

M. Sc. BIOCHEMISTRY
SYLLABUS - 2014

**SCHOOLS OF EXCELLENCE
with
CHOICE BASED CREDIT SYSTEM (CBCS)**



**SCHOOL OF BIOLOGICAL SCIENCES
St. JOSEPH'S COLLEGE (Autonomous)**

Accredited at 'A' Grade (3rd Cycle) by NAAC
College with Potential for Excellence by UGC
TIRUCHIRAPPALLI - 620 002, INDIA

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS)

POST GRADUATE COURSES

St. Joseph's College (Autonomous), a pioneer in higher education in India, strives to work towards the academic excellence. In this regard, it has initiated the implementation of five "Schools of Excellence" from this academic year 2014 – 15, to standup to the challenges of the 21st century.

Each School integrates related disciplines under one roof. The school system allows the enhanced academic mobility and enriched employability of the students. At the same time this system preserves the identity, autonomy and uniqueness of every department and reinforces their efforts to be student centric in curriculum designing and skill imparting. These five schools will work concertedly to achieve and accomplish the following objectives.

- Optimal utilization of resources both human and material for the academic flexibility leading to excellence.
- Students experience or enjoy their choice of courses and credits for their horizontal mobility.
- The existing curricular structure as specified by TANSCH and other higher educational institutions facilitate the Credit-Transfer Across the Disciplines (CTAD) - a uniqueness of the choice based credit system.
- Human excellence in specialized areas
- Thrust in internship and / or projects as a lead towards research and
- The **multi-discipline** nature of the newly evolved structure (School System) caters to the needs of stake-holders, especially the employers.

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 correlation between credits and hours.

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

For PG courses a student must earn a minimum of 110 credits. The total number of courses offered by a department is given above. However within their working hours few departments / School can offer extra credit courses.

SUMMARY OF HOURS AND CREDITS PG COURSES - BIOCHEMISTRY

Part	Semester	Specification	No. of Courses	Hours	Credits	Total Credits
1	I-IV	Core Courses Theory Courses Laboratory Courses	12 6	62 22	56 16	81
	II	Self Paced Learning	1	-	2	
	IV	Comprehensive Examination	1	-	2	
	IV	Project Dissertation & Viva Voce	1	12	5	
2	III-IV	Core Electives	3	12	12	12
3	I-III	IDC (WS) IDC (Common) IDC (BS)	1 1 1	4 4 4	4 4 4	12
4	I-IV	Additional Core Courses	-	-	-	
5	IV	SHEPHERD & Gender Studies	-	-	5	5
		TOTAL			120	110

IDC – Inter Departmental Courses

BS – Between School

WS – Within School

Total Hours : 120

Total Credits : 110

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 110 credits. The total number of courses offered by a department is given above. However within their working hours few departments / School can offer extra credit courses.

Course Pattern

The Post Graduate degree course consists of five vital components. They are cores courses, core electives, additional core courses, IDC's and SHEPHERD. Additional Core courses are purely optional on the part of the student. SHEPHERD, the extension components are mandatory.

CORE COURSE

A core course is the course offered by the parent department related to the major subjects, components like theories, practicals, self paced learning, common core, comprehensive examinations, dissertations & viva voce, field visits, library record form part of the core courses.

CORE ELECTIVE

The core elective course is also offered by the parent department. The objective is to provide choice and flexibility within the School. There are three core electives. It is offered in different semester according to the choice of the school.

ADDITIONAL CORE COURSES (If any)

In order to facilitate the students gaining extra credit, the additional core courses are given. The students are encouraged to avail this option of enriching with the extra credits.

INTER DEPARTMENTAL COURSES (IDC)

IDC is an interdepartmental course offered by a department / School for the students belonging to other departments / school. The objective is to provide mobility and flexibility outside the parent department / School. 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.

There are three IDC's. Among three, one is the Soft-Skill course offered by the JASS in the II Semester for the students of all the Departments. The other one is offered "With-in the school" (WS) and the third one is offered "Between the school" (BS). The IDC's are of application oriented and inter disciplinary in nature.

Subject Code Fixation

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

14 ↓	PXX ↓	X ↓	X ↓	XX ↓
Year of Revision	PG Code of the Dept	Semester of the Part	Specification of Part	Running number in the part
14	PBC	1	1	01

For Example :

I M.Sc. Biochemistry, first semester, Biomolecular Chemistry

The code of the paper is 14PBC1101.

Thus, the subject code is fixed for other subjects.

Specification of the Part

1. Core Courses: (Theory, Practical, Self paced Learning, Common Core, Comprehensive Examination, Dissertation and Viva-voce)
2. Core Electives
3. Additional Core Courses (if any)
4. Inter Departmental Courses (WS, Soft Skill & BS)
5. SHEPHERD & Gender Studies

EXAMINATION

Continuous Internal Assessment (CIA):

PG - Distribution of CIA Marks	
Passing Minimum: 50 Marks	
Library Referencing	5
3 Components	35
Mid-Semester Test	30
End-Semester Test	30
CIA	100

MID-SEM & END – SEM TEST

Centralised – Conducted by the office of COE

1. Mid-Sem Test & End-Sem Test: (2 Hours each); will have Objective + Descriptive elements; with the existing question pattern PART-A; PART-B; and PART-C
2. CIA Component III for UG & PG will be of 15 marks and compulsorily objective multiple choice question type.
3. The CIA Component III must be conducted by the department / faculty concerned at a suitable computer centres.
4. The 10 marks of PART-A of Mid-Sem and End-Sem Tests will comprise only: OBJECTIVE MULTIPLE CHOICE QUESTIONS; TRUE / FALSE; and FILL-IN BLANKS.
5. The number of hours for the 5 marks allotted for Library Referencing/ work would be 30 hours per semester. The marks scored out of 5 will be given to all the courses (Courses) of the Semester.

SEMESTEREXAMINATION

Testing with Objective and Descriptive questions

Part-A: 30 Marks

Objective MCQs only

Answers are to be marked on OMR score-sheet. The OMR score-sheets will be supplied along with the Main Answer Book. 40 minutes after the start of the examination the OMR score-sheets will be collected

Part-B + C = 70 Marks

Descriptive

Part-B: $5 \times 5 = 25$ marks; inbuilt choice;

Part-C: $3 \times 15 = 45$ marks; 3 out of 5 questions, open choice.

The Accounts Paper of Commerce will have

Part-A: Objective = 25

Part-B: $25 \times 3 = 75$ marks.

Duration of Examination must be rational; proportional to teaching hours
90 minute-examination / 50 Marks for courses of 2/3 hours/week (all Part IV
UG Courses) 3-hours examination for courses of 4-6 hours/week.

EVALUATION

Percentage Marks, Grades & Grade Points

UG (Passing minimum 40 Marks)

Qualitative Assessment	Grade Points	Grade	Mark Range %)
Exemplary	10	S	90 & above
Outstanding	9	A+	85-89.99
Excellent	8	A	80-84.99
Very Good	7	B	70-79.99
Good	6	C	60-69.99
Pass (PG)	5	D	50-59.99
RA(PG)	0	RA	<50

CGPA - Calculation

Grade Point Average for a semester is calculated as indicated here under:

Sum total of weighted Grade Points

Sum of Credits

Weighted Grade Points is ***Grade point x Course Credits***. The final CGPA will only include: Core, Core Electives & IDCs.

A Pass in SHEPHERD will continue to be mandatory although the marks will not count for the calculation of the CGPA.

CLASS	POSTGRADUATE	
	Mark Range (%)	
	ARTS	SCIENCES
Distinction	75 & above, first attempt	80 & above, first attempt
First	60 - 74.99	60 - 79.99
Second	50 - 59.99	50 - 59.99

Declaration of Result:

Mr./Ms. _____ has successfully completed the Post Graduate in _____ programme. The candidate's Cumulative Grade Point Average (CGPA) is _____ and the class secured _____ by completing the minimum of 110 credits.

The candidate has also acquired _____ (if any) additional credits from courses offered by the parent department.

M. Sc. Biochemistry
Course Pattern - 2014 Set

Sem	Course Code	Course Title	Hrs	Credits
I	14PBC1101	Biomolecular Chemistry	6	5
	14PBC1102	Molecular Biology	6	5
	14PBC1103	Enzymology and Bioenergetics	6	5
	14PBC1104	Lab Course - 1	4	3
	14PBC1105	Lab Course - 2	4	3
	14PBC1106	<i>Self paced learning</i> – Biochemical Calculations	-	2
	14PBC1201 A	Developmental Biology	OR	
	14PBC1201 B	Biochemistry of Natural Products	4	4
Total for Semester I			30	27
II	14PBC2107	Microbiology	5	5
	14PBC2108	Recombinant DNA Technology	5	5
	14PBC2109	Human Physiology	4	4
	14PBC2110	Lab Course - 3	4	3
	14PBC2111	Lab Course - 4	4	3
	14PBC2202 A	Life Sciences for Competitive Examinations-I	OR	
	14PBC2202 B	Molecular Diagnostics	4	4
	14PSS2401	IDC: Soft Skills	4	4
Total for Semester II			30	28+3*
III	14PBC3112	Research Methodology	4	4
	14PBC3113	Clinical Biochemistry	4	4
	14PBC3114	Immunology	4	4
	14PBC3115	Lab Course - 5	3	2
	14PBC3116	Lab Course - 6	3	2
	14PBC3203 A	Life Sciences for Competitive Examinations-II	OR	
	14PBC3203 B	Drug Biology	4	4
	14PBC3402	IDC (WS): Bioprocess Technology	4	4
Total for Semester III			30	28
IV	14PBC4117	Advanced Endocrinology	6	5
	14PBC4118	Biochemical Technology	6	5
	14PBC4119	Advances in Clinical Research	6	5
	14PBC4302	Publication/Presentation of Research Papers	-	5*
	14PBC4120	Comprehensive Examination	-	2
	14PBC4121	Project Dissertation and Viva Voce	12	5
	Total for Semester IV			30
Total for all Semesters			120	110+8*

* Extra Credits

Sem. I
14PBC1101

Hours/Week: 6
Credits: 5

BIOMOLECULAR CHEMISTRY

Objectives

- i) To study the structure, properties and metabolism of different biomolecules.
- ii) To know the interrelationships between different metabolisms.

Unit I

The molecular logic of life: The chemical unity of diverse living organisms, composition of living matter. Water - Physio-chemical properties, biomolecular reactions. Macromolecules and their monomeric subunits, Bioenergetics - laws of thermodynamics, Gibb's Free energy, Activation energy, exergonic and endergonic reactions, Biological energy transductions. Enzymes - nomenclature, classification, principle, regulation and mechanisms of enzyme catalysis. Enzyme kinetics- MM equation, LB plot, Inhibition. Introduction to Metabolism - Anabolism and Catabolism, Experimental approaches to study metabolism.

Unit II

Carbohydrates - classification, structure and isomerism. Monosaccharides, oligosaccharides & polysaccharides - structure and properties. Metabolism of carbohydrates: glycolysis, citric acid cycle, HMP shunt, glucuronic acid pathway, gluconeogenesis, glycogenesis, glycogenolysis, glyoxylate cycle, Regulations of glycolysis and gluconeogenesis. Metabolism of Amino sugars- sialic acids, mucopolysaccharides and glycoproteins.

Unit III

Amino acids - structures, classification and properties. Biosynthesis of aspartate, pyruvate and aromatic amino acids families. Amphibolic activity of amino acids. Protein - classification, types, characteristics and structures, functions. Methods for determining protein conformations, symmetry and functional properties, protein folding, denaturation & renaturation, ramachandran plot, solid state synthesis of peptides, sequence determination. Degradation of proteins and amino acids. Urea cycle and its significance.

Unit IV

Lipids - classification, sources and biological functions. Biosynthesis of fatty acids and its regulation, hydroxy fatty acids, acylglycerols. Membrane lipids - phospholipids, sphingolipids & eicosanoids. Cholesterol

biosynthesis and its regulation. Fatty acid degradation. Lipoproteins- types and functions. Methods of inter organ transport of fatty acids. Formation of ketone bodies.

Unit V

Nucleic acids - bases, nucleosides & nucleotides, Structure of RNAs and DNA, forces stabilizing nucleic acid structures. Fractionation, sequencing and chemical synthesis of oligonucleotides. Denaturation and hybridization. Synthesis of purines and pyrimidines, synthesis of deoxy ribonucleotides. Biosynthesis of nucleotide coenzymes, nucleotide degradation. Intermediary metabolism.

Books

1. Zubay, G L., 1998. Biochemistry, WCB Publishers, USA.
2. Robert K. Murray et al., 2000. Harper's Biochemistry, Appleton and Lange Stamford Publishers, Connecticut.
3. Lehninger, A. L. et al., 1993. Principles of Biochemistry, Worth Publishers. Inc. USA.

References

1. Stryer, L., 1988. Biochemistry (2nd Edition), W.H. Freeman & Co., New York.
2. White, A. et al., 1959. Principles of Biochemistry, McGraw Hill Book Co., New York.

Sem. I
14PBC1102

Hours/Week: 6
Credits: 5

MOLECULAR BIOLOGY

Objectives

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

Unit I

Terms and definitions - DNA is the Genetic Material: Griffith's Experiment, Avery, Hershey & Chase Experiment. RNA as the Genetic Material: Conrat & Singer Experiment with TMV - Central Dogma. Viral genome - types of RNA and their role. Organization of Chromosome: Structural organization of eukaryotic chromosomes. 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. Duplication & segregation of chromosomes. Components, types & structure of nucleic acids, C-value paradox.

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 mtDNA, theory of prokaryotic endosymbionts. Plasmids: definition, types, structure, properties and gene content. Use in rDNA technology.

Unit III

DNA replication: Models - Meselson & Stahl experimental proof for semi-conservative 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 - RNA and DNA mediated. Recombination: Homologous and non-homologous recombination- Site specific recombinations & transposition of DNA.

Unit IV

Transcription: RNA types (tRNA, mRNA, rRNA, Ribozyme, snRNA, 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. Wobble hypothesis. Translation machinery, initiation, elongation and termination of translation in bacteria and eukaryotes. Translational proof reading, translational inhibitors, post-translational modifications, chaperones and protein targeting- translocation, heat shock proteins, glycosylation; SNPs and SNAREs. Bacterial signal sequences. Mitochondrial, chloroplast and nuclear protein transport. Endocytosis - viral entry. Ubiquitin TAG protein destruction.

Unit V

Chromosomal changes and consequences: changes in the chromosome number: euploidy and 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 verses somatic mutants, insertional mutagenesis. DNA repair mechanism: thymine dimer, light activation, excision, recombinational, SOS and mismatch 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.

Books

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

References

1. Ajoy Paul. 2007. Textbook of Cell and Molecular Biology. Books and Allied, Kolkata.
2. De Robertis and De Robertis. 1990. Cell and Molecular Biology. Saunders, 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, US.
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
14PBC1103

Hours/Week: 6
Credits: 5

ENZYMOLOGY AND BIOENERGETICS

Objectives

- i) To impart thorough knowledge about enzymes and enzyme kinetics.
- ii) To understand the various concepts of bioenergetics.

Unit I

Historical aspects of enzymology, nomenclature and classification of enzymes according to IUB-EC-1964. Intracellular localization of enzymes, homogenization techniques, isolation and fractionation of enzymes - classical methods of purification and crystallization - separation based on molecular size, electric charge, solubility difference and selective adsorption, criteria of purity, units of enzyme activity. Turn over number, specific activity, specificity. Active site - definition, organization and determination of active site residues.

Unit II

Principles of catalysis - collision & transition state theories, specificity of enzymes. Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Theories on mechanism of catalysis. Coenzymes - structure and functions, Mechanism of enzyme action: lysozyme, chymotrypsin, carboxypeptidase and DNA polymerase. Isoenzymes and multienzymes - mechanism of action and regulation of pyruvate dehydrogenase, LDH and fatty acid synthase complex.

Unit III

Kinetics of catalysed reaction: Single substrate reactions, bisubstrate reactions, concept and derivation of Michaelis -Menten equation, Briggs Haldane relationship, Determination and significance of kinetic constants, limitations of Michaelis - Menten kinetics. Inhibition kinetics- competitive, non-competitive and uncompetitive. Allosteric inhibition, cooperative, cumulative, feedback inhibition.

Unit IV

Various methods of immobilization - ionic bonding, adsorption, covalent bonding, microencapsulation and gel entrapment. Immobilized multienzyme systems. Biosensors - glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors. Abzymes and ribozymes. Enzymes of clinical importance and diagnostic significance. Enzyme engineering.

Unit V

Thermodynamic terms and basic concepts - types of thermodynamic systems. Enthalpy and biochemical reactions, biological thermodynamic standard state, activation energy. Biological oxidation, oxidation-reduction reactions. High-energy phosphate compounds, role of ATP in biological system; energy transfer; acyl-phosphate group transfer. Types of energy transformation in living systems; energy in photosynthesis. Phosphorylation - types. Organization of electron carriers and enzymes in mitochondria, chloroplast and microsomes and their inhibitors, cyanide resistant respiration.

Books

1. Dixon, M. and Webb, J.F., 1979, Enzymes, Longman Publishing, London.
2. Price and Stevens, 1999, Fundamentals of Enzymology, Oxford University Press, UK.
3. Trevor Palmer, 1991, Understanding Enzymes, 3rd Edition, Ellis Harwood, UK.

References

1. Bohinski, R.C., 1987, Modern concepts in Biochemistry, Allyn and Bascon Inc., Boston.
2. Caret et al., 1993, Inorganic, Organic and Biological Chemistry, W. M. C. Brown, USA.
3. Lehninger, A. H. et al., 1993, Principles of Biochemistry, Worth Publ. Inc., USA.
4. Rawn, J.D., 1989, Biochemistry, Neil Patterson Publ., North Carolina, USA.
5. Stryer, I. 1988, Biochemistry (II Ed), W.H. Freeman & Co., New York, USA.
6. Voet, D. and Voet, J.G, 1990, Biochemistry, John Wiley & Sons Inc., New York, USA.

Sem. I**14PBC1104****Hours/Week: 4****Credits: 3****LABORATORY COURSE - I****BIOCHEMISTRY**

1. Estimation of liver glycogen.
2. Estimation of amino acids by Sorenson's formal titration.
3. Estimation of Iodine value of oil.
4. Estimation of Acid value of oil.
5. Estimation of Reducing sugars by Benedict's titration.
6. Estimation of Water content of food samples.
7. Estimation of Ash content
8. Estimation of Magnesium
9. Estimation of phosphorus
10. Estimation of Tryptophan
11. Estimation of Total lipids
12. Estimation of Vitamin C (Titration)
13. Extraction of DNA and RNA
14. Estimation of DNA and RNA
15. Biochemical techniques
 - i) Column chromatography for plant Pigments
 - ii) Separation of phospholipids by TLC.
 - iii) Paper chromatography

Sem. I**14PBC1105****Hours/Week: 4****Credits: 3****LABORATORY COURSE - II****ENZYMOLOGY**

1. Assay of acid phosphatase.
2. Assay of salivary amylase.
3. Factors influencing reaction rates of acid phosphatase
 - i) Effect of Temperature
 - ii) Effect of Time
 - iii) Effect of pH
 - iv) Effect of Enzyme concentration
 - v) Effect of substrate concentration
 - vi) Measurements of V_{max} & K_m

Sem.I
14PBC1106

Credits: 2

Self Paced Learning
BIOCHEMICAL CALCULATIONS

Objectives

- i) To make the calculations, part of the curriculum.
- ii) To enhance the calibre of the students in calculation, through their own effort.

Unit I

Acids, bases and buffers: Preparation of solutions: volume by volume, weight by volume, molar, molal, normal, formal, ppm solutions. pH and pOH. Definition and calculations. H-H equation. Buffer solutions - phosphate, Tris-HCl, Acetate buffer preparation. Titration curves. Buffering capacity. Factors affecting solubility- saturated solution. Isoelectric pH-definition and calculation of pI of amino acids.

Unit II

Biomolecules-concentration and molecular weight: spectrophotometric determination of concentration-Lambert-Beer's law, colorimetry. Calculation of absorbance and transmittance. Determination of molecular weight using molar extinction co-efficient. Determination of molecular weight (carbohydrates, proteins, nucleic acids and lipids) - from composition, sedimentation velocity, gel electrophoresis, affinity labelling and osmotic pressure.

Unit III

Enzymology and bioenergetics: Derivation and Applications of Michaelis - Menten equation. Inhibition kinetics- competitive, non-competitive and uncompetitive. Calculation of Specific activity, turn over number, IU and KATAL units (alkaline phosphatase, SGOT, & SGPT). Free energy - calculation of free energy change; relationship between equilibrium constant and free energy change (Gibbs).Calculation of equilibrium concentrations. Calculation of ATP yield and utilisation - glycolysis, TCA cycle, fatty acid oxidation, proteins and nucleic acid synthesis.

Unit IV

Radioactivity: Types of radioactive decay - alpha, beta and gamma particle emission. Measurement of radioactivity - units, Curie, Becquerel. Half life- definition. Derivation of equation for half life. Determination of decay

constant of various radionuclide and age of archaeological samples (Radiocarbon dating). Determination of blood volume.

Unit V

Nutrition: Calculation of acid value, saponification number and iodine number of fat and their applications. Calculation of respiratory quotient and calorific value of carbohydrates, proteins and lipids- Bomb calorimeter. Determination of BMI. Determinations of body fat- measurement of skin fold thickness and circumference. Determination of ash and moisture content of foods.

Book

1. Irwin H. Segel, 2004, Biochemical Calculations 2nd Edition, John Wiley & Sons, India.

References

1. Upadhyay and Upadhyay Nath, 2014, Biophysical Chemistry, Himalaya publishing, India.
2. Plummer Mu and Plummer, 1988, Introduction to practical biochemistry, Tata McGraw Hill Publishing Company, India.
3. Markus R Wenk and Aaron zefrin Fernandis eds, 2013, A manual for biochemistry protocols, National University of Singapore, Singapore.

Sem.I
14PBC1201A

Hours/Week: 4
Credits: 4

DEVELOPMENTAL BIOLOGY

Objectives

- i) To study the cellular basis of development.
- ii) To elucidate the early developmental 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; ultra structure 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.

Book

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

References

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

Sem. I**14PBC1201B****Hours/Week: 4****Credits: 4****BIOCHEMISTRY OF NATURAL PRODUCTS****Objectives**

- i) To study the occurrence, properties and economic importance of natural products from plants, animals and microbes.
- ii) To discover the therapeutic importance of those natural products.

Unit I

General aspect of sources of natural medicinal plant products: Introduction to primary and secondary metabolites, types of secondary metabolites, production under stress, isolation of active constituent from plant material.

Unit II

Alkaloids: Definition, general properties, classification based on nitrogen heterocyclic ring, types - phenylalkylamines, pyridine alkaloids, tropane alkaloids, quinolizidine and pyrrolizidine alkaloids, isoquinoline alkaloids, quinoline, monoterpenes, indole alkaloids, purine alkaloids, ruta alkaloids, medicinal importance of each type. Role of alkaloids in plants.

Unit III

Saponins and Steroids: Definition, general properties, medicinal importance of saponins. Important saponins of plant origin - diosgenin, hecogenin, glycyrrhizin, aescin and ginseng. Steroids: Definition, general properties, classification, introduction and medicinal importance of - cardiac glycosides from *Digitalis*, *Strophanthus*, *Urginea*, steroids from *Withania somnifera*, *Holarrhena* and *Solanum*.

Unit IV

Terpenoids: Definition, general properties, classification, introduction and medicinal importance of terpenoids. General account and medicinal importance of myrcene, ocimene, citronellol, menthol and camphor. Tannins, lignin and pectin: Definition, general properties and classification.

Unit V

Plant pigments: Occurrence, classification, introduction and applications of carotenoids, xanthophylls, anthocyanins, flavones, flavonols. Acetate pathway and Shikimic acid pathway. Pyrethrroids and rotenones of plant origin: Definition, general properties and importance. Natural products of

therapeutic importance from animals: Venom, Body fluids - Urine, Saliva and Faeces. Zootherapy.

Books

1. K.G. Ramawat and J.M. Merillon (Eds.), 2010, Biotechnology- secondary metabolites, Oxford & IBH publishing Co. Pvt. Ltd.
2. J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope, J.B. Harborne, 1994, Natural Products: Their Chemistry and Biological Significance, Longman Pub Group.
3. Ata-ur-Rahman and M.L. Choudhary, 1995, New trends in natural product chemistry:, Harwood Academic Publishers, Netherlands.
4. G.E. Trease and W.C. Evans, 2002, Pharmacognosy and Phytochemistry, 15th Edition, W.B Saunders Edinburgh, New York.

References

1. Chemistry and biology of herbal medicine: V.P. Agrawal and V.P. Khamboj, (Eds.) (Society of Biosciences).
 2. Lemke TL, Williams DA, Roche VF, Zito SW eds, 2008, Foye's Principles of Medicinal Chemistry. 6th ed., Wolters Kluwer Lippincott Williams & Wilkins, Philadelphia.
 3. Wallis TE, 1985, Text Book of Pharmacognosy 16th Edition, CBS Publishers and Distributors, New Delhi.
 4. Gurdeep Chatwal, 1995, Organic chemistry of natural products, Himalaya publishing House, India.
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**Sem. II
14PBC2107**

**Hours/Week: 5
Credits: 5**

MICROBIOLOGY

Objectives

- i) To understand the applications of different microbes.
- ii) To study the applications of microbiology in various industries.

Unit I - General Microbiology

Introduction and scope of microbiology. Brief study of structure and organization of major groups of microorganisms - archaebacteria, cyanobacteria, eubacteria, fungi, algae, protozoa and viruses. Culture of microorganisms - batch, continuous and pure cultures. Control of microorganisms - physical, chemical and chemotherapeutic agents. Preservation of microorganisms.

Unit II - Environmental Microbiology

Microbiology of soil - soil microflora, role of soil microbes in biogeochemical cycles (C,N,S) - Marine and fresh water microbiology. Contamination of domestic and marine waters. Water purification and sewage treatment. Microbes in waste water treatments. Microbiology of air.

Unit III - Industrial Microbiology

Selection of industrially useful microbes. Fermentors and fermentation technology. Industrial production of alcohol, vinegar, lactic acid, antibiotics, enzymes and amino acids. Microbiology of food: sources of contamination, food spoilage and food preservation methods.

Unit IV - Clinical Microbiology

Epidemic, endemic, pandemic and sporadic diseases. Pathogenicity, virulence and infection. Epidemiology of infectious diseases. Bacterial diseases of human (typhoid, cholera, syphilis, gonorrhoea and pertussis). Fungal diseases of human (superficial, cutaneous, subcutaneous and systemic mycoses). Viral diseases of human (AIDS, hepatitis, polio, rabies and measles). Mycoplasmal, Chlamydial, Rickettial and protozoan diseases of human. Mycotoxins.

Unit V - Applied Microbiology

Role of microbes in the manufacture of antibiotics and vaccines. Microorganisms as biofertilizers. Microbes as foods - SCP production. Role of microbes in biogas production, petroleum industry and mining. Microbial

degradation of lignin, cellulose and pesticides. Microbial immobilization. Microbes in biological warfare.

Books

1. Pelczar et al. (1998): Microbiology. Tata McGraw-Hill, New Delhi.
2. Prescott et al. (1996): Microbiology, WMC Brown Publishers, USA.

References

1. Martin Alexander (1969): Introduction to soil microbiology. Wiley International, NY.
2. Gladwin and Trattler, 2013, Clinical Microbiology Made Ridiculously Simple (6th Edition), Medmaster, UK.

Sem. II
14PBC2108

Hours/Week: 5
Credits: 5

RECOMBINANT DNA TECHNOLOGY

Objectives

- i) To study the various underlying principles of genetic engineering that forms the basis of rDNA technology.
- ii) 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, shotgun) & purification of nucleic acid, PCR; enzymes in molecular biology (restriction endonuclease, ligases, reverse transcriptase, nucleases, polymerase, alkaline phosphatase, terminal transferase, and T4 polynucleotide kinase). Joining DNA molecules: E. coli DNA ligase, T4 DNA ligase, linkers, 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 λ, M13), cosmids, phagemids, yeast plasmid vector, viral vectors, (adenovirus, adeno associated virus, baculovirus, 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, CaPO4 mediated gene transfer), Biological method (Agrobacterium mediated gene transfer). Expression systems - prokaryotes (Bacteria) and eukaryotes (yeast, mammalian and, insect cell lines).

Unit IV

Screening and selection methods - insertional inactivation, blue-white selection, colony - in situ hybridization, in vitro selection, in vitro translation, radioactive antibody test, immunological techniques, DNA labelling, dot blot hybridization, Molecular beacons. Gene Silencing, RNA interference, antisense therapy, gene knockout. 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.

Books

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

Reference

1. Brown T. A. 1988. Gene cloning - An introduction. VNR (UK) co. Ltd, England.
2. David M Glover. 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. WH freeman and co., NY.
5. Maniatis T. and J. Sambrook et al. 2003. Molecular cloning - A laboratory manual. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

HUMAN PHYSIOLOGY

Objectives

- i) To study the functional mechanism of body organ systems.
- ii) To understand the homeostatic mechanism of each organ system.

Unit I - General and cellular physiology

Cell as the living unit of the body. The internal environment - homeostasis. Control systems, organization of a cell, transport across cell membranes, functional systems in the cells, blood - composition of body fluids. Homeostasis. Plasma proteins and its function. Formed elements - development and function. Hemoglobin - structure and function. Homeostasis and coagulation of blood, mechanism of clotting - clotting factors, clot retraction, fibrinolysis.

Unit II - Gastro-intestinal system

General principles of GI function - mastication & swallowing, esophageal motility, salivary secretion, gastric mucosal barrier, pancreatic & biliary secretion, gastrointestinal motility, digestion & absorption, functions of colon, pathophysiology of peptic ulcer, gastrointestinal hormones and their actions. Absorption of carbohydrates, fats and proteins, vitamins, water and electrolytes.

Unit III - Cardio-vascular and respiratory physiology

Properties of cardiac muscle, cardiac cycle, heart as a pump, cardiac output, specialized tissues of the heart, coronary circulation, generation & conduction of cardiac impulse, control of excitation & conduction, electrocardiogram-arrhythmias. Principles of hemodynamics, neurohumoral regulation of cardiovascular function, microcirculation and regional circulations, cardiac failure, circulatory shock. Respiration - functional anatomy of respiratory system, pulmonary ventilation, alveolar ventilation, mechanics of respiration, pulmonary circulation, principles of gaseous exchange - oxygen & carbon-dioxide transport, regulation of respiration, hypoxia, oxygen therapy & toxicity, artificial respiration.

Unit IV - Nerve and muscle physiology

Classification and Properties of nerve fibers, nerve conduction, functional anatomy of skeletal muscle, neuro-muscular transmission and blockers, excitation-contraction coupling, mechanisms of muscle contraction, smooth

muscles. general design of nervous system, classification of somatic senses, sensory receptors, sensory transduction, information processing, dorsal column & medial lemniscal system, thalamus, somatosensory cortex, somatosensory association areas, pain, organization of spinal cord for motor function and motor cortex. Special senses - vision, hearing, smell, taste and their perceptions. Autonomic nervous system, limbic system and hypothalamus. EEG, sleep, emotions & behavior. Learning & memory.

Unit V - Renal and environmental physiology

Structure and function of kidney - Structure of nephron, glomerular filtration, tubular reabsorption of glucose, water and electrolytes. Tubular secretion. Homeostatic regulation of water and electrolytes, acid-base balance. Body fluid compartments. Urine formation. Regulation of extracellular sodium & osmolarity, renal mechanisms for the control of blood volume, blood pressure, micturition, diuretics, renal failure. Environmental physiology - physiology of hot and cold environment, high altitude, aviation physiology, space physiology, deep sea diving & hyperbaric conditions.

Books

1. Arthur C. Guyton, 2005, Text Book of Medical Physiology, WB Saunders's, USA.
2. C. C Chatterjee, 1985, Human Physiology Vol I & Vol II. 11th Edn, Kalyani Mukerjee Publications, Kolkata, India.

Reference

1. West, E.S. and Todd, W.R., 1985, Textbook of Biochemistry, MacMillan, Germany.
2. Zubay, 1998, Biochemistry 4th Edition, WMC Brown Publishers, USA.

Sem. II
14PBC2110

Hours/Week: 4
Credits: 3

LABORATORY COURSE - 3

MICROBIOLOGY

1. Media preparation and Culture techniques.
2. Staining techniques (simple, differential and capsular)
3. Biochemical Characterization of Microbes.
 - Amylase activity
 - Methyl Red test
 - TSI Agar test
 - Citrate Utilization test
4. Potability test of water.
5. Qualitative test for Milk.
 - Methylene Blue Reductase Test.
 - Phosphatase test.
6. Antibiotic sensitivity test.

Sem. II
14PBC2111

Hours/Week: 4
Credits: 3

LABORATORY COURSE - 4

RECOMBINANTDNA TECHNOLOGY

1. Agarose gel electrophoresis of Nucleic acids (DNA & RNA)
2. Polyacrylamide gel electrophoresis (protein)
3. Isolation of chromosomal DNA from blood samples by Phenol-Chloroform method.
4. Preparation of genomic DNA from Plant tissue by CTAB method
5. Preparation of genomic DNA from bacteria
6. Plasmid DNA isolation
7. Enzyme Linked Immuno Sorbent Assay
8. Plant Tissue culture techniques (Callus induction)
9. Synthetic seed preparation
10. Denaturation of DNA and UV absorption studies.
11. Absorption spectra of Nucleic Acids. Determination of melting temperature of calf thymus DNA.
12. Restriction digestion.
13. PCR

Sem. II
14PBC2202A

Hours/Week: 4
Credits: 4

LIFE SCIENCES FOR COMPETITIVE EXAMINATIONS-I

Objectives

- i) To help the students to prepare for competitive exams along with their regular curriculum.
- ii) Facilitate the students to learn the topics that are not covered in the core courses.

Unit I

Principles & methods of taxonomy, classical & modern methods of taxonomy of plants, animals and microorganisms. Levels of structural organization: Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Herbarium preparation.

Unit II

Outline classification of plants, animals & microorganisms, structural details: Important criteria used for classification in each taxon. Classification of plants (Bentham & Hooker), animals (whitaker's) and microorganisms. Prokaryote and eukaryote cell: Structural and function of cell wall, mitochondria, chloroplast, ribosomes, E.R., golgi complex and nucleus.

Unit III

Plant hormones and Nitrogen metabolism: Plant hormones - Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Sensory photobiology & structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. Nitrogen metabolism-Nitrate and ammonium assimilation.

Unit IV

Photosynthesis - Mechanism of Photosynthesis - Light reaction and dark reaction. (C3, C4 and CAM plants). Photorespiratory pathway. Translocation of water, ions, solutes and macromolecules from soil-xylem and phloem, transpiration, introduction to secondary metabolites. Stress physiology. Response of plants to biotic (pathogens and insects) and abiotic (water, temp and salt) stresses.

Unit V

Environmental hazards and management: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Bioremediation; Phytoremediation; Solid waste management: toxic effects and treatments, methods, technologies for management of hospital waste - incineration, autoclaving, mechanical / chemical, microwave, plasma torch, detoxification, advanced wet oxidation and dry heat.

Books

1. Verma P.S. & V.K. Agarwal, 2003, Cytology, Genetics, Evolution and Ecology, S. Chand & Co Ltd., New Delhi.
2. Verma, S.K. 1999, Text Book of Plant Physiology, S. Chand & Co Ltd., New Delhi.

Reference

1. Lawrence G.H.M., 1995, The Taxonomy of Vascular Plants, Mac Millan Publishers, NY.
2. Noggle G.R. and Fritz G.J., 1976, Introductory Plant Physiology, Prentice-Hall Publishers, India.

Sem. II

14PBC2202B

Hours/Week: 4

Credits: 4

MOLECULAR DIAGNOSTICS

Objectives

- i) To explore the molecular mechanisms of diseases.
- ii) To study the various diagnostic tools available for these diseases.

Unit I

Molecular mechanisms of diseases: Detection of genetic defects, detection of infectious agents, tumor diagnosis markers and grading. Molecular genetics of B- cell neoplasia. Liver specific expression of cloned human genes, technology of carrier erythrocytes: a tool for diagnosis and therapy. Diagnosis of single gene disorders - spinal muscular atrophy, DMD and BMD, Fragile X syndrome.

Unit II

Restriction Fragment Length Polymorphism (RFLP) - DNA probes detection of mutations and deletions in gene. Eg: thalassemia, haemophilia, sickle cell anemia, retinoblastoma. DNA finger printing. Genetic disease probes. Chromosomal DNA probes for prenatal diagnosis of X-linked retinitis pigmentosa, prenatal sex determination.

Unit III

Hereditary persistence of fetal hemoglobin: model for abnormal development regulation. Apolipoprotein genes, DNA polymorphism and hyperlipidemia, cDNA of human protein C for diagnosis of protein C deficiency. Prenatal diagnosis and carrier detection of phenylketonuria by gene, fluorescent in situ hybridization (FISH). -DNA probes - fluorescent labeling, chromosome painting and spectral karyotyping, peptide mapping.

Unit IV

Approaches in hybridoma technology: hybridoma variants affecting isotype, antigen binding and idiotype: isolation of class and subclass switch variants by selection. MHC locus, HLA polymorphisms, HLA nomenclature, molecular analysis of the MHC, serological analysis DNA-based typing, combining typing results, HLA test discrepancies, coordination of HLA test methods, additional recognition factors, minor histocompatibility antigens, nonconventional MHC antigens, killer cell immunoglobulin-like receptors, MHC & its disease association.

Unit V

Polymerase Chain Reaction - Its applications in diagnosis of infectious diseases - eg: HIV, hepatitis B and tuberculosis. Identification of gene mutations and deletions - eg: p53mutations. Use in solving paternity disputes and crime detection. Molecular oncology - classification of neoplasms, molecular basis of cancer, analytical targets of molecular testing- gene and chromosomal mutations in solid tumors, microsatellite instability, loss of heterozygosity. Enzyme linked immunosorbent assay (ELISA) - Diagnosis of infectious diseases and cancer antigens, HIV detection.

Book

1. Lela Buckingham, Maribeth L. Flaws, 2007, Molecular Diagnostics - Fundamentals, Methods, & Clinical Applications, F.A. Davis & Company, Philadelphia.

Reference

1. Gath, D.D, 1994. PCR-based diagnostics in infectious diseases. Blackwell Scientific, UK.
2. Fazal Ahmed, 1984, Advances in Gene technology: human genetic disorders, ICSU, Paris.
3. Stanely, A et al., 1994, Vaccines, W. B. Saunders & Co., USA.

Sem. II
14PSS2401

Hours/Week: 4
Credits: 4

IDC-1
SOFT SKILLS

Objectives

- * Introducing learners to the relevant soft skills at the territory level in order to make them gain competitive advantage both professionally and personally.

Module 1: Basics of communication and Effective communication

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

Module II: Resume writing and Interview skills

Resume Writing: What is Resume? Types of Resume? Chronological, Functional and Mixed Resume, Steps in preparation of Resume. Interview Skills: Common interview questions, Attitude, Body Language, The mock interviews, Phone interviews, Behavioral interviews.

Module III: Group discussion and team building

Group Discussion: 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 GDS. Team Building: Team Vs Group - synergy, Stages of Team Formation, the Dabbawala. Leadership - Styles, Work ethics. Personal Effectiveness: Personal Effectiveness: Self Discovery, Self Esteem, and Goal setting. Conflict and Stress Management.

Module IV: Numerical Ability

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, Rations and Proportions.

Module V: Test of reasoning

Verbal Reasoning: Series Completion, Analogy, Data Sufficiency, Assertion and Reasoning, Logical Deduction. Non-Verbal Reasoning: Series, Classification

References

1. Aggarwal, R.S. 2010 Quantitative Aptitude, S.Chand & Sons
 2. Aggarwal, R.S. 2010. A Modern Approach to Verbal and Non Verbal Reasoning. S.Chand
 3. Covey, Stephen. 2004. 7 Habits of Highly effective people, Free Press.
 4. Egan, Gerard. 1994. The Skilled Helper (5th Ed). Pacific Grove, Brooks / Cole.
 5. Khera, Shiv 2003. You Can Win. Macmillan Books , Revised Edition
 6. Murphy, Raymond. 1998. Essential English Grammar. 2nd ed., Cambridge Univ. Press.
 7. Prasad, L. M. 2000. Organizational Behaviour, S.Chand
 8. Sankaran, K., & Kumar, M. 2010 Group Discussion and Public Speaking. M.I. Pub, Agra, Adams Media.
 9. Schuller, Robert. (2010). Positive Attitudes. Jaico Books.
 10. Trishna's (2006). How to do well in GDs & Interviews, Trishna Knowledge Systems.
 11. Yate, Martin. (2005). Hiring the Best: A Manager's Guide to Effective Interviewing and Recruiting.
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RESEARCH METHODOLOGY

Objectives

- i) To understand the working principles, construction and applications of the instruments used in the studies related to various disciplines of biological sciences.
- ii) To understand the statistical concepts and their significance.
- iii) To appreciate the importance of research and to learn the art of scientific writing.

Unit I

Electrochemical techniques: Principles, electrochemical cells and reaction, pH and buffers; measurement of pH (glass electrode) and titration curves. Ion selective and gas sensing electrodes, oxygen electrode, and their applications. Chromatographic techniques: general principles; adsorption and partition chromatography. Techniques and applications of - paper, column, thin layer, normal phase and reverse phase - ion-exchange chromatography, exclusion chromatography, affinity chromatography, GLC and HPLC, HPTLC.

Unit II

Centrifuges: Principles, differential and analytical centrifugation, density gradient centrifugation; Analysis of sub cellular fractions, ultracentrifuge and its application. Electrophoresis: Principles, electrophoretic mobility, factors influencing electrophoretic mobility - paper, disc, slab gel electrophoresis. Isoelectric focussing, 2D PAGE, blotting techniques, capillary electrophoresis.

Unit III

Spectroscopy - Properties of EMR, absorption spectrum, absorption Vs emission spectrophotometry, AAS & flame photometer, UV / VIS spectroscopy, IR, NMR, GC-MS, MALDI-TOF, LC-MS. Tracer technique: Nature of Radioactivity: Patterns of decay, half life and its application, Geiger Muller Counter- principle and applications. Scintillation counter - Principle, types and applications. Use of isotopes in biological studies.

Unit IV

Research: selection of research problems - hypothesis - definition and characteristics. Experimental approaches - biological, physical and chemical

methods. Sources of information: Journals, e-journals, books, biological abstracts, Preparation of index cards, Review writing, Article writing - structure of article. Selection of journals for publication- Impact factor - Citation index and H-index. Proposal writing for funding. Biostatistics - basics and uses of measures of central values, measures of dispersion (Standard Deviation and coefficient of variation) in data analysis and presentation. Sample testing: large samples (Z), small sample test: t, Chi-square, ANOVA - one way & two way, SPSS.

Unit V

Bioinformatics: Introduction to Bioinformatics, Bioinformatics and its applications, Information networks - EMB net and NCBI. Databases; primary nucleic acid databases - EMBL; GenBank and DDBJ. Structure of gene bank entries. Protein sequences databases; primary databases PIR, MIPS, SWISS - PROT, TrEMBL, NRL-3D. Structure of SWISS - PROT entries. Secondary Databases; PROSITE, PROFILES, PRINTS, Pfam, BLOCKS and IDENTITY. Composite protein Databases.

Books

1. Keith Wilson & John Walker 2005. Principles and Techniques of Practical Biochemistry, Cambridge University Press, India.
2. Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath, 2014 Biophysical Chemistry (Principles and Techniques) 4th Edition, Himalaya Publishing House, India.
3. Braun, R.P. 1987: Introduction to Instrumental Analysis, Tata McGraw Hill, India.
4. West, E.S. and Todd, W.R., 1985, Textbook of Biochemistry, MacMillan, Germany.
5. Kothari, C.R. Research Methodology, Methods and Techniques 2nd Edn, New Age International Publishers. New Delhi.

Reference

1. Wayne W. Daniel, 2006, Biostatistics: A Foundation for Analysis in the Health Sciences (9th Edition), John Wiley and Sons Inc., USA.
2. Attwood, T.K. and Parry-Smith, D.J. 1999. Introduction to bioinformatics. Pearson Education Ltd., Delhi, India.

Sem. III
14PBC3113

Hours/Week: 4
Credits: 4

CLINICAL BIOCHEMISTRY

Objectives

- i) To impart thorough knowledge about the biochemical basis of various diseases and disorders.
- ii) To study various diagnostic and therapeutic methodologies available for diseases and disorders.

Unit I

Blood coagulation - disturbances in blood clotting - haemophilia A and haemophilia B. anticoagulants. Blood groups, haemoglobin in anaemias, sickle cell anemia, thalassemia, abnormal haemoglobins identifications, systematic analysis of haemorrhage disorders. Porphyrias and porphyrinurias. Blood banking. Hemolytic diseases of the new born. Adverse reactions of blood transfusions.

Unit II

Blood sugars - their maintenance, hyper and hypoglycemia. Regulation of blood glucose concentration, diabetes mellitus - complications, secondary degenerative diseases. Laboratory diagnosis of early and latent diabetes. Glucose tolerance test. Dietary regimes in diabetes mellitus. Hypoglycemic agents. Galactosemia, fructosuria and lactose intolerance. Hypo and hyper cholesterolemia, Hypo and hyper lipoproteinemia, hypocholesteremic agents, hypertension. Lipid storage diseases- fatty liver & obesity.

Unit III

Protein deficiency diseases, plasma proteins, their significance and variation in health and diseases. Agammaglobulinemia, multiple myeloma, proteinuria, wilson's disease, gout, lesch-nyhan syndrome. Orotic aciduria, and xanthinuria, cystinuria, hartnup disease, maple syrup urine disease, alkapturia, albinism, tyrosinosis, phenylketonuria. Disorders of sulphur containing amino acid and urea cycle.

Unit IV

Normal structure and functions of liver - diseases of the liver - hepatitis - types, jaundice and its types. Cirrhosis, alcoholic liver diseases. Cholestatic liver diseases. Hepatic tumors and biliary tract diseases - clinical manifestation of liver diseases. Liver functions tests. Disorders of bilirubin metabolism. Enzyme released from diseased liver tissue. Pancreatic function test; Gastric function test. Biochemical parameters of CSF in health and disease.

Unit V

Renal function tests - biochemical changes in acute and chronic renal failure. Normal and abnormal urinary constituents. Renal stress and its analysis. Enzyme parameters in pathological conditions. Cardiac pathology - major manifestations of heart disease - ischaemic heart diseases, angina pectoris, myocardial infarction. Cardiac markers in infarction - LDH, creatine kinase. Serological tests in infectious diseases. Serological diagnosis of viral infections. Amniotic fluid and maternal serum, ailment in pregnancies.

Books

1. Devlin,1997. Textbook of Biochemistry (with clinical correlation), John Wiley, UK.
2. M.N. Chatterjee and Rana Shinde 1995. Text book of Medical Biochemistry 2nd Edition, Jaypee Brothers Medical publishers Private limited, New Delhi.

Reference

1. Henry, R.J., Cannon, D.C. and Winkelman, J.W., 1974. "Clinical Chemistry: Principles and Techniques" 2nd ed. pp. 1354-1369. Harper and Row, Hagerstown, Maryland.
2. Cantrow and Trumper, 1962, Clinical Biochemistry, 6th edition, V.Y.B. Saunders Company, Philadelphia.
3. Luxton R, 2010, Clinical Biochemistry, 2nd edition, Vinoth Vashista Pvt. Ltd., New Delhi.

Sem. III
14PBC3114

Hours/Week: 4
Credits: 4

IMMUNOLOGY

Objectives

- i) To study in detail the components of immune system.
- ii) To learn the biochemical basis of immune disorders.

UNIT I

Infection-types, factors influencing infection - pathogenicity. Sources and carriers of infectious agents. Immune system - definition and properties. Cells of the immune system; lymphoid organs - primary and secondary; structure and functions. Natural defences of the body (innate immunity): skin, mucous membrane, lysozyme and phagocytes. Reticuloendothelial system and its components.

UNITII

Antigens: definition and properties - antigenicity and immunogenicity; antigenic determinants and haptens. Types of antigens - flagellar, somatic, capsular, soluble, heterophile, tumour and autoantigens. Antigen-antibody interactions and molecular mechanism of binding: affinity, avidity, valency, cross reactivity and multivalent binding. Complement system components - alternate and classical pathways, initiators and MAC. Inflammation - acute and chronic; mechanism and significance.

UNITIII

Immunoglobulins: basic structure, classes and distribution of antibodies. Antibody diversity - genetic and other factors; theories of antibody formation. Acquired immunity - humoral: biosynthesis of antibodies; B and T lymphocyte cooperation. Primary and secondary immune response. Cell immunity: components of T lymphocytes, T cell receptor diversity and CD molecules. Role of antigen presenting cells and regulation of immune response. Cytokines and their role in immunity. Mitogens and immunosuppressants; immunological tolerance at birth and among adults; induction and termination.

UNITIV

Transplantation immunology: graft rejection and HLA antigens; role of MHC and T cells; prevention of graft rejection; hypersensitivity - immediate and delayed types; mechanism of reaction. Vaccines and toxoids: types, production and uses. Active and passive immunization and immunization schedule. Tumor immunology: tumor antigens, immuno surveillance and NK cells. Autoimmunity - mechanism of breakdown, pathogenesis and specific diseases.

UNITV

Immunological Techniques: polyclonal antibodies - principles and production of antisera. Monoclonal antibodies - hybridoma technique, applications, merits and demerits. Recombinant antibodies. Principles and applications of RIA, ELISA, FISH and Western blot. Precipitation reaction, immunodiffusion, immunoelectrophoresis and precipitin ring test. Agglutination tests - haemagglutination, febrile and latex agglutination. Widal, VDRL, pregnancy and rheumatoid factor tests.

Text Books

- Ivan Roitt, Jonathan Brostoff and David Male (1998): Immunology- 5th Edition. (Churchil Livingstone Publishers).

- Janis Kuby (1998). Immunology - 3rd and 4th Edition (W.H.Freeman).
- Weir, D.N. (1997): Immunology (8th edn) Churchill Livingstone.

Reference

- Fahim Halim Khan, 2009, The Elements of Immunology, Pearson education, New Delhi.
- Frank C. Hay and Olwyn M. R. Westwood, 2006, Practical Immunology 4th Edition, Blackwell Publishing, India.

Sem.III

14PBC3115

Hours/Week: 3

Credits: 2

LABORATORY COURSE - 5

CLINICAL BIOCHEMISTRY

I. Hematological studies

- Collection of Blood
- Estimation of hemoglobin content.
- Total RBC count.
- Total WBC count.
- Determination of Packed Cell Volume.
- Differential WBC count (DC).
- Absolute Eosinophil count (AEC).
- Total platelet count.
- Determination of clotting time
- Determination of Prothrombin time
- Determination of ESR.
- Grouping of blood and Rh typing.
- Pathological examination of blood film.

II. Biochemical analysis of blood

- Estimation of blood glucose (2 methods)
- Estimation of serum proteins
- Estimation of plasma fibrinogen
- Estimation of A: G ratio in serum
- Estimation of blood urea (2 methods)
- Estimation of serum uric acid
- Estimation of serum creatinine.
- Estimation of serum triglycerides.

9. Estimation of serum cholesterol.
10. Estimation of serum phospholipids.
11. Estimation of serum calcium.
12. Estimation of serum bilirubin.
13. Estimation of Vit-A, E & C

III. Enzyme assays

1. Determination of serum alkaline phosphatase
2. Determination of serum acid phosphatase
3. Determination of serum LDH
4. Determination of CPK

IV. Urology

1. Identification of abnormal constituents
2. Screening of inborn errors of metabolism

V. Andrology

1. Total sperm count.
2. Motility Test.
3. Fructose estimation.

**Sem. III
14PBC3116**

**Hours/Week: 3
Credits: 2**

LABORATORY COURSE - 6

IMMUNOLOGY AND PHYSIOLOGICAL METHODS

I. Immunological techniques

1. Widal test - rapid slide test for typhoid
2. VDRL test - test for syphilis
3. Latex agglutination test for rheumatoid factor and Pregnancy
4. Immunoelectrophoresis
5. Skin Prick Test.

II. Miscellaneous

1. Blood Pressure - Measurement - Effect of exercise and postural variation on BP.
2. ECG recording
3. Histopathology

III. Visit to National Research Centers

**Sem. III
14PBC3203A**

**Hours/Week: 4
Credits: 4**

LIFE SCIENCES FOR COMPETITIVE EXAMINATIONS-II

Objectives

- i) To help the students to prepare for competitive exams along with their regular curriculum.
- ii) This course consists of topics present in the CSIR-NET syllabus that are not covered in the core courses.

UNIT I

Emergence of evolutionary thoughts - Lamarck; Darwin-concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations. Origin of cells and unicellular evolution: Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concept of Oparin and Haldane; experiments of Miller; The first cell; evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes; anaerobic metabolism, and aerobic metabolism.

UNIT II

Paleontology and evolutionary history: the evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multi cellular organisms; major groups of plants and animals; stages in primate evolution including Homo. Molecular evolution: concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification.

UNIT III

Mechanisms of speciation and behavior: speciation; allopatricity and sympatricity; convergent evolution; Sexual selection; co-evolution. Approaches and methods in study of behavior; proximate and ultimate causation; altruism and evolution; neural basis of learning, memory, cognition, sleep and arousal; biological clocks; social communication; social dominance; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior; habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes.

UNIT IV

The environment; biotic and abiotic interactions. Concept of habitat and niche; population ecology; concept of metapopulation. Species interactions: Types of interactions, interspecific competition, herbivory, carnivory,

pollination, symbiosis. Community ecology: nature, structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological succession: Types, mechanisms, changes involved in succession & concept of climax.

UNITV

Ecosystem ecology: Ecosystem structure, function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Conservation biology: principles and management, Indian case studies on conservation / management strategy (Project Tiger, Biosphere reserves).

Books

1. Verma P.S & V.K. Agarwal, 2003, Cytology, Genetics, Evolution and Ecology, S. Chand & Co. Ltd., New Delhi.
2. Sharma P.D., 1999, Ecology and Environment, Rastogi Publishers, Meerut.

Reference

1. Odum. E.P, 1970, Fundamentals of Ecology, 3rd edition, W.B. Saunders Ltd., U.K.
2. Karl J. Nikias, 1981, Paleobotany, Paleoecology & Evolution, Praeger Pub., USA.

Sem. III
14PBC3203B

DRUG BIOLOGY

Objectives

- i) To make a detailed study of drugs, particularly their actions on living systems.
- ii) To know their chemotherapeutic value.

Unit I

Drugs - definition, source and nature, types of classification and nomenclature, dose response curve and LD50. Role of drugs, Drug - protein interactions, routes of drug administration.

Unit II

Drug targets - Enzymes, receptors, carrier proteins. Structural proteins, nucleic acids, lipids and carbohydrates. Forces in drug - receptor interaction, Receptor theories.

Hours/Week: 4
Credits: 4

Unit III

Drug absorption, distribution, metabolism, excretion and dosing. Pharmacokinetic oriented drug design - Drug solubility and drug stability.

Unit IV

Biological testing and bioassays - testing drugs in vitro and in vivo. Drug discovery. Lead compounds - natural sources and synthetic sources.

Unit V

Drug development. Target - oriented drug design, computer aided drug design, Quantitative structure, activity relationship - binding interaction, functional groups and pharmacophore. High throughput screening and Molecular docking.

Books

1. Patrick G, 2002, Medicinal Chemistry- Instant notes series, Viva Books, India.
2. Barar F S K, 2004, Essentials of Pharmacotherapy, S. Chand, New Delhi.

Reference

1. Trends in Molecular Pharmacology, Elsevier Publications, India.

Sem. III
14PBC3402

Hours/Week: 4
Credits: 4

IDC-2 (WS) **BIOPROCESS TECHNOLOGY**

Objectives

- i) To study the avenues of exploiting microbes in bioconversion technology.
- ii) To study the downstream processing for product recovery in fermentation.

Unit I

Principles of fermentation process, Bioprocess Vs Chemical process, Media formulation - Growth factors, Buffers, O₂, Antifoams and Media Optimization. Cell growth and quantitation - density, cell mass, growth pattern, yield factors and environmental conditions. Batch, Continuous and Fed batch cultures.

Unit II

Bioreactor design, parts and functions, sterilization, impellers, baffles and sparger. Types of reactor - submerged reactor, mechanically stirred draught-tube reactor, continuous flow stir type reactor, airlift reactor, jet loop reactor, surface reactor and packed bed reactor.

Unit III

Bioprocess control and monitoring variables: O₂ requirement and uptake-factors affecting KLa-aeration, agitation, pressure and pH, medium rheology. Computers in bioprocess. Flow measurement and control, control system - manual and automatic PID control.

Unit IV

Bioconversion and biocatalysts: Immobilization of cells and enzymes - methods and advantages. Selection of industrially important microorganisms. Strain improvement preservation and properties of industrial strains. Production strategies for insulin, lactic acid and vinegar. Scale-up and scale-down - problems and solutions.

Unit V

Downstream processing: recovery of microbial cells and products - precipitation. Filtration and centrifugation. Cell disruption - physical and chemical methods. Extraction - liquid-liquid extraction and aqueous-two phase extraction. Chromatography. Membrane processes, drying and crystallization.

Books

1. Stanbury, P F & Whitaker, A, 1995, Principles of Fermentation Technology, Pergamon.
2. Schuler ML & Fikret Kargi, 2002, Bioprocess Engg: Basic Concepts, Prentice Hall, NJ.
3. Wulf Crueger & Anneliese Cruger, 2004, Biotechnology: A Textbook of Industrial Microbiology, 2nd Edn., Panima Publishing Co., India.

Reference

1. E. MT. El-Mansi & C F A Bryce, 2002, Fermentation Microbiology and Biotechnology, Taylor & Francis Co., USA.
 2. Bailey & Ollis, 1986, Biochemical Engg Fundamentals, McGraw Hill, New York, USA.
 3. Coulson, J M & Richardson, S F, 1984, Chemical Engg, Pergamon Press, USA.
 4. Mooyoung (ed.), 1985, Comprehensive Biotechnology, Vol. I, II, III & IV, Pergamon Press, USA.
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Sem. III

14PBC3403

Hours/Week: 4

Credits: 4

IDC-3(BS)

FIRST AID MANAGEMENT

Objectives

- i) To enable the students to perform a basic assessment of an emergency situation.
- ii) To demonstrate an awareness of signs, symptoms and treatment for common medical emergencies.

Unit I

Basic knowledge about human body organs and their functions. Principles of first aid. Causality assessment. Priorities of first aid, unconsciousness and recovery positions. Resuscitation, control of major bleedings, chocking and treatment of shocks. Emergency aid in schools and others.

Unit II

Patient management and care, labeling of causalities. Approach to a causality. Handling and transport of injured persons. Disaster management and multiple causalities.

Unit III

Internal and external bleeding, injuries to muscles, joints and bones, stroke. Miscellaneous injuries, splinting skill tests, head, neck, back, chest, abdomen injuries. poisoning - bites and stings. Drug abuse. Frostbite and cold exposure. Burns and Scalds. Heat stroke, heat cramps and heat exhaustion.

Unit IV

Accident reporting, first aid to victims of road accidents. Patient assessment and management, breathing emergencies, oxygen therapy - resuscitation, defibrillation. Sudden illness - heart attack, stroke, fainting, convulsion epilepsy, prevention of heart attack and apoplexy.

Unit V

First aid rooms and equipments, first aid kits, cleaning of wounds, dressing and bandages. antiseptics - types and action. Injury assessment in factories and in rural areas. Psychological first aid.

Books

1. First Aid Manual- St. John Ambulance Guide.
 2. Standard First Aid and Personal Safety 8th edition - American Red Cross.
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Sem.IV
14PBC4117

Hours/Week: 6
Credits: 5

ADVANCED ENDOCRINOLOGY

Objectives

- i) To study the hormonal regulations of various physiological functions.
- ii) To explore the various hormonal cell signaling mechanisms.

Unit I - Introduction and genetic control of endocrinology

Hormones - definition; classical and nonclassical endocrinology. Pituitary hormones and their control by the hypothalamus. Thyroid metabolic hormones. Adrenocortical hormones. Feedback mechanisms (HPA & HPG). Inactivation and degradation of hormones. Hypothalamus - neurohypophyseal hormones. Hormone resistant syndrome and multiendocrine neoplasia - different types. Melatonin and serotonin - light and dark cycles. Bioassay of hormones - RIA and ELISA. Genetic control of hormone formation.

Unit II - Hormones acts through cell surface receptors

Hormones acting through cell surface receptors. Hormone - receptor interaction; multiple hormone subunits, Scatchard analysis; peptide hormone receptors: types of receptors- beta - adrenergic receptor and insulin receptor- structure and mechanism of action. Signal transducers and second messengers- protein kinases, cAMP, IP₃, DAG, Calcium and Calmodulin. Eicosanoids and mechanism of action.

Unit III - Molecular endocrinology of insulin resistance

Endocrinology of adipose tissues - leptin, ghrelin, adiponectin and resistin. Fetal endocrine programming of adult disorders (FEPAD): Adverse effects of glucocorticoids in programming events. Endocrinology of insulin like growth factors (IGF's) and its binding proteins (IGFBP). Modulation of placental hormones and growth factors in FEPAD.

Unit IV - Reproductive endocrinology

Genetic, endocrine and biochemical aspects of testis and ovarian differentiation and development. Neuroendocrine perspectives of mammalian reproduction. Endocrine, paracrine and autocrine regulation of spermatogenesis, oogenesis, ovulation and steroidogenesis (Testosterone, 17B-estradiol, Progesterone). Control of synthesis and release of steroid hormones. Structure, function and regulation of male and female accessory sex organs. Conception and contraception. Transport of steroid hormones

in blood. Apoptosis - steroid hormone action at cell level. Hormonal physiology of parturition and lactation. Functional and signaling role of relaxin, follistatin & inhibin. Placental hormones and its neuronal control release.

Unit V - Nuclear receptors (NR)

General features of NR, Ligands that act via nuclear receptor and its sub classes (Orphan receptor and variant receptors). Domain structure of NR - hormone binding domain, antigenic domain and DNA binding domain. Hormone response elements. Detailed study of thyroxine, estrogen, androgen, vitamin D, glucocorticoids, peroxisome proliferator activated receptor and Liver X Receptor. PPAR in insulin resistance. Receptor activation - upregulation and down regulation. Selective estrogen receptor modulator. Endocrine responsive cancer - breast, endometrial and prostate cancers.

Books

1. Devlin, 1997, Textbook of Biochemistry (with clinical correlation), John Wiley, USA.
2. Wilson and Foster, 1992, Textbook of Endocrinology, (8th edn), W.B. Saunders, USA.

Reference

1. Robert, K. Murray et al., 2003, Harper's Biochemistry (25th Edition), Mc Graw Hill Publishers (Asia), India
2. Arthur C. Guyton and Hall, 2006, Text Book of Medical Physiology, Elsevier India pvt. Ltd., New Delhi.
3. Mac. E. Hadley and Jon. E. Levin, 2009, Endocrinology 6th ed., Darling Kindersly Pvt. Ltd., India.

Sem.IV
14PBC4118

Hours/Week: 6
Credits: 5

BIOCHEMICAL TECHNOLOGY

Objectives

- i) To study the biochemical characters for beneficial manipulation.
- ii) To know the recent developments in the field of biochemical technology.

Unit I

In vitro synthesis of tissue and organs - organotypic and histotypic models of engineered tissues - biomaterials in tissue engineering - approaches to transplanting engineered cells and tissues - engineering challenges in immunoisolation device development. Breast reconstruction, Small diameter

vascular grafts - cardiac prostheses, bioartificial pancreas. Hepatassist liver support system - hematopoietic system: red blood cell substitutes.

Unit II

Bioreactors, growth kinetics, industrial strain improvement, downstream processing of biological separation of cell- foam separation, flocculation, filtration - plate filters, rotary vacuum filter, lyophilization, disintegration of microorganisms - mechanical and non mechanical methods, membrane filtration - types. Drier - types.

Unit III

Exploitation of recombinant techniques. Genetic engineering of microbes - crop improvement, resistance to herbicide, pests, insects and viruses. Cytoplasmic male sterility, delayed fruit ripening, antibody, vaccine and interferon production in plants, synthetic seeds, synthesis of biodegradable plastics, RFLP, RAPD, PCR and SSRs in crop improvement, Gene tagging. Site directed mutagenesis.

Unit IV

Present status of DNA vaccines - introduction and development of DNA vaccines, safety and efficacy of DNA vaccines, mechanism for generation of immune response, vector design, delivery and antigen presentation strategies for improving responses to DNA vaccines. Identification of T & B epitopes for vaccine development.

Unit V

Application of recombinant DNA technology in industrial production of hormones (insulin, GH, FSH). Genetic manipulation of cells and animals. Molecular approaches for treating endocrine diseases. Principles of gene therapy. Methods for inserting and expressing gene in a target cell or tissue. Methods for repairing or inactivating pathogenic genes in a cell or tissue. Prospects of gene therapy in treating endocrine diseases.

Books

1. Bain, W (1993). Biotechnology. Oxford University Press, Oxford, UK.
2. Prokop Ales et al., Recombinant DNA technology, Academy of Sciences, New York Stowell, ID., (1986) Bioactive microbial products, Academic Press, New York.

Reference

1. Stanely A. et al., (1994) Vaccines, W.B. Saunders & Co., India
2. Kirby, L.T. (1990) DNA finger printing. Stockton press, UK.

**Sem. IV
14PBC4119**

**Hours/Week: 6
Credits: 5**

ADVANCES IN CLINICAL RESEARCH

Objectives

- i) To provide the students with requisite knowledge that will enable them to pursue a career in the clinical research industry.
- ii) To ensure that India does not lag behind in maintaining the internationally prescribed standards of clinical ethics.

Unit I - Introduction to clinical research

Introduction to clinical research, terminologies and definition in clinical research, origin and history of clinical research, difference between clinical research and clinical practice, types of clinical research, phases of clinical research, clinical trials in India -the national perspective, post marketing surveillance, pharmaceutical industry - global and Indian perspective, clinical trial market, career in clinical research.

Unit II - Pharmacology and drug development

Introduction to pharmacology, concept of essential drugs, routes of drug administration, introduction to drug discovery and development, hurdles in drug development, sources of drugs, basics of drug, discovery & development, approaches to drug discovery, evolutionary classification of the strategies for drug discovery, emerging technologies in drug discovery, preclinical testing, investigational new drug application, clinical trials, new drug application and approval, pharmacokinetics, pharmacodynamics, recent advances - pharmacogenomics and protein based therapies.

Unit III - Ethical considerations and guidelines in clinical research

Historical guidelines in clinical research, Nuremberg code, declaration of Helsinki, Belmont report, international conference on harmonization (ICH)- brief history of ICH, structure of ICH, ICH harmonization process, guidelines for good clinical practice, glossary, the principles of ICH GCP, institutional review board / independent ethics committee, investigator, sponsor, clinical trial protocol and protocol amendment(s), investigator's brochure, essential documents for the conduct of a clinical trial.

Unit IV - Regulation in clinical research & management

Introduction of clinical trial regulation, European Medicine Agency, US FDA, drug and cosmetic act, Schedule Y, ICMR Guideline. Clinical Trial Management

- project management, protocol in clinical research, informed consent, case report form, investigator's brochure (IB), selection of an investigator and site, clinical trial stakeholders, ethical and regulatory submissions, documentation in clinical trials, pharmacovigilance, training in clinical research, roles and responsibilities of clinical research professionals.

Unit V - Clinical data management

Introduction to CDM, CRF Design, clinical data entry, electronic data capture, data validation, discrepancy management, clinical data coding, SAE reconciliation, quality assurance & clinical data management, guideline & regulation in clinical trial data.

Books

1. Satoskar RS, Bhandarkar SD, Ainapure SS, 2003. Pharmacology and Pharmacotherapeutics. 18th ed. Mumbai: Popular Prakashan: 376.
2. Syme SL, 1986, Social determinants of health and disease. In: JM Last (ed) Maxcy- Rosenau Public Health and Preventive Medicine (12th Edition), Norwalk, Conn.:Appleton-Century-Crofts.
3. Bertram Katzung, Susan Masters, Anthony Trevor, 2012. Basic and Clinical Pharmacology 12/E, McGraw Hill publishers, USA.

Reference

1. K. D. Tripathi, 2008, Essentials of Medical Pharmacology, Jaypee Brothers Medical Publishers, India.
2. Narayanan, 2001, Intellectual Property Law, 3rd Ed., 10th Revised, Eastern Law House Private Ltd, India.
3. Bhushan Patwardhan, 2007, Drug Discovery and Development: Traditional Medicine and Ethnopharmacology, New India Publishing, India.
4. Robert B. Taylor, 2011, Medical Writing: A Guide for Clinicians, Educators, and Researchers, Amazon, USA.

**Sem. IV
14PBC4121**

**Hours/Week: 12
Credits: 5**

PROJECT DISSERTATION
&
VIVA VOCE
