste water treatment - Preliminary, Primary, Secondary, Tertiary treatment. Treatment schemes for waste waters of dairy, distillery, tannery, antibiotic industries.

Concepts of bioremediation (in-situ and ex-situ), Biosorption and bioaccumulation principles. Concepts of phyto-remediation. Micro-organisms involved in bioremediation and their genetic manipulation. Microbial biotransformation of xenobiotics.

Microbial leaching of ores – Microorganisms involved in leaching and their genetic manipulation - direct and indirect mechanisms – Leaching process (Slope, Heap, *Insitu*)

UNIT V

Biofertilizers and their importance in crop productivity. Bacterial (Nitrogen fixer, phosphate solublizier), Algal and fungal (mycorrhizal) biofertilizers.

Biopesticides : Bacterial (Bt pesticides), Viral (Baculovirus, NPV insecticides), fungal (Trichoderma)

Text Book(s)

1. Jogdand S.N. 1995. Environmental Biotechnology. Himalaya Publishing house, Mumbai.

Reference(s)

1. Bruce E. Rittman, Perry L McCarty. 2001, Environmental Biotechnology Principles and Applications, McGraw Hill, New York.
2. Indu Shekhar Thakur. 2006. Environmental Biotechnology - Basic Concepts and Applications. IK International Pvt. Ltd., New Delhi.
3. Srinivas T. 2008. Environmental Biotechnology. New Age International, New Delhi.
4. India: http://www.pfc.org.in/workshop/workshop.pdf includes basics of patent, copy right, trademark and Industrial Designs.
5. PCT - http://www.wipo.int/pct/en/texts/articles/atoc.htm
6. Treaties: http://www.wipo.int/treaties/en/ip/paris/
7. US-http://www.law.cornell.edu/patent/patent.overview.html

SEM: II ***Hours/Week: 4***

12PBT2202B ***Credits: 4***

CELLULAR, MOLECULAR & IMMUNO DIAGNOSTICS (Core Elective 2)

Objectives

- To know about resources available in the health system and to discuss what the future may hold for molecular diagnostics.
- To describe concepts that provides the foundation for implementing and designing new techniques and assays.

UNIT - I : Tools for diagnostics

Redox - mediated systems, Field Effect Transistors, Thermistors, Conductimeters, Piezoelectric crystals, Optoelectric biosensors, PCR, Electrophoresis, Atomic force microscope, Scanning electron microscope, Transmission electron microscope, Spectroflourimetry, UV-VIS spectrophotometer, FT-IR, Electroporation, Confocal Laser scanning microscope, FISH, Autoradiography, Gas-liquid chromatography, HPLC, NMR, ESR.

UNIT - II : DNA based diagnostics

Types of PCR for DNA and RNA: Reverse Transcriptase-PCR, Real Time - PCR, Inverse PCR, Multiplex PCR, Nested PCR, Alu-PCR, Hot-start, *In situ* PCR, Long-PCR, PCR-ELISA, Arbitrarily primed PCR, RAPD PCR, Ligase Chain Reaction, ARDRA, DGGE, SSCP and TRFLP, G-banding, in *situ* hybridization (FISH and on-FISH) and comparative genomic hybridization (CGH). Applications of PCR and other DNA based techniques- Detection and identification of bacteria, fungus, virus. Genetic diversity studies, forensic science, Determination of Paternity, Mutation detection, Automated DNA sequencing, Microarrays, Southern blotting, Single nucleotide polymorphisms and Microsatellites in molecular diagnosis of genetic disorders and infectious diseases.

UNIT - III : Cellular diagnostics

Genetic and chromosomal disorders: autosomal and allosomal chromosomes; karyotype analysis. Cancer formation and diagnosis - Tumor suppressor genes and oncogenes; Screening, visualization and differentiation of cancer cells for potential anti-cancer therapies;

development of new diagnostic tests, and other innovations for the future; Diagnosis of hematological, thrombotic, and genetic disorders.

UNIT - IV : RNA based diagnostics

Structure, types and function of mRNA, tRNA, rRNA, Ribozymes. Isolation and characterization of RNA - RNA libraries, Northern blotting, RACE, RNA fingerprinting, RNA chips and Micro-arrays, RNA Disruption Assay. siRNA, miRNA, RNAi therapies.

UNIT - V : Imuunodiagnostics

Proteomics - Clinical Proteomics, Phage display concept and its applications, Applications and uses of biosensors, Immunoarrays, FACs, Immuno electrophoresis: rocket immunoelectrophoresis; CIE, Graber and William Technique, RIA, ELISA - Principle, Methodology and applications, Agglutination: Direct and Indirect, Widal test, VDRL test, Immuno fluorescence: Direct, indirect and Sandwich, Western blotting, Immunodiagnostics: diagnosis of infectious diseases, respiratory diseases, Monoclonal antibodies in diagnosis, Immunoblot analysis & immunocytochemical staining, Development of rapid diagnostic tests and their applications, Biochemical diagnostics: Biochemical markers (Antibody markers, CD Markers) of disease diagnosis and their applications.

Text Book(s)

1. Rao J.R *et al.* 2006. Molecular Diagnostics: Current Technology and Applications (Ed. 1), Taylor & Francis, USA.
2. Tsongalis G.J and W. B. Coleman. 2002. Molecular Diagnostics: A Training and Study Guide. AACC Press. Washington D.C.
3. Bruns D.E *et al.* 2007. Fundamentals of Molecular Diagnostics (Ed: 1). Saunders Publishers, UK.

Reference (s)

1. Edwards R. 1999. Immunodiagnostics: A Practical Approach. OUP Oxford Publishers, London.
2. O'Connor L. 2006. Diagnostic Bacteriology Protocol ((Methods in Molecular Biology)
3. (Ed:1). Humana press, New York.
4. Viljoen G.J. *et al.* 2005. Molecular Diagnostic PCR Handbook (Ed:1). Springer publishers, New York.

SEM: II ***Hours/Week: –***

12PBT2303 ***Credits:(5)***

INTERNSHIP (Additional Core 3) (OPTIONAL)

Objectives

- To acquire Hands on skill on the various Industrial processes or the technique developed in the R & D Division of the Industries.
- To prepare and complete the preliminary exercises that will lead to their Main Project.

– This exercise is optional but could earn additional credits.

– This exercise could be for two months, after the 2nd semester (Summer vacation).

– Students are permitted to take up the exercise only in reputed companies and Institutions shortlisted by the Department and approved by the Guide and Head of the Department (preferably where the student did his/her Industrial Training).

– On their return, students should submit a report on their Inplant training with the following details and duly signed by the authorized signatory of the company concerned.

i. Name & Address of the company/Institute
ii. Division and the Name of the supervisor under whom he/she worked
iii. Date of joining and date of relieving
iv. Knowledge acquired
v. Conduct of the student during this period

– On their return, he/she will present (*viva voce* examination) his experience and the knowledge acquired during this period to the review committee constituted by the guide and the HOD.

– The maximum mark for the Report will be 50 and for the *viva voce* examination 50 and the total credit will be 5.

SEM-II *Hours/Week - 4*

12PSK2401 *Credits - 4*

IDC-I: SOFT SKILLS

Unit 1: Effective Communication & Resume Writing 12 Hours

Effective Communication

Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication, Johari Window, The Art of Listening, Kinesthetic, Production of Speech, Organization of Speech, Modes of delivery, Conversation Techniques, Dialogue, Good manners and Etiquettes.

Resume Writing

What is Resume? Types of Resume? Chronological, Functional and Mixed Resume**,** Steps in preparation of Resume.

Unit II: Group Discussion, Interview Skills & Team Building 18 hours

Group Discussion (GD)

Group Discussion Basics, GD Topics for Practice, Points for GD Topics, Case-Based and Article based Group Discussions, Points for Case Studies, and Notes on Current Issues for GD.

Interview Skills

Common interview questions, Attitude, Body Language, The mock interviews, Phone interviews, Behavioral interviews.

Team Building

Team Vs Group – synergy, Stages of Team Formation, Dabbawala-Case Study-PPT, Broken Square-Exercise, Group dynamics, Win as much as you win- Exercise, Leadership – Styles, Work ethics.

Unit III: Personality Development, Attitude & Motivation 18 hours

Personality Development

Self awareness, Assertiveness, Goal setting, Problem-solving, Conflict and Stress Management, Decision-making skills, Positive and Creative thinking, Lateral thinking, Time management.

Attitude

Concept, Significance, Factors affecting attitudes, Positive attitude, Advantages, Negative attitude, Disadvantages, Ways to develop positive attitude, Difference between Personalities having positive and negative attitude.

Motivation

Concept of motivation, Significance, Internal and external motives, Importance of self-motivation, Factors leading to demotivation.

Unit IV: Numerical Ability **8 hours**

- Average, Percentage
- Profit and Loss**,** Simple Interest, Compound Interest
- Time and Work, Pipes and Cisterns
- Time and Distance**,** Problems on Trains**,** Boats and Streams
- Calendar**,** Ratios and Proportions.

Unit- V: Test of Reasoning **8 hours**

Verbal Reasoning

- Series Completion, Analogy
- Data Sufficiency, Assertion and Reasoning
- Logical Deduction

Non-Verbal Reasoning

- Series
- Classification

References

* Aggarwal, R.S. *Quantitative Aptitude*, S.Chand & Sons.
* Aggarwal, R.S. (2010). *A Modern Approach to Verbal and Non Verbal Reasoning*, S.Chand & Co., Revised Edition.
* Alex, K. (2009). *Soft Skills*, New Delhi, S. Chand & Company Ltd.

* Covey, Stephen. (2004). *7 Habits of Highly effective people,* Free Press.

* Egan, Gerard. (1994). *The Skilled Helper* (5th Ed), Pacific Grove, Brooks/Cole.

* Khera, Shiv (2003). *You Can Win*, Macmillan Books, Revised Edition.

* Murphy, Raymond. (1998). *Essential English Grammar*, 2nd ed., Cambridge University Press.

* Prasad, L.M. (2000). *Organizational Behaviour*, S.Chand & Sons.

* Ravindran, G., Elango, S.P.B., Arockiam, L. (2009). *Success through Soft skills*, IFCOT Publications.

* Sankaran, K. & Kumar, M. *Group Discussion and Public Speaking*, M.I. Pub, Agra, 5th ed., Adams Media.

* Schuller, Robert. (2010). *Positive Attitudes*, Jaico Books.

* Thamburaj, Francis (2009). *Communication Soft skills*, Grace Publications.

* Trishna's (2006). *How to do well in GDs & Interviews*, Trishna Knowledge Systems.

** Yate, Martin. (2005). H*iring the Best: A Manager's Guide to Effective Interviewing and Recruiting**

SEM: III ***Hours / Week: 5***

12PBT3110 ***Credits: 5***

BIOPROCESS TECHNOLOGY (Core 10)

Objectives

- To study the avenues of exploiting microbes.
- To study the downstream processes for product recovery in fermentation.

UNIT I

Introduction to fermentation technology: Interaction between chemical engineering, Microbiology and Biochemistry. History of fermentation. Introduction to fermentation processes, Media formulation and optimization. Basic concepts - batch, Continuous and fed batch culture, selection methods for industrially important microorganisms. Strain improvement, preservation, and properties of industrial strains.

UNIT II

Gaden's Fermentation classification, Design and operation of Fermenters, Basic concepts for selection of a bioreactor, Impellers, baffles and sparger, sterilization. Types of reactor - submerged reactor - mechanically stirred draught - tube reactor - continuous flow stir type reactor - airlift reactor - jet loop reactor, surface reactor, packed bed reactor, Fluidized bed reactor.

UNIT III

Production strategies for industrial products (Lactic acid and Ethanol), Production strategies for therapeutics (Insulin and Interferon), Production strategies for antibiotics (Cephalosporin). Bioprocess control and monitoring variables - O_2 requirement and uptake, factors affecting KLa. Flow measurement and control, control system - manual and automatic. PID control. Application and the role of computers in bioprocess.

UNIT IV

Down stream processing: Introduction, recovery of microbial cells, precipitation, filtration - theory of filtration, batch and continuous filters. Centrifugation. Cell disruption-physical and chemical methods. Extraction - liquid - liquid extraction and aqueous - two phase extraction. Chromatography, membrane processes, drying and crystallization.

UNIT V

Bioprocess economics. Bioproduct regulation. General fermentation economics - Strain improvement, market potential, equipment, media, sterilization, heating and cooling, aeration and agitation.

Text Book(s)

1. Stanbury P.F. *et al*. 1999. Principles of Fermentation Technology, (Ed:2) Butterworth-Heinemann, United Kingdom.
2. El-Mansi E.M.T. *et al*. 2007. Fermentation microbiology and biotechnology. (Ed: 2), CRC / Taylor & Francis.

Reference(s)

1. Bailey J and D.F. Ollis. 1986. Biochemical Engineering Fundamentals (Ed: 2): McGraw-Hill, Inc. New York.
2. Cinar A *et al*. 2003. Batch Fermentation - Modeling, Monitoring and Control. Marcel Dekker. USA.

SEM : III ***Hours/Week : 6***

12PBT3111 ***Credits : 5***

BIOINFORMATICS (Core 11)

Objectives

- To understand the importance of various databases.
- To understand various dimension of bioinformatics.

UNIT-I

History of Bioinformatics; Role of Bioinformatics in biological sciences; Scope of Bioinformatics; Types of biological databases; Data mining and its techniques; Data warehousing.

UNIT-II

Nucleic acid databases - Genbank, NCBI, EMBL, DDBJ; Primary protein databases - PIR, SWISSPROT, TrEMBL; Secondary protein databases - PROSITE, PROFILES, PRINTS, Pfam; Structural classification databases - SCOP, CATH; Literature databases - PubMed, Medline; Bibliographic databases - OMIM, PubMed.

UNIT-III

Sequence Annotation - Principles and tools; Sequence retrieval system - Entrez, SRS; Sequence submission tool - BANKIT, SEQUIN, WEBIN, SAKURA.

Introduction to Phylogenetic analysis - Concepts of tree - rooted and unrooted trees; Clustering and Phenetic method, Cladistic method; Steps in constructing phylogenetic analysis; Bootstrapping strategies.

UNIT-IV

Sequence alignment - Local & Global; Pairwise & Multiple; Tools for sequence alignment - BLAST, FASTA, Clustal W; Substitution matrices; Scoring matrices - PAM & BLOSUM; Dot plot; Algorithm (Needleman-Wunsch algorithm and Smith-Waterman algorithm).

UNIT-V

Genomics - Comparative, Structural & Functional genomics; Proteomics - Expression, Structural & Functional proteomics; Applications of Metabolomics & Transcriptomics; Concept of system biology.

Text Book(s)

1. Arthur M Lesk. 2005. Introduction to Bioinformatics(Ed:2). Oxford university press, New York.

Reference(s)

1. Andreas D. Baxevanis and B. F. Francis Ouellette. 2005. Bioinformatics - A Practical guide to the analysis of Genes and Proteins (Ed:3). John Wiley & Sons, Inc., Publications, US.
2. David W Mount. 2004. Bioinformatics: sequence and Genome analysis(Ed:2). Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

Website(s)

- http://www.ncbi.nlm.nih.gov/genbank
- www.phylogeny.fr/
- www.bioinformatics.oxfordjournals.org/egi/content/full/btp228
- www.bioinformatics.org/
- www.ebi.ac.uk/

SEM: III ***Hours / Week: 5***

12PBT3112 ***Credits: 5***

GENES, GENOMES,GENOMICS & PROTEOMICS (Core 12)

Objectives

- To understand thoroughly the concepts and importance of Genes and genomes.
- To understand the principles and significance behind the nature and organization of genes and genomes.
- To study the basic techniques and concepts in genomics and proteomics.
- To understand the applied fields of genomics and proteomics.

UNIT I: Structure & Inheritance of Genes & Genomes

Gene fine structure: concept of the gene, units of genetic structure and genetic function, Gene - cistron relationship in prokaryote and eukaryote Genome size & complexity - C-Value paradox - Structure and types of Chromosomes - Molecular structure of Centromere and Telomere, unique and repetitive sequences - Molecular Organization of Chromosome (Eukaryotic & Prokaryotic) - Mitosis and Meiosis - Segregation of genes, Gene interactions, patterns of single gene inheritance (Autosomal dominance & recessive, sex linked inheritance). Centromere & chromosome stability - Human Karyotype.

UNIT II: Chromosome Mapping

Coupling & Repulsion of Syntenic alleles - Linkage & Crossing over – Map distance and frequency of recombination - Genetic mapping with three point crosses - Mapping by Tetrad analysis (Yeast & Neurospora) - Genetic mapping in Human pedigrees: Maximum likelihood and Lod scores.

Basics of Gene Regulation - Transcriptional regulation in prokaryotes: Inducible and repressible systems of positive and negative regulation - Operon system.

Molecular Evolution & Population Genetics: Molecular Evolution - Population Genetics - Inbreeding Genetics and Evolution

- Mutation and Migration - Natural selection - Random Genetic drift - Tracing Human Heredity through mtDNA.

Unit III: DNA and chromosome variation

(origin of DNA variation: low - copy sequences, dispersed repetitive and tandemly repeated sequences, processes that affect genome size).

Genome Mapping-types and uses. Human physical map.

Sequencing strategies and automation: (maxam and gilbert ,sanger's method,) advanced methods (automated DNA sequencing, pyrosequencing, MPSS,BAC end sequencing).

Human Genome Project.

UNIT IV

Functional genomics (**Functional studies at genetic level):** Genetic interaction mapping, Transcriptome profiling: Microarray, ChIP, SAGE) RNAi.-Studying gene function through protein-protein interaction. (Phage display, yeast two hybrid,) Loss of function techniques (mutagenesis and RNAi). Functional annotation of genes. **Structural genomics:** (methods, protein structure database), **Comparative genomics**: Tools for comparative genomics-sequence alignment tools (VISTA), Gene finding tools: (*GenScan*).

UNIT V

Proteomics: Protein expression analysis by 2-DE, 2D-MALDI-TOF MS, LC-MS/MS, Quantitative proteomics. Tandem Mass spectrometry, peptide mass fingerprinting. Mining the proteome, Protein expression profiling, Protein tags; protein arrays and antibody arrays.

Book(s)

1. Daniel L. Hartl and Elizabeth W. Jones. 2009. Genetics (Ed: 7) Jones and Barlett Publushers Inc, Subury.
2. Primrose S.B. and Twyman R.M. 2004. Principles of Genomics and Proteomics (Ed: 3). Blackwell Science Ltd. Oxford, UK.
3. Westermeier R. and Naven T. 2002. Proteomics in Practice: A Laboratory Manual of Proteome Analysis, John Wiley & Sons Ltd, England.

Reference(s)

1. Brown T.A. 2007. Genomes 3. Garland Science Publishing.
2. Cullis C.A. 2004. Plant Genomics and Proteomics. John Wiley & Sons, Inc., Hoboken, New Jersey.
3. Dale J.W. and M.V. Schantz. 2002. From Gene to Genomes: Concepts and Applications of DNA Technology, John Wiley& Sons Ltd., England.
4. Grandi G. 2004. Genomics, Proteomics and Vaccines, John Wiley & Sons Ltd., England.
5. Jocelyn E Krebs *et al.* 2011. Lewin's Genes X (Ed:10).Jones and Barlett Publishers Inc., Subury.
6. Liebler D.C. 2002. Introduction to Proteomics: Tools for the new biology, Humana Press, Totowa, New Jersey.

SEM: III ***Hours/week: 3***

12PBT3113 ***Credits: 2***

LAB COURSE 5: BIOINFORMATICS & BIOSTATISTICS (Core 13)

Bioinformatics

1. Biological databases
2. Sequence analysis: Pairwise alignment (BLAST)
3. Sequence analysis: Multiple alignment (Clustal W)
4. Phylogenetic analysis
5. Six frame translation
6. Primer designing

Biostatistics

7. Random sampling by Random Number Table (Tipett's) Method (Cluster Bean N = 500 ? n = 50).
8. Data Collection on discrete and continuous variables.
9. Data classification: Discrete frequency distribution, Continuous frequency distribution and Cumulative frequency distribution.
10. Statistical Illustrations - Manual and Computer aided using Microsoft Excel.
11. Measure of Central values (Mean, Median and Mode) for the data collected in the earlier exercises.
12. Determining the correlation coefficient between pod length & Pod weight and testing the relationship.
13. Training on the SPSS (Statistical Soft Ware).

SEM: III *Hours/week: 3*

12PBT3114 *Credits: 3*

LAB COURSE 6: PLANT TISSUE CULTURE & BIOPROCESS TECHNOLOGY (Core 11)

Plant Tissue Culture

1. Preparation of Stock solutions for MS Medium & Preparation of MS Medium.
2. Preparation of sterile Explants.
3. Production of different types of callus by altering the type and concentration of Plant growth Hormones.
4. Direct and indirect organogenesis.
5. Rooting, Hardening and field establishment
6. Production of Somatic Embryos and synthetic Seeds
7. Suspension Culture and the Kinetics of cell multiplication.
8. Protoplast isolation and fusion.

Bioprocess Technology

9. Fermentation Kinetics.
10. Microbial Production of amino acids.
11. Screening and isolation of Antibiotic producing organisms from soil.
12. Microbial production of Lactic acid.
13. Production of cellulase by solid state fermentation.

SEM: III ***Hours/Week: 4***

12PBT3203A ***Credits: 4***

BIOINSTRUMENTATION & BIOSTATISTICS (Core Elective 3)

Objectives

- To understand the working principles, construction and applications of the instruments often used in the studies related to Biotechnology.
- To understand the statistical concepts and applying them in data collection, analysis and interpretation.

UNIT I

Microscopy: Light microscope, Electron Microscope – SEM & TEM, Florescence Microscope.

pH Meter: pH - definition. Principle of pH meter, Electrodes, Construction and measurement of pH. Buffers: Types, Preparation, and Uses. Preparation of Standard (Molar & Normal) solutions.

Centrifuges: Principles, Types and Applications.

UNIT II

Chromatography: Basic principles, Adsorption and Partition Chromatography: Column Chromatography, Paper Chromatography, Thin layer Chromatography, Gas Chromatography, HPLC, HPTLC, Ion exchange chromatography, Molecular Sieve, Affinity Chromatography.

Electrophoresis: Basic Principles, Construction, operating procedure, Types and their applications. Iso-electric focusing, Factors determining the electrophoretic mobility of the molecules.

UNIT III

Spectrophotometry: Principles, types, Construction and applications of UV/VIS spectrophotometer, Flame Photometer (Emission Spectrophotometry), Atomic Absorption Spectrophotometer.

Tracer technique: Nature of Radioactivity, Patterns of decay, half life and its application, Detection and measurement of radioactivity: Geiger Muller Counter - principle, construction,

applications, advantages and disadvantages. Scintillation counter - Principle, types, construction and applications. Use of isotopes in biological studies.

UNIT IV

Definition of Biostatistics, Parametric and non-parametric statistics. Population, Sample, Sampling distribution, Sampling Techniques, Data collection, Classification, tabulation and diagrammatic presentation.

Measures of Location: Measures of Central values - Mean, Median and Mode. Measures of dispersion - Range, Mean Deviation, Standard Deviation, coefficient of variation, Skewness & kurtosis.

Probability: Binomial, Poisson and Normal distributions.

UNIT V

Correlation: Definition, Types, Measurement, Karl Pearson's Coefficient of Correlation. Regression (simple & Linear only) analysis

Test of Significance: General Procedure. Confidence interval, errors, Large sample test, Small sample (t, chi-square) tests

Principles of Experimental designs - Randomization, Replication, Local control, Size & shape of the plot., CRD, RBD, One way and two way ANOVA. Basics of Muetrovariate.

Text Book(s)

1. Jerrold H. Zar. 2008. Biostatistical Analysis (Ed: 4). Pearson Education, New Delhi.
2. Upadhyay A. *et al*. 2009. Biophysical Chemistry – Principles and Techniques (Ed: 4). Himalaya Publishing House, Chennai.

Reference(s)

1. Anbalagan K. 1985. Electrophoresis a Practical Approach. Life Science Book House, Madurai.
2. Gupta S. 2008. Elementary statistical Methods (Ed: 7). Sultan Chand & Sons, New Delhi.
3. Jayaraman J. 1972. Techniques in Biology. Higginbothoms Pvt. Ltd, Madras.

4. Ragava Rao D.1883. Statistical Techniques in Agricultural and Biological Research. Oxford & IBH Publishing Co., New Delhi.

5. Stock R. and C.B.E. Rice. 1977. Chromatographic Methodes, Chapman and Hall Ltd., London.

6. Wilson K. and J. Walker.2000. Practical Biochemistry: Principles and Techniques (Ed: 5). Oxford University Press, UK.

SEM: III ***Hours / Week: 4***

12PBT3203B ***Credits: 4***

DRUG DYNAMICS & DESIGN (Core Elective 3)

Objectives

- Understand the mechanisms of drug biology in human system.
- Designing the steps in the process of drug discovery.

UNIT I: General concepts of drugs

Drugs - definition, source and nature, classification and nomenclature. Pharmacokinetics and Pharmacodynamics of drugs. Drug metabolism - phase I and phase II biotransformation, microsomal and non-microsomal biotransformation reactions.

UNIT II: Molecular dynamics

Molecular Dynamics using simple models. Dynamics with continuous potentials. Constant temperature and constant dynamics. Conformation searching, Systematic search. Applications to protein folding.

UNIT III: Protein structure prediction

Prediction of protein structure from sequences, functional sites, Protein folding problem, protein folding classes, protein identification and characterization. Primary structure analysis and prediction, Secondary structure analysis and prediction, motifs, profiles, patterns and fingerprints search. Modelling by Homology - alignment, construction of frame work, selecting variable regions, side chain placement and refinement, validation of protein models - Ramachandran plot, threading and *ab initio* modeling.

UNIT IV: Basic concepts of drug design

Drug Designing - Introduction to QSAR. Lead module (biological activities, physicochemical parameters and molecular descriptors) - linear and nonlinear modeled equations. Structure Based Drug Design: *De novo* Ligand design - 3D pharmacophores, molecular docking, Free energies and solvation.

UNIT V: Refinements for drug design

3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries - generation and utility. Molecular targets and pathways relevant to disease processes - receptors - channels - transporters and enzymes as drug targets.

Text Book(s)

1. Andrew R. Leach. 2001. Molecular Modelling. Principles and Applications (Ed: 2). Pearson Education EMA, Prentice Hall. UK.
2. Merz K.M *et al*. 2010. Drug Design: Structure and Ligand Based Approaches. Cambridge University press, Cambridge.
3. Hillisch A. and R. Hilgenfeld. 2003. Modern Methods of Drug Discovery. Birkhauser BioSciences, Springer Verlag, New York.
4. Todeschini R. *et al*. 2002. Handbook of Molecular Descriptors, Wiley-VCH Verlagsgesellschaft mbH. London.

Reference(s)

1. Beck-Sickinger A. and P. Weber. 2002. Combinatorial Strategies in Biology and Chemistry. John Wiley & Sons. UK.
2. Ghose A.K. and V.N. Viswanadhan. 2001. Combinatorial Library Design and Evaluation. Principles, Software, Tools, and Applications in Drug Discovery. CRC Press. USA.
3. Chasman D. 2003. Protein Structure. Determination, Analysis and Application for Drug Discovery. CRC Press. USA.
4. Vogel H. 2002. Drug Discovery and Evaluation. Springer Verlag, New York.

SEM: III ***Hours / Week: 4***

12PBT3402 ***Credits: 4***

IDC-II: APPLIED BIOTECHNOLOGY

Objectives

- To understand the basics of rDNA technology.
- To understand the importance and application of genetic engineering for human welfare.

UNIT I

Basics of cellular organization: Introduction to prokaryotes and eukaryotes cell. Structure and function of cell organelles. Similarities and variations in structural and genetic organization between prokaryotes and eukaryotes.

Introduction to nucleic acids: Structure of DNA, RNA and nucleic acids types.

Fundamental processes: Transcription, translation and replication.

UNIT II

Introduction to Recombinant DNA technology: Vectors - plasmids-PBR322, Methods of gene transfer -electroporation and microinjection.

Application of plant transformation technology: Genetically improved crops - Golden rice, Flavr Savr tomato, Bt cotton)

Animal biotechnology: Transgenic animals-methods of production and applications (transgenic live stock production, transgenic fishes, pigs, cows).

UNIT III

Environmental biotechnology: Biotechnological methods to detect the pollutants in environment (Biosensors).

Waste water treatment: Primary, secondary-trickling filters, activated sludge process and tertiary treatment of sewage.

Bioremediation: Biodegradation principle, methods, importance, applications: superbug.

UNIT IV

Biotechnological methods in disease diagnosis: DNA based diagnosis, monoclonal antibodies.

Vaccines: Conventional vaccines, DNA vaccines.

Assisted reproductive technology: IVF.

UNIT V

Bioreactor – basic design, basic types (Surface and submerged reactors).

Bioprocess technology: Commercial production of enzymes, organic acids - lactic acids, acetic acid, amino acids - glutamate and beverages-Beer, wine. Application of recombinant DNA technology in industrial biotechnology.

Text Book(s)

1. Satyanarayana U.G. 2006. Biotechnology. Books and Allied [P] Ltd, Kolkata.

Reference(s)

1. Adrian Slater *et al.* 2003. Plant Biotechnology - The genetic manipulation of plants (Ed: 2). Oxford University press, New York.
2. Brown T.A. 2006. Gene cloning and DNA analysis - an introduction (Ed: 5). Blackwell Science ltd. Oxford, UK.
3. Glick B.R. and Pasternak J.J. 1998.Molecular Biotechnology: Principle and Applications of recombinant DNA (Ed: 2). ASM Press, Washington, USA.
4. Stanbury P.F. and Whitaker A. 1995. Principles of Fermentation Technology (Ed: 2). Elsevier Science Ltd, Kidlington.

SEM: IV ***Hours / Week: 6***

12PBT4115 ***Credits: 5***

PLANT & ANIMAL BIOTECHNOLOGY (Core 15)

Objectives

- To study the basic principles and Techniques involved in plant and animal cell culture.
- To understand the concepts of transformation and achievements of biotechnology in Plant and Animal systems.

UNIT I

Establishment of plant tissue culture: culture media (types of media), explants and its preparation, Types of culture (callus, suspension, Meristem, Embryo, Protoplast, Root cultures), Regeneration of plants (organogenesis and Somatic embryogenesis), Haploid plant production (androgenesis and gynogenesis). Isolation and fusion of Protoplast, Artificial seeds, Hardening of plants, Cryopreservation and Germplasm storage. Applications of plant tissue culture in Agriculture and Forestry.

UNIT II

Introduction of genetic engineering of plants - Vector (Viral vectors and Ti & Ri plasmids) and Gene transfer methods (Electroporation, Particle bombardment, Microinjection). Chloroplast transformation.

Transgenic plants - Biotic stress resistance (Pest, Viral, Bacterial & Fungal), Abiotic stress tolerance (Herbicide, Salt, Drought), Crop improvement (*Flavr Savr* tomato, Golden rice, Amino acid enrichment, Preventing discolouration, Improving flower pigmentation, Male sterility).

UNIT III

Transgenic plant as bioreactors – Plantibodies, Therapeutic proteins and Edible vaccines.

Introduction to animal tissue culture - culture media. Primary cell culture. Development and maintenance of cell lines. Infinite and finite cell lines, Suspension culture, Embryo culture, Organ and Histotypic cultures.

UNIT IV

Lab based and large-scale culture. Cell synchronization. Cryobiology. Applications of animal cell culture. Stem cells - isolation, culture, manipulation and applications.

Gene therapy-method, gene delivery systems and applications. Production and applications of monoclonal antibodies.

UNIT V

Methods of animal cloning (Somatic nuclear transfer, Chromatin transfer, Embryo splitting) and its pros& cons. Methods of production of transgenic animals (Transfection, Retroviral vector, Microinjection, Embryonic stem cells, YAC, Gene trageting) and its applications (Human disease models, Gene knockout mice, Transgenic cattle, sheep, fish, Chickens).

Transgenic animals as bioreactors - Therapeutic proteins, Vaccines, Recombinant Insulin.

Text Book(s)

1. Adrian Slater *et al.* 2003. Plant Biotechnology – The genetic manipulation of plants. Oxford University press, USA.
2. Ranga M.M. 2010. Animal Biotechnology, Agrobios ,India.

Reference(s)

1. Butler M. 1987. Animal cell technology- Principles and procedures. Open University press, New York
2. Darling D.C. and S.J Morgan. 1994. Animal cell cultures and media. BIOS scientific publishers Ltd, London.
3. Ed. Martin Clynes. 1998. Animal Cell Culture Techniques. Springer, Heidelberg.
4. Gamborg O.L and Philips, G.C. 1995. Plant Cell, Tissue and organ culture - Fundamental methods. Narosa Publishing House, New Delhi.

5. Kalyan Kumar. 1992. Plant tissue culture. New central book agency. Calcutta.
6. Robert N. Trigiano and Dennis J. Gray. 1996. Plant Tissue Culture - Concept and Laboratory Exercises. CRC press, London.
7. Roberta Smith. 2000. Plant Tissue Culture - Techniques and Experiments(Ed: 2). Academic Press, New York.
8. Spier R.E and Griffiths J.B. 1988. Animal cell biotechnology. Academic press, New York.

SEM : IV ***Hours / Week: 6***

12PBT4116 ***Credits: 5***

REGULATION OF GENE EXPRESSION (Core 16)

Objectives

- To understand the mechanisms of gene regulation in various groups of organism so us to plan the genetic engineering experiments.
- To understand the regulation of gene during the various stage of development of an organism.

UNIT I

Central Dogma - Need for gene regulation. Gene regulation in Prokaryotes: Gene Expression by regulatory proteins, Regulation by activators and repressors, Allostery: Post RNA polymerase binding & Action at distance and, Anti-termination and beyond.

UNIT II

Regulation of transcription initiation: Bacteria: Lac gene - Activator and repressor together control, Combined control of CAP on other genes. S factor, NtrC & MerR Transcriptional activators. AraC and control of araBAD operon. Gene regulation after Transcription initiation: Premature transcription termination Regulation in Phage l. Ribosomal Proteins as repressors.

UNIT III

Transcriptional - Level Control: Role of Transcription factors - Structure of transcription factors - DNA sites involved in regulation - Transcriptional Activation: Role of Enhancers, Promotors, and coactivators - transcriptional repressors. Processing level control - Translational level control: Cytoplasmic localization of mRNA, Control of mRNA translation, control of mRNA stability - Post translational control, Determining Protein stability.

UNIT IV

Gene regulation in Eukayotes: transcriptional Regulation in Yeast & Mammals. Eukaryotic Activators - Signal Integration &

Combinatorial control. Transcriptional repressors. Signal transduction and the control of transcriptional regulators. Gene silencing by modification of Histones and DNA - regulation after transcription initiation - RNAs in gene regulation. Regulation of gene expression in Plant cells by light. Regulation of synthesis of Vitellogenin. Human Gene Expression.

UNIT V

Gene regulation during development. Expression of specific sets of genes during development - Establishing differential gene expression. Regulation of gene during *Drosophila* embryogenesis.

Text Book (s)

1. Freifelder D. 2008. Molecular Biology (Ed. 2). Narosa Publishing House. New Delhi (pp. 453 -550)
2. Gardner E.J. *et al*. 2004. Principles of Genetics (Ed. 8). John Wiley & Sons, Inc. NY. (pp 390 – 487)
3. Watson J.D. *et al*. 2006 Molecular Biology of the Gene (Ed. 5),Pearson Education INC. London. (pp 483 – 612)

Reference (s)

1. Karp G. 2008. Cell & Molecular Biology - Concepts and Experiments. John Wiley & Sons Inc. USA (pp 485 – 541)
2. Strachan T. and Read A. 2011. Human Molecular Genetics (Ed. 4) Garland Science. USA (pp 345 -380)

SEM: IV ***Hours / Week: 6***

12PBT4117 ***Credits: 5***

EMERGING TRENDS IN BIOTECHNOLOGY (Core 17)

Objectives

- To acquaint the students newer developments in Biotechnology and their potential roles in human welfare.

UNIT I (Medical Biotechnology - I)

Drug Development - Production of pharmaceuticals by genetically engineered cells (hormones, interferons), Microbial transformation for production of steroids and semi-synthetic antibiotics, Techniques for development of new generation antibiotics, Protein engineering, Pharmacogenomics - drug design and targeting. Disease diagnosis and therapy - ELISA and hybridoma technology, DNA vaccine, gene therapy and toxicogenomics.

UNIT II (Medical Biotechnology - II)

Cell and Tissue transplantation, Diagnosis and Kit Development - Use of enzymes in clinical diagnosis, Use of biosensors for rapid clinical analysis. Identification and isolation of disease genes - positional cloning, functional cloning, DNA and cDNA microarrays.

UNIT III (Nanobiotechnology)

The nanoscale science, dimension, paradigm and principles. DNA based Nano structures. Protein based Nano structures. Biosynthesis of Nanoparticles and Nanotubes, Nanobiometrics - Introduction - lipids as nanobricks and mortar: self assembled nanolayers. Nanocomposites - biologically derived synthetic nanocomposites, Nano analytics - quantum dot biolabeling, nanoparticle molecular labels. Nano simulation - Molecular Manufacturing. Nano-bio applications and bioinformatics, Quantum computing and informatics.

UNIT IV (Stem cells - I)

Stem cells - definition; unique properties - proliferation, differentiation and potency. Isolation, culture, identification and assays of stem cells. Types: Embryonic and adult stem cells. Stem cell niches, Stem cell renewal, Cell cycles regulators in stem cells. Hematopoietic Stem Cells: Identification, Characterization, Assays and Cell Lineages.

UNIT V (Stem cells - II)

Stem cell based therapies - Current State and Future Perspectives, Embryo culture, transplantation and teratogenesis. Controversies and Guidelines for hES cell research, Current regulation of Human Embryonic Stem Cell Research. Prospects of Stem Cell research.

Text book(s)

1. Albert Sasson, 2005. Medical Biotechnology: Achievements, Prospects and Perceptions United Nations.
2. Chiu A. and M. Rao. 2003. Human Embryonic Stem Cells, Humana Press.
3. Davis Baird et al., 2004. Discovering the Nanoscale. I O S Press.
4. Jennie P. Mather. 2008. Stem cell culture (Ed:1) Elseiver/ Academic Press, Amsterdam; Boston.
5. Mick Wilson *et al*., 2002. **Nanotechnology: Basic Science and Emerging Technologies (Ed:1)**. Chapman and Hall/CRC**.**
6. Pongracz & Keen. 2009. Medical Biotechnology (Ed:1), Churchill Livingstone.
7. Raphael Gorodetsky *et al*., 2011. Stem cell based tissue repair. RSC Publishing.

Reference(s)

1. Ann A. Kiessling. 2003. Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential. Jones and Bartlett Publishers, Inc.
2. Michael Rusehttp://www.amazon.com/Stem-Cell-Controversy-Contemporary-Prometheus/dp/1591024048/ref=pd_sim_sbs_b_4, Christopher A. Pynes. 2006. The Stem Cell Controversy: Debating the Issues. Prometheus Books.

SEM: IV ***Hours/Week: 12***

12PBT4501 ***Credit: 5***

PROJECT

- Outstanding students (First 10 ranks in Semester 1 & 2 aggregate) can take up outstation project in Reputed Institutions only. The background, Objectives, Methodology of the project work have to be presented and got approved by the review committee constituted by the Guide and the HOD before pursuing the project further.
- The students taking up outstation project should also take up the three theory papers. However they have to do it as a self study.
- The students taking up outstation project should take up all the Internal components, such as Midsemester, Endsemester and the three CIA components.
- The three CIA components could be attended from the Project station itself through online objective type tests.
- However it is mandatory that they need to come to the college to take up the Midsemester, Endsemester and Semester Examinations the dates of which are printed in the College Calendar.
- All the other students will follow the regular system as found in the course content of the syllabus.

INTER DEPARTMENTAL COURSE – IDC

BIOCHEMISTRY

12PSK2401 SOFT SKILLS

12PBI3402 FIRST AID MANAGEMENT

BIOTECHNOLOGY

12PSK2401 SOFT SKILLS

12PBT3402 APPLIED BIOTECHNOLOGY

BOTANY

12PSK2401 SOFT SKILLS

12PBO3402 HORTICULTURE & LANDSCAPING

CHEMISTRY

12PSK2401 SOFT SKILLS

12PCH3402 HEALTH CHEMISTRY

COMMERCE

12PSK2401 SOFT SKILLS

12PCO3402 FINANCIAL ACCOUNTING FOR MANAGERS

COMMERCE (CA)

12PSK2401 SOFT SKILLS

12PCC3402 CAREER PLANNING AND MANAGEMENT

COMPUTER APPLICATIONS

12PSK2401 SOFT SKILLS

12PCA3402 COMPUTER APPLICATIONS FOR SOCIAL SCIENCES

12PCA3403 FUNDAMENTALS OF PROGRAMMING

COMPUTER SCIENCE

12PSK2401 SOFT SKILLS

12PCS3402A FLASH

12PCS3402B WEB DESIGN

ECONOMICS

12PSK2401 SOFT SKILLS

12PEC3402 INDIAN ECONOMY

ELECTRONICS

12PSK2401 SOFT SKILLS

12PEL3402 COMPUTER HARDWARE

ENGLISH

12PSK2401 SOFT SKILLS

12PEN3402 ENGLISH FOR MEDIA STUDIES

HISTORY

12PSK2401 SOFT SKILLS

12PHI3402 INDIAN CONSTITUTION

HUMAN RESOURCE MANAGEMENT

12PSK2401 SOFT SKILLS

12PHR3402 FUNDAMENTALS OF HRM

INFORMATION TECHNOLOGY

12PSK2401 SOFT SKILLS

12PIT3402A FLASH

12PIT3402B WEB DESIGN

MATHEMATICS

12PSK2401 SOFT SKILLS

12PMA3402 OPERATIONS RESEARCH

PHYSICS

12PSK2401 SOFT SKILLS

12PPH3402 MODERN PHOTOGRAPHY

TAMIL

12PSK2401 நுண்வகைமைத்திறன்கள்

12PTA3402 அரசுப்பணித்தேர்வுத் தமிழ் - I