



**Shri Vile Parle Kelavani Mandal's
MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF
SCIENCE & AMRUTBEN JIVANLAL COLLEGE OF
COMMERCE AND ECONOMICS (AUTONOMOUS)**
*NAAC Reaccredited 'A' grade, CGPA: 3.57,
Granted under RUSA, FIST-DST & Star College Scheme of DBT, Government of
India, Best College (2016-17), University of Mumbai*

Affiliated to the
UNIVERSITY OF MUMBAI

Program: Bachelor of Science-Biochemistry

Semester V & VI

**Choice Based Credit System (CBCS) with effect
from the Academic year 2021-22**

A.C. No: 7

Agenda No: 7.1

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

On completion of the T. Y. B. Sc. -Biochemistry, the learners should be enriched with knowledge and be able to-

- PSO1:** Get insight with excellent training in Biochemistry emphasizing on solid background of basic concepts as well as rapid advancement in the field.
- PSO2:** Able to employ critical thinking and efficient problem solving skills in the various areas of biochemistry and related disciplines.
- PSO3:** Apply knowledge as Biochemistry being the foundation for understanding all biological processes.
- PSO4:** Convey complex technical information relating to biochemistry in a clear and concise manner in both oral and written formats.
- PSO5:** Empower themselves with the ability to plan, execute and report the results of an experiment or investigation.
- PSO6:** Gain knowledge of ethical and good laboratory practices, health and biohazard regulations, plagiarism and intellectual property rights related issues practiced in modern era of scientific investigation.
- PSO7:** Explore various fields of higher education or related profession in various disciplines, armed with plethora of knowledge, hands-on experience and scientific attitude, at national and global levels.
- PSO8:** Apply and effectively communicate scientific reasoning and data analysis in both written and oral forms. They will be able to communicate effectively with well-designed posters and slides in talks aimed at scientific audiences as well as the general public.

Preamble

This curriculum is designed to give sound knowledge of the Subject-Biochemistry to final year students of the three-year B.Sc. degree program. The aim of the syllabus is to make the study of Biochemistry interesting, encouraging, and popular for the learners to take up higher studies including research. To bridge the industry-academia gap, the final year course helps prepare the learner to be better equipped with the required skills and training. At the same time the syllabus has been mapped with the syllabi of other universities, so as to evolve a curriculum that fulfills the needs for research as well as industries.

The modules of the curriculum are well defined taking into consideration the level of the students. The multidisciplinary nature of the undergraduate program in Biochemistry with components as metabolism, recombinant DNA technology, immunology and advanced bioanalytical techniques such as electrophoresis, chromatography, spectroscopy, centrifugation, radio isotopic techniques and their applications are integral part of curriculum

Having learnt the basic concepts of biomolecules, genetics, pharmacology and enzymology, the topics are extended to clinical enzymology employed for diagnosis, to advanced genetics and RDT and its applications, immunology and pathophysiology of disorders, oncology and toxicology. The important issues pertaining to environmental science, biodiversity, sustainable development and IPR are also addressed so as to sensitize the learner towards current topics. Biostatistics and bioinformatics are also introduced to educate them regarding different tools that can be applied in research for data analysis and conclusive interpretation.

During the course, learners are required to complete a research project and present their findings. The project is aimed to inculcate research aptitude and problem-solving ability in the learners and to further apply these skills in their post graduate studies in the field.

The world today requires innovative solutions to tackle conventional as well as new problems. The skill enhancement course encompasses wide array of topics on nutrition, dietetics and entrepreneurship and aims to create learners who are self-reliant and have the ability to contribute towards nation building and the world as a whole.

Thus, the syllabus is designed to equip the learner to accept the challenges in life sciences and expose them to various emerging areas of the subject.

The courses are as follows: -

Semester V : USMABCH501: Metabolism and Analytical Techniques-I
 USMABCH505: Pharmacological Sciences and Nutrition
 USMABCH503: Advanced Genetics and RDT
 USMABCH504: Immunology and Pathophysiology-I
 USMABCHAC501: Food Nutrition and Dietetics-I (Applied Component)
 USMABCH512: Biochemistry Practical-V
 USMABCH534: Biochemistry Practical-VI
 USMABCHACP1: Biochemistry - Applied Component Practical-I

Semester VI : USMABCH601 : Metabolism and Analytical Techniques-II
 USMABCH602 : Environmental Science
 USMABCH603 : Biostatistics and Bioinformatics
 USMABCH604 : Immunology and Pathophysiology-II
 USMABCHAC601: Food Nutrition and Dietetics-II (Applied Component)
 USMABCH612: Biochemistry Practical-VII
 USMABCH634: Biochemistry Practical-VIII
 USMABCHACP2: Biochemistry - Applied Component Practical-II

We profusely thank all the committee members for their efforts in drafting the syllabus.

Note:- (i) The duration of each theory lecture will be of 48 minutes. A course consists of 4 modules. For each module the number of lectures allotted are 15. The total number of lectures for each course will thus be 60.

(ii) There will be one practical per batch for each course. The duration of each practical will be of 4 lectures.

For practical component the value of One Credit is equal to double the value of credits for theory course.

Evaluation Pattern for theory papers

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester end Examinations is as shown below:

a) Details of Internal Continuous Assessment (ICA)

25% of the total marks per course:

Continuous Assessment	Details	Marks
Component 1 (ICA-1)	Test (MCQ/Subjective) or Assignments or Project	15 marks
Component 2 (ICA-2)	Test (MCQ/Subjective) or Assignments or Project	10 marks

b) Details of Semester End Examination

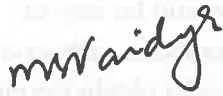
75% of the total marks per course. Duration of examination will be two and half hours.


Question Number	Description	Marks	Total Marks
Q1 to Q4	Compulsory question 10 marks	10	$(10 + 5) \times 4 = 60$
	+ Answer any 1 out of 2 questions	+ 05 x 1	
Q5	Answer any 3 out of 4 questions	05	15
Total Marks			75

Evaluation Pattern for practical papers

In the Practical Exams, there will be 40% assessment for journal and laboratory work and 60% as term end component to be conducted as a semester end exam per course. For each course there will be one examiner per batch who will assess the practical examination answer books.


Signature
HOD


Signature
Approved by Vice –Principal


Signature
Approved by Principal

Program: B.Sc. Biochemistry			Semester: V	
Course: Metabolism and Analytical Techniques-I			Course Code: USMABCH501	
Teaching Scheme			Evaluation Scheme	
Lecture (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE)	End Semester Examinations (ESE)
4	-	2.5	25%	75%
Learning Objectives:				
<p>Human beings survive at the expense of energy. Hence it is important to study the energy metabolism pathway of carbohydrates. Being an alternate source of energy lipids also play a vital role in the generation of ATP. Along with the energy source carbohydrates and lipids perform other crucial functions to keep living system active. Therefore, study of anabolism and catabolism of carbohydrates and lipids would help understand the basics of life.</p> <p>As different biomolecules play different roles. It is mandatory to separate, isolate such molecules and analyze the properties and characteristics of those. Analytical techniques help reveal different methods of separation and isolation of macro and micro molecules along with their estimation. Enzymes have great importance in diagnosis which leads to promote the study of such enzymes of clinical importance in details.</p>				
Course Outcomes:				
After completion of the course, learners would be able to:				
CO1: Explain the role of catabolic and anabolic pathways in cellular metabolism				
CO2: Understand in general terms how cells obtain the energy to do cellular work				
CO3: Explain process of ATP generation				
CO4: Compare energetics of aerobic and anaerobic respiration				
CO5: Apply the principles of chromatography and spectrophotometer				
CO6: Describe the methods used in the analysis of compounds				
CO7: Demonstrate the operation chromatography and spectrophotometer				
CO8: Explain the chemistry behind the methods of analysis of compounds				
CO9: Identify which method is more effective for analysis of compounds				
CO10: Enumerate the examples of enzymes reflecting organ pathophysiology				
CO11: Recognize enzymes useful in diagnosis of various diseases				
Outline of Syllabus: (per session plan)				
Module	Description			No of hours
1	Carbohydrate Metabolism			15
2	Lipid Metabolism			15
3	Chromatography			15
4	Spectroscopy & Clinical Enzymology			15
	Total			60
PRACTICALS				60

Module	Metabolism and Analytical Techniques-I	No. of Hours/Credits 60/2.5
1	Carbohydrate metabolism	15
	<p>Catabolism – Cellular location, sequence of reactions, labelling of carbon atoms, and energetics of: Glycolysis (aerobic and anaerobic) (WITH STRUCTURES) Metabolic fates of pyruvate (WITH STRUCTURES) Multienzyme complex - Pyruvate Dehydrogenase Complex (PDH) Cellular location, sequence of reactions, labelling of carbon atoms, and energetics of: Krebs cycle (WITH STRUCTURES) Cellular location, sequence of reactions: Glyoxylate pathway (WITH STRUCTURES) Sequence of reactions: Glycogenolysis – [schematic – NO STRUCTURES, but with enzymes and coenzymes]</p>	6
	<p>Anabolism – Cellular location, sequence of reactions, multifunctional nature HMP shunt (WITH STRUCTURES) Cellular location and Sequence of reactions: Gluconeogenesis (WITH STRUCTURES), Glycogenesis – [schematic – NO STRUCTURES, but with enzymes and coenzymes]</p>	6
	Role of regulatory enzymes in carbohydrate metabolism	1
	Carbohydrate metabolism disorders: Glycogen storage disease Type III, Glucosemia, Galactosemia, Fructosemia	2
2	Lipid metabolism	15
	<p>Catabolism – Knoop's Experiment Cellular location, sequence of reactions, labelling of carbon atoms, and energetics of: Beta oxidation of even carbon saturated fatty acids (C4 to C20) and odd carbon saturated fatty acids. (WITH STRUCTURES) Comparative account of saturated and unsaturated fatty acid oxidation.</p>	5
	<p>Anabolism – Structural and functional division of Fatty Acid Synthase Complex Fatty acid biosynthesis of even (palmitic acid) and odd carbon chain fatty acid (WITH STRUCTURES) Comparative account of saturated and unsaturated fatty acid biosynthesis. (No structure/ only flowsheet)</p>	5
	Ketone body formation and utilization (WITH STRUCTURES)	3
	Physiological significance of Ketone bodies in Diabetes	

	mellitus, Starvation, Pregnancy and Alcoholism Role of regulatory enzymes in lipid metabolism Lipid metabolism disorders: Obesity and hyperlipidemia	1 1
3	Chromatography	15
	<i>Principle, Technique and Industrial Applications of the following kinds of chromatography:</i> Partition chromatography (Paper), Adsorption Chromatography (TLC and column); Ion exchange Chromatography-Properties, characteristics and types of exchangers Gel filtration- Properties, characteristics and types of gels <i>Principles and industrial applications of:</i> GLC, HPLC and Affinity chromatography Case studies and Numericals based on the above concepts	7 5 3
4	Spectroscopy & Clinical Enzymology	15
	<i>Spectroscopy</i> Introduction to Electromagnetic spectrum and concept of Lambda max Determination of molar extinction coefficient Beer-Lambert law: derivation and limitations Applications of Beer-Lambert law in the estimation of biomolecules (carbohydrates, proteins and lipids) and evaluating the sensitivity of methods. Construction, working and applications of a simple colorimeter and Spectrophotometer Numericals based on the above concept <i>Clinical Enzymology</i> Principles of diagnostic enzymology <i>Enzymes in diagnostics:</i> Enzyme and isozyme patterns in health and diseases with special mention of: CPK and LDH Enzyme in health and diseases with special mention of alkaline and acid phosphatase, SGOT and SGPT Case studies	2 2 4 1 2 4

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

RECOMMENDED READING:

Essential Reading:

1. David L. Nelson, Lehninger's Principles of Biochemistry, 5th edition, W.H. Freeman
2. Donald Voet, Biochemistry, 2nd revised, John Willey and Sons. Inc
3. Robert K. Murray, Harper's Illustrated Biochemistry, 32nd edition, Mc Graw Hill Professionals

4. Avinash Upadhyay, Biophysical Chemistry, Revised, Himalaya Publications
5. S.K Sawhney, Randhir Singh, Introductory Practical Biochemistry, 2nd edition, Alpha Science International

Suggested Reading:

1. Jeremy M. Berg, Lubert Stryer, John Tymoczko, Biochemistry, 9th edition, Macmillan Learning
2. David E. Metzler, Biochemistry: The Chemical Reactions of Living Cells, Volume 1 and 2 (2nd edition), Academic press
3. Rodney F. Boyer, Basic Concepts in Biochemistry: A Student's Survival Guide, 3rd edition, Brooks/Cole Publishing
4. Rodney F. Boyer, Modern Experimental Biochemistry, 3rd edition, Pearsons
5. David Holme, Analytical Biochemistry, Longman
6. David Plummer, Practical Biochemistry, 3rd edition, Tata McGraw Hill

Any other reference sources as recommended by the course instructor.

Program: B.Sc. Biochemistry			Semester : V	
Course: Pharmacological Sciences and Nutrition			Course Code: USMABCH505	
Teaching Scheme			Evaluation Scheme	
Lecture (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE)	End Semester Examination (ESE)
04	-	2.5	25%	75%
Learning Objectives:				
<p>As molecular biology, biochemistry, and genetics advance, nutrition has become more focused on metabolism and metabolic pathways. Nutrition also focuses on how diseases, conditions, and problems can be prevented or reduced with a healthy diet. Pharmacology exists in our everyday life in the form of pharmacy and inevitably influences our health condition and well-being. It is important to understand the clinical applications, side effects and toxicities of drugs used in medicine, which can be explained only by knowing the mechanisms of action and pathology of drugs and drug abuse. The course aims to translate pharmacological principles into clinical decision-making. Studies on the action of drugs on genes and the action of genes on drugs (interaction between genes and drugs) help understand the drug development. It is also significant to study nutrient gene and drug nutrient interaction. This paper gives basic understanding the pharmacology, pharmacogenetics and mechanism of action of therapeutic drugs.</p>				
Course Outcomes:				
After completion of the course, learners would be able to:				
CO1: Appreciate the role of minerals and vitamins in nutrition				
CO2: Comprehend the mechanism of drug action				
CO3: Utilize critical thinking skills in discussing the concept of pharmacotherapy.				
CO4: Understand basic concepts of pharmacogenomics				
CO5: Understand the fate of drugs in the body				
CO6: Discuss the various types of responses that individuals may have to drugs				
Outline of Syllabus: (per session plan)				
Module	Description			No of hours
1	Nutrition-II			15
2	General Pharmacology & Pharmacokinetics			15
3	Pharmacodynamics			15
4	Toxicology			15
	Total			60
PRACTICALS				60

Module	Pharmacological Sciences and Nutrition	No. of Hours/Credits 60/2.5
1	Nutrition-II	15
	<i>Physiological roles and deficiency diseases of-</i> Macrominerals: Calcium, Phosphorus, Sodium Microminerals: Iron, Potassium Trace: Iodine	5
	<i>Physiological roles and deficiency diseases of Vitamins-</i> Water soluble vitamins – Thiamin, Riboflavin, Niacin, Pyridoxine, Biotin, and Lipoic acid: Chemistry of the Vitamin and its coenzyme form [structure not to be done, only group involved in its activity] Fat soluble vitamins A, D, E, and K: Vitamin A – Chemistry, Wald's Visual cycle and role of Rhodopsin (with structure), Transducin, cGMP in vision; Vitamin D – role in Ca absorption and mobilization; Vitamin E and Vitamin K– physiological role (Vitamins D, E and K-NO STRUCTURES)	5
	<i>Recent trends in nutrition:</i> Nutrigenomics, Nutrient-Gen Interaction, Drug-Nutrient Interaction	5
2	General Pharmacology & Pharmacokinetics	15
	<i>General pharmacology</i>	3
	<i>Physicochemical properties of drugs-</i> Chelation, Hydrogen bonding, Surface area, Redox potential, Ionization	
	<i>Pharmacokinetics:</i> Drug absorption through-GIT, pulmonary, renal, placental and blood-brain barrier; Drug Distribution, Drug Metabolism; Drug Excretion Bioavailability and Bioequivalence	5
	Therapeutic drug monitoring	3
	<i>Pharmacokinetic parameters:</i> Half Life, Loading dose, Maintenance dose, Therapeutic dose, Therapeutic Index, Tolerance, Drug plasma concentration, Volume of distribution, Clearance	
	Bioassays: Principles and methods	1
	Preclinical evaluation: Hyperacute, Acute, and Chronic toxicity	1
	Clinical Evaluation-Clinical Trials	2
3	Pharmacodynamics	15

	<p>Introduction to Pharmacodynamics: Principles of drug action; Receptor theory of drug action</p> <p>Mechanism of action of drugs: Specific interaction – receptor mediated Partially specific – drugs via enzymes Non-specific interactions – antimetabolites and antiseptics Through Antibodies-Vaccines Placebo effects</p> <p>Therapeutic drugs: Mechanism of action and adverse effects Narcotic Analgesics-Morphine, Opium Anti-inflammatory – Non Steroidal Anti-inflammatory (NSAID) [Ibuprofen], Salicylates – [Aspirins], Paracetamol Cardiovascular drugs- CVS [Ca channel blocker -Amlodipine, and Beta blocker – Propranolol Antibiotic – Penicillin and Sulphonamide Antacid- Proton pump blocker –Omeprazole Anti-malarial Anti-Tuberculosis treatment MDR and Antibiotic abuse</p>	<p>6</p> <p>7</p> <p>2</p>
4	Toxicology	15
	<p>Introduction to toxicology Functional areas of toxicology General characteristics of the toxic response Classification of toxic agents Spectrum of undesired effects: Allergic reactions; Idiosyncratic reactions; Immediate versus delayed toxicity Reversible versus irreversible toxic effects; Local versus systemic toxicity; Interaction of chemicals Characteristics of exposure: Route and site of exposure; Duration and Frequency of Exposure Dose-Response relationship and Dose response curve Measurement of toxic response and its significance: LD1, ED99 Case studies based approach Types of poisons: Mechanism of action and its antidote: (At least one of each type) Corrosive poisons: strong mineral acids, base and organic acids Animal poisons: Snake and scorpion bites. Delirians: Datura, Cannabis and Cocaine. Asphyxiants: Carbon monoxide, Carbon dioxide, Methane and cyanides. Case studies based approach Biological warfare (any two agents)</p>	<p>7</p> <p>5</p> <p>3</p>

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

RECOMMENDED READING:

Essential Reading:

1. FSK Barar, Essentials of Pharmacotherapeutics, 1st Edition, S. Chand & Co.
2. M.N. Chatterjee & Ranashinde, Textbook of Medical Biochemistry, 6th Edition, Jaypee Brothers

Suggested Reading:

1. Karen Whalen, Richard S. Finkel, Pharmacology, 6th Edition, Lippincott Illustrated Reviews
2. N. Murugesh, Concise textbook of pharmacology, 7th edition, Sathya publications
3. David Plummer, An Introduction to Practical Biochemistry, 1st Edition, Tata McGraw Hill
4. Davidson S et al., Human Nutrition and dietetics, Churchill Livingston
5. Joshi, Shubhangini A, Nutrition and dietetics, 1st Edition, Tata Mc Graw Hill
6. Srilakshmi, B., Nutrition Science, 2nd Edition, New Age International publishers
7. S.K Sawhney, Randhir Singh, Introductory Practical Biochemistry, 3rd edition, Narosa Publishing House
8. David Plummer, Practical Biochemistry, 3rd edition, Tata McGraw Hill

Any other reference sources as recommended by the course instructor.

Practical USMABCHP512 includes Practicals of USMABCH501 and USMABCH505		
	Practical (Hours per week)	Credit
	8	3
Practicals of USMABCH501		
Sr. No.	Topic.	
1	Determination of the optimum pH of β -Amylase.	
2	Determination of K_m of β -Amylase from sweet potato.	
3	Determination of the activity and specific activity of β -Amylase from sweet potato.	
4	Effect of an inhibitor (eg. EDTA) on Amylase activity.	
5	Determination of K_m of lipase	
6	Estimation of glucose by Benedict's method.	
7	Separation of sugars by circular paper chromatography	
8	Separation of plant pigments by thin-layer chromatography	
Practicals of USMABCH505		
Sr. No.	Topic.	
1	Monograph of Vitamin C.	
2	Monograph of Acetyl salicylate	
3	Estimation of vitamin C by Iodimetry method	
4	Estimation of starch by Willstatter method	
5	Estimation of glucose by Iodometry method	
6	Estimation of copper by the dithiocarbamate method	

Program: B.Sc. Biochemistry			Semester : V	
Course: Advanced Genetics and RDT			Course Code: USMABCH503	
Teaching Scheme			Evaluation Scheme	
Lecture (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE)	End Semester Examination (ESE)
4	-	2.5	25%	75%
Learning Objectives: It is well known that DNA is a genetic material which helps regulate all basic processes of life. As cell divides DNA also duplicates by the process of replication. Alteration in the process of replication may leads to change in the expression profile of DNA which might be lethal. Hence it is mandatory to study the when, where and how DNA replication takes place and also to understand the repair mechanism system. Central dogma is a key process in the development of a living cell which tells about the protein synthesis through transcription and translation. It is important to acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology. A sound knowledge on methodological repertoire allows students to innovatively apply these in basic and applied fields of biological research. Hence this paper will give an idea about the enzymes, cloning vectors, probes in RDT and different techniques in isolation, amplification of gene.				
Course Outcomes: After completion of the course, learners would be able to: CO1: Understand the basic rules governing replication CO2: Explain the formation and regulation of synthesis of proteins CO3: Illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences CO4: Apply recombinant DNA technology in biotechnological research. CO5: Be trained in strategizing research methodologies employing genetic engineering techniques				
Outline of Syllabus: (per session plan)				
Module	Description			No of hours
1	DNA Replication & Repair			15
2	Transcription & Translation			15
3	Recombinant DNA Technology (RDT)			15
4	Recombinant DNA Technology (RDT) techniques			15
	Total			60
PRACTICALS				60

Module	Advanced Genetics and RDT	No. of Hours/Credits 60/2.5
1	<p>DNA Replication & Repair</p> <p><i>Replication of DNA (in prokaryotes)</i> Models of DNA replication: Semi-conservative, Dispersive & Conservative <i>Modes of DNA replication:</i> Theta & rolling circle Enzymes (pol I, II and III) and accessory proteins; Mechanism of semi-conservative and semi-discontinuous replication DNA repair: 4 <i>Replication errors :</i> Transition, Transversion, Thiamine dimers <i>DNA damage -</i> Deamination, depurination, dimerization and repair <i>Types of Repair:</i> 4 Direct repair Excision repair Mismatch repair Recombination repair SOS-error prone repair</p>	15
2	<p>Transcription & Translation</p> <p><i>Transcription</i> RNA polymerase and promoter <i>Mechanism of transcription (in prokaryotes):</i> Initiation, Elongation, Termination Overview of eukaryotic transcription of mRNA, tRNA, rRNA Types of eukaryotic RNA polymerases <i>Post-transcriptional Modifications-</i>Processing of tRNA, rRNA, mRNA and concept of split genes <i>Role of Inhibitors-</i> Rifampicin , Actinomycin D, α-amanitin Transport of mRNA <i>Translation in prokaryotes</i> Genetic code <i>Mechanism of translation:</i> Activation of tRNA; Initiation; Elongation; Termination Post-translational modifications of proteins <i>Role of Inhibitors:</i> Puromycin, tetracycline, chloramphenicol, aminoglycosides</p>	15

3	Recombinant DNA Technology (RDT)	15
	Introduction to RDT-Chimeric DNA and Genetic engineering Tools for RDT Enzymes: Restriction endonucleases and its types, mechanism of action; Ligases; Terminal transferases; Reverse transcriptase; S I nuclease Cloning vectors: Plasmid, pBR322, PUC-19, Bacteriophage – Lambda phage; Cosmid Expression Vectors: Artificial Chromosomes (BAC and YAC); Shuttle vectors Probes and types Selection and screening- Antibiotic and Lac selection (of transformed and recombinant cells)	8 3 4
4	Recombinant DNA Technology (RDT) techniques	15
	Gene Transfer techniques and their applications: Transformation Transfection Electroporation Microinjection Liposome Microprojectile Gene library and c-DNA library Blotting techniques: Southern blot and Western Blot DNA Amplification by PCR-Modifications and applications of PCR-DNA fingerprinting, RAPD and RFLP Applications of RDT- Agriculture (Bt Cotton, Agrobacterium tumifaciens) Medicine (Insulin, Growth hormone) GM food (Pomato, Golden rice) Human Genome Project Gene therapy	5 3 2 2 1 1 1

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

RECOMMENDED READING:

Essential Reading:

1. Peter Russell, iGenetics A: Molecular Approach, 3rd edition, Pearson Publication
2. S. N. Jogdand, Gene Biotechnology, 4th revised edition, Himalaya Publishing House
3. S. N. Jogdand, Advance in Biotechnology, Himalaya Publishing House

4. T.A. Brown, Gene Cloning and DNA Analysis: An Introduction, 6th edition, Wiley Publication

Suggested Reading:

1. J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levin, R. Losick, Molecular Biology of the Gene, 7th edition, Pearson Publication
2. S Benjamin Cummings, R.F. Weaver, Molecular Biology, 4th edition, McGraw Hill. New York. USA
3. L. Harvey, B. Arnold, Z.S. Lawrence, M. Paul, D. Baltimore, J.E. Darnell, Molecular Cell Biology, 7th edition, W. H. Freeman & Co, New York, USA
4. T.A. Brown, Gene Cloning and DNA Analysis: An Introduction, 6th edition, Wiley Publication
5. Maloy SR, Cronan JE & Freifelder D, Microbial Genetics, 4th edition , Jones& Bartlett publishers
6. Carl Wu and C. Allis, Nucleosome Histone, and Chromatin; Part-A, Vol 512, Academic Press
7. Lodish et al., Molecular Cell Biology, 6th edition, W.H freeman
8. Strick Berger, Genetics, 3rd edition, McMillan
9. T A Brown, Introduction to Genetics: A Molecular Approach, Garland Science
10. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter, Molecular Biology of the Cell, 6th edition, Garland Science, New York, USA
11. Lewin B, gene XI , 11th edition, Oxford University Press`
12. Jha A.P., Genes and Evolution, Macmillan, Delhi
13. Winchester A.M, Genetics: A Survey of Principles of Heredity, Oxford IBH Public Co.

Any other reference sources as recommended by the course instructor.

Program: B.Sc. Biochemistry			Semester : V	
Course: Immunology and Pathophysiology-I			Course Code: USMABCH504	
Teaching Scheme			Evaluation Scheme	
Lecture (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE)	End Semester Examination (ESE)
4	-	2.5	25%	75%
<p>Learning Objectives: The immune system is complex and it has to be understood in terms of specific functional modules. It is also important to identify the fundamental characteristics of both the innate and adaptive immune systems and begin to understand how they must work in concert to protect the host from infectious diseases. The key reaction of immunology and immune defense is the interaction of antibodies and antigens. This interaction is responsible for the body's defense against viral and bacterial infections and other toxins. This paper will help reveal the understanding of basic immune cells and their characteristics along with the types of immune responses. In addition to the above concept antibody diversity will also be explained. It will also help students develop a general fundamental understanding on the disease and health problems associated with metabolic disorders of the macromolecules including; Carbohydrates, Lipids, proteins and hormones. The basic objective of studying cancer biology is to translate basic findings into diagnostics, treatments and cures.</p>				
<p>Course Outcomes: After completion of the course, learners would be able to:</p> <p>CO1: Understand the overall organization of the immune system</p> <p>CO2: Appreciate the structure and function of antibodies</p> <p>CO3: Understand the relationship between the innate and adaptive systems</p> <p>CO4: Explain humoral and cellular immunity and their relative significances to transfusion science theory and practice</p> <p>CO5: Learn the normal and abnormal metabolic pathways of bio-molecules (carbohydrates, proteins, lipids)</p> <p>CO6: Describe the roles of cytokines, chemokines, and colony-stimulating factors in the immune response</p> <p>CO7: Acquire the most important diseases related to carbohydrates, proteins, lipids abnormalities</p> <p>CO8: Be aware of various metabolic disorders and in born errors</p> <p>CO9: Discuss pathophysiology and etiology of different diseases</p> <p>CO10: Understand basic aspects of cancer biology</p> <p>CO11: Familiarize with elementary facets of carcinogenesis and types of cancer along with therapy to treat the cancer</p>				
Outline of Syllabus: (per session plan)				
Module	Description			No of hours
1	Human immune system			15
2	Adaptive Immune Response			15
3	Pathology of Physiological disorders			15
4	Oncology			15
	Total			60
PRACTICALS				60

Module	Immunology and Pathophysiology-I	No. of Hours/Credits 60/2.5
1	Human immune system	15
	<i>Types of Immunity</i> Innate immunity – Anatomical barriers, physiological barriers, Characteristics of Inflammation, phagocytosis and fever Adaptive immunity – Active & Passive Introduction to Humoral & Cell mediated immunity Overview of role of MHC and Antigen presentation	7
	<i>Organs of the immune system:</i> Primary lymphoid organs: Thymus, Bone marrow Secondary lymphoid organs: Lymphatic system, Lymph nodes, Spleen, MALT.	4
	<i>Cells of the immune system:</i> Lymphocytes – B cells and T cells, Natural killer cells – Mononuclear phagocytes, Granulocytes, Antigen presenting cells. Clonal selection & immunologic memory. <i>Cytokines:</i> biological functions of IL1, tumor necrosis factor-alpha, interferon –alpha, IL2, interferon-gamma.	4
2	Adaptive Immune Response	15
	<i>Antigens:</i> Antigenicity, immunogenicity, epitope, factors determining immunogenicity, Haptens, T dependent & T- independent Antigen	3
	<i>Antibodies:</i> Fine structure of immunoglobulin, Antibody classes , Antibody-mediated functions, Monoclonal antibodies	5
	<i>Antibody diversity:</i> Multi-gene organization of immunoglobulin genes – Lambda, kappa & heavy chain Light chain DNA – VJ rearrangements Heavy chain DNA - VDJ rearrangements	3
	Cell-mediated immune response- TCR and co-receptors and accessory molecules	2
	Correlation between HI and CMI	2
3	Pathology of physiological disorders	15
	<i>Metabolic disorders</i> Concept and discovery through Alkaptonuria; Phenylketonuria Inborn error: Etiology, Biochemical pathophysiology and Clinical manifestations Carbohydrate Metabolism: Glycogen storage disease Type 1 Protein Metabolism: Albinism Lipid Metabolism: Tay Sach's disease	5
	<i>Blood related diseases:</i> Etiology, Biochemical pathophysiology	5

	and Clinical manifestations Anemia-Iron deficiency, Pernicious, Megaloblastic and Hemolytic Sickle cell anemia Thalassemia Cardio Vascular System and related diseases: Etiology, Biochemical pathophysiology and Clinical manifestations: Hypertension-Classification Atherosclerosis & Arteriosclerosis	4
4	Oncology	15
	Cancer Biology -Morphological and Biochemical changes in Cancer cells Cell cycle control in mammalian cells- Role of cyclins CDK and MPF Check points and restriction points Genetics of cancer: Protooncogenes, Oncogenes and Tumor Suppressor-Role of pRb and p53 Classification of tumors <i>Types of tumors</i> <i>Carcinogens:</i> Physical, Chemical, Biological Mutagenicity test (Ames Test) Cancer therapy: Surgery, Radiotherapy, Immunotherapy Chemotherapy – purine, pyrimidine and folate analogs	3 4 1 2 2 1 2

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

RECOMMENDED READING:

Essential Reading:

1. Thomas J. Kindt, Barbara A. Osborne, Richard Goldsby, Kuby Immunology, 6th edition, W.H. Freeman
2. M.N. Chatterjea & Ranashinde, Jaypee Brothers, Textbook of Medical Biochemistry, 8th edition, Medical Publishers

Suggested Reading:

1. Chakravarty A. K., Immunology, 2nd edition, Tata McGraw Hill, New Delhi
2. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, Roitt's Essential Immunology, 13th edition, Wiley Blackwell
3. William L. Nyhan, M.D. Ozand, Pinar T, Atlas of Metabolic Diseases, 2nd edition, CRC Press
4. Bruce Alberts Alexander Johnson Julian Lewis David Morgan Martin Raff Keith Roberts Peter Walter, Molecular Biology of the Cell, 6th edition, Garland Science

5. Sulabha Pathak and Urmi Palan, Immunology 3E: Essential and Fundamental, 3rd edition, Science Publishers Inc
6. Raven, Johnson, Mason, Losos, Biology, 11th edition, McGraw Hill Publications
7. Abul K. Abbas, Cellular and Molecular Immunology, 9th edition, Elsevier

Any other reference sources as recommended by the course instructor.

Practical USMABCHP534 includes Practicals of USMABCH503 and USMABCH504		
	Practical (Hours per week)	Credit
	8	3
Practicals of USMABCH503		
Sr. No.	Topic.	
1	Isolation of starch from potato.	
2	Estimation of DNA by the Diphenylamine method	
3	Estimation of RNA by Orcinol method	
4	Isolation and spooling of DNA from moong	
5	Isolation of RNA from yeast/liver	
6	Estimation of phosphorus by Fiske and Subbarow method	
Practicals of USMABCH504		
Sr. No.	Topic.	
1	Estimation of glucose by DNSA method.	
2	Estimation of glucose by the Folin Wu method.	
3	Determination of the Hemoglobin content by the Sahli's hemoglobinometer.	
4	Determination of blood groups	
5	Estimation of Mg ⁺² ions in by the Eriochrome Black T-EDTA method	

Program: B.Sc. Biochemistry			Semester : V	
Course: Food Nutrition and Dietetics–I (Applied Component)			Course Code: USMABCHAC501	
Teaching Scheme			Evaluation Scheme	
Lecture (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE)	End Semester Examination (ESE)
4	-	2	25%	75%
Learning Objectives: The immune system is complex and it has to be understood in terms of specific functional modules. It is also important to identify the fundamental characteristics of both the innate and adaptive immune systems and begin to understand how they must work in concert to protect the host from infectious diseases. The key reaction of immunology and immune defense is the interaction of antibodies and antigens. This interaction is responsible for the body's defense against viral and bacterial infections and other toxins. This paper will help reveal the understanding of basic immune cells and their characteristics along with the types of immune responses. In addition to the above concept, antibody diversity will also be explained. It will also help students develop a general fundamental understanding on the disease and health problems associated with metabolic disorders of the macromolecules including; Carbohydrates, Lipids, proteins and hormones. The basic objective of studying cancer biology is to translate basic findings into diagnostics, treatments and ultimate cures.				
Course Outcomes: After completion of the course, learners would be able to: CO1: Correlate microorganisms with health and disease CO2: Independently examine and assess nutrient intake, nutritional status and nutrient requirements CO3: Plan and manage the nutritional needs of different groups in society and the ability to educate and inform about diet and health CO4: Grasp the basic concept of therapeutic diet and diet planning CO5: Learn prevention, investigation, assessment, treatment and evaluation of nutrition-related problems, symptoms and disease.				
Outline of Syllabus: (per session plan)				
Module	Description			No of hours
1	Food microbiology			15
2	Nutrition & Chemical Constituents of Food groups			15
3	Introduction to Dietetics-I			15
4	Diet Planning			15
	Total			60
PRACTICALS				60

Module	Food Nutrition and Dietetics-I (Applied Component)	No. of Hours/Credits 60/2
1	Food microbiology	15
	<i>Different sources of contamination, intrinsic and extrinsic parameters of food which effect microbial growth.</i>	2
	General principles underlying food spoilage, chemical changes caused by microorganisms.	3
	Spoilage changes in different food stuffs in brief.	
	Microbiology of water - number and kinds of microorganisms present, test for contamination of bacteria	2
	Food borne diseases: Food Poisoning, Food intoxication (Natural and chemical), Study of causative agents and symptoms of disease: (i) Bacteria (Cholera and Typhoid); (ii) Viruses (Hepatitis and gastroenteritis) (iii) Fungi (Mycotoxin, Ochratoxin -Aflatoxin-Patulin) (v) Parasites (Amoebiasis and Giardiasis)	6
	Microorganisms and their applications in fermented Foods: Alcoholic beverages, Indigenous fermented foods like Idli/ Dosa / Khaman Dhokla/ Bread/Soya Bean Fermented Foods and acid fermented milk products	2
2	Nutrition & Chemical constituents of Food groups	15
	Introduction to Nutrition	8
	Principles of Foods and Nutrition, Food groups	
	Nutritional role of water, carbohydrates, proteins, fats, fiber, vitamins and minerals	
	Concept of calorie and energy requirements of normal men and women of different age groups with reference to height, Weight, physical activity, job status etc	
	Composition and nutrient content (macro and micro)	7
	Cereals	
	Pulses	
	Fruits and Vegetables	
	Milk and milk products	
	Oil seeds and spices (any five with active constituents)	
	Meat, fish and poultry	
3	Introduction to Dietetics- I	15
	i) Concept of health (Physical, emotional, psychological, spiritual)	4
	ii) Factors affecting nutritional status- iii) Psycho-emotional influences on food intake and nutritional status (packed lunch, school lunch programmes (Mid-day meal), food habit	
	Dietary management and balanced diet: Meal planning, meal pattern, selection of adequate diet, SDA, RDA of different age groups, use of Food exchange list	2

	Nutritional problems in India: Anaemia, protein energy malnutrition, over and under-nutrition, psychological nutritional problems- Bulimia nervosa, anorexia	3
	Nutritional requirements for: i) Children- pre-school, school going and adolescents ii) Normal adults iii) Expectant & nursing mothers iv) Sports nutrition	5
	Geriatric nutrition- nutritional requirement, physiological changes, nutritional problem during old age	1
4	Oncology	15
	Introduction to therapeutic diets: Basic concepts, principles, factors considered, classification, special feeding methods, pre and post-operative diet. Role of dietician in the Hospital and Community	4 3
	Therapeutic diets: Regular diet, light diet, soft diet, full liquid diet, clear liquid diet and tube feedings	3
	Etiology and modification of diet in febrile conditions - Typhoid, Tuberculosis	2
	Etiology and modification of diet in obesity and underweight. Role of Leptin, Ghrelin, Adiponectin in food intake	3

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

RECOMMENDED READING:

Essential Reading:

1. Frazier and Westhoff, Food Microbiology, 4th edition, Tata McGraw Hill Publishers
2. B. Srilaxmi, Nutrition science, 4th revised edition, New age international
3. B. Srilaxmi, Food Science, 5th edition, New age international
4. Shubhangini Joshi, Nutrition and Dietetics, 4th edition, McGraw Hill Publications

Suggested Reading:

1. B. Srilaxmi, Dietetics, 4th edition, New age International
2. Antia F P., Clinical Dietetics and Nutrition, 4th revised edition, Oxford University Press
3. U Satyanarayan, Biochemistry, 5th edition, Books and Allied Publications
4. Pelczar, Michael J Textbook of Microbiology, 4th edition, Tata-McGraw Hill Publishing
5. Adams and Moss, Food Microbiology, 2nd edition, Panima Publishing Corporation
6. Potter and Hotchkiss, Food Science, 5th edition, Springer Publications

Any other reference sources as recommended by the course instructor.

Practicals of USMABCHACP1-Biochemistry Applied Component Practical-I		
	Practical (Hours per week)	Credit
	4	2
Sr. No.	Topic.	
1	Proximate Analysis	
a	Estimation of Iron by Wong's method	
b	Estimation of proteins by Biuret method	
2	Egg Chemistry:	
a	Isolation of lecithin and cholesterol from egg yolk	
3	Characterization of Fats:	
	Determination of saponification value of fats & oils	
4	Estimation of ascorbic acid by 2,6 -dichlorophenol indophenol	
5	Isolation of Fibers from oranges	
6	Quality criteria for milk by (a) MBRT and (b) Clot test	
7	Assignment / Report writing on diet planning	

Program: B.Sc. Biochemistry			Semester : VI	
Course: Metabolism and Analytical Techniques-II			Course Code: USMABCH601	
Teaching Scheme			Evaluation Scheme	
Lecture (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE)	End Semester Examination (ESE)
4	-	2.5	25%	75%
<p>Learning Objectives: Bioenergetics has traditionally been a difficult area for students, partly because of its inherent complexity, and partly because some of the theories were fiercely contested. This is less of a problem today, but many people still find particular difficulty with the idea of an ion gradient as a convertible form of energy, with the resolution of the proton gradient into electrical and pH components. This paper makes understand these key topics with respect to electron transport chain and regulatory bodies along with oxidative phosphorylation as a vital part of ATP generation. Amino acids being building blocks of cell and nucleic acids being basic functional unit of cell, it is important to study the anabolism and catabolism of these biomolecules. In addition the paper also appreciates the interrelationship between metabolic processes of proximate principles as different biomolecules play different roles. It is mandatory to separate, isolate such molecules and analyze the properties and characteristics of those. Analytical techniques help reveal different methods of separation and isolation of macro and micro molecules along with their estimation.</p>				
<p>Course Outcomes:</p> <p>After completion of the course, learners would be able to:</p> <p>CO1: Understand the operation of the major trans membrane ion pumps and the ATP synthase</p> <p>CO2: Explain concept of energy, cite examples and assess its importance to living organisms</p> <p>CO3: Explain the chemiosmotic hypothesis of ATP synthesis</p> <p>CO4: Explain general reaction for photosynthesis in terms of water, light, oxygen and carbon dioxide and carbohydrate</p> <p>CO5: Explain role of catabolic and anabolic pathways of amino acids, proteins and nucleic acids in cellular metabolism</p> <p>CO6: Understand in general terms how cells obtain the energy to do cellular work.</p> <p>CO7: Explain how ATP is generated from performs cellular work</p> <p>CO8: Apply the principles of centrifugation, radioactivity and electrophoresis.</p> <p>CO9: Demonstrate the operation centrifugation and electrophoresis</p> <p>CO10: Explain the chemistry behind the methods of analysis of compounds</p>				
Outline of Syllabus: (per session plan)				
Module	Description			No of hours
1	Bioenergetics & Oxidative Phosphorylation			15
2	Amino acid, Protein metabolism & Nucleic acid metabolism			15
3	Centrifugation and Radioisotopic techniques			15
4	Electrophoresis			15
	Total			60
PRACTICALS				60

Module	Metabolism and Analytical Techniques-II	No. of Hours/Credits 60/2.5
1	Bioenergetics & Oxidative Phosphorylation	15
	<i>Bioenergetics</i> Laws of Thermodynamics as applicable to biological systems <i>Concept of free energy, enthalpy and entropy</i> Respiratory electron transport chain – Complexes (Carriers, basic chemistry, redox potentials, orientation on the membrane, sequence) Q cycle in Complex III Inhibitors of electron transport chain– Antimycin A, Amytal, Rotenone, CN, Azide, CO	3 3
	<i>Oxidative phosphorylation</i> Chemi-osmotic hypothesis, Proton motive force Structure of ATP synthase	2
	<i>Uncouplers of ETC</i> Oxidative phosphorylation [DNP]	
	<i>Malate-Aspartate shuttle</i> <i>Glycerol phosphate shuttle</i>	2
	<i>Photosynthesis</i> Hill's experiment	1 1
	Electron carriers, pigments	1
	<i>Comparative study of photosystems I and II</i> Light and dark reactions Z scheme (Linear) and cyclic photophosphorylation	2
	Calvin cycle – schematic (WITH STRUCTURES) with enzymes	
2	Amino acid, protein and nucleic acid metabolism	15
	<i>Amino acid and protein metabolism</i> <i>Reactions of amino acids:</i> Transamination: Mechanism of transamination, example of GOT/GPT (WITH STRUCTURES) Decarboxylation: Mechanism of decarboxylation and reactions of His, Trp, and Glu (WITH STRUCTURES) Deamination: Mechanism of deamination Types of deamination: (WITH STRUCTURES) Trans-deamination, Oxidative deamination– NAD(P) linked dehydrogenases and D & L-Amino acid oxidases Non oxidative deamination–Reactions of Asp, Cys and Ser. Glutamine as the amino group carrier -Transport of NH ₃	2 1
	<i>Urea cycle:</i> Cellular location, sequence of reactions, Labeling of N atom (WITH STRUCTURES)	2
	Concept of Kreb's bicycle	1

	<p><i>Nucleic acid metabolism</i></p> <p>Biosynthesis of purines and pyrimidines (Adenine and cytosine)</p> <p>Catabolism of purines and pyrimidines (Adenine and cytosine)</p> <p><i>Concept of de novo and salvage pathways and their precursor molecules</i></p> <p><i>Disorders due to defect in nucleotide metabolism-Gout, Lesch Nyhan syndrome</i></p> <p><i>Integration of metabolism-Carbohydrates, Proteins, Lipids (Interconversion between the three principal components)</i></p>	<p>3</p> <p>2</p> <p>2</p> <p>2</p>
3	Centrifugation and Radioactivity	15
	<p><i>Centrifugation</i></p> <p>RCF, RPM and derivation of an equation relating the two;</p> <p>Nomogram;</p> <p>Derivation of rate of sedimentation</p> <p>Sedimentation coefficient</p> <p>Wall effect</p> <p><i>Principle, Types, Instrumentation and applications of centrifuges:</i></p> <p>Clinical</p> <p>High speed</p> <p>Ultra centrifuges</p> <p><i>Preparative centrifuge:-Differential, Rate-zonal and Isopycnic</i></p> <p><i>Analytical centrifuge</i></p> <p>Types and characteristics of density gradient materials</p> <p><i>Radioactivity:</i></p> <p>Radioactive and Stable isotopes</p> <p>Types, pattern and rate of radioactive decay</p> <p>Concept of Decay Constant, Half-life</p> <p>Units of radioactivity (Curie, Becquerel)</p> <p><i>Measurement of radioactivity: Principle of working Geiger-Muller Counter</i></p> <p><i>Basic Scintillation counter, Concept of Quenching</i></p> <p><i>Diagnostic applications of radioactivity:</i></p> <p>Autoradiography</p> <p>Radioimmunoassay</p> <p>Heavy water (D₂O)-its properties and applications</p> <p>Use of radioisotopes in biological sciences</p> <p>Precautions associated with radioactivity handling</p>	<p>2</p> <p>3</p> <p>3</p> <p>2</p> <p>2</p> <p>3</p>
4	Electrophoresis	15
	<p><i>Principle of electrophoresis:</i></p> <p>Experimental set up</p> <p>Factors affecting the rate of migration of sample in an electric field</p> <p><i>Moving boundary and zone electrophoresis</i></p>	<p>2</p>

	Components of electrophoresis unit/apparatus	2
	Various Support media – paper, cellulose acetate, agar, agarose and polyacrylamide	1
	Solubilizers: SDS, Urea, β -mercaptoethanol	
	Technique of electrophoresis with staining or visualization method:	4
	Agarose electrophoresis for separation of DNA	
	Native PAGE for separation of proteins	
	SDS PAGE: determination of subunit stoichiometry and molecular weight of protein	
	Discontinuous electrophoresis	
	Principles and Applications of electrophoresis:	4
	Blotting techniques: Southern, Northern and Western	
	Isoelectric focusing	
	Capillary electrophoresis	
	2D electrophoresis	
	Case studies on above concepts	2

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RECOMMENDED READING:

Essential Reading:

1. Nelson, D. L. and Cox, M.M Lehninger Principles of Biochemistry 5th edition Macmillan Education
2. Victor Rodwell, David Bender, Kathleen Botham, Peter Kennelly, P. Anthony Weil, Harpers illustrated biochemistry, 31st edition, Mc Graw Hill, Lange
3. Williams. B and Wilson K, A Biologists Guide to Principles and Techniques of Practical Biochemistry, 2nd edition, Edward Arnold publisher
4. Donald Voet, Judith G. Voet, Biochemistry, 4th Edition, John Wiley & Sons
5. Upadhyay; Upadhyay, Biophysical Chemistry Principle and Techniques, 2nd edition, Nath, Himalaya Publishing House.
6. David Holme and Hazel Peck, Analytical Biochemistry, 3rd edition, Pearson Education

Suggested Reading:

1. Basic Concepts in Biochemistry: A Student's Survival Guide by Hiram F. Gilbert
2. Biochemistry by Jeremy M. Berg
3. Biochemistry (2 Volume Set): The Chemical Reactions of Living Cells by David E. Metzler
4. Modern Experimental Biochemistry by Rodney F. Boyer
5. Biochemical Calculation by Segel
6. Biochemical Methods by Sadashivam
7. Introductory Practical Biochemistry by Sawhney
8. Practical Biochemistry by David Plummer

Any other reference sources as recommended by the course instructor

Program: B.Sc. Biochemistry			Semester : VI	
Course: Environmental Science			Course Code: USMABCH602	
Teaching Scheme			Evaluation Scheme	
Lecture (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE)	End Semester Examination (ESE)
4	-	2.5	25%	75%
Learning Objectives: The environmental studies prepare students for career as leaders in understanding and addressing complex environmental issues from a problem oriented. It is important to articulate the interdisciplinary context of environmental issues. It not only helps students to get acquainted with their own environment but also strengthen their bond with it. Hence this paper deals with the study of various spheres surrounding the earth viz air, water and soil along with noise. It will make student appreciate the corresponding pollutants, monitoring methods and corrective measures.				
Course Outcomes: After completion of the course, learners would be able to: CO1: Develop a sense of community responsibility by becoming aware of scientific issues in the larger social context CO2: Pursue meaningful careers and post-graduate education in fields related to environmental science and beyond				
Outline of Syllabus: (per session plan)				
Module	Description			No of hours
1	Air & Noise Pollution			15
2	Soil & Water Pollution			15
3	Energy, Industrial Pollutants			15
4	Biodiversity & Sustainable Development			15
	Total			60
PRACTICALS				60

Module	Environmental Science	No. of Hours/Credits 60/2.5
1	Air & Noise Pollution	15
	<p><i>Atmosphere</i> Multidisciplinary nature of environmental studies Composition and structure of atmosphere Particles, ions and radicals in the atmosphere Chemical and photochemical reactions in the atmosphere [reactions of oxygen, ozone, sulphur dioxide nitrogen oxide and organic compounds]</p>	5
	<p><i>Air Pollutants:</i> Sources and effect of: CO, Oxides of Nitrogen, SO₂, hydrocarbons and suspended particulate matter Photochemical smog Green-house gases and Global Warming; Depletion of ozone Sampling, monitoring and analysis of Air pollutants Air quality parameters Current environmental issues in the national context and remedial measures</p>	5
	<p><i>Noise and its measurement</i> Permissible limit of noise in different zones <i>Causes of noise pollution</i> <i>Classification of Noise</i> <i>Sonic boom</i> <i>Circadian rhythm</i> Effect of Noise on general health and Sleep cycle</p>	5
2	Soil & Water Pollution	15
	<p><i>Soil</i> Composition of soil Nitrogen cycle; Soil microbiology Types of soil pollution – acidification, agrochemical pollution, salinization, Sampling, monitoring and analysis of Soil pollutants</p>	2
	<p><i>Solid waste management</i> Types of solid waste Disposal (sorting at source, land fill, incineration, ocean dumping) E-waste and its management</p>	2
	<p><i>Water Pollution</i> Organic pollutants [pesticides, insecticides, detergents, oil spills, toxic organic chemicals] Inorganic pollutants [heavy metals – Hg, Pb, As, Cd]</p>	3
	<i>Thermal pollution of water</i>	1

	Criteria for water purity	1
	Sewage	1
	Types of sewage	
	Water treatment strategies:	5
	Preliminary treatment	
	Primary treatment	
	Secondary treatment	
	Tertiary treatment	
	Treatment of Domestic and industrial waste water	
	Sampling, monitoring and analysis of water pollutants	
3	Energy, Industrial Pollutants	15
	Energy	2
	Environmental impact of conventional Sources of energy:	
	Coal	
	Coke	
	Natural gas (CNG)	
	Biomass and Bioenergy production	2
	Emerging eco-friendly alternatives for chemical industry: Green Chemistry and Green Technology	3
	Concept of 5R's	3
	Sources, Environmental implications and abatement strategies for:	3
	Polymers and Plastics pollution	
	Asbestos pollution	
	Poly Chlorinated Biphenyls pollution	
	Mining (Acid mine drainage)	
	Remote Sensing (Principle and Applications of the same)-Case studies	2
4	Biodiversity & Sustainable Development	15
	Biodiversity and Conservation	1
	Levels of biological diversity: genetic, species and ecosystem diversity.	3
	Biogeographic zones of India	
	Biodiversity patterns and global biodiversity hot spots	
	India as a mega-biodiversity nation	
	Endangered and endemic species of India	
	Threats to bio-diversity (Experiential learning through a case study on each): Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions	3
	Conservation of biodiversity	2
	Sustainable development	3
	Concepts: Ecological, Economical, Socio-economical aspects of sustainable development	

	Kyoto protocol and Sustainable development goals Concept of sustainable cities Economic models: Green Audit Carbon foot-printing and carbon credit Green building	3
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To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

RECOMMENDED READING:

Essential Reading:

1. A.K.De, Environmental Chemistry, 7th edition, New Age International Publication
2. U. Satyanarayana, Biotechnology, 2nd edition, Books & Allied Ltd
3. S. N. Jogdand, Advances in Biotechnology, revised edition, Himalaya Publishing House

Suggested Reading:

1. Irwin Segel, Biochemical Calculations, 2nd edition, John Wiley and sons
 2. S. Sadashivam, Biochemical Methods, 2nd edition, New Age International Publication
 3. Sawhney, S.K. and Singh, Randhir, Introductory Practical Biochemistry, 1st edition Narosa Publishing House
 4. Plummer, David T, Introduction to Practical Biochemistry, 3rd edition, Tata Mc. Graw and Hill Publishers
- Any other reference sources as recommended by the course instructor

Practical USMABCHP612 includes Practicals of USMABCH601 and USMABCH602		
	Practical (Hours per week)	Credit
	8	3
Practicals of USMABCH601		
Sr. No.	Topic.	
1	Separation of amino acids by circular paper chromatography	
2	Determination of the optimum pH of Acid phosphatase.	
3	Determination of the Km of Acid phosphatase	
4	Determination of the Km of Catalase.	
5	Estimation of lactose by Cole's ferricyanide method.	
6	Separation of oil by Thin Layer Chromatography	
7	Separation of serum proteins by agarose-gel electrophoresis	
8	Isolation of plasmids	
Practicals of USMABCH602		
Sr. No.	Topic.	
1	Estimation of fluoride in water by the Alizarin red method	
2	Determination of the Dissolved Oxygen content of water/effluent by the Winkler's Iodometric method - Azide modification	
3	Determination of the Biological Oxygen Demand of water/effluent	
4	Determination of the acidity and alkalinity of water/ effluent	
5	Estimation of CaCO ₃ of soil - Bromothymol Blue method	
6	Estimation of organic content of soil –Diphenylamine method	
7	Estimation of lead by the EDTA method	

Program: B.Sc. Biochemistry			Semester : VI	
Course: Biostatistics and Bioinformatics			Course Code: USMABCH603	
Teaching Scheme			Evaluation Scheme	
Lecture (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE)	End Semester Examination (ESE)
4	-	2.5	25%	75%
Learning Objectives: Biostatistics is the application of statistical principles to questions and problems in medicine, public health or biology. It would be impossible to answer many questions just by collecting information (data) from all subjects in the populations of interest. The discipline of biostatistics provides tools and techniques for collecting data and then summarizing, analysing, and interpreting it. This paper introduces fundamental concepts and definitions for biostatistics. Further it also presents hypothesis testing and introduction to bioinformatics which is an interdisciplinary program offering substantial training in both the biological sciences and the physical and mathematical sciences.				
Course Outcomes: After completion of the course, learners would be able to: CO1: Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation. CO2: Understand and use mathematical and statistical theory underlying the application of bio statistical methods. CO3: Interpret statistical results correctly, effectively, and in context CO4: Define and apply null hypothesis, alternative hypothesis, level of significance, test statistic, p value, and statistical significance CO5: Make appropriate use of statistical software CO6: Interpret relationships among living things and analyze and solve biological problems, from the molecular to ecosystem level using basic biological concepts, grounded in foundational theories with the help of bioinformatics tools CO7: Apply existing software effectively to extract information from large databases and to use this information in computer modeling				
Outline of Syllabus: (per session plan)				
Module	Description			No of hours
1	Biostatistics and Descriptive Statistics			15
2	Probability			15
3	Hypothesis Testing			15
4	Bioinformatics & IPR			15
	Total			60
PRACTICALS				60

Module	Biostatistics and Bioinformatics	No. of Hours/Credits 60/2.5
1	Biostatistics and Descriptive Statistics	15
	<i>Introduction: scope and applications of biostatistics</i>	2
	<i>Common statistical terms:</i>	2
	<i>Sources of statistical data</i>	2
	<i>presentation of data (tabular and graphical);</i>	3
	<i>Measurement and scales of measurement</i>	3
	<i>Descriptive statistics:</i>	3
	Measures of central tendency- Mean, Median and mode	
	Measures of dispersion- Mean deviation, SD, variance	
	Measures of partition- Range, percentiles, decile, quartile	
2	Probability	15
	<i>Probability</i>	5
	Basic concepts of probability: definition	
	Basic terminologies- Random experiment or trial, sample space, sample point, Types of events	
	Permutation and combinations	
	<i>Theorems of probability</i>	5
	Addition theorem	
	Multiplication theorem	
	Probability with the dependent and independent events	
	Marginal, Joint, conditional	
	Probability distribution: normal distribution and normal curve, Asymmetric distribution- skewness, curtosis and coefficients	
	Correlation: types and coefficients	
	Regression: types and coefficients	
	<i>Statistical problems based on the above concepts</i>	5
3	Hypothesis Testing	15
	<i>Introduction; Single population mean, difference between population means</i>	2
	<i>Type I and Type II errors,</i>	2
	<i>One-tailed and two tailed tests</i>	2
	<i>Z-test</i>	2
	<i>Chi-square</i>	2
	<i>t-test- Paired and unpaired</i>	2
	<i>ANOVA</i>	2
	Statistical problems based on the above concepts	1
4	Bioinformatics & IPR	15

Bioinformatics: Definition, Aims and Branches of Bioinformatics	1
Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, Medical informatics and agriculture.	3
Introduction to Genomics and Proteomics	1
Databases- Definition & types – Public domain database, Sequence database, Structural database, Motif database, Genome database, Proteom database, Annotated sequence database.	2
Full form & function in brief of - GenBank, EMBL, PIR, SWISS PROT, PDB,GDB.	1
Sequence analysis Tools - Explain the following terms in brief - BLAST, FASTA, L-ALIGN, CLUSTAL- X & W, RASMOL, Software for protein sequencing - PROPECT, AMMP, COPIA (Explanation of the terms in brief)	2
Micro-array analysis-concept and applications	
IPR: Introduction to Intellectual property: types Patent: Objectives; Patent Act 1970 and ins amendment Patent filing procedures and its infringement Copy rights (introduction, works protected under copyright law,; transfer of copy right and its infringement Trade mark- introduction, types, protection of good will and infringement and IPR in- Protection of plant varieties, IT related, Biotechnology	5

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

RECOMMENDED READING:

Essential Reading:

1. PN Arora & PK Malhan, Biostatistics, 2012, Himalaya Publishing House
2. Arun Bhadra Khanal and B. K. Mahajan, Methods in Biostatistics, 2010, Jaypee Publishers
3. Rastogi, S.C., Mendiratta Namita and Rastogi Parag, Bioinformatics- Concepts, Skill and applications, 2nd edition, C.B.S. Publishers & Distributors
4. N. K Acharya, Textbook of Intellectual Property rights, 7th edition, Asia Law House

Suggested Reading:

1. P. K. Banerjee, Introduction to biostatistics, revised edition, S Chand publishing.
2. Khan and Khanum, Fundamentals of Biostatistics, Ukaaz publications
3. Rachna Singh Puri, A. Vishwanathan, Practical approach to Intellectual property rights, International Publishing House

Any other reference sources as recommended by the course instructor

Program: B.Sc. Biochemistry			Semester : VI	
Course: Immunology and Pathophysiology-II			Course Code: USMABCH604	
Teaching Scheme			Evaluation Scheme	
Lecture (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE)	End Semester Examination (ESE)
4	-	2.5	25%	75%
<p>Learning Objectives: The key reaction of immunology and immune defense is the interaction of antibodies and antigens. The body's defense mechanism recognizes foreign substances, or antigens, and raises specific antibodies against them. This paper involves the study of an immunodiffusion technique in which antigen and antibody are allowed to diffuse in solid agarose medium. The complement system is a group of serum proteins which interact to form an effector arm of the immune system. Sequential activation of the components of the complement cascade leads to the cytolysis of microorganisms by osmotic lysis, phagocytosis of microorganisms coated with complement proteins or their fragments, (opsonization), induction of the inflammatory response, the clearance of immune complexes from the circulation, and efficient activation of B lymphocytes. Along with complement system it deals with major histocompatibility molecules which are important for immune response, also for evoking transplant rejections. It is a need to understand the basic biological properties of viruses. After studying metabolic disorders of proximate principles, it is also of great importance to understand the disorders of endocrine system and ageing, which include chemistry, functions of endocrine hormones and disease related to those</p>				
<p>Course Outcomes:</p> <p>After completion of the course, learners would be able to:</p> <p>CO1: Describe the three pathways that activate the complement system</p> <p>CO2: Explicate the mechanism and consequences of the activation of the complement system</p> <p>CO3: Explain the MHC; its structure and classes, specific role of each class of MHC</p> <p>CO4: Relate the importance of MHC in immune response and graft rejection</p> <p>CO5: Characterize the significance and function of major histocompatibility complex molecules</p> <p>CO6: Grasp a contemporary understanding of classification, structure and mechanism of replication of viruses</p> <p>CO7: Understand the pathophysiology, symptoms and preventive measures of AIDS</p> <p>CO8: Describe the basic concepts of demography and epidemiology of aging</p> <p>CO9: Identify important concepts of pathophysiology & issues in common diseases of older people.</p>				
Outline of Syllabus: (per session plan)				
Module	Description			No of hours
1	Antigen- Antibody interactions & Complement system			15
2	Major histocompatibility complex & Transplant immunology			15
3	Virology and AIDS			15
4	Endocrinology II and Ageing			15
	Total			60
PRACTICALS				60

Module	Immunology and Pathophysiology-II	No. of Hours/Credits 60/2.5
1	Antigen- Antibody interactions & Complement system	15
	<i>Antigen- Antibody interactions:</i> Forces involved, antibody affinity, antibody avidity. Precipitation reactions – Oudins, Ouchterlony Agglutination reactions: Blood typing, bacterial agglutination, Passive agglutination, agglutination inhibition, Coomb's test. Immuno-electrophoresis ; Principles of Radioimmunoassay, ELISA, Immunofluorescence, Flow cytometry	8
	<i>Complement</i> Components of complement; Complement activation – Classical & alternate pathway; formation of membrane attack complex. Biological consequences of complement activation.[in brief]	7
2	Major histocompatibility complex & Transplant immunology	15
	<i>Major histocompatibility complex:</i> MHC polymorphism & organization of MHC genes- class I & class II ; Cellular distribution & structure of class I & II molecules Self MHC restriction of T-cells. Role of antigen presenting cells	6
	<i>Transplant immunology:</i> Types of transplant; immunological basis of allograft rejection	4
	<i>Autoimmunity: Causes of autoimmune disorders</i> Organ specific –Myasthenia gravis, IDDM Systemic – Rheumatoid arthritis, Multiple sclerosis (immunological basis of these autoimmune diseases)	3
	<i>Hypersensitivity-Overview of Types-IgE mediated (Type I); Antibody mediated (Type II), Immune complex mediated (Type III) and DTH-mediated (Type IV)</i>	2
3	Virology and AIDS	15
	<i>General Structure of Virus</i> (i) Components of virus envelope, capsid and genome (ii) Interaction of viruses with cellular receptors and entry of virus (iii) Assembly, maturation & release of virions	2
	<i>Baltimore Classification of Virus</i>	
	<i>Satellite Viruses, Virioids, Virusoids</i>	1
	<i>Structure and mechanism of replication in:</i>	2
	Vaccinia	3
	Polio	

	Influenza , Hepatitis, Rabies Ebola Prevention and control of viral diseases: antiviral compounds-Interferons and viral vaccines AIDS: Structure and genetics basis of AIDS virus. Replication of AIDS Virus Symptoms and Causes of AIDS AIDS Therapy Diagnostic tests	3 4
4	Endocrinology II and Ageing	15
	Endocrine diseases: Chemistry, synthesis, secretion and physiological effects of Insulin [synthesis from preproinsulin], Physiological role of ADH, Diabetes insipidus. Chemistry, synthesis, secretion and physiological effects of Thyroxine; Hypothyroidism [cretinism and myxedema], Hyperthyroidism [goiter – simple & toxic] Overview of Diagnosis therapy Hormonal imbalances in PMS, PCOS and infertility Ageing: Definition of ageing. Theories of Ageing; Molecular changes associated with ageing. Alzheimer's disease Parkinson's disease	9 2 2 2

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

RECOMMENDED READING:

Essential Reading:

1. M.N. Chatterjea & Ranashinde, Textbook of Medical Biochemistry, 8th edition
2. Jenni Punt; Sharon Stranford; Patricia Jones; Judy Owen, Kuby Immunology, 6th edition, Macmillan learning

Suggested Reading:

1. Jeremy M. Berg, Lubert Stryer, et al. Biochemistry: International Edition, W. H. Freeman Publications
2. Sawhney, S.K. and Singh, Randhir, Introductory Practical Biochemistry, 1st edition Narosa Publishing House
3. Plummer, David T, Introduction to Practical Biochemistry, 3rd edition, Tata Mc. Graw and Hill Publishers
4. Text book of Medical physiology by Guyton, Arthur C. and Hall, John E.; Harcourt Brace & Company Asia Pvt Ltd

Any other reference sources as recommended by the course instructor.

Practical USMABCHP634 includes Practicals of USMABCH603 and USMABCH604		
	Practical (Hours per week)	Credit
	8	3
Practicals of USMABCH603		
Sr. No.	Topic.	
1	Estimation of protein by the Folin-Lowry method	
2	Immunoprecipitation reaction of antigen and antibody	
3	Diagnostic test for typhoid - Widal Qualitative	
4	Diagnostic test for typhoid - Widal Quantitative	
5	Oral GTT curve analysis	
6	Estimation of glucose by GOD-POD method	
7	Isolation of casein from milk	
8	Practicals on Bioinformatics	
9	Tutorials on Biostatistics	
Practicals of USMABCH604		
Sr. No.	Topic.	
	<p>Students have to perform a research project and presentation.</p> <p>The main purpose of introduction of Project Work at TYBSc is to make the students familiar with Research Methodology i.e. reference work, experimental work, statistical analysis of experimental data, interpretation of results obtained, writing of project work and compilation of bibliography in proper order. This will not only help train the inquisitive minds of the students, but also inspire them to take up research- oriented higher studies and career.</p> <p>The following will be considered as the Research Project.</p> <p>a. Experimental based involving laboratory analytical work, or Survey based Field work with statistical analysis of data collected</p>	

Program: B.Sc. Biochemistry				Semester : VI	
Course: Food Nutrition and Dietetics-II				Course Code: USMABCHAC601	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE)	End Semester Examination (ESE)
04	04	-	2	25%	75%
Learning Objectives:					
<p>The functional foods are of importance in today's world as they explain the scientific reasons of traditional foods. Also functional foods can be derivatized into nutraceuticals for betterment of human health. Hence this syllabus deals with the objectives of functional foods, and antinutritional factors. Diet is a basis of life as well as the remedy for variety of diseases. This syllabus would give an insight into use of different diet as a therapy in diseases. It also explains the objectives and work of Indian Dietetic Association. Quality control is an area mandatory for industries which are assured by Quality assurance department. Hence this course gives an idea about various statutory bodies for maintaining the quality of the food and other products produced in the industries and legal aspects</p>					
Course Outcomes:					
<p>After completion of the course, learners would be able to:</p> <p>CO1: Define, classify and characterize different components of food other than essential nutrients</p> <p>CO2: Demonstrate the ability to initiate and use new methods in the field</p> <p>CO3: Understand the significance of diet in various pathophysiological conditions</p> <p>CO4: Understand general principles, methods, techniques associated with food preservation</p> <p>CO5: Apply the knowledge for better employability in QA/QC</p> <p>CO6: Understand adulteration in food and its health hazards</p> <p>CO7: Explain food safety and different legal aspects for the same.</p>					
Outline of Syllabus: (per session plan)					
Module	Description				No of hours
1	Functional foods				15
2	Dietary Management				15
3	Food preservation				15
4	Adulterants & Food Safety and Legal aspects				15
	Total				60
PRACTICALS					60

Module	Food Nutrition and Dietetics-II	No. of Hours/Credits 60/2
1	Functional Food	15
	<i>Food components other than essential nutrients:</i> Introduction-Functional foods Classification	3
	<i>Bioactive proteins and peptides as functional food</i> Bioactive substance from plant food	3
	<i>Probiotics-Good bacteria</i> Prebiotics-Definition and characteristics and their mode of action/effect	3
	<i>Polyphenols</i> -Definition and classification; Bioavailability of polyphenols; Influence of Polyphenols on macro and micro nutrients and minerals.; Health benefits of Polyphenols Phytoestrogens; Dietary sources and chemical forms	3
	<i>Other dietary factors with anti-nutritional factors</i> Protease inhibitors; Amylase inhibitors; Trypsin Inhibitors; Saponins; Lectins and hemagglutinins; Pressor Amines; Phytates; Oxalates	3
2	Dietary Management	15
	<i>Etiology and modification of diet in gastro intestinal disease (any three)</i> , peptic ulcer - diarrhea, constipation, celiac diseases, Sprue, malabsorption syndromes	2
	<i>Etiology and modification of diet in diseases of liver and gall bladder (any two)</i> (a) hepatitis (b) cirrhosis (c) Cholestasis and (d) Cholelithiasis.	3
	<i>Modification of diet in cardiovascular disease atherosclerosis, hypertension.</i>	2
	<i>Dietary management in metabolic disorder - diabetes mellitus</i>	2
	<i>Etiology and modification of diet in diseases of the kidney (any two)</i> - glomerulonephritis, nephrotic syndrome, acute and chronic renal failure, dialysis	3
	<i>Dietary management in cancer</i> - Nutritional problems of cancer therapy - Role of antioxidants	2
	<i>The Dietitian</i> - Responsibilities in Indian context - Diet counseling - Registered dietitian and the Indian dietetic Association	1
3	Food Preservation	15

	<p>General principles of food preservation: Asepsis, removal of micro-organisms and anaerobic conditions</p> <p>Preservation by use of high and low temperatures: drying, radiations, chemical preservatives, inert gases, mechanical preservation techniques (vacuum packaging, tetra packs), canning, TDT, heat resistance TDT curves.</p> <p>Drying (dehydration) Methods, factors in control of drying treatment of food before and after drying</p> <p>Chemical preservatives: Organic acids, propionate, benzoates, sorbates, acetates Ethylene and propylene oxide Sugar and salt Alcohol Wood smoke Esters</p> <p>General principles of Quality Control in food industry.</p> <p>Determination of shelf – life of food products, transport of perishable food items</p>	<p>1</p> <p>3</p> <p>3</p> <p>3</p> <p>3</p> <p>2</p>
4	Adulterants , Food Safety and Legal Aspects	15
	<p>Detection of common food adulterants in (theoretical aspects) Spices ii. Grains iii. Coffee iv. Tea v. Oil fats vi. Food colours vii. Milk / Adulterants and their toxic effects</p> <p>Unintentional food additives</p> <p>Aspects of food safety- Legal aspects, Prevention of Food adulteration act of 1954; HACCP, GMP, role of FDA, AGMARK, ISI</p> <p>Good manufacturing practices and ethics in food and pharma industry</p> <p>Concept of sanitation and hygienic production of food</p> <p>National and International agencies in uplifting the nutritional status -WHO, UNICEF, CARE, ICMR, ICAR, CSIR, CFTRI. Various nutrition related welfare programmes: ICDS and others</p>	<p>3</p> <p>1</p> <p>2</p> <p>3</p> <p>3</p> <p>3</p>

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

RECOMMENDED READING:

Essential Reading:

1. Frazier and Westhoff, Food Microbiology, 5th edition , Tata McGraw Hill Publishers, New Delhi
2. Antia F P, Clinical Dietetics and Nutrition, 4th edition, 1997, Oxford university press, New Delhi
3. B. Srilaxmi, Nutrition science,, 4th edition, New age international (P) Ltd

Suggested Reading:

1. Biochemical Methods, S. Sadasivan and A. Manickam, 2nd edition, New age international (P) Ltd
2. Pelczar, Michael J, Textbook of Microbiology, 5th edition, Tata McGraw Hill Publishing Co. Ltd
3. B. Srilaxmi, Dietetics, 4th edition, New age international (P) Ltd
4. Sawhney, S.K. and Singh, Randhir, Introductory Practical Biochemistry, 1st edition Narosa Publishing House
5. Plummer, David T, Introduction to Practical Biochemistry, 3rd edition, Tata Mc. Graw and Hill Publishers
6. Guyton, Arthur C. and Hall, John E., Text book of Medical physiology, 11th edition, Harcourt Brace & Company Asia Pvt Ltd

Any other reference sources as recommended by the course instructor

Practicals of USMABCHACP2- Biochemistry Applied Component Practical-II		
	Practical (Hours per week)	Credit
	4	2
Sr. No.	Topic	
1	Preparation of sample for mineral analysis by ashing method	
2	Determination of moisture content	
3	Detection of common food adulterants	
4	Extraction of alkaloids	
5	Isolation of carotenoids from carrots by thin layer chromatography	
6	Estimation of Acid value of fats	
7	Determination of Iodine number of oil	
8	Analysis of Antinutritional factors	
9	Estimation of Riboflavin	
10	Estimation of lead by the EDTA method	
11	Isolation of Casein	
12	Estimation of Isothiocyanate content	

