COURSE PATTERN – M.Sc. BIOCHEMISTRY -

Sem	Course Code	Course Title	Hours / week			Credits
			L	P	Total	
I	16PBI1101	*Core 1*: Biomolecular Chemistry	6	-	6	5
	16PBI1102	*Core 2*: Molecular biology	6	-	6	5
	16PBI1103	*Core 3*: Bioenergetics and Enzymology	6	-	6	5
	16PBI1104	*Core 4*: Lab Course – 1	-	4	4	4
	16PBI1105	*Core 5*: Lab Course – 2	-	4	4	4
	16PBI1106	*Core 6:* ***Self paced learning*** – Advanced Nutrition	-	-	-	2
	16PBI1201A 16PBI1201B	*Core Elective 1A*: Developmental Biology (OR) *Core Elective 1B*: Biochemistry of Natural Products	4	-	4	4
		Total for Semester I	**22**	**08**	**30**	**30**
II	16PBI2107	*Core 7*: Microbiology	4	-	4	4
	16PBI2108	*Core 8*: r DNA technology	5	-	5	4
	16PBI2109	*Core 9*: Human Physiology	5	-	5	4
	16PBI2110	*Core 10*: Lab Course – 3	-	4	4	4
	16PBI2111	*Core 11*: Lab Course – 4	-	4	4	4
	16PBI2202A / 16PBI2202B	*Core Elective 2A*: Life Sciences for Competitive Examinations-I (***Integrated lecture – e-resource course***) / *Core Elective 2B*: Molecular Diagnostics	4	-	4	4
	16PBI2401	IDC – 1- Soft Skills	4	-	4	4
	16PBI2301	*Additional Core 1*: Training Programme	-	-	-	3*
		Total for Semester II	**22**	**08**	**30**	**30**
III	16PBI3112	*Core 12*: Research Methodology	4	-	4	4
	16PBI3113	*Core 13*: Clinical Biochemistry	4	-	4	4
	16PBI3114	*Core 14*: Immunology	4	-	4	4
	16PBI3115	*Core 15*: Lab Course – 5	-	3	3	2
	16PBI3116	*Core 16*: Lab Course – 6	-	3	3	2
	16PBI3203A / 16PBI3203B	*Core Elective 3A*: Life Sciences for Competitive Examinations-II (***Integrated lecture – e-resource course***) / *Core Elective 3B*: Pharmaceutical Biochemistry	4	-	4	4
	16PBI3402	IDC WS (within schools) – Bioprocess Technology	4	-	4	4
	16PBI3403	IDC BS (between schools) – First Aid Management	4	-	4	4
		Total for Semester III	**24**	**06**	**30**	**28**
IV	16PBI4117	*Core 17*: Advanced Endocrinology	6	-	6	4
	16PBI4118	*Core 18*: Pharmaceutics and Nanotechnology	6	-	6	4
	16PBI4119	*Core 19*: Advances in Clinical Research	6	-	6	4
	16PBI4120	*Core 20*: Lab Course – 7	-	4	4	4
	16PBI4121	Comprehensive Examination	-	-	-	2
	16PBI4122	Project Dissertation and *Viva Voce*	-	8	8	4
	16PBI4302	*Additional Core 2*: Publication of Review Articles / Presentation of Research Papers	-	-	-	5*
		Total for Semester IV	**18**	**12**	**30**	**22+5***
	16PBI4601	**Community Service** (SHEPHERD) and Gender Studies	-	-	-	5
		Total for all Semesters	**86**	**34**	**120**	**112+8***

*- Extra Credits, **L**- Lecture, **P**- Practicals

BIOMOLECULAR CHEMISTRY

SEM-I **Hours/week: 6**
16PBI1101 **Credits: 5**

Assurance of Learning:

- *The course assure to provide students with a basic understanding of:*
- *the molecular makeup of living cells;*
- *the chemical nature of biological macromolecules, their three-dimensional construction, and the principles of molecular recognition;*
- *the metabolism of dietary and endogenous carbohydrate, lipid, and protein.*
- *At the end of the course, the students should be able to demonstrate the biomolecular constitution and metabolic processes*

Unit - I: The molecular logic of life:
The chemical unity of diverse living organisms, composition of living mater. Water - Physio-chemical properties, biomolecular reactions. Macromolecules and their monomeric subunits, Carbohydrates – classification, structure and isomerism. Monosaccharides, oligosaccharides & polysaccharides – structure and properties. Amino acids - structures, classification and properties. Proteins – classification, types, characteristics and structures, functions. Lipids – classification, sources and biological functions. Nucleic acids- bases, nucleosides & nucleotides.

Unit – II: 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: Metabolism of Proteins and Amino acids:
Biosynthesis of aspartate, pyruvate and aromatic amino acids families, Amphibolic activity of amino acids. 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 aminoacids. Urea cycle and its significance.

Unit – IV: Metabolism of lipids:
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: Metabolism of nucleic acids:
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.

Text books for study

1. Robert K. Murray *et al*, 2000.Harper's Biochemistry, Appleton and Lange Stainford Publishers, Connecticut.
2. Lehninger, A. L. *et al.,* 1993. Principles of Biochemistry, Worth Publishers. Inc. USA.

References

1. Stryer, I., 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.
3. Donald Voet and Judith, G. Voet. 2011. Biochemistry. (4th Edition). John Wiley and Sons, New York.

MOLECULAR BIOLOGY

SEM – I **Hours/Week: 6**
16PBI1102 **Credits: 5**

Assurance of Learning *- The course assure to provide students with a basic understanding of:*

- *the fundamentals of informational pathways;*
- *the gene expression and regulations of cellular functions in cells;*
- *the molecular machinery of informational pathways;*
- *the errors and correction mechanisms of informational molecules.*

Unit – I: Introduction:
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.

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 mDNA, theory of prokaryotic endosymbionts. Plasmids: Definition, Types, Structure, Properties, gene content. Use in rDNA technology.

Unit – III: DNA replication:
Models – Messelson& 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. Wobbling hypothesis. 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; SNAPs 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.

Text books for study

1. David Freifelder, 2008. Molecular Biology. (Ed: 2). Narosa Publications. NewDelhi.
2. Jeoffrey M. Cooper & Rober E. Hausman. 2000. The Cell: A Molecular Approach ASM Press, Washington D.C.

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.

BIOENERGETICS AND ENZYMOLOGY

SEM-I **Hours/Week: 6**
16PBI1103 **Credits: 5**

Assurance of Learning *- The course assure to provide students with a basic:*

- *understanding of bioenergetics;*
- *knowledge concerning biotransformation reactions involving enzymes;*
- *enzyme reactions and its characteristics along with the production and purification process;*
- *understanding of enzyme kinetics and applications in various fields.*

Unit – I: Thermodynamics:
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.

Unit – II: Basics of Enzymology:
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 – III : Criteria of chemical reactions:
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: mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymerase. Isoenzymes. Multienzymes system- mechanism of action and regulation of pyruvate dehydrogenase ,LDH and fatty acid synthase complex.

Unit – IV: 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 – V: Applications of Enzymes:
Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), 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.

Text books for study

1. Dixon, M. and Webb, J.F., 1979, Enzymes, Longman Publishing, London.
2. Price and Stevens, 1999, Fundamentals of Enzymology, Oxford University Press, UK.

References

1. Trevor Palmer, 1991, Understanding Enzymes, 3rd Edition, Ellis Harwood, UK.
2. Lehninger, A. H. *et al.,* 1993, Principles of Biochemistry, Worth Publ. Inc., USA.
3. Jeremy M .Berg., John L Tymoczko and Lubert Stryer. 2007. Biochemistry. (6th Edition). W H Freeman and Co, New York

LABORATORY COURSE - 1

SEM-I **Hours/Week; 4**
16PBI1104 **Credits: 4**

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

References

1. Praful. B. Godkar, 2014, Text book of Medical laboratory technology; III edition, Volume I and II, Bhalani Publishing house.
2. Alan H .Gowenhock , Varley's Practical Clinical Biochemistry ,6th Edition ; CBS publishers.

LABORATORY COURSE – 2

SEM-I **Hours/Week: 4**
16PBI1105 **Credits: 4**

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

References

1. Sadasivam, S. and Manickam, A. 2010. Biochemical Methods. (3rd Edition), New Age International (P) Ltd., New Delhi.
2. David T. Plummer. 1988. Practical Biochemistry. (3rd Edition). Tata McGraw Hill Publishers, New Delhi.

ADVANCED NUTRITION

(Self paced Learning)

SEM-I **Hours/Week: 0**

16PBI1106 **Credits: 2**

Assurance of Learning- *The course assures the students to;*

- *study the proximate principles of Nutrition with reference to RDA;*
- *understand the disorders associated with nutrition intake*;
- *learn the basic requirement of nutrition at different stages of life.*
- *At the end of the course the students would be able to assess nutritional status and design diet plans.*

Unit – I: Energy Metabolism:

Basal metabolism – Basal metabolic rate – Factors affecting BMR, - determination of BMR, direct and indirect methods, - Benedict's Roth apparatus, - respiratory quotient – Biological oxygen demand. Anthropometry; Height, Weight, Skin fold thickness and arm circumference -Their importance in nutrition.

Unit – II: Introduction to Nutritional Biochemistry:

Carbhydrate ; Source of energy; Glycogen , Fibre in diet. Proteins – essential amino acids and non essential amino acids – sources, functions – relation with Marasmus, Kwashiorkar disease. Biological value of proteins.

Fats: Sources- Saturated and unsaturated fatty acids ,essential and non-essential fatty acids – disorders concerned with fatty acid metabolism – Refsum's disease, Atherosclerosis.

Unit – III: Vitamins:

Fat soluble and water soluble – B-complex vitamins – source, daily requirements – deficiency manifestations. Role of Vitamins as co-factors- in Electron transport chain; and enzyme reactions; Vitamins involved in haemopoiesis.; Role as antioxidants.

Unit – IV: Minerals –

Micro, macro and trace elements – daily requirements – functions – deficiency manifestations – Role as electrolytes.- sodium and potassium. Food fads and Facts

Unit – V: Nutrition at different Stages of life:

During infancy, adolescence, pregnancy ;and aging. Therapeutic diet – Formulations for DM, Hypertension and Atherosclerosis.

Assessment of nutritional status, - methods – intake, Biochemical and clinical methods.

Text books for study

1. Swaminathan, M. 2004, Essentials of Food and Nutrition. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
2. Anthony A. Albanase (1972), Newer Methods of Nutritional Biochemistry (Academic Press, New York)

References

1. Garrow, J. S. and James, W. P. T. 2000. Human Nutrition and Dietetics. (10th Edition). Churchill Livingstone Publishers, UK.
2. Wong, D. W. S. 1996. Mechanism and Theory in Food Chemistry. CBS, New Delhi.

DEVELOPMENTAL BIOLOGY

SEM-I **Hours/Week: 4**
16PBI1201A **Credits: 4**

Assurance of Learning – *The course assures the students to;*

- *study the cellular basis of development.*
- *acquire fundamental knowledge of animal embryonic development--that is how an egg develops into an adult*
- *learn how genes function to control phenotype of an organism*
- *study the role of environment in the developmental process*

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

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:
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.

Unit – IV: Organogenesis - II:
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.

Text books for study
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. Harvey Lodish., Arnold Berk and Paul Matsudaira. 2008. Molecular Cell biology. (5th Edition). W. H. Freeman and Company, New York.

BIOCHEMISTRY OF NATURAL PRODUCTS

SEM-I **Hours/Week: 4**
16PBI1201B **Credits: 4**

Assurance of Learning *– The course assures the students to;*

- *study the occurrence, properties and economic importance of natural products from plants, animals and microbes.*
- *classify the natural compounds based on chemistry and applications*
- *learn isolation strategies of natural products*
- *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, monoterpene, 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: 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, lignins and pectins: 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. Pyrethroids and rotennones of plant origin: Definition, general properties and importance. Natural products of therapeutic importance from animals- Zootherapy -Venom, Body fluids as medicines – Urine, Saliva and Faeces.
Isolation, qualitative and quantitative analysis of secondary metabolites (Skill component)

Text books for Study

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.

References

1. Chemistry and biology of herbal medicine: V. P. Agrawal and V. P. Khamboj, (Eds.) (Society of Biosciences).
2. G. E. Trease and W. C. Evans, 2002, Pharmacognosy and Phytochemistry, 15th Edition,W.B Saunders Edinburgh, NewYork.
3. Gurdeep Chatwal, 1995, Organic chemistry of natural products, Himalaya publishing House, India.

MICROBIOLOGY

SEM-II **Hours/Week: 5**
16PBI2107 **Credits: 4**

Assurance of Learning *– The course assures the students to;*

- *understand the basic classification and characteristic features of microbes;*
- *learn the implications of microbes in the environment;*
- *be aware of the microbial diseases, their diagnosis and treatment options;*
- *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 pertusis). Fungal diseases of human (superficial, cutaneous, subcutaneous and systemic mycoses). Viral diseases of human (AIDS, hepatitis, polio, rabies and measles). Mycoplasmal, Chlamydial, Rickettsial 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.

Text books for study

1. Ananthanarayan, R. and Jayaram Paniker, C.K. 2007. Text Book of Microbiology. (7th Edition). Orient Longman Ltd., Chennai.
2. Lansing M Prescott, John P Harley and Donald A Klein. 2007. Microbiology. (7th Edition). Mc Graw Hill, New York.

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.
3. Mackie and McCarthy, 1994. Medical Microbiology, (4th Edition). Churchill Livingstone, New York.

RECOMBINANT DNA TECHNOLOGY

SEM: II **Hours/Week: 5**
16PBI2108 **Credits: 4**

Assurance of Learning -

- *Study of the various underlying principles of genetic engineering that forms the basis of rDNA technology.*
- *Study the methodologies of gene transfer*
- *Knowledge on the general principles of generating transgenic plants, animals and microbes*
- *Students in strategizing research methodologies employing genetic engineering techniques.*

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, T_4 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 λ, 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), 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 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.

Text books for Study

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.

References

1. David M Glove. 1984. Gene cloning - The mechanisms of DNA manipulations. Chapman and hall, New York.
2. Ernst L Winnacker. 2002. From genes to clones - Introduction to gene technology. VCR Pub., Weinheim.
3. James D Watson. *et al.* 1992. Recombinant DNA. WH freeman and co., NY

HUMAN PHYSIOLOGY

SEM-II **Hours/Week: 4**
16PBI2109 **Credits: 4**

Assurance of Learning-

- *Study the functional mechanism of body organ systems;*
- *Understand the homeostatic mechanism of each organ system;*
- *Recognize and explain the interrelationships within and between anatomical and physiological systems of the human body;*
- *Knowledge on the influence of environment in the physiological processes.*

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 and compartments. Homeostasis –Mechanisms, Homeostatic regulation of water and electrolytes. Plasma proteins and its function. Formed elements – development and function. Hemoglobin – structure and function. Blood Clotting mechanisms.

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. 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 - General design of nervous system: Classification and Properties of nerve fibers, nerve conduction, Classification of somatic senses, sensory receptors, sensory transduction, information processing, 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. Functional anatomy of skeletal muscle, mechanisms of muscle contraction, smooth muscles.

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. Urine formation, 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.

Text books for study

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. 11thEdn, KalyaniMukerjee Publications, Kolkata, India.

References

1. Kathleen, J.W. Wilson and Anne Waugh. 1998. Ross and Wilson Anatomy and Physiology in health and illness. (8th Edition). Churchchill Livingstone, New York.
2. Gerald J. Tortora and Sandra Reynolds. 2003. Principles of Anatomy and Physiology. (10th Edition). John Wiley and Sons. Inc. Pub. New York
3. Abraham White., Philip Handler and Emil L. Smith. 1983. Principles of Biochemistry. (6th Edition). Tata Mc Graw – Hill Publishing Company, New Delhi.

LABORATORY COURSE – 3

SEM-II **Hours/Week: 4**
16PBI2110 **Credits: 4**

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.

References:

1. Lansing M Prescott, John P Harley and Donald A Klein. 2007. Microbiology. (7th Edition). Mc Graw Hill, New York.
2. James G. Cappucino and Sherman Natalie 2005. Microbiology – A Laboratory Manual. (7th edition). Pearson education India, New Delhi.

LABORATORY COURSE - 4

SEM- **Hours/Week: 4**
16PBI2111 **Credits: 4**

RECOMBINANT DNA 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

References

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.

LIFE SCIENCES FOR COMPETITIVE EXAMINATIONS – I
(***Integrated lecture – e-resource course***)

SEM-II **Hours/Week: 4**
16PBI2202A **Credits: 4**

Course Description:

The elective course is offered to enhance the students to get through in the competitive exams like UGC & CSIR-JRF NET. The course would be taught in lectures both classical and online. The evaluation will be as online MCQ tests.

Assurance of Learning – *The course assure the students to;*

- *gain knowledge on the classification, taxonomy and plant physiology;*
- *acquaint with the strategies of e-learning*
- *covers the topics of the CSIR UGC – Net syllabus that are not included in the core courses;*
- *make them familiar with pattern of testing in competitive examinations*

Unit – I:
Basics of Taxonomy: 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:
System of classifications: Outline classification of plants, animals & microorganisms, structural details: Important criteria used for classification in each taxon. Classification of plants (Benthem and 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 and plant physiology: Photosynthesis – Light reaction and dark reaction fixation C_3, $C_4$and CAM pathways, photorespiratory pathway. Translocation of water, ions, solutes and macromolecules from soil-xylem and phloem, transpiration, introduction to sec 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 biodiversitychange; 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 thermal, dry heat.

Text books for study

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

References

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.

MOLECULAR DIAGNOSTICS

SEM-II **Hours/Week: 4**
16PBI2202B **Credits: 4**

Assurance of Learning-

- *Explore the molecular mechanisms of diseases.*
- *Study the various molecular diagnostic tools available for these diseases.*
- *Enable the students to learn tissue matching procedures*
- *Outlines the forensic methodologies*

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: M
odel 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.

Text books for study

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

References

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.

RESEARCH METHODOLOGY

SEM-III **Hours/Week: 4**
16PBI3112 **Credits: 4**

Assurance of Learning *- The course assures the students to;*

- *understand the working principles, construction and applications of the instruments used in the studies related to various disciplines of biological sciences;*
- *understand the statistical concepts and their significance;*
- *appreciate the importance of research and to learn the art of data collection;*
- *know the nuances of scientific writing and publishing*

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 principle; adsorption and partition chromatography. Techniques and application of paper, column, thin layer**,** normal phase and reverse phase - ion-exchange chromatography, exclusion chromatography, affinity chromatography, GLC and HPLC, HPTLC.

Unit – II:

Centrifugation: 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 Methodology: 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 ofDispersion (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; Gene Bank 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.

Text books for study

1. Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath, 2014 Biophysical Chemistry (Principles and Techniques) (4th Edition,) Himalaya Publishing House, India.
2. Research Methodology, Methods and Techniques C.R. Kothari, (2ndEdn), New Age International Publishers. New Delhi.

References

1. Wayne W. Daniel, 2006, Biostatistics: A Foundation for Analysis in the Health Sciences (9th Edition), John Willey and Sons Inc., USA.
2. Attwood, T. K., and Parry-Smith, D.J. 1999. Introduction to bioinformatics. Pearson Education Ltd., Delhi, India.
3. Rodney F. Boyer. 1993. Modern Experimental Biochemistry. (2nd Edition), Benjamin-Cummings Publishing, Redwood City, CA.

CLINICAL BIOCHEMISTRY

SEM-III **Hours/Week: 4**
16PBI3113 **Credits: 4**

Assurance of Learning – *The course assures the students to;*

- *gain thorough knowledge about the biochemical basis of various diseases and disorders;*
- *analyze the symptoms of various diseases;*
- *study various diagnostic and therapeutic methodologies available for diseases and disorders;*
- *know the available treatment modalities.*

Unit – I:

Blood and body fluids: Collection and preservation, Disturbances in Blood cloting-haemophilia A and haemophilia B. Haemoglobin in anaemias-sickle cell, thallasemia, abnormal haemoglobins. Porphyrias and porphyrinurias. Anticoagulants. Hemolytic diseases of the new born. Adverse reactions of blood transfusions. Blood banking

Cellular injury: causes, pathogenesis and morphology of cell injury. Intercellular alterations in lipids, proteins and carbohydrates, cellular adaptation, atrophy and hypertrophy. Basic mechanism involved in the process of inflammation and repair: alteration in vascular permeability and blood flow. Brief outline of the process of repair.

Unit – II:

Disturbances of carbohydrate metabolism: Blood sugars – Its 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 cholesteremia, Hypo and hyper lipoprotenemia, hypocholestremic 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, Alkaptonuria, Albinism, Tyrosinosis, Phenylketonuria. Disorders of sulphur containing amino acid and urea cycle.

Unit – IV:

Diseases of the liver: Macro and micro anatomy of liver, Hepatitis and its 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 Diseases: Renal stress and its analysis. Renal function tests - biochemical changes in acute and chronic renal failure. Normal and abnormal urinary constituents. 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 and viral infections. Amniotic fluid and maternal serum, ailment in pregnancies.

Text books for study

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.

References

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, VY.B. Saunders Company, Philadelphia.
3. Luxton. R, 2010, Clinical Biochemistry, 2nd edition, VinothVashista Pvt. Ltd., New Delhi.

IMMUNOLOGY

SEM-III **Hours/Week: 4**
16PBI3114 **Credits: 4**

Assurance of Learning *– The course assures the students to;*

- *study in detail the components of immune system;*
- *learn the features of immune reactions;*
- *learn the biochemical basis of immune disorders;*
- *know the analytical methods involved in immunology*

Unit – I: Introduction to Immunology: Infection- types, factors influencing infection- pathogenicity. Sources and carriers of infectious agents. Immune system- definition and properties. Cells of the immune system. Lymophoid 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.

Unit – II:
Antigens and Antibodies: definition, properties- antigenicity and immunogenicity, antigenic determinants and haptens. Types of antigens - flagellar, somatic, capsular, soluble, heterophile, tumour and autoantigens. Antigen - antibody interactions - 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.

Unit – III:
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. Regulation of immune response. Cytokines, types and role in immunity. Mitogens and immunosuppresants. Immunological tolerance- at birth and in adults; induction and termination.

Unit – IV:
Immune system in health & disease: 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, immunization schedule. Tumor immunology: tumor antigens, immunosurveilance and NK cells. Auto immunity-mechanism of breakdown, pathogenesis and specific diseases.

Unit – V:
Immunological techniques: Polyclonal antibodies- principle and production of antisera. Monoclonal antibodies - hybridoma technique, applications, merits and demerits. Recombinant antibodies. Principle and applications of RIA, ELISA. Precipitation reaction - Immunodiffusion, immunoelectrophoresis, precipitin ring test. Agglutination tests - heamagglutination, febrile and latex agglutination. Widal, VDRL, pregnancy and rheumatoid factor tests.

Text books for study

1. Charles A. Janeway and Paul, J. R. 1994. Immunobiology. (4th Edition), Travels Blackwell Scientific Publishers, New York.
2. Kuby Richard, A. Goldsby., Thomas J. Kint and Barbara. A. Osborne. 2000. Immunology. (4th Edition), W.H. Freeman and Company, New York.

References

1. Fahim Halim Khan, 2009, The Elements of Immunology, Pearson education, New Delhi.
2. Frank C. Hay and Olwyn M. R. Westwood, 2006, Practical Immunology, Blackwell Publishing, India.
3. Ivan M. Roitt and Peter J. Delves. 2005. Roitt's Essential Immunology. (10th Edition). Blackwell Scientific Publishers, New York.

LABORATORY COURSE – 5

SEM-III **Hours/Week - 3**
16PBI3115 **Credits - 2**

CLINICAL BIOCHEMISTRY

I. Hematological studies

1. Collection of Blood
2. Estimation of hemoglobin content.
3. Total RBC count.
4. Total WBC count.
5. Determination of Packed Cell Volume.
6. Differential WBC count (DC).
7. Absolute Eosinophil count (AEC).
8. Total platelet count.
9. Determination of clotting time
10. Determination of Prothrombin time
11. Determination of ESR.
12. Grouping of blood and Rh typing.
13. Pathological examination of blood film.

II. Biochemical analysis of blood

1. Estimation of blood glucose (2 methods)
2. Estimation of serum proteins
3. Estimation of plasma fibrinogen
4. Estimation of A: G ratio in serum
5. Estimation of blood urea (2 methods)
6. Estimation of serum uric acid
7. Estimation of serum creatinine.
8. 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.

References

1. Praful.B.Godkar, 2014, Text book of Medical laboratory technology; III Edition , Volume I and II , Bhalani Publishing house.
2. Alan H .Gowenhock, Varley's Practical Clinical Biochemistry, 6th Edition; CBS publishers.

LABORATORY COURSE – 6

SEM-III **Hours/Week 3**
16PBI3116 **Credits 2**

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.

References

1. Kuby Richard, A. Goldsby., Thomas J. Kint and Barbara. A. Osborne. 2000. Immunology. (4th Edition), W.H. Freeman and Company, New York.
2. Ivan M. Roitt and Peter J. Delves. 2005. Roitt's Essential Immunology. (10th Edition). Blackwell Scientific Publishers, New York.

LIFE SCIENCES FOR COMPETITIVE EXAMINATIONS – II
(*Integrated lecture – e-resource course*)

SEM-III **Hours/week: 4**
16PBI3203A **Credits: 4**

Course Description:

The elective course is offered to enhance the students to get through in the competitive exams like UGC & CSIR-JRF NET. The course would be taught in lectures both classical and online. The evaluation will be as online MCQ tests.

Assurance of Learning – *The course assure the students to;*

- *gain knowledge on evolution and ecology;*
- *acquaint with the strategies of e-learning*
- *covers the topics of the CSIR UGC – Net syllabus that are not included in the core courses;*
- *make them familiar with pattern of testing in competitive examinations*

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; Experiment 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.

Unit – V: 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)

Text books for study

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.

References

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.

PHARMACEUTICAL BIOCHEMISTRY

SEM III **Hours/Week: 4**
16PBI3203B **Credits - 4**

Assurance of Learning *– The course assures the students to;*

- *make a detailed study of drugs, particularly their actions on living systems;*
- *learn the pharmacokinetics and pharmacodynamics of drugs;*
- *know their chemotherapeutic value;*
- *familiarize with the adverse effects of drug action.*

Unit – I:

Drugs – definition, source and nature, types of classification and nomenclature, dose response curve and LD_{50}. 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.

Unit – III:

Pharmacokinetics and Pharmacodynamics: Drug absorption, distribution, metabolism, Phase I and Phase II reactions. Excretion and dosing. Pharmacokinetic oriented drug design – Drug solubility and drug stability. Biological testing and bioassays – testing drugs *in vitro* and *in vivo*. Drug discovery. Lead compounds – natural sources and synthetic sources.

Unit – IV:

Drugs acting on various systems: CNS- Sedatives- Hypnotics, GI tract- drugs for peptic ulcer, diarrhoea and constipation. Miscellaneous drugs - antiseptics, disinfectants, chelating agents. Adverse drug reactions and drug induced side effects, biological effects of drug abuse and drug dependence, drug tolerance and intolerance.

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.

Text books for study

1. K. D. Tripathi, Essentials of Medical Pharamacology, (7th Edition), Jaypee Publishers, 2010.
2. Jayashree Ghosh, A Textbook of Pharmaceutical Chemistry (3rd edition). S.Chand & Company Ltd., New Delhi, 2010.

References

1. Robert K. Murray, Daryl K. Granner, Peter A. Mayer and Victor W. Rodwell, Harper's Biochemistry. (25th edition), Mc Graw Hill, New York, 2006.
2. Bertram Katzung, Basic and Clinical Pharmacology, (12th edition), Lange Publishers, 2012.
3. Gareth Thomas, Fundamentals of Medicinal Chemistry, Wiley Blackwell Publishers, 2003.

BIOPROCESS TECHNOLOGY

IDC (WS)

SEM III **Hours/Week 4**
16PBI3402 **Credits 4**

Assurance of Learning – The course assures the students to;

- *study the avenues of exploiting microbes in bioconversion technology;*
- *study the downstream processing for product recovery in fermentation;*
- *know the instrumentation of industrial bioconversion;*
- *learn the influence of various parameters in the industrial productions.*

Unit – I:

Fermentation: Principles of fermentation process, Bioprocess *Vs* Chemical process, Media formulation – Growth factors, Buffers, O_2, Antifoams and Media Optimization. Cell growth and quantitation – density, cell mass, growth pattern, yield factors and environmental conditions. Batch, Continuous and Fed batch culture.

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: O_2 requirement and uptake-factors affecting K_La-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.

Text books for study

1. Stanbury, P F & Whitaker, A, 1995, Principles of Fermentation Technology, Pergamon.
2. Schuler M L & Fikret Kargi, 2002, Bioprocess Engg: Basic Concepts, Prentice Hall, NJ.

References

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

FIRST AID MANAGEMENT

IDC (BS)

SEM-III **Hours/Week 4**

16PBI3403 **Credits 4**

Assurance of Learning *– The course assures the students to;*

- *perform a basic assessment of an emergency situation;*
- *undertake immediate relief and rescue during emergency;*
- *learn the instrumentations available for emergency relief and rescue;*
- *demonstrate an awareness of signs, symptoms and treatment for common medical emergencies.*

Unit – I:

Principles of First Aid Management: 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:

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

Unit – III:

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

Unit – IV:

Emergency Care: Accident reporting, first aid to victims of road accidents. Patient assessment and management, breathing emergencies, 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.

Text books for study

1. First Aid Manual- St. John Ambulance Guide.
2. Standard First Aid and Personal Safety 8 thedition – American Red Cross

ADVANCED ENDOCRINOLOGY

SEM-IV **Hours/Week 6**
16PBI4117 **Credit 5**

Assurance of Learning – *The course assures the students to;*

- *study the components of endocrine systems;*
- *learn the molecular features of hormones and their synthesis;*
- *study the hormonal regulations of various physiological functions and signaling mechanisms;*
- *familiarize with the endocrine diseases.*

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. Melatonins and serotonin – light and dark cycles. RIA and ELISA in Bioassay of hormones. 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, gherlin, adiponectin, 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. Transport of steroid hormones in blood. Conception and contraception. Apoptosis – steroid hormone action at cell level. Hormonal physiology of parturition and lactation.

Unit – V:

Nuclear receptors (NR)- General features, 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.

Text books for study

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

References

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.

PHARMACEUTICS AND NANOTECHNOLOGY

SEM-IV **Hours/Week 6**
16PBI4118 **Credits 5**

Assurance of Learning *– The course assures the students to;*

- *study the preparation and packaging methodologies of pharmaceuticals;*
- *demonstrate various drug delivery system;*
- *know the basics of nanotechnology and it's potential as medicines;*
- *cognize with the prospective of placement in the pharmaceutical industries.*

Unit – I:

Tablets - Characteristics, advantages and disadvantages. Types of tablets, excipients, granulation methods and machinery involved. Tablet compression operation-single punch and rotary tablet presses, processing problems, evaluation, packaging. Tablet coating: Types-sugar coating, film coating, compression coating, electrostatic and enteric coating. Film forming materials, formulation of coating solution, equipments for coating, Processing problems in coating, evaluation.

Unit – II:

Capsules: Advantages and disadvantages of capsules. Materials and method of production of hard gelatin capsule, size of capsules, Formulation, method of filling, equipments involved, finishing techniques and evaluation. Storage of capsules. Soft gelatin capsules-shell and capsule content, manufacture, processing and control. Sterilization of injections, formulations, aerosols, ophthalmic preparations, Surgical ligatures and sutures, Blood products and plasma substitutes

Unit – III:

Packaging materials: Types of glasses and plastics employed for packing and their evaluation. Cosmetics. Introduction, fundamentals of cosmetic science. Formulation, preparation, packaging and evaluation of following Cosmetics- cosmetics for skin and face, Nail polish, lipstick, rouge, Hair preparation-Shampoo, Hair dyes, depilatories, shaving cream, after shave lotion. Oral hygiene preparation-dentifrices, mouth washes.

Unit – IV:

Controlled drug delivery systems: Advantages of controlled drug delivery systems.
a) An introduction to novel drug delivery systems- Liposomes, niosomes, nanoparticles and osmotically conrolled systems b) Micro encapsulation c) Transdermal drug delivery systems-Formulation and evaluation.

Unit – V:

Introduction to Nanotechnology: Properties and Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes), Green synthesis, characterization of Nano material; Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging. Applications of nanotechnology in medicine & health, food, agriculture, livestock, aquaculture, forestry and sustainable environment.

Text books for study

1. Theory and practice of industrial pharmacy; by Leon Lachman, Herbert. A. Lieberrman, Joseph. L. kanig; Third edition ; Lea & Febiger.
2. Pharmaceutics, The Science of Dosage Form Design: Michael. E. Aulton ; Second edition; English language book society/Churchill Livingstone.

References

1. Pharmaceutical dosage forms: Tablets, Volume 1, 2, 3; Herbert. A. Lieberman, Leon lachman & Joseph. B .Schwartz; Marcel Dekker INC.
2. Nanobiotechnology: Concepts, Applications and Perspectives, Christ of M. Niemeyer (Editor), Chad A. Mirkin (Editor) , Wiley-VCH; 1 edition , 2004.
3. NanoBioTechnology: BioInspired Devices and Materials of the Future by Oded Shoseyov and Ilan Levy, Humana Press; 1 edition 2007.

ADVANCES IN CLINICAL RESEARCH

SEM-IV **Hours/Week 6**
16PBI4119 **Credits 5**

Assurance of Learning *– The course assures the students to;*

- *be aware of the protocols and regulations in clinical research;*
- *familiarize with the ethics and SOPs of clinical research;*
- *acquire requisite knowledge that will enable them to pursue a career in the clinical research industry;*
- *not lag behind in maintaining the internationally prescribed standards of clinical ethics.*

Unit – I:

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, 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 Guideline 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 ICHGCP, 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, Food and Drug Administration (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, 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.

Text books for study

1. Satoskar RS, Bhandarkar SD, Ainapure SS, 2003. Pharmacology and Pharmacotherapeutics. 18th ed. Mumbai: Popular Prakashan: 376.
2. Bertram Katzung, Susan Masters, Anthony Trevor, 2012.Basic and Clinical Pharmacology 12/E, Mc Graw Hill publishers, USA.

References

1. K. D. Tripathi, 2008, Essentials of Medical Pharmacology, Jaypee Brothers Medical Publishers, India.
2. BhushanPatwardhan,2007, Drug Discovery and Development: Traditional Medicine and Ethnopharmacology, New India Publishing, India.
3. Robert B. Taylor, 2011, Medical Writing: A Guide for Clinicians, Educators, and Researchers, Amazon, USA.

LAB COURSE – 7

SEM-IV **Hours/Week 4**
16PBI4120 **Credits 4**

1. Handling of laboratory animals
2. Extraction of phytochemicals using soxhlet apparatus.
3. Identification of active principles by spectral studies(FTIR, UV-Vis)
4. Estimation of clinical parameters (sugar , Hb , Cholesterol , Proteins and creatinine) using automated analyzer.
5. Routes of administration of drugs/xenobiotics
6. Dissection of animals and aseptic removal of individual organs
7. Histological studies on animals
8. Recording and management of research data.

References

1. Handbook on Laboratory Animal Handling.
2. Sudha Gangal, 2010. Principles and Practice of Animal Tissue Culture. (2nd Edition). University Press (India) Pvt. Ltd.
3. Freshney, R.I. 2005. Culture of Animal Cells: A manual of basic technique. (5th Edition). John Wiley and Sons, New Jersey.
4. Vogel, 1989, Text Book of Practical Organic Chemistry, Longman Scientific and Technical Publishers, Newyork.