

**Deccan Education Society's
FERGUSSON COLLEGE (AUTONOMOUS),
PUNE**

Syllabus
for

M. Sc.(Biochemistry) Part II

(Semester-III and Semester-IV)

[Pattern 2019]

from Academic Year

2020-21

Program Structure of M.Sc. (Biochemistry) Part-II

Particulars	Paper	Paper code	Title of Paper	Type of Paper	No. of Credits
M.Sc. Semester- III	Paper- 1	CHB5301	Genetic Engineering and Animal cell culture	T CORE-1	4
	Paper - 2	CHB5302	Immunology and Toxicology	T CORE- 2	4
	Paper - 3	CHB5303	Neurochemistry and Endocrinology	T CORE- 3	4
	Department Electives Courses/MOOCs/General Elective (any One)				
	Paper -4	CHB5304	Biostatistics, Bioinformatics and Advance Biophysical techniques	D Elective-1	4
		CHB5305	Nutraceuticals, Pharmaceuticals and Molecular Oncology	Elective-2 Or MOOCs	
		CHB5306	Clinical Nutrition and Food Technology		
	Paper -5	CHB5307	Biochemistry Practical-V (Molecular Biology and Immunology)	PCORE-1	4
	Paper -6	CBH5308	Biochemistry Practical-VI (Bioinformatics, Computer Skills and Statistical Analysis)	PCORE-1	4
M. Sc. Semester- IV	Paper -1	CHB5401	Biochemistry Project	PCORE-1	8*

***One Project credit is equivalent to minimum 5-6 hours (for 8 Credits 40 – 48 Hours per week)**

MOOC courses	Note: Students offering less than 12 theory papers i.e. (48 credits) in previous semester can opt for the following MOOCs courses				
	Course- 1	CHB-01	Food and Nutrition	MOOCs	4
	Course- 2	CHB-02	Drug delivery: Principles and Engineering	MOOCs	4
	Course-3	CHB-03	Introduction to Developmental Biology	MOOCs	4
	Course- 4	CHB-04	Introduction to Proteogenomics	MOOCs	4
	Course- 5	CHB-05	Virology	MOOCs	4

Guidelines for CHB5401: Biochemistry Project [8 credits]

Student need to select **project and internship** in industry/ R and D Institutes.

1. It is expected to spend 5-6 hours per credit i.e. for 8 Credits project course 40 – 48 Hours per week.
2. Therefore, a full-time intern is expected to spend 40 -48 hours per week on Internship with Project work.
3. Weekly reporting of the progress of work should be done to the Faculty Mentor of the department.

CHB5301: Genetic Engineering and Animal Cell Culture

[Credits – 4]

Course Outcomes

After learning this course student will be able to

CO1. Understand the concepts of Genetic engineering, its importance, enzymes used, modification techniques, comprehend what a cloning and expression vector means, their applications, grasp the compatibility between vectors and host for recombinant DNA technology.

CO2. Know the transformation techniques and apply suitable methods for selection of transformed cells; design the process for producing recombinant proteins using different hosts, methods of gene amplification and their application

CO3. Aware of gene editing tools like RNA interference, CRISPR-Cas9 technique, their uses and use of FISH, GISH, Microarray techniques in GE

CO4. Design a conventional cloning protocol and identify techniques used to prepare transgenic plants and animals.

CO5. Study the steps involved in the production of biopharmaceuticals – recombinant hormones, vaccines and other proteins

Genetic Engineering

Unit I	Genetic engineering concepts: Genetic engineering concepts: early development in genetics, concept of gene cloning and its importance.
Unit II	Manipulation of DNA : Important enzymes used in genetic engineering, Restriction endonucleases - types, Restriction-Modification system, Nomenclature, Recognition sequences, cleavage pattern, ligation, modification of cuts ends
Unit III	Cloning vectors : Introduction, properties, types: cloning and expression vector, host, Vectors for E.coli: plasmid vectors - pBR322, pUC18/19, Bacteriophage vectors - lambda phage vectors, phage M13 vectors, Cosmid vectors, Eukaryotic cloning vectors : Yeast vectors, YAC, Shuttle vector, Ti plasmid, Ri plasmid, examples of viral vectors for mammals, insects and plants
Unit IV	Introduction of DNA in living cells: Transformation, identification of clones having recombinant DNA (recombinants), introduction of phage DNA into bacterial cells (transfection), identification of recombinant phage. Cloning strategies: Genomic libraries, cDNA libraries
Unit V	Identification and Selection of recombinant DNA clones: Hybridizations - colony, blotting (radioactive and non-radioactive procedures), plaque hybridization probing, Differential screening, reporter genes
Unit VI	Expression of foreign gene: Gene expression in E coli, production of recombinant proteins in Eukaryotes, yeast, mammalian and insect cells systems. Expression of industrially important products (recombinant hormones, recombinant vaccines etc

Unit VII	Sequencing genes and genomes: DNA sequencing using dideoxy chain termination method, primer walking, Next-generation sequencing methods; pyrosequencing, DNA profiling: RFLP, AFLP etc., Gene annotation
Unit VIII	Nucleic acid amplification techniques: Polymerase chain reaction: concept, procedure, variations, applications and advantages of PCR, real-time PCR method and applications
Unit IX	Transgenic plants: Gene transfer methods, vectors; Applications of Transgenic plants: herbicide resistance, insect resistance, drought resistance, GMO food, Antisense RNA approach and other applications
Unit X	Transgenic animals: Introduction about transgenic animals, Gene transfer strategies – chemical and physical methods, production of recombinant proteins (eg. Insulin, hormone, antibodies, clotting factors etc) and other applications, Knockout mice, Knock in Mice
Unit XI	Protein Engineering: In vitro mutagenesis, Oligonucleotide directed, PCR based, applications of protein engineering
Unit XII	Advance tools in GE and their applications : Introduction to gene editing tools and their applications: RNA interference, CRISPR-Cas9, FISH, GISH, Microarrays
Animal Cell Culture	
Unit XIII	Introduction to Animal cell culture laboratory: Definition, applications and limitations of tissue culture. Requirement of the tissue culture laboratory: different areas requirement, equipments. Aseptic Techniques, Sterilization of materials to be used for cell culture: Liquid reagents, media, serum.
Unit XIV	Media requirements: Properties and special requirements of tissue culture media, requirement of serum, antibiotics, growth factors, conditioned medium, serum free media, commonly used cell lines and media used.
Unit XV	Types of Tissue Culture: Organ culture, Primary Explant Culture, Cell Cultures: primary culture (adherent cell and suspension cells) and secondary cell culture, contact inhibition. Transformation, differentiation and dedifferentiation. Cell lines: concept, properties and maintenance. Types of microbial contaminants. Cryopreservation and thawing of cells
Unit XV1	Applications of Cell Culture: In vitro testing of drugs, production of pharmaceutical proteins and vaccines.
Reference Books:	
<ol style="list-style-type: none"> 1. Gene cloning- An introduction, T.A Brown, 2nd and 3rd ed, Chapman &Hall. 2. Recombinant DNA- genes and genomes a short course JD Watson, R.M.Myers, A.M.Caudy, J.A.Witkowski, WH Freeman &Co. 2007 (II/ III rd ed) 3. Principles of Gene manipulation, SB Primrose (6th ed). 4. Principles and Techniques of Biochemistry and Molecular Biology, K Wilson and J Walker, 7th edn 	

5. Genetic Engineering, Smita Rastogi, Neelam Pathak, Oxford University press, 2009.
6. Biotechnology by B.D.Singh
7. Culture of Animal Cells: A Manual of Basic Technique and Specialize Applications, 6th Edition by Ian Freshney.
8. Principle and practice of Animal Tissue Culture by Sudha Gangal
9. Cell and Tissue Culture –Alan Doyle and J. Bryan Griffiths

CHB5302 Immunology and Toxicology [Credits – 4]

Course Outcomes

After learning this course student will be able to

CO1. Understand the basis of immunity and its types, various lymphoid organs, theory behind antibodies production, process and purification methods for antibodies. They will be aware of structure for different types of MHC molecules and antibodies

CO2. List the types of different antigen-antibodies reactions, RIA, ELISA and western blotting and aware of their principle and applications.

CO3. Understand the complement system, types of hypersensitivity and its reaction, ABO blood group system, immunization and vaccine types.

CO5. Aware of different area of toxicology, doses responsible for toxicity, its risk and safety measures. Interaction of chemicals dose response and its selectivity with animals. Enlist different toxicity test And understand teratology and reproduction

CO6. Understand biotransformation reactions and their phases, detoxication and toxication reaction. Understand the role of Cytochrome P-450 monooxygenase system. Students will know about the different applications of toxicology .

Immunology

Unit I	<p>Introduction and concept of Diseases. Overview of immune system. Disease types Communicable and Non communicable, Intracellular and Extracellular pathogens. Phylogeny of Immune system, innate and acquired immunity, Nature and Biology of antigens and super antigens, Antigens, Antigenic determinants, antigenicity and immunogenicity.</p>
Unit II	<p>Cells and Organs of immune system Lymphoid cells, Primary and secondary Lymphoid Organs, Lymphocyte Traffic. B cell maturation, activation and differentiation. T cell subset and their function. T lymphocytes and cell mediated immunity, T cell sub populations, immune response genes, T cell receptor, structure, organization and rearrangement of TCR genes. T cell receptor complex- TCR-CD3. T cell accessory membrane molecule. Maturation, Activation & Differentiation. Development of Immune System in short.</p>
Unit III	<p>Clonal selection theory of antibody production, monoclonal and polyclonal antibodies, catalytic antibodies (abzymes). Methods of raising antibodies. Monoclonal and polyclonal antibodies, production and purification.</p>
Unit IV	<p>Major Histocompatibility Complex (MHC) Structure and functions of class I and class II molecules. MHC restriction. Antigen processing and presentation. Effector mechanisms of immune response; macrophage activation; Mechanism of humoral and Cell mediated cytotoxicity</p>

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Unit V	Immunoglobulin Structure: Antibody structure and function, constant and variable regions, Fab, F(ab ₂) and Fc fragments, different classes of antibodies and their functions, fine structures of antibodies, isotypes, allotypes and idiotypes.
Unit VI	Immunodiagnostic techniques: Precipitation reactions: Immunodiffusion, immunoelectrophoresis, Agglutination reactions: Radioimmunity assay, ELISA, Chemiluminescence immuno assay, Western blotting technique, Complement fixation test, Immunofluorescence,
Unit VII	Complement system: classical, alternate and lectin pathway
Unit VIII	Hypersensitivity and allergy, immunodeficiency diseases (AIDS) : Hyper sensitivity reaction – Type I, II, III and IV reactions. Immunodeficiency disorders: Phagocytic cell defect (Chediak-Higashi syndrome); B -cell deficiency (Bruton's X-linked hypogammaglobulinemia); T-cell deficiency disorder (DiGeorge Syndrome); Combined B-cell & T-cell deficiency disorder (SCID- Severe combined immunodeficiency diseases, Wiskott-Aldrich syndrome), Complement deficiencies and secondary immunodeficiency conditions carried by drugs, Nutritional factors & AIDS.
Unit IX	Blood group substance and Rh factor: Immunological basis of Blood transfusion.
Unit X	Vaccine: Mechanism: Active and passive immunization, Live, killed, attenuated, sub unit vaccines; Recombinant Vaccines, Polyvalent vaccines, DNA vaccines
Toxicology	
Unit XI	Principles of Toxicology Different areas of toxicology, spectrum of toxic dose, risk and safety. Classification of toxic agents, characteristics of exposure, route and site of exposure. Duration of frequency of exposure. Spectrum of undesired effects: Allergic reactions, Idiosyncratic reactions, Immediate verses delayed toxicity, Reversible verses irreversible toxicity, Local verses systemic toxicity. Interaction of chemicals, Tolerance, Dose response. Selective toxicity.
Unit XII	Target Organ Toxicity and its Evaluation Descriptive Animal toxicity tests: Acute lethality, Sub acute, sub chronic and chronic toxicity testing. Teratology and reproduction, Mutagenicity and Genetic toxicity
Unit XIII	Biotransformation of toxicants Phase I and II biotransformation reactions, Detoxication and toxication. Components of Cytochrome P-450 monooxygenase system, Mechanism of phase I and II reaction. Bioactivation, Toxicity of insecticides i.e. organophosphorous, carbamates and chlorinated insecticides metals, animal and plant toxins, industrial solvents and vapors.

Unit XIV	Applications of toxicology Forensic, clinical and occupational health and industrial hygiene
Reference Books: <ol style="list-style-type: none">1. Immunology 5th ed Janis Kuby2. Fundamental Immunology 5th edition (August 2003): by William E., Md. Paul (Editor) By Lippincott Williams & Wilkins Publishers3. Essential Immunology, Ivan M. Roit (1994) – Blackwell Scientific Pub, Oxford.4. Cellular and Molecular Immunology, 3rd ed, Abbas5. Immunology by Nandini Shetty6. Immunology by Sudha Gangal7. Haye's principles and methods of Toxicology Ed. A Wallace Hayes, Pub. Raven press, NY8. Casarett and Doull's Toxicology ed. John Doull, Curtio D Kleassen and Mary D9. Aunder McMillan publisher Co, NY10. Appraisal of the Safety of Chemicals in foods, drugs and cosmetics. Ed. The Editorial Committee of Association of Food and Drug Officials of the United States11. Toxicology- Mechanisms and analytical methods, Vol I and II, ed Stewart CP and12. Stolman A, Pub Academic press13. Veterinary toxicology by RJ Garner ed Beilliere, Tindall and Cox London14. The Chemistry and Microbiology of Pollution (1975) IJ Higgins and RG Burns Acad Press, NY15. Introduction to Ecological Biochemistry JB Harbone Acad Press, NY (1977)	

Course Outcomes

After learning the course student will be able to

- CO1. Learn basic anatomy of brain, various parts and their important functions Use of computer networking in various walks of life, describe the types of networks, network configurations and network topologies.
- CO2. Get the knowledge of major functional areas and functional pathways of nervous system
- CO3. Learn coordination and communication between body parts and brain. Role of brain in social behaviour of a person.
- CO4. Get an idea about various chemical compounds involved in neurons their mode of actions for brain functions Introduction to the concept of wireless sensor networks with applications.
- CO5. Learn clinical markers for identification brain related disorders and techniques for their identification or diagnosis
- CO6. Basic idea about Endocrine glands and its secretion
- CO7. Learn various classes, types and chemical nature of hormones and their targets
- CO8. Students will know the precursors, synthesis, mode of action, degradation and transport of various hormones.
- CO9. Know the secondary mechanism for action of hormones and interrelations
- CO10. Understand various disorders related to hyper and hypo secretion of these hormones

Neurochemistry

Unit I	Anatomical organization of Brain and spinal cord: Constituents of central nervous system: Brain and its parts, spinal cord, Blood brain barriers (BBB), cerebrospinal fluid (CSF) - Normal and Abnormal constituents.
Unit II	Peripheral nervous system. Afferent and efferent pathways. Correlation between Brain, Nerve cells and behaviour. Functions of brain, nerve cells with respect to behaviour
Unit III	Neurotransmitters: Types of neurotransmitters, Synthesis, storage, uptake, degradation and mechanism of action of acetyl choline, GABA, serotonin, dopamine, glutamate, aspartate, nitrous oxide and neuropeptides (Endorphins, enkephalins and substance P)
Unit IV	Receptors for signal transduction: Types of receptors: on the basis of ligand and location in neurons. Types of sensory receptors, properties of receptors, sensory modalities and sensory circuits.
Unit V	Learning and memory: Short term memory and long-term potentiation (LTP), neurons and neurotransmitters involved in learning and memory function. NMDA and AMPA receptors, retrograde messengers in synaptic transmission. Role of CAM kinase II, calcium, protein

	kinase, cAMP, cGMP, calcium calmodulin and other proteins in learning and memory process.
Unit VI	Circadian rhythms: cycle of sleep and wakefulness, role of neurotransmitters in circadian rhythm
Unit VII	Disorders of Nervous system and detection tests Disorders of various parts of brain (Aphasia, Wernick's syndrome), spinal cord (Meningitis, sclerosis), sensory neurons, motor neurons (Neuropathies). Disorders related to learning and memory. Parkinson's disease, Alzheimer, Dementia. Hallucination and haullucinogens. Diagnosis, preventive measures and treatment for disorders.
Endocrinology	
Unit VIII	General characteristics of hormones: General characteristics and properties of hormones, classification on the basis of their location (anterior and posterior pituitary) and chemical nature
Unit IX	Chemistry, structure, synthesis, secretion, transport, metabolism & mechanism of action of hormone: Study of thyroid, parathyroid, erythropoietin, prolactin, FSH, LH, growth hormone, adrenocorticotrophic hormones (ACTH corticotropins), oxytocin, vasopressin, hormones of pancreas and gastrointestinal track, steroid hormones (aldosterone and testosterone), prostaglandins. Biological functions of all hormones.
Unit X	Disorders related to hormones: Hyper and hypo secretion conditions, deficiency syndrome, disease condition detection techniques and treatment or prevention.
Unit XI	Secondary messengers and their mode of action: cAMP, cGMP, phosphoproteins, phosphokinases, MAP-Kinase JAK/STAT pathway, Calcium, Phosphoinositols, Calmodulin, Zinc fingers and other proteins.
Unit XII	Cell Surface and intracellular receptors for hormones EGF, NGF, PDGF and Enkephalin: Various cell surface and membrane receptors and other hormone like factors
Unit XIII	Hormonal inter relationship, overproduction and Target cell insensitivity: Correlation between hormones, role of hormones during exercise
Reference Books:	
<ol style="list-style-type: none"> 1. Vertebrate endocrinology- Norris DO (1985) 2nd ed 2. Endocrine physiology- Martin, CR (1985) Oxford Univ press (NY) 3. Physiological chemistry –Harper 17ed Lange medical 4. Biochemistry- Zubay (1983) Addison, Wesley publ. Co. 5. Textbook of endocrinology –Williams, 6th ed Saunders Co (1981) 6. Biochemical endocrinology E. Frieden (1983) 7. Anatomy and Physiology Gerard J. Tortora & Mark T. Nielsen 8. Principles of neural science Kandel ER, Schwartz JH, Elsevier, N.Holland, NY 9. Textbook of physiology- Guyton 	

Department Electives Courses/MOOCs/General Elective (any One)

CHB5304 Biostatistics, Bioinformatics and Advance Biophysical techniques [Credits – 4]

Course Outcomes

After learning this course student will be able to

- CO1. Understand the basic of statistical analysis and various techniques to handle the biological data and apply statistic on it.
- CO2. Find the importance of statistics in biochemistry and research and its application on biological data.
- CO3. Understand the basic concepts of Bioinformatics and its significance in Biological data analysis.
- CO4. Classify different types of Biological Databases (DNA, RNA, Protein) and use them, understand the basics of sequence alignment and analysis
- CO5. Get an overview about protein structure database and structure prediction methods.
- CO6. Realize the importance of advanced spectroscopic methods in research.
- CO7. Understand the theory, principle, Instrumentation and working of NMR, ESR, IR, Fluorescent microscopy, ORD, CD and biosensors and their applications in biochemistry.
- CO8. Aware of Mass spectrometry, LCMS, GCMS, MALDI-MS and MALDI-TOF-MS techniques.

Biostatistics

Unit I	Principles and practice of statistical methods in biological research, samples and populations, Basic statistics-average, statistics of dispersion, coefficient of variation, confidence limits, Probability distribution, normal, binomial and Poisson distribution. Mean variants, standard deviations and standard error, correlation and regression, test of statistical significance, and analysis of variance, latest software, introduction of software, exercise on biochemical problems.
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Bioinformatics

Unit II	Introduction Scientific literature search: Pubmed, Scopus, google scholar. Measures of scientific impact assessment: impact factor, h-index, i10-index etc.
Unit III	Computational biology resources: EBI, ExPASY, NCBI DNA sequence databases: GenBank, EMBL, DDBJ, dbEST, RefSeq, dbSTS, Probe Database
Unit IV	RNA sequence databases: Relevant microRNA, long non-coding RNA, siRNA, tRNA and UTR databases

Unit V	Protein sequence database- GenPept, UniProtKB, UniRef, UniParc, Proteomes, NextProt
Unit VI	Sequence alignment: Pair-wise and Multiple Sequence Alignment (MSA) and analysis, Global and Local alignment. Alignment based tools: BLAST, BLAT, CLUSTALW
Unit VII	Phylogenetic analysis, Protein structure database: PDB and Structure visualization
Advanced Biophysical Techniques	
Unit VIII	Spectroscopic methods : (a)NMR, (b) ESR, (c) IR, (d) Fluorescence, (e) ORD and CD
Unit IX	Biosensors : Introduction, types, Microchips, Cell Biosensors and application.
Unit X	Mass Spectrometry : LCMS, GCMS, MALDI-MS, MALDI-TOF-MS
Unit XI	SEM and TEM : Introduction, importance of electron microscopy, theory, sample preparation, working, principle, instrumentation and application.

Reference Books:

1. Fundamentals of Biostatistics by Khan and Khanum
2. Biostatistics-A foundation for Health Science, Daniel WW, John Wiley (1983).
3. Statistical Methods, Medhi J, Willey Eastern Limited, (1992).
4. Bioinformatics Databases, Tools and Algorithms: Orpita Bosu, Simminder Kaur Thukral
5. Bioinformatics Sequence and Genome Analysis: David Mount.
6. Introduction to bioinformatics, 2001. AH wood, T.K. Parry smith DJ, Pearson education Asia.
7. Bioinformatics : A practical guide to the analysis of genes and proteins – 2001 – AD Baxevanis & BFF Ouellette – Wiley Interscience – New York.
8. Bioinformatics: Methods and Protocols – 2000 – Stephen Misener & Stephen A. Krawetz, Humana Press, New Jersey.
9. Bioinformatics : Sequence, structure and databanks – 2000 – Des Higgins & Willie Taylor – Oxford University Press.
10. Physical Biochemistry by D. Freifelder IInd Edition Freeman publication (1982)
11. Biochemical techniques by Wilson and Walker.

CHB5305 Nutraceuticals, Pharmaceuticals and Molecular Oncology [Credits – 4]

Course Outcomes

After learning this course student will be able to

CO1. Understand the importance of nutraceuticals and pharmaceuticals in our daily life, types, nature and sources of these compounds, their properties and working

CO2. Interpret the interaction of these molecules with host cell and its journey to the target cell.

CO3. Screen and isolate nutraceuticals and pharmaceuticals

CO4. Understand the disease management using nutraceuticals

CO5. Understand Cancer, its types, carcinogens and molecular mechanisms behind the disease

CO6. Aware of tumour environment and immunology, specific biomarkers involved

CO7. Aware of research going on in Cancer biology including bioinformatics and clinical research.

Nutraceuticals and Pharmaceuticals

Unit I	Introduction and history of Nutraceuticals and Pharmacology
Unit II	Mode of action of Nutraceuticals and drug receptor interactions: Types of drugs, Path of action of nutraceutical and drug molecules, receptors involved in it and interaction between them
Unit III	Factors modifying interactions of nutraceuticals and drug with receptor: Structure, functional group, configuration, environment, inhibitors, Interactions of drug and nutraceuticals to enzymes
Unit IV	Drug and nutraceuticals Metabolism: Metabolism of drug and nutraceutical after action.
Unit V	Basic approach to drug discovery and development: Requirement of new drug, synthesis criteria in general and processing
Unit VI	Extraction of nutraceuticals and processing: Extraction of nutraceuticals from plant, animal and bacteria, methods of extraction in brief and processing.
Unit VII	Pharmacological screening models for therapeutic areas: Microbial cell, plant cell and mammalian models and related ethical aspects in India
Unit VIII	Monitoring of multi-component phytopharmaceuticals: Various components in phytopharmaceuticals and its study.
Unit IX	Disease-management using nutraceuticals (case studies): Examples of some common diseases and use of nutraceuticals

Molecular Oncology	
Unit X	<p>Introduction to Cancer Biology : What is carcinogenesis? Theories behind the cause of cancer, Initiation, Promotion and Progression of Cancer.</p> <p>Cancer and carcinogens: Role of DNA damage, repair and mutations, viruses and carcinogens. Benign and Malignant tumours, Tissue specificity, Hyperplasia and Precancerous lesions.</p>
Unit XI	<p>Genetic, molecular and cellular mechanisms of cancer : Genome stability, Transcriptional controls in cancer, Suppression and activation of oncogenes during transformation of cell, Viral oncogenes, examples ERB, HER-2, rel, large T-antigen etc.</p> <p>Cell cycle regulation and its alteration in cancer, Apoptosis, Necrosis, signalling pathways in cancer involving p53, Ras and Rb, Growth factors.</p>
Unit XII	<p>Tumour environment and cell interactions: Tumour cell dormancy in microenvironment, Cell-Cell interactions, Cell matrix interactions, Invasive characters, activity of Morphogens, Angiogenesis, Tumour Stem Cells.</p>
Unit XIII	<p>Types of Cancers: Leukaemia: types of chromosomal translocations. Hodgkin's lymphoma, Burkitt's Lymphoma, HPV+ uterus cancer, Prostate cancer,</p>
Unit XIV	<p>Immunology and Tumours : Immune responses in tumour growth, Immune suppression by tumours, Tumour specific antigens and Immune response, immunotherapy by immune modulations. Cancer Vaccines- Whole cell vaccines, Peptide vaccines, Dendritic vaccines, Prophylaxis.</p>
Unit XV	<p>Cancer research: Tumour specific Biomarkers for efficient diagnosis and prognosis Imaging-Use of different Imaging Modalities for assessing molecular and functional aspects of Tumour cells. DNA Microarrays- for individual specific analysis of target tumour, example-lymphochip. Metastasis detection- Techniques and Challenges. Nanotechnology in tumour therapy- Nano vectors for targeted drug delivery. Bioinformatics- Early diagnosis, Personalized therapy by comparing patient's tumour genetic profile to data of genetic profiles, respective treatments and responses globally. Treatment of cancer symptoms at molecular level targeting specific molecules, drug discovery. Introduction about clinical research of proposed treatment strategies for ensuring safety, efficacy and early implementation. miRNAs- role in tumours and use in therapy</p>
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Goodman Gillman's The Pharmacological basis of therapeutics. (2001) Ed. Hardman JG, Limbird LE (Tenth Edition) McGraw Hill press New York. 2. Applied biopharmaceutics and pharmacokinetics (1999) Ed. Shargel L. (4th Edition) Prentice- Hall International, London. 3. Fundamentals of experimental pharmacology. (1984) Ed. Ghosh MN. Scientific book agency, Calcutta. 4. Textbook of receptor pharmacology (1996) Eds. Forman JC, Johansen TJ. CRC 	

- Press New York
5. Drug Discovery and Evaluation –Pharmacological assays. (1997) Ed.Vogel HG & Vogel WH Springer- New York.
 6. Methods of Analysis for Functional Foods and Nutraceuticals. Chadwick R., Henson S., Mosley B., Hurst G.W.
 7. A guide to understanding dietary supplements. Tracy T.S. et al.
 8. Pharmacology-related journals from PubMedCentral (refer study pack for papers)
 9. Molecular Biology of Cancer-Mechanisms, Targets and Therapeutics, Lauren Pecorino
 10. Advances in Cancer Research, D. Avecedo
 11. The Cell: A Molecular Approach by Geoffery M. Cooper
 12. Molecular Oncology: Principles and Recent Advances by Javier Camacho
 13. Principles of Molecular Oncology, Edited by MH Bronchud, MA Foote, G Giaccone, O Olopade and P Workman

CHB5306 Clinical Nutrition and Food Technology [Credits – 4]

Course Outcomes

After learning this course student will be able to

CO1. Understand the nutritional status of Indian population and effect of various factors on food pattern, types of food given to patients.

CO2. Know the diet pattern in some of the common diseases, malnutrition and effect on mental development. Role of food in behavioural pattern and food requirements for infant and old age people.

CO3. Understand about effect of tranquilizers, dietary intake for metabolic errors, toxic food and its effect on health and importance of food of plant and animal origin.

CO4. Enlist experiments carried to monitor food quality, enzymes used in food processing

CO5. Aware of enzymes involved in food spoilage and understand the principle of food preservation, role of food additives, flavoring agents and aware of genetically modified foods

Clinical Nutrition

Unit I	Food habits and nutritional status of India: Food pattern in India with respect to location and production, effect of lifestyle, impact of modernization and technology
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Unit II	Diet in disease condition
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Unit III	Malnutrition and mental development, Behavior, Infant and Geriatric Nutrition and Tranquilizers: Types of malnutrition: Kwashiorkor- Marasmus, symptoms, diagnosis, treatment and preventive measures. Effect of malnutrition on development of brain and behaviour. Food requirement in various stages of age
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Unit IV	Nutritional Management of Inborn Errors of Metabolism, Amino acid Therapy: Inborn errors of metabolism, its causes, presumptive measures through diet
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Unit V	Food Toxins, Adverse Effects of Alcohol, Tobacco, Tea 1. Various food toxins 2. Adverse effects of alcohol, tobacco and tea
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Food Technology

Unit VI	Food of Animal and Plant Origin: few examples
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Unit VII	Monitoring food quality: analytical methods to check the quality
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Unit VIII	Enzymes in food analysis and processing, toxins in food. Use of alcohols, amino acids and glucose in food
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Unit IX	Biochemistry of food spoilage, principles of food preservations: reasons, causative agents, preservatives
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Unit X	Food additives and flavouring agents and genetically modified foods: examples and applications
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Reference Books:

1. Essentials of food and nutrition M Swaminathan Vol. II, Applied aspects (1974), Ganesh Pub. Madras
2. Human biochemistry – James Orten and Otto Neuhaus, 10th ed, CV Mosby co. London
3. Human nutrition and dietetics-Davidson and Passmore
4. Amino acids in therapy – Leon Chaitwo, Thorsons publishers Inc. NY
5. Physiological chemistry- Hawk
6. Enzymes and food processing- GG Birch, N Blackbrough (1981)
7. Nutrition and food processing- MG Miller, G Tobin, AVI publishing Co, Creem Holm., (1980)
8. Introduction to food sciences and technology –GF Stewart and MA Amerine (1973), Academic Press

CHB5307: Biochemistry Practical Course – V(Molecular Biology and Immunology)

[Credit-4]

Any 12 Practical (+)

Title of Experiment: Molecular Biology and Immunology

Molecular Biology (Any Eight)

1. Isolation of DNA from bacteria/ liver/ plant/ yeast source
2. Isolation of RNA from bacteria/ plant/yeast/ mammalian source.
3. Spectrophotometric analysis of nucleic acids
4. Agarose gel electrophoresis of DNA and molecular size determination
5. Determination of T_m
6. Restriction digestion of DNA
7. Preparation of plasmid DNA
8. Transformation
9. Ligation study
10. PCR demonstration
11. Real time PCR analysis

Immunology (Any Four)

1. Principles of Antigen-antibody interactions, and its applications in research
2. Agglutination test: Blood typing
3. Latex agglutination test.
4. Precipitation test: Radial immunodiffusion test, Ouchterlony immunodiffusion
5. Immunoelectrophoresis.
6. ELISA, RIA demonstration
7. Antibody conjugation with enzyme tag, Purification of IgG antibodies
8. Western blotting.

Note: Any other equivalent practical

CHB5308: Biochemistry Practical Course – VI (Bioinformatics, Computer Skills and Statistical Analysis) [Credit-4]

Any 12 Practical(+)

Title of Experiment: Bioinformatics, Computer Skills and Statistical Analysis

Bioinformatics (Any Eight)

1. In Study of Internet resources in Bioinformatics. E.g. NCBI, CGEB, EMBL.
2. Searches on MEDLINE, PubMed and CDROM bibliographic databases. Concept of boolean operators in searching
3. Introduction to sequence data bases. Protein sequence databank, NBRF-PIR, SWISSPROT, EMBL. Nucleic acid sequence databank – Gene bank, EMBL
4. Pair wise alignment- Needleman-Wunsch and Smith-Waterman algorithms
5. Multiple alignment- CLUSTALW & PRINTS
6. BLAST, FASTA programs for sequence database search
7. Genome data bank – study the features of human genome
8. Evaluation of protein structure by Swiss PDB viewer and by other molecular visualization tools
9. Calculation of phi – psi angles - Ramachandran plot
10. Homology modeling of a given protein sequence

Computer skills and Statistical analysis (Any Four)

1. Statistical analysis: Selection of data, R-square, SD & average,
2. Use of Microsoft word, Excel & Power point to present experimental data
3. Construction of Standard curve and calculation of unknown concentration
4. Application of ANNOVA to the data
5. Construction of Network pharmacology diagram (Data mining, data linking and diagram construction)
6. Box and Whisker Plot
7. Presentation of research paper using power point.
8. Use of Mendeley

Note: Any other equivalent practical
