

**UNIVERSITY OF MUMBAI**



**Syllabus for Sem III and Sem IV**

**Program: M.Sc.**

**Course: Bio-Chemistry**

(Credit Based Semester and Grading System with  
effect from the academic year 2013–2014)

## Theory

### SEMESTER III

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
<b>PSBCH301</b>	<b>I</b>	Overview of classical Genetics, Nature of genetic material	<b>4</b>	<b>1</b>
	<b>II</b>	Structure and characteristic of DNA & RNA, Organization of DNA in genome, Functions of gene		<b>1</b>
	<b>III</b>	Cell cycle and its regulation , Replication of DNA		<b>1</b>
	<b>IV</b>	Transcription of DNA, Translation (Protein Biosynthesis)		<b>1</b>
<b>PSBCH302</b>	<b>I</b>	Introduction to Immune system, Cell and organs of Immune system	<b>4</b>	<b>1</b>
	<b>II</b>	Antigens and antibodies, organization, MCA and expression of immunoglobulin gene and its regulation		<b>1</b>
	<b>III</b>	Antigen antibodies interaction		<b>1</b>
	<b>IV</b>	Molecules involved in Immunology, MHC and complement system.		<b>1</b>
<b>PSBCH303</b>	<b>I</b>	Carbohydrate metabolism and related disorders	<b>4</b>	<b>1</b>
	<b>II</b>	Lipid metabolism and related disorders		<b>1</b>
	<b>III</b>	Protein metabolism and related disorders		<b>1</b>
	<b>IV</b>	Nucleotide metabolism and related disorders		<b>1</b>
<b>PSBCH304</b>	<b>I</b>	Macronutrients of Nutritional significance	<b>4</b>	<b>1</b>
	<b>II</b>	Techniques in Nutrition		<b>1</b>
	<b>III</b>	Nutrigenomics		<b>1</b>
	<b>IV</b>	Community Nutrition		<b>1</b>

<b>PSBCHP301</b>	Isolation of DNA and RNA	<b>2</b>	<b>4</b>
<b>PSBCHP302</b>	Immunology/Serology/ Hematology	<b>2</b>	<b>4</b>
<b>PSBCHP303</b>	Estimation of metabolites	<b>2</b>	<b>4</b>
<b>PSBCHP304</b>	Clinical Biochemistry and Nutrition	<b>2</b>	<b>4</b>

### SEMESTER IV

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
<b>PSBCH401</b>	<b>I</b>	Regulation of gene expression, Medical genetics	<b>4</b>	<b>1</b>
	<b>II</b>	Chromosomal abnormalities, Mutations, DNA repair mechanism		<b>1</b>
	<b>III</b>	Enzymes and techniques in Nucleic acids		<b>1</b>
	<b>IV</b>	Recombinant DNA technology		<b>1</b>
<b>PSBCH402</b>	<b>I</b>	Cytokines and Immune response	<b>4</b>	<b>1</b>
	<b>II</b>	Immune responses in infectious diseases and transplantation.		<b>1</b>
	<b>III</b>	Immunological tolerance, Autoimmunity, Autoimmune diseases		<b>1</b>
	<b>IV</b>	Tumour Immunology, Immuno deficiencies		<b>1</b>
<b>PSBCH403</b>	<b>I</b>	Water and electrolyte balance ,Mineral metabolism	<b>4</b>	<b>1</b>
	<b>II</b>	Hemoglobin metabolism ,Hemoglobinopathies, porphyrias, Acid base balance		<b>1</b>
	<b>III</b>	Organ function test , Biochemical assessment and changes in endocrine disorders, pregnancy, lactation		<b>1</b>
	<b>IV</b>	Stem cell, Ageing, Cancer		<b>1</b>
<b>PSBCH404</b>	<b>I</b>	Composition of body fluids in health and disease	<b>4</b>	<b>1</b>
	<b>II</b>	Diet in health and disease		<b>1</b>
	<b>III</b>	Pharmacokinetics ,Clinical research and trials and ethical issues		<b>1</b>
	<b>IV</b>	Mechanism of drug action ,structure- function, relationship, New drug investigation and application		<b>1</b>

<b>PSBCHP401</b>	Research project	<b>2</b>	<b>4</b>
<b>PSBCHP402</b>	Immunology/Serology/ Hematology	<b>2</b>	<b>4</b>
<b>PSBCHP403</b>	Estimation of metabolites	<b>2</b>	<b>4</b>
<b>PSBCHP404</b>	Clinical Biochemistry and Nutrition	<b>2</b>	<b>4</b>



<p>proteins involved in genetic recombination</p> <p>2.3.2 Gene mapping by conjugation, transformation &amp; transduction</p>	
<p><b>Unit : III</b></p> <p><b><u>3.1 Cell cycle and its regulation</u></b></p> <p>3.1.1 Mitosis and meiosis</p> <p>3.1.2 Phases of cell cycle; state of DNA in different phases of cell cycle</p> <p><b><u>3.2 Replication of DNA</u></b></p> <p>3.2.1 Modes of replication; Meselson and Stahl's experiment Semi-conservative replication, Okazaki fragments, enzymes and proteins in DNA replication prokaryotic &amp; eukaryotic DNA polymerases; types and their functions</p> <p>3.2.2 Genomic and subcellular organelle replicons, viral and plasmids replicons, replication origin, initiation and replication, multiple initiation sites,</p> <p>3.2.3 Bidirectional replication, replication bubble and fidelity of replication</p>	<p>7</p> <p>8</p>
<p><b>Unit : IV</b></p> <p><b><u>4.1 Transcription of DNA</u></b></p> <p>4.1.1 DNA dependant RNA polymerases in prokaryotes and eukaryotes, <i>in vitro</i> assay, properties of the enzymes, subunit structure</p> <p>4.1.2 Mechanism of transcription: template directed synthesis, sigma cycle, promoter recognition. Properties of promoter in prokaryotes and eukaryotes</p> <p>4.1.3 Post-transcriptional processing; maturation of rRNA&amp;tRNA, RNA splicing mechanism, poly A tail and 5' capping, noncoding sequences</p> <p><b><u>4.2 Translation</u></b></p> <p>4.2.1 Mechanism of translation: activation, initiation (importance of Shine-Dalgarno sequence), elongation and termination: Rho-dependent and Rho-independent, nonsense codons, role of RF1 and RF2 and GTP</p> <p>4.2.2 Post translational processing and modification, signal hypothesis, zymogen activation.</p> <p>4.2.3 Specific Inhibition of protein biosynthesis .</p>	<p>7</p> <p>8</p>

**Course Code PSBCH302**

Course Code	Title	Credits
<b>PSBCH302</b>	<b>Advanced Immunology</b>	<b>4</b>
<b>Unit I:</b> <b>1.0 Introduction of Immune system-Adaptive and innate immunity</b>		<b>Number of Lectures</b>
<b>1.1 Cells and organs of Immune systems</b>		<b>1</b>
1.1.1 Lymphoid cells, mononuclear, phagocytes, antigen presenting cell, polymorphs, mass cells and platelets.		
1.1.2 Primary and secondary Lymphoid Organs, Lymphocyte Traffic.		
1.1.3 B cell maturation, activation and differentiation.		<b>12</b>
1.1.4 T cell subset and their function. T cell receptor, structure, organization and rearrangement of TCR genes. T cell receptor complex- TCR- CD3. T cell accessory membrane molecule. Ternary TCR Peptide MCH Complex. T cell – Maturation, Activation & Differentiation.		
1.1.5 Development of Immune System in short- Myeloid Cells, Memory B cells		<b>2</b>
<b>Unit II:</b> <b>2.0 Antigens ,Antigenic determinants, antigenicity and immunogenicity</b>		
<b><u>2.1 Immunoglobulins –Basic structure ,classes,subclasses,function</u></b>		
<b><u>2.2 Antibody receptors</u></b>		<b>2</b>
<b><u>2.3 Organization and expression of immunoglobulin genes</u></b>		<b>8</b>
2.3.1 Theories of antibody formation, Immunoglobulin variability		
2.3.2 Genetic basis of antibody diversity		
2.3.3 Regulation of Immunoglobulin production		<b>4</b>
<b><u>2.4 Monoclonal antibodies</u></b>		
2.4.1 Production and clinical uses		
2.4.2 Engineered monoclonal antibodies, Chimeric and hybrid monoclonal antibodies		
2.4.3 Monoclonal antibodies constructed from immunoglobulin gene library.		
<b><u>2.5 Regulation of Immune response</u></b>		<b>1</b>

<p><b>Unit : III</b></p> <p><b>3.0 Antigen-Antibody Interaction (Ag-Ab Interaction)</b></p> <p>3.1 <u>Strength of Ag-Ab Interaction, Antibody Affinity, Scatchard Equation, Antibody Avidity, Cross Reactivity.</u></p> <p><b>3.2 Primary and Secondary Ag-Ab Interaction</b></p> <p>3.2.1 Principles and practical aspects and Application of Primary Ag-Ab Interaction- Equilibrium Dialysis, RIA, ELISA, Immunofluorescence, Biotin-AvidinAb Technique, Western Blotting, Flow Cytometry</p> <p>3.2.2 Principle &amp; practical Aspects and Application of Secondary Antigen Antibody Interaction-Precipitation, Agglutination, Complement Fixation Reactions</p> <p>3.3 <u>Experimental Animal Models,</u> In Breed Strength, Adoptive Transfer Systems, SCID Mice and SCID Human Mice.</p> <p>3.4 <u>Cell Culture System</u> Primary Lymphoid Cell Culture, Clone Lymphoid Cell Line, Hybrid Lymphoid Cell Line</p>	<p>2</p> <p><b>10</b></p> <p>2</p> <p><b>1</b></p>
<p><b>Unit : IV</b></p> <p><b>4.0 Molecules involved in Immunology</b></p> <p><b>4.1 Major Histocompatibility Complex (MHC)</b></p>	<p><b>6</b></p>





<p>oligosaccharides and glycoproteins</p> <p>.1.1.6 Mucopolysaccharides ;Stucture,function and disorders.</p>	
<p><b>Unit II</b></p> <p><b><u>2.1 Lipid and related disorders &amp; Free radical Metabolism</u></b></p> <p>2.1.1 Digestion &amp; absorption of Lipids: an overview, Fatty acid oxidation: of unsaturated fatty acids and odd carbon chain fatty acid oxidation.( saturated, unsaturated, odd chain, even chain, peroxisomal minor pathways of fatty acids oxidation) Disorder related to fattyacid oxidation, (Genetic deficiencies in carnitine transport and Acyl CoA dehydrogenase, Refsum’s disease, Zellweger syndrome)</p> <p>2.1.2 Fatty acid biosynthesis, Elongases&amp;desaturases, synthesis of Triacylglycerol.</p> <p>2.1.3 Cholesterol: Biosynthesis, control, transport, utilization and atherosclerosis, cholesterol lowering drugs (statins etc.)</p> <p>2.1.4 Arachidonate metabolism: Prostaglandins, Prostacyclins, thromboxanes and leukotrienes, the cyclic pathway of prostaglandins, Prostacyclins, thromboxanes’ the linear pathway of leucotrienes.</p> <p>2.1.5 Phospholipid, glycolipid and lipoprotein: metabolism of glycerophospholipids, sphingolipids, sphingophospholipids, sphingoglycolipids.</p> <p>2.1.6 Lipoprotein Metabolism : Metabolisam of chylomicrons,VLDL,LDL,HDL, disorders of lipoprotein metabolism ( Hypo and hyper lipoproteinemias) transport lipoproteins and membrane lipoproteins</p> <p>2.1.7Adipose tissue Metabolism, starvation metabolism , fatty liver ,ketone bodies-formation, utilization, ketosis , metabolisam of alcohol (ethanol), disorders of lipid metabolism( Sphingolipidosis) – Neimann-Pick and Tay-Sach’s disease, Gaucher’s disease, Fabry’s disease.</p> <p>2.1.8 Free radical metabolism: Generation of free radicals, damage produced by reactive oxygen species (ROS), free radical scavenger systems (enzymatic &amp;nonenzymatic),</p>	<p><b>15</b></p>
<p><b>Unit : III</b></p> <p><b><u>3.1 Protein metabolism and related disorders</u></b></p> <p>3.1.1 Digestion &amp; absorption of Protein . reactions of amino acids: Deamination, Transamination , Decarboxylation , Transmethylation, Transdeamination, Essential / non-essential amino acids</p> <p>3.1.2 Ammonia formation, transport and detoxification in brain and liver. Urea cycle-regulation and disorder</p> <p>3.1.3 Biosynthesis &amp; catabolism of – Glycine,Alanine, Aspartic acid, Glutamic acid, Serine, Proline, Hydroxyproline, Catabolism of threonine and basic amino acids</p>	<p><b>15</b></p>

<p>Metabolism of aromatic amino acids, Sulphur containing aminoacids, branched chain aminoacid, and related inborn errors of metabolism</p> <p>3.1.4 Formation of specialized products from amino acids and their functions- glutathione, creatine, creatinine, biogenic amines (dopamine, norepinephrine, tyramine, serotonin, melatonin, GABA, Histamine) polyamines (Putrescine, Spermidine, Spermine) Amino Acids as neuro-transmitters</p> <p>3.1.5 Biologically important peptides (Insulin, Glucagon, AdrenoCortico Trophic Hormone-ACTH, Thyrotropin Releasing Hormone, Corticotropin, Oxytocin, Vasopressin, Gastrin, Angiotensin, Carnocin and Anserine, bradikinin, enkephalin, Aspartamine.</p> <p>3.1.6 Nitrogen Balance, Biological Value of Protein, Protein Energy Malnutrition – PEM, Marasmus, Kwashiorkor.</p>	
<p><b>Unit : IV</b>  <b><u>4.1 Nucleoprotein Metabolism and related Disorders</u></b></p> <p>4.1.1 Digestion &amp; absorption of Nucleic acid: an overview.</p> <p>4.1.2 Nucleotide Metabolism: Biosynthesis &amp; degradation of purines &amp; their regulation.</p> <p>Biosynthesis and degradation of pyrimidine and their regulation. Inter-conversion of Nucleotides.</p> <p>4.1.3 Deoxyribonucleotide Formation. Nucleoside and nucleotide kinases. Salvage pathways of Purine and Pyrimidine. Nucleotide Metabolizing Enzymes as a function of Cell Cycle and Rate of Cell Division. Biologically important nucleotides (Adenosine, Guanosine, Cytidine, Uridine and their derivatives)</p> <p>4.1.4 Nucleotide coenzyme synthesis. Structural analogs of Purine and Pyrimidine bases and their use as chemotherapeutic agents, Antifolate and Antiviral Agents.</p> <p>4.1.5 Disorders of Purine and Pyrimidine Metabolisms, Gout, Lesch-Nyhan Syndrome, Orotic Aciduria, Immune Deficiency Diseases associated with Adenosine deaminase- ADA and Purine Nucleoside Phosphorylase – PNP deficiencies</p>	<p><b>15</b></p>

**Course Code PSBCH304**

Course Code	Title	Credits
PSBCH304	<b>Clinical and Pharmaceutical Biochemistry, Human Nutrition and Dietetics</b>	<b>4</b>
<p><b>Unit I:</b>  <b><u>1.1 Macronutrients of Nutritional significance</u></b></p> <p>1.1.1 Carbohydrates: Role of Oligosaccharides, Dietary Fibre, Non-starch polysaccharides, Prebiotics and Probiotics, Sugar alcohols in human nutrition,</p>		<p><b>Number of Lectures</b></p>

<p>Glycemic Index , Sweeteners</p> <p>1.1.2 Lipids: SFA, MCT, MUFA, PUFA, Trans fatty acids, Omega 3 , 6 Fatty Acids and their implications on health, Biochemical functions and deficiency disorders of essential fatty acids, fat replacers</p> <p>1.1.3 Proteins: Nitrogen Balance, Protein Energy Malnutrition-Clinical features, Biochemical and Metabolic Changes, Nutritional Requirements. Anti-nutritional Factors-Trypsin Inhibitors, Pressor Amines, Phytates, Oxalates. Quality of Protein scoring system, Complementary value of Protein</p>	<p><b>15</b></p>
<p><b>Unit II:</b></p> <p><b><u>2.1 Techniques in Nutrition</u></b></p> <p>2.1.1 Assessment of Nutritional Status: A B C D, i.e. Anthropometry, Biochemical Indices, Clinical; Examination, Dietary Assessment</p> <p>2.1.2 Role of National and International Agencies in combating malnutrition WHO, FAO, UNICEF, ICAR, NIN, ICMR, Food Nutrition Board, CFTRI, NSI, IDA, ICDS.</p> <p>2.1.3 Recommended Dietary allowances (RDA), factors affecting RDA, Methods used to calculate RDA, Practical application of RDA, Reference man and woman.</p>	<p><b>15</b></p>
<p><b>Unit : III</b></p> <p><b><u>3.1 Nutrigenomics</u></b></p> <p>3.1.1 Nutrient-Gene Interaction</p> <p>3.1.2 Drug-Nutrient Interaction</p> <p>3.1.3 Obesity, Brown and White Adipose Tissue, Specific dynamic action factors affecting thermic effect of food.</p> <p>3.1.4 Role of Leptin, Ghrenin, Adiponectin in food intake.</p> <p>3.1.5 Eating Disorders: Anorexia Nervosa, Bulimia Nervosa.</p>	<p><b>15</b></p>
<p><b>Unit : IV</b></p> <p><b><u>4.1 Current topics in Nutrition</u></b></p> <p>4.1.1 Mid day programme</p> <p>4.1.2 Chemical and biochemical indices of food quality</p> <p>4.1.3 Food safety: Laws and regulations, regulatory agencies</p> <p>4.1.4 Bioactive proteins and peptides as functional food, and Nutraceuticals</p>	<p><b>15</b></p>

## **Syllabus for Semester –III practicals**

### **PSBCHP301**

1. Isolation of DNA (Crude) from germinating moong seeds & qualitative test.
2. Isolation of RNA (Crude) from Baker's Yeast & qualitative test.

### **Demonstration Experiments**

1. Determination of base composition of DNA.
2. Staining of Cellular RNA & DNA and microscopic examination.
3. Study of bacterial conjugation
4. Study of bacterial transformation.
5. Study of mutation in E.coli by UV.
6. Induced expression of alpha & beta galactosidases and catabolic repression in micro-organisms.
7. Chemical Mutagenesis in Yeasts.
8. Polymerase chain Reaction (PCR).
9. Cell free protein synthesis.
10. Restriction Digestion & separation of DNA restriction fragments
11. Gene cloning & selection of recombinant clones.
12. T<sub>m</sub> of DNA.
13. AMES Test.
14. DNA Sequencing
  - a) Maxam Gilbert Method
  - b) Sanger's Method
15. Blotting Techniques
  - a) Southern
  - b) Western
  - c) Northern

## Practical paper II- Advance Immunology

### PSBCHP302

1. Blood grouping test.
2. Haematological test- Bleeding time, clotting time, PCV, Hb by Sahli's method and Drabkin's method, ESR, Blood spectroscopy, (only oxy Hb, meth Hb, acid and alkali hematin, reduced Hb), RBC count, WBC count, Total and differential WBC count.

### PSBCHP303: Organ Function Test

1. Renal Function Tests: Urea and Creatinine Clearance Test with Clinical Interpretation
2. Urine Report- Abnormal constituents
3. Pancreatic Function Tests: Estimation of Serum Amylase Activity.  
Glucose Tolerance Test (GTT)
4. Gastric Function Tests: Gastric Juice- Total and Free Acidity

### PSBCHO304

1. Isolation and Estimation of
  - a. Oxalates from spinach/ *Aloe vera*
  - b. Lycopene from tomatoes.
2. Estimation of Vitamin C From food sample by Dichlorophenol indophenols Dye method

## Semester IV Course Code PSBCH401

Course Code	Title	Credits
PSBCH401	Advanced Genetics	4
<b>Unit I:</b> <b>1.1 Regulation of gene expression</b> 1.1.1 Organization of gene: structural & regulatory elements; split genes 1.1.2 Prokaryotic gene regulation; positive and negative control, induction and repression, attenuation. Example: lac, trp, his operons; SOS regulation 1.1.3 Eukaryotic gene regulation: Role of upstream, downstream and enhancer elements, cis-trans acting elements in gene expression, examples and		Number of Lectures  <b>8</b>





	Number of Lectures
<p><b><u>Unit I:</u></b>  <b><u>1.0 Cytokines</u></b></p> <p>1.1 General structure and functions  1.2 Cytokine receptors, cytokine antagonists  1.3 Cytokine secretion by TH1 and TH2 subsets  1.4 Cytokine related diseases  1.5 Therapeutic uses of cytokines  1.6 Immune Responses  1.6.1 Inflammation mediators of inflammation and process of inflammation  1.6.2 Hypersensitivity Gell and coombsclassification types I to IV with mechanisms</p> <p><b><u>Unit II:</u></b>  <b><u>2.0 Immune Response to infectious diseases</u></b></p> <p>2.1 Viral, Bacterial, Fungal and Protozoal diseases  2.2 Helminthes (parasitic worms) infections- effector mechanisms  2.3 Immune Response in Transplantation  2.3.1 Types of graft, immunological basis of graft rejection- 1<sup>st</sup> set, 2<sup>nd</sup> set rejection- role of T lymphocytes  2.3.2 Tissue typing and laboratory investigations- microcytotoxicity test, mixed lymphocyte reaction (HLA Typing)  2.3.3 Clinical manifestation of graft rejection,  2.3.4 General and specific immunosuppressive therapy</p>	<p>6</p> <p>3</p> <p>6</p> <p>7</p> <p>8</p>
<p><b><u>Unit : III</u></b></p> <p><b><u>3.0 Immunological Tolerance</u></b></p> <p>3.1 Pathways to B and T cell tolerance  3.2 General characteristics of B and T cell tolerance  3.3 Mechanisms of tolerance inductions self tolerance  3.4 Potential therapeutic applications of tolerance  3.5 Autoimmunity and autoimmune Diseases their etiology  3.5.1 Organ specific autoimmune diseases (Hashimoto's thyroiditis and insulin dependent diabetes mellitus)  3.5.2 Diagnostic and prognostic value of auto antibodies- Treatment of autoimmune diseases  3.5.3 Role of CD4, T cell, MHC and TCR in autoimmunity  3.5.4 Proposed mechanisms for induction of auto immunity</p>	<p>3</p> <p>12</p>
<p><b><u>Unit : IV</u></b></p> <p><b><u>4.0 Tumour Immunology</u></b></p> <p>4.1 Classification of tumours  4.2 Oncogenes and cancer induction  4.3 Tumour associated antigens Immune Response to tumour antigens, Immunosurveillance, Immunological escape mechanisms  4.4 Immunodiagnostic  4.5 Immunotherapy of tumours  4.6 Apoptosis and immune system  4.7 Immunodeficiencies  4.7.1 Classification of immunodeficiencies: primary and secondary  4.7.2 Immunology of HIV/AIDS : Discovery ,caucuses,Structure, process of infection, destruction of CD4 T cells</p>	<p>7</p> <p>8</p>



4.7.3 Immunological abnormalities	
4.7.4 Clinical Diagnosis	
4.7.5 Development of vaccine and preventive measures	

**Course Code PSBCH403**

<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>PSBCH403</b>	<b>Advanced Metabolism</b>	<b>4</b>
<b>Unit I:</b> <b>1.1 <u>Water and Electrolyte Balance, Mineral Metabolism and related disorders. Vitamin/ Mineral Interaction</u></b>		<b>15</b>
1.1.1 Importance of Water. Total Body Water (TBW) and its distribution, normal water balance. (Intake and output of water, osmolarity of extracellular fluid)		
1.1.2 Electrolytes. Distribution of electrolytes in body fluids. Water and Electrolyte balance. Regulation of Sodium and Water balance. (Aldosterone. Renin-Angiotensin system, aquaporins) Disorders of fluid and electrolyte balance. Laboratory assessment of Serum electrolytes. Expansion and contraction of ECF (isotonic, hypotonic, hypertonic).		
1.1.3 Metabolism of sodium, potassium, chloride, calcium, phosphorus, magnesium: Dietary sources, RDA, absorption and excretion, metabolic functions, clinical condition related to their plasma level alteration. Regulation of plasma calcium and phosphorus		
1.1.4 Vitamin/ Mineral interaction: Role of Vitamin D in Ca& P metabolism, relationship of vitamin C with Fe, role of vitamin E & its interaction with Se. Interaction between vitamin A, B <sub>3</sub> , B <sub>6</sub> and Zn.		
1.1.5 Metabolism of Sulfur and Trace elements (Micro minerals): Cu, Cr, Co, F, I, Fe. Mn, Mo, Se, Zn, Cd.		
<b>Unit II:</b> <b>2.1 <u>Hemoglobin Metabolism, Hemoglobinopathies, Porphyrins, Acid base balance</u></b>		<b>15</b>
2.2.1 Haemoglobin synthesis & degradation. Hb derivatives: Oxy, Reduced, Met, Carboxy, Carbamino		
2.1.2 Abnormal Hb derivatives .Hemoglobinopathies: 1) Haemolytic Anemia- Unstable Hb, 2) Hb with abnormal O <sub>2</sub> affinity-High affinity (Polycythemia) Low affinity (Cyanosis) 3) Hb with structural and synthetic Variation in globin chains : Sick cell Anemia (Structural) Alpha and Beta Thalassemia ( Synthetic),		
2.1.3 Disorders of Heme synthesis and degradation , Hyperbilirubinemias ( Jaundice), Porphyrins.		
2.1.4 Acid Base balance : Role of Blood buffers, Kidney, Lungs		

<p>2.1.5 Acidosis &amp; Alkalosis and Compensatory Mechanisms</p> <p>2.1.6 Blood Gas Analysis (pH, pO<sub>2</sub>,pCO<sub>2</sub>, Bicarbonate) and interpretation</p>	
<p><b>Unit : III</b></p> <p><b><u>3.1 Organ Function Tests. Biochemical Assessments and Changes in Endocrine Disorders</u></b></p> <p>3.1.1 Liver Function test</p> <p>3.1.2 Renal Function test including mechanism of urine formation</p> <p>3.1.3 Gastric and Pancreatic Function test</p> <p>3.1.4 Thyroid Function test</p> <p>3.1.5 Cardiac Profile</p> <p>3.1.6 Biochemical assessment and changes in Endocrine disorder( Pituitary, Thyroid, Adrenal Medulla, Adrenal Cortex, Ovaries , testes.</p>	<p><b>15</b></p>
<p><b>Unit : IV</b></p> <p><b><u>4.1 Stem Cell , Cancer, Aging</u></b></p> <p>4.1.1 Stem cell systems: Essentials of stem cell, Basic principles and methodologies. Types of stem cells and their properties. Totipotent, multipotent, pluripotent stem cells. Sources of stem cells with advantages and disadvantages. Cell cycle regulators in stem?</p> <p>4.1.2 Stem cells of epithelial skin, skeletal muscle, heart, embryonic kidney, adult liver, pancreas, GI tract. Methods: Isolation and propagation of stem cells. Characterization, microarray analysis and differentiation of stem cells</p> <p>4.1.3 Stem Cell Research: Therapeutic applications of stem cells. Problems in stem cell research. The ethics of human stem cell research. Stem cell based therapies: FDA products and preclinical regulatory consideration</p> <p>4.1.4 Cancer: Origin, characteristics of Benign and Malignant Tumours classification of Malignant Tumour types, Cancer Metastasis, Factors responsible for the Transformation of a Normal Cell to a Cancerous cell. Carcinogens (Physical, Chemical). Mechanism of action, Proto-oncogenes, oncogenes, oncogenic viruses. Genetic defects, tumor viruses, Inherited genetic defects, acquired chromosomal defects, defects in or suppression of immune response, hormonal factors, growth factors, tumour markers.</p> <p>4.1.5 Cancer Chemotherapy: Basic principles. Anti cancer drugs: Different types and their mode of action.</p> <p>4.1.6 Aging: Definition, Symptoms, Aging theories (Free Radical theory, Glycation Theory). Molecular, Biochemical Mechanisms.</p> <p>4.1.7 Mitochondria and ageing protein damage &amp; maintenance, neurodegeneration, DNA Damage &amp; Repair, Telomeres, Telomerase, Cellular senescence and Apoptosis in ageing</p> <p>4.1.8 Longevity Genes. Sirtuinis, Deacetylases, hormones, Immune system, Inflammation, Cancer &amp; Aging. Biomarkers of aging, method to show Aging. Regenerative medicine, stem cells and rejuvenation.</p>	<p><b>15</b></p>

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**Course Code PSBCH404**

Course Code	Title	Credits
<b>PSBCH404</b>	<b>Clinical and Pharmaceutical Biochemistry, Human Nutrition and Dietetics</b>	<b>4</b>
<b>Unit I:</b> <u><b>1.1` Compstion and Functions of Body Fluids in Health and Disease</b></u> 1.1..1 Plasma, lymph, urine, cerebrospinal fluid, gastric juice , pleural fluid, saliva, sweat and tears ,synovial fluid, 1.1.2 Blood Chemistry 1.1.3 Erythroid cell development 1.1.4 Blood Coagulation 1.1.5 Porphyrias ,Hyperbilirubinemia.		<b>15</b>
<b>Unit II:</b> <u><b>2.1 Diet in Health and Disease</b></u> 2.1.1 Nutrition during pregnancy, lactation, infancy, childhood, adolescence, adulthood, ageing. 2.1.2 Nutrition for health & weight management. 2.1.3 Nutrition for Exercise and Sport performance. 2.1.4 Nutrition for bone health. 2.1.5 Nutrition for therapeutic condition: Hypertension, CVD, GI disorders, (peptic ulcer. <i>H. Pylori</i> ), Diabetes mellitus, anemia, Renal disorders, CRF, ARF, Jaundice		<b>15</b>
<b>Unit : III</b> <u><b>3.0 Pharmacokinetics, Clinical Research , trials and Ethical issues</b></u> <u><b>3.1 Pharmacokinetics</b></u> 3.1.1 Pharmacokinetics (PK) and drug metabolism, objectives of PK Analysis in drug discovery, fundamental concepts in drug absorption, distribution, metabolism & elimination (ADME) Kinetics of drug following different modes of drug administration. 3.1.2 Introduction to important PK parameters, PK of oral administration & bioavailability  <u><b>3.2 Clinical Research and Trials</b></u> 3.2.1 Clinical research- its importance, significance & rationale, Models used		<b>10</b>          <b>2</b>



inquisitive minds of the students, but also inspire them to take up research- oriented higher studies and career.

## 2. **Duration of Project work :-**

Development on the nature of the research problem and the infrastructure available in the respective Biochemistry Departments or Research Institutes or Industries, the duration of Project Work is recommended as follows:-

- a. 06 Months:- From May 01 to Oct 31 of the given calendar year (the project work will commence immediately after the conclusion of Semester II of MSc Part – I on April 30 of given academic year)
  - b. 03Months:- From May 01 to July 31 or from mid- June to mid- September (either in summer vacation upto July 31 of Semester III or immediately after the commencement of Semester III in mid- June upto mid- September)
  - c. Entire Sem-III i.e. mid- June to Oct 31 depending on the first and the last working days of Sem III.
3. Each student shall complete a small research project during his/ her academic year of MSc Part- III However, the initial reference work can be started in MSc part- I and summer vacation to MSc Part-II

## 4. **Nature of Research Project:-**

The following will be considered as the Research Project.

- a. Experimental based involving laboratory analytical work, or
- b. Survey based Field work with statistical analysis of data collected, or
- c. Industrial training based provided that the candidate has undergone actual hands on training in instrumental analytical techniques.

## 5. **Schedule for Submission of project Work:-**

- a. Experiment work or Field work or Industrial training must be completed by October 31.
- b. The duration of Diwali Vacation and the part of Sem IV upto December 31 shall be utilized for finalizing the written contents of the project work.
- c. The final copy of the project work (2 Copies) will have to be submitted to the respective HOD by January 15 of Sem IV.

6. The project containing about 50-100 pages. Should be divided into the following parts:-

- a. Certification of completion of Project Work from the HOD.
  - b. Acknowledgement.
  - c. Introduction
  - d. Review of Related Literature
  - e. Aims and Objectives
  - f. Signification of research problems selected
  - g. Plan of work
  - h. Material and Methods
  - i. Results
  - j. Discussion
  - k. Bibliography
7. The project should not be submitted at the time of University Practical Examination, as the same will be assessed internally.

### **GUIDELINE FOR THE INTERNAL ASSESMENT OF PROJECT WORK**

1. The practical 401 of Sem IV (Course Code No. PSBCHP 401) shall be exclusively devoted for the project
2. Each student will complete the project (2 copies) and get both the copies certified by the guiding teacher and the Head of Dept.(HOD) by January 15 of Sem IV.
3. One copy of the certified project will be submitted to the HOD; while the other copy will be retained by the students for his/ her personal record.
4. After the certification of the project, the HOD will invite a PG – Recognized Teacher of Biochemistry Dept of any other College/ Institute/ Research centre for the assessment of Research Project.
5. The candidate is required to present the Research Project to the invited examiner followed by Viva- Voce examination based on the project work by the examiner.
6. The following Marking Scheme shall be considered while assessing the project work

<u>Particular</u>		Marks
a)	Project Work (Contents Submitted in the bound form)	30
b)	Presentation of Project Work to Examiner	10
c)	Viva- voce Exam based in Project Work	10
<b>TOTAL</b>		50

### Syllabus for Semester –IV practicals

#### **Practical PSBCHP402- Advanced Immunology**

1. Serological tests- Rheumatoid arthritis factor, c- reactive protein, vidal, VDRL, Pregnancy test
2. Demonstration experiments RIA, ELISA and Immunodiffusion.

#### **PSBCHP403: Organ Function Test**

1. Liver Function Tests: Estimation of serum ALT, AST, Total & Direct Billirubin, Alkaline Phosphatase. Estimation of serum Total Proteins, Albumin & determination of A/G ratio.
2. Lipid Profile: Estimation of serum Total cholesterol, Estimation of HDL, Estimation of Triglycerides, Estimation of LDL by calculation.
3. Estimation of serum Acid Phosphatase. Estimation of serum Electrolytes. (Na & K).
4. Demonstration Experiments:  
Estimation of Serum Glycosylated Haemoglobin  
Separation of LDH Isoenzymes  
Arterial Blood Gas Analysis

#### **PSBCHO 404**

3. Tests of body fluids: CSF for Protein, Glucose, Chloride
4. Preparation of Aspirin from salicylic acid
5. Estimation of Aspirin

**Suggested Readings for paper 301 and 401 and Practical 301 and 401 :**

1. Lewin Benjamin, Genes (Latest edition) Oxford Univ. Press
2. Jha A.P. Genes and Evolution 1993, Macmillan, Delhi.
3. Williamson Robert, Genetic Engineering I, Academic Press
4. Williamson Robert, Genetic Engineering 2, Academic Pres
5. Fisher R.A. Genetic Theory of Natural Selection, RESTE, New Delhi.
6. MitraSnadhya, Genetic Engineering: Principles and Practice, Macmillan India Pvt. Ltd.
7. Sang J. H, Genetics, 1984, Longman, London, 1984.
8. Hayes, William, Genetics of Bacteria and Viruses, CBS Publisher, New Delhi.
9. Bain Bridge Brian W, Genetics of Microbes, 1980, Blackie and Son, London
10. Winchester A.M. Genetics: A Survey of Principles of Heredity, Oxford IBH Public Co.

**Suggested Readings for paper 302 and 402 and Practical 302 and 402 :**

1. Weir D.M., immunology, 5<sup>th</sup> ed., ELBS and Churchill Livingston.
2. Chakravarthy A.K. Immunology, Tata McGraw Hill, New Delhi.
3. Callaghan Richard B. Immunology, Academic Press



4. Weir D.M., Immunology: Student's Notes, ELBS- Oxford.
5. Bowry T.R., Immunology Simplified, 2<sup>nd</sup> Ed., ELBS and Oxford.
6. Ivan, Immunology Method Manual, Vol. 4 1997, Academic Press, Sani Diego.
7. Roitt Ivan and others, Immunology, 6<sup>th</sup> Ed., Mosby, Edinburg.
8. Kuby, Janis, Immunology. 3<sup>rd</sup> Ed., 1997, W.H. Freeman Co.
9. Hood Leroy E., Immunology, 2<sup>nd</sup> Ed., 1976, Benjamin Cummings Publication
10. Topley Wilson, Topley and Wilson's Principle of Bacteriology, Virology and immunity Edward Arnold Ltd., London

**Suggested Readings for paper 303 and 403 and Practical 303 and 403 :**

1. Greenberg David M – Metabolic Pathways. Vols 2 and 3, 3<sup>rd</sup> editions. Academic Press, New York
2. Henry Richard et al – Clinical Chemistry, Principles and Techniques, 2<sup>nd</sup> edition, Harper and Row, New York
3. Kamal SH – Clinical Biochemistry for Medical Technologies, Churchill Livingston, London
4. Todd et al – Clinical Diagnosis and Management, 17<sup>th</sup> edition, WB Saunders, Philadelphia
5. Stokes Joan et al – Clinical Microbiology, Edward Arnold, London
6. Gill CV – Short cases in clinical biochemistry, Churchill Livingston, Edinburgh, 1984
7. RaoRanganathan – Text book of biochemistry 3<sup>rd</sup> edition, Prentice Hall, New Delhi
8. Rodrigues Fred K Carbohydrate chemistry with clinical correlations, New Age International, New Delhi
9. BayensDominiezak – Medical biochemistry, Mosby Publishers, Harcourt, 1999

**Suggested Readings for paper 304 and 404 and Practical 304 and 404 :**

1. Anderson I et al. Nutrition in Health and Disease, 17<sup>th</sup> ed., 1982, J.B. Lippincott Co.,
2. Anita F.P., Clinical Dietetics and Nutrition's, 4<sup>th</sup> ed., 1997 Oxford University Press, New Delhi.
3. Bennion H., Clinical Nutrition, 1979, Harper Row, New York.
4. Carolyn E., et al, Nutrition and Diet Therapy, 7<sup>th</sup> Ed.,2000, Delmer Publishers
5. Gopalan C et al, Dietary Allowances for Indians, NIH, Hyderbad.

6. Gopalan C et al, Nutritive Value of Indian Foods, 1988, NIH, Hyderabad.
7. Halpern S.L., Quick reference to Clinical nutrition, 2<sup>nd</sup> Ed., 1987, J.B.Lippincott Co.
8. Kinney J.M. et.al, Nutrition and Metabolism in Patient Care, 19<sup>th</sup> ed., 1999, W.B. Saunders and Co.
9. Pike R.L. and Brown M.L., Nutrition: An Integrated Approach, 1987, John Wiley and Sons.
10. Robinson C.et al, Normal and Therapeutic Nutrition, 16<sup>th</sup> Ed., 1982, Macmillan Publishing Co.
11. Shils M.E.et al, Modern Nutrition in Health and Disease, 1998, Lea and Febiger, Philadelphia.
12. Swaminathan M., Essentials of food and Nutrition, 2<sup>nd</sup> Ed., 1985, Ganesh and Co.
13. Williams S., Nutrition and Diet Therapy, 4<sup>th</sup> Ed., The C.V. Mosby Co., Missouri.
14. Essentials of Pharmacotherapeutics, 3<sup>rd</sup> Ed., By F.S.K.Barar, S chand& Company Ltd. 2005.
15. Pharmaceutical chemistry, G Melentyeva L LAntonova Mir Publishers, Moscow
16. Chemical Pharmacology, R B Barlow, 2<sup>nd</sup> Ed, Methven and CO. New Feters Lane
17. Medicinal Chemistry, Vol I, 3<sup>rd</sup> Ed, Alfred Burga, Wiley Inter sciences
18. Textbook of paramedical chemistry, JayshreeGhosh, S chand and company, New Delhi
19. Pharmacology, B Suresh, 1<sup>st</sup> Ed. Shanti, Publication.

### **Scheme of Theory examination Mc. (Sem I TO SemIV)**

- 1) Each theory paper shall carry 60 marks
- 2) Each theory paper shall be 2 1/2 hours duration
- 3) Each theory paper shall contain 05 questions of 12 marks each as follows:-
  - Q I : Based on Unit I
  - Q II : Based on Unit II
  - Q III : Based on Unit III
  - Q IV : Based on Unit IV
  - Q V : Based on Unit I to Unit IV
- 4) Marking system for **Questions I to IV**

Sub Q A : Attempt any one out of two ----- 02 marks each

Sub Q B : Attempt any one out of two ----- 04 marks each

Sub Q C : Attempt any one out of two ----- 06 marks each

Sub Qs B & C may be further sub-divided into 2 marks x 2 and 3 marks x 2 if necessary.

5) Marking system for **Questions V**

Q no V shall contain 08 sub-questions i.e

Two sub questions based on each of the units I to IV.

Each sub question shall carry 03 marks.

Sub Q (a) and Sub Q (b) : Based on Unit I

Sub Q (c) and Sub Q (d) : Based on Unit II

Sub Q (e) and Sub Q (f) : Based on Unit III

Sub Q (g) and Sub Q (h) : Based on Unit IV

Student shall attempt one sub question (a) **OR** (b) and(c) **OR** (d)and (e) **OR** (f)and (g) **OR** (h). Thus a student shall attempt a total of 04 sub questions carrying 03 marks each from Q No V.

**Scheme of Practical Examination at MSc Part I and MSC Part II (Semi I to IV)[Except for Practical Exam for PS BCH P 401]**

- 1) Each practical (PS BCH P 101 to PS BCH P 404) shall carry 50 Marks.
- 2) Distribution of 50 Marks shall be as follow:- (Except PS BCH P 401]

**ExperimentsMarks**

- |   |    |
|---|----|
| a) Any Two Experiments<br>(20 Marks each) | 40 |
| b) Certified Journal                      | 05 |
| c) Viva- voce Exam                        | 05 |

**TOTAL50**

3) **Duration of University Practical Examination**

A) For PS BCH P 101, 102, 103, 104, 201, 202, 203, 204, 301, 303, 304.

- a) Two days with 2 Sessions on each day i.e. Total 4 Sessions.
- b) Each Sessions shall be of 3 ½ Hours.
- c) Morning Session: 09.00 am to 12:30 pm  
Afternoon Session: 01:00 pm to 04:30 pm
- d) **DAYSESSIONPRACTICALS**

1 <sup>st</sup>	Morning	PS BCH P 101 or 201 or 301
1 <sup>st</sup>	Afternoon	PS BCH P 102 or 202 or 302
2 <sup>nd</sup>	Morning	PS BCH P 103 or 203 or 303
2 <sup>nd</sup>	Afternoon	PS BCH P 104 or 204 or 304

- B) **For PS BCH P 401:**  
Project Work carrying 50 Marks to be evaluated internally in Feb/ Mar of Sem IV as per the guidelines included in the syllabus.

C) **For PS BCH P 402, 403 & 404:**

- a) Only 03 Sessions spread over 1 ½ days as given below:-

b) DAY	SESSION	PRACTICALS
1 <sup>st</sup>	Morning	PS BCH P 402
1 <sup>st</sup>	Afternoon	PS BCH P 403
2 <sup>nd</sup>	Morning	PS BCH P 404

- 4) Students are required to submit the “Certified Journals” at the time of University Practical Examination.

## **Revised**

### **M.Sc. Semester I Practical**

**PSBHP101:-**

**Colorimetry, Volumetry, Enzymology, Buffers and Microscopy**

1. Estimation of proteins by Bradford and Folinlowry method.
2. Amino Acids by Ninhydrin method.
3. Estimation of percentage of purity of starch from starch hydrolysate by Willstatter’s method.
4. Amylase (km, optimum PH, optimum temperature from sweet potatoes.
5. Pka Values of Alanine or Glycine by Titration curve.
6. Demonstration Expts.
  - a) Gram staining

- b) Spores staining
- c) Capsule Staining
- d) Acid Fast Staining

### **PSBCHP102**

#### **Biochemical/ Clinical Analysis**

1. Estimation of plasma glucose by GOD-POD method.
2. Estimation of serum calcium by clark and collip method/ Trinder's method.
3. Estimation of serum iron by Dipyrldyl method
4. Estimation of serum phosphorus by fiskeubarow method.

### **PSBCHP103**

#### **Isolation, Preparation, Extraction calculation of percentage yield and confirm to test.**

1. Extraction of casein from milk.
2. Extraction of albumins and globulins from egg white.
3. Extraction of proteins from germinating seeds.
4. Estimation of sodium benzoate from jam/jelly.

### **PSBCHP104**

#### **Research Methodology and Biostatistics.**

1. Preparation of research proposal for minor/ major research projects to be submitted to the funding agencies.
2. Review of Research work being carried out of any 5 national or International Research center or Institute.
3. One numerical problem each on
  - a) Measurement of central tendency (Mean, Median, Mode)

1) P 101, P102, P103, & P104 to be introduced from the sem of 2013-14.

## **Practical Semester II**

### **PSBBCHP201**

#### **Chromatography and Electrophoresis Techniques**

1. Ascending and circular paper chromatography for amino acid and sugars.
2. Thin layer chromatography of oils
3. Serum proteins electrophoresis (Agar/ Agarose)
4. Separation of Glucose and starch or separation of starch and casein by Gel filtration.

### **PSBBCHP202**

#### **Clinical Estimations**

1. Estimation of serum creatinine by Jaffe's method.
2. Estimation of Blood urea Nitrogen by diacetylmonoxime method.
3. Estimation of serum uric acid by caraway method.

### **PSHBCHP203**

1. Extraction, isolation, calculation of percentage yield and a confirmatory test for the following.
  - a) Starch from potato
  - b) Pectin from apples/ bananas
  - c) Lecithin and cholesterol from egg yolk
2. Separation of the following pigments on TLC slide
  - a) Curcumin from turmeric
  - b) Carotene from carrots
  - c) Chlorophyll from spinach
3. Estimation of
  - a) Total Alkalinity of water effluent.
  - b) COD of waste water
  - c) Total Hardness of well water

### **PSBBCHP204**

#### **Biostatistics and Bio- informatics**

Statistical problems based on

- a) Chi- square, paired and unpaired t Test and Z- Test, Simple regression analysis

**2) P201, P202, P203 & P204 to be introduced from the sem II of 2012-13.**