

UNIVERSITY OF MUMBAI



**Syllabus for the M.Sc. Semester III and
Semester IV
Program: M.Sc.
Course: Bio-Chemistry**

(Credit Based Semester and Grading System with
effect from the academic year **2018–2019**)

Semester-wise Details of Unit I to IV in each theory paper

SEMESTER III

| Course Code | UNIT | TOPIC HEADINGS | Credits | L / Week |
|---------------------|---|---|----------|----------|
| PS BCH 301 | I | Overview of Classical Genetics, Nature of genetic material | 4 | 1 |
| | II | Structure and characteristic of DNA & RNA, Organization of DNA in genome, Functions of gene | | 1 |
| | III | Cell cycle and its regulation , Replication of DNA | | 1 |
| | IV | Transcription of DNA, Translation (Protein Biosynthesis) | | 1 |
| PS BCH 302 | I | Introduction to Immune system, Cell and organs of Immune system | 4 | 1 |
| | II | Antigens and antibodies, Monoclonal antibodies, organization and expression of immunoglobulin gene and its regulation | | 1 |
| | III | Antigen antibodies interaction, experimental animal models, cell culture system. | | 1 |
| | IV | Molecules involved in Immunology, MHC and complement system. | | 1 |
| PS BCH 303 | I | Carbohydrate metabolism and related disorders | 4 | 1 |
| | II | Lipid metabolism and related disorders | | 1 |
| | III | Protein metabolism and related disorders | | 1 |
| | IV | Nucleoprotein metabolism and related disorders | | 1 |
| PS BCH 304 | I | Composition and functions of body fluids in health and disease | 4 | 1 |
| | II | Pharmacokinetics ,Clinical research and trials and ethical issues | | 1 |
| | III | Macronutrients of Nutritional Significance | | 1 |
| | IV | Nutri-genomics, Current topics in nutrition, Sports nutrition. | | 1 |
| PS BCH P-301 | Isolation of DNA and RNA | | 2 | 4 |
| PS BCH P-302 | Immunology/Serology/ Haematology | | 2 | 4 |
| PS BCH P-303 | Estimation of metabolites | | 2 | 4 |
| PS BCH P-304 | Clinical &Pharma biochemistry and Nutrition | | 2 | 4 |

SEMESTER IV

| Course Code | UNIT | TOPIC HEADINGS | Credits | L / Week |
|---------------------|--|---|----------|----------|
| PS BCH 401 | I | Regulation of gene expression, Medical genetics | 4 | 1 |
| | II | Chromosomal abnormalities, Mutations, DNA repair mechanism | | 1 |
| | III | Enzymes acting on nucleic acids and techniques in Nucleic acid analysis | | 1 |
| | IV | Recombinant DNA technology and human genome project | | 1 |
| PS BCH 402 | I | Cytokines | 4 | 1 |
| | II | Immune response to infectious diseases. | | 1 |
| | III | Immunological tolerance, Autoimmunity, Autoimmune diseases | | 1 |
| | IV | Tumour Immunology, Immunotherapy of tumours and Immunodeficiency | | 1 |
| PS BCH 403 | I | Water and electrolyte balance, Mineral metabolism, vitamin – mineral interaction. | 4 | 1 |
| | II | Haemoglobin metabolism, Hemoglobinopathies, porphyrias, Acid base balance | | 1 |
| | III | Cancer | | 1 |
| | IV | Stem cell, Ageing, | | 1 |
| PS BCH 404 | I | Organ Function Tests: Biochemical Assessments and changes in Endocrine Disorders | 4 | 1 |
| | II | Mechanism of drug action ,structure-function relationship, New drug investigation and application | | 1 |
| | III | Diet in health and disease | | 1 |
| | IV | Techniques in Nutrition | | 1 |
| PS BCH P-401 | Research project | | 2 | 4 |
| PS BCH P-402 | Immunology/Serology/ Haematology | | 2 | 4 |
| PS BCH P-403 | Estimation of Metabolites | | 2 | 4 |
| PS BCH P-404 | Clinical & pharma biochemistry and Nutrition | | 2 | 4 |

Semester III Syllabus details

| Course Code | Title | Credits |
|---|--------------------------|---|
| PS BCH 301 | Advanced genetics | 4 |
| <p>Unit I:</p> <p><u>1.1 Overview of classical genetics</u></p> <p>1.1.1 Mendelian genetics: Mendelian laws and basis of inheritance, dominance, recessivity, genotype, phenotype</p> <p>1.1.2 Problems based on Mendelian genetics</p> <p>1.1.3 Chromosomal theory of heredity, sex-linked inheritance, multiple alleles, lethal genes, genetic heterozygosity</p> <p>1.1.4 Gene linkage & crossing over, tetrad analysis</p> <p><u>1.2 Nature of genetic material</u></p> <p>1.2.1 Discovery of gene, action spectrum, genetic transformation, fine structure analysis of rII locus of T4 phage, overlapping genes</p> <p>1.2.2 Meischer, Griffith, Hershey-Chase & Avery; RNA as genetic material</p> | | <p>Number of Lectures</p> <p>10</p> <p>5</p> |
| <p><u>Unit II:</u></p> <p><u>2.1 Structure and characteristic of DNA & RNA</u></p> <p>2.1.1 Types of DNA</p> <p>2.1.2 T_m of DNA, its relation to GC content, unique and repetitive sequences of DNA, Cot curves and its significance, C-value paradox</p> <p>2.1.3 Genome of prokaryotes, viruses, mitochondria, chloroplasts and eukaryotic organisms; movable genes, transposons & retroposons, invert repeats</p> <p>2.1.4 Types of RNA, structure & functions, genetic code & their characteristics</p> <p><u>2.2 Organization of DNA in genome</u></p> <p>2.2.1 Histones, nucleosomes, structure of chromatin</p> <p>2.2.2 Eukaryotic chromosomes, lamp brush & polytene chromosomes</p> <p><u>2.3 Functions of gene</u></p> <p>2.3.1 Genetic recombination: Holliday & Messelson-Radding models; enzymes and</p> | | <p>6</p> <p>5</p> <p>4</p> |

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| <p>proteins involved in genetic recombination</p> <p>2.3.2 Gene mapping by conjugation, transformation & transduction</p> | |
| <p>Unit: III</p> <p><u>3.1 Cell cycle and its regulation</u></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><u>3.2 Replication of DNA</u></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 & 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. Inhibitors of Replication</p> | <p>7</p> <p>8</p> |
| <p>Unit: IV</p> <p><u>4.1 Transcription of DNA</u></p> <p>4.1.1 DNA dependant RNA polymerases in prokaryotes and eukaryotes, <i>in vitro</i> assay, properties of the enzymes, subunit structure. Reverse Transcription.</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 & tRNA, RNA splicing mechanism, poly A tail and 5' capping, non coding sequences. Inhibitors of Transcription</p> <p><u>4.2 Translation</u></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> |

Semester III Syllabus details

| Course Code | Title | Credits |
|--|----------------------------|---|
| PS BCH 302 | Advanced Immunology | 4 |
| <p>Unit I:</p> <p>1.0 Introduction of Immune System-Adaptive and innate immunity</p> <p>1.1 Cells and organs of Immune systems</p> <p>1.1.1 Lymphoid cells, mononuclear, phagocytes, antigen presenting cell, polymorphs, mass cells and platelets.</p> <p>1.1.2 Primary and secondary Lymphoid Organs, Lymphocyte Traffic.</p> <p>1.1.3 B cell maturation, activation and differentiation.</p> <p>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.</p> <p>1.1.5 Development of Immune System in short- Myeloid Cells, Memory B cells</p> | | <p>Number of Lectures</p> <p style="text-align: center;">1</p> <p style="text-align: center;">12</p> <p style="text-align: center;">2</p> |
| <p>Unit II:</p> <p>2.0 Antigens, Antigenic determinants, antigenicity and immunogenicity</p> <p><u>2.1 Immunoglobulins –Basic structure, classes, subclasses, function</u></p> <p><u>2.2 Antibody receptors</u></p> <p><u>2.3 Organization and expression of immunoglobulin genes</u></p> <p>2.3.1 Theories of antibody formation, Immunoglobulin variability</p> <p>2.3.2 Genetic basis of antibody diversity</p> <p>2.3.3 Regulation of Immunoglobulin production</p> <p><u>2.4 Monoclonal antibodies</u></p> <p>2.4.1 Production and clinical uses</p> <p>2.4.2 Engineered monoclonal antibodies, Chimeric and hybrid monoclonal antibodies</p> <p>2.4.3 Monoclonal antibodies constructed from immunoglobulin gene library.</p> <p><u>2.5 Regulation of Immune response</u></p> <p>2.5.1 Antigenic competition. Suppression of response to Antigen by presence of Antibody.</p> | | <p style="text-align: center;">2</p> <p style="text-align: center;">8</p> <p style="text-align: center;">4</p> <p style="text-align: center;">1</p> |

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| <p>Unit: III</p> <p>3.0 Antigen-Antibody Interaction (Ag-Ab Interaction)</p> <p>3.1 <u>Primary and Secondary Ag-Ab Interaction</u></p> <p>3.1.1 Principles and practical aspects and Application of Primary Ag-Ab Interaction- Equilibrium Dialysis, RIA, ELISA, Immunofluorescence, Biotin-Avidin Ab Technique, Western Blotting, Flow Cytometry</p> <p>3.1.2 Principle & practical Aspects and Application of Secondary Antigen Antibody Interaction-Precipitation, Agglutination, Complement Fixation Reactions</p> <p>3.2 <u>Experimental Animal Models,</u> In Breed Strength, Adoptive Transfer Systems, SCID Mice and SCID Human Mice.</p> <p>3.3 <u>Cell Culture System</u> Primary Lymphoid Cell Culture, Clone Lymphoid Cell Line, Hybrid Lymphoid Cell Line</p> | <p>2</p> <p>10</p> <p>2</p> <p>1</p> |
| <p>Unit: IV</p> <p>4.0 Molecules involved in Immunology</p> <p>4.1 <u>Major Histocompatibility Complex (MHC)</u></p> <p>4.1.1 General organization and inheritance of MHC.</p> <p>4.1.2 Structure of Class I and Class II HLA Molecules and organization of Class I and Class II HLA Genes. Cellular distribution of MHC Molecules.</p> <p>4.1.3 Regulation of MHC Expression- Determinant Selection Model, Holes in the Repertoire Model.</p> <p>4.1.4 MHC and susceptibility to disease</p> <p>4.2 <u>Antigen processing and presentation</u></p> <p>4.3 <u>Self MHC Restriction of T Cell</u></p> <p>4.4 <u>Role of Antigen presenting cells.</u></p> <p>4.5 <u>Pathways for Antigen Processing, Cytosolic and Endocytic pathway, clinical application</u></p> <p>4.6 <u>Complement System</u></p> <p>4.6.1 Definition, components and function. Complement activation, Classical and alternative pathways of membrane attack complex.</p> <p>4.6.2 Complement receptor and biological consequences of Complement activation, cell lysis, inflammatory response, opsonisation of antigen, viral neutralization, Solubilisation of immune complexes</p> <p>4.6.3 Complement deficiency</p> | <p>6</p> <p>4</p> <p>5</p> |

Semester III Syllabus details

| Course Code | Title | Credits |
|--|----------------------------|-----------|
| PS BCH 303 | Advanced Metabolism | 4 |
| <p>Unit I: <u>1.1 Carbohydrate Metabolism & related disorders:</u> 1.1.1. Glycogen Metabolism: Synthesis, breakdown, regulation, Glycogen storage disorder. 1.1.2. Gluconeogenesis: Cori cycle, Glucose-Alanine cycle, Regulation of Gluconeogenesis, Rapaport Luebering cycle & its significance. 1.1.3 Uronic acid pathway (biosynthesis, degradation & its significance), Galactose and fructose metabolism; lactose intolerance, essential fructosuria, fructose intolerance, Sorbitol pathway, 1.1.4 Regulation of Blood glucose level by liver, renal regulation & hormonal regulation. Diabetes mellitus and its diagnosis – GTC, HbA₁C, Sugar interconversion and nucleotide sugar formation. Biosynthesis of oligosaccharides and glycoproteins 1.1.5 Mucopolysaccharides ;Structure, function and disorders.</p> | | 15 |
| <p>Unit II <u>2.1 Lipid and related disorders & Free radical Metabolism</u> 2.1.1 Peroxisomal minor pathways of fatty acids oxidation) Disorder related to fatty acid oxidation, (Genetic deficiencies in carnitine transport and Acyl CoA dehydrogenase, Refsum’s disease, Zellweger syndrome) 2.1.2 Cholesterol: Biosynthesis, control, transport, utilization and atherosclerosis, cholesterol lowering drugs (statins etc.) 2.1.3 Arachidonate metabolism: Prostaglandins, Prostacyclins, thromboxanes and leukotrienes, the cyclic pathway of prostaglandins, Prostacyclins, thromboxanes’ the linear pathway of leucotrienes. 2.1.4 Phospholipid, glycolipid and lipoprotein: metabolism of glycerophospholipids, sphingolipids, sphingophospholipids, sphingoglycolipids. 2.1.5 Lipoprotein Metabolism: Metabolism of chylomicrons, VLDL, LDL, HDL, disorders of lipoprotein metabolism (Hypo and hyper lipoproteinemias) transport lipoproteins and membrane lipoproteins 2.1.6 Adipose tissue Metabolism, starvation metabolism, fatty liver, ketone bodies-formation, utilization, ketosis, metabolism of alcohol (ethanol), disorders of lipid metabolism(Sphingolipidosis) – Neimann-Pick and Tay-Sach’s disease, Gaucher’s disease, Fabry’s disease.</p> | | 15 |

Unit: III

3.1 Protein metabolism and related disorders

- 3.1.1 Biosynthesis & catabolism of – Glycine, Alanine, Aspartic acid, Glutamic acid, Serine, Proline, Hydroxyproline, Catabolism of threonine and basic amino acids
Metabolism of aromatic amino acids, Sulphur containing amino acids, branched chain amino acid, and related inborn errors of metabolism
- 3.1.2 Formation of specialized products from amino acids and their functions- glutathione, creatine, creatinine, biogenic amines (dopamine, norepinephrine, tyramine, serotonin, melatonin, GABA, Histamine) polyamines (Putrescine, Spermodine, Spermine) Amino Acids as neuro-transmitters
- 3.1.3 Nitrogen Balance, Biological Value of Protein, Protein Energy Malnutrition – PEM, Marasmus, Kwashiorkor.

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Unit: IV

4.1 Nucleoprotein Metabolism and related Disorders

- 4.1.1 Nucleotide Metabolism: Precursors required for denovo synthesis of purines. Degradation of purines & its regulation. Biosynthesis and degradation of pyrimidine and their regulation. Inter-conversion of Nucleotides.
- 4.1.2 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)
- 4.1.3 Nucleotide coenzyme synthesis. Structural analogs of Purine and Pyrimidine bases and their use as chemotherapeutic agents, Antifolate and Antiviral Agents.
- 4.1.4 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

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Semester IV Syllabus details

| Course Code | Title | Credits |
|---|--------------------------|---|
| PS BCH 401 | Advanced Genetics | 4 |
| <p>Unit I: <u>1.1 Regulation of gene expression</u></p> <p>1.1.1 Organization of gene: structural & regulatory elements; split genes</p> <p>1.1.2 Prokaryotic gene regulation; positive and negative control, induction and repression, attenuation. Example: lac, trp, his operons; SOS regulation</p> <p>1.1.3 Eukaryotic gene regulation: Role of upstream, downstream and enhancer elements, cis-trans acting elements in gene expression, examples and experimental evidences</p> <p>1.1.4 Epigenetic inheritance – Mechanisms</p> <p><u>1.2 Medical genetics</u></p> <p>1.2.1 Genetic screening, Genetic diagnosis, Genetic counselling</p> <p>1.2.2 Genetic Medicine –Gene therapy, Personalised/tailor made medicine ,Predictive medicine</p> | | <p>Number of Lectures</p> <p style="text-align: center;">8</p> <p style="text-align: center;">7</p> |
| <p><u>Unit II:</u> <u>2.1 Chromosomal abnormalities</u></p> <p>2.1.1 Chromosomal aberration</p> <p>2.1.2 Structural and numerical abnormalities</p> <p>2.1.3 Euploidy and aneuploidy(Autosomal and Sex chromosomes)</p> <p>2.1.4 Monosomies (Turner syndrome) Disomies and trisomies (Down Syndrome) and their causes</p> <p><u>2.2 Mutations</u></p> <p>2.2.1 Types of mutations</p> <p>2.2.2 Physical, chemical and Biological agents causing mutations</p> <p>2.2.3 Mutational hot spot, reverse mutations, Mutagenesis, Ames test.</p> <p>2.2.4 Site directed mutagenesis</p> <p><u>2.3 DNA repair Mechanism</u></p> <p>2.3.1 Photoreactivation, nucleotide excision, SOS repair, recombination repair, mismatch repair</p> | | <p style="text-align: center;">7</p> <p style="text-align: center;">5</p> <p style="text-align: center;">3</p> |
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| 4.2 <u>Human Genome project</u> | |
| 4.2.1 Project period and accomplishment | 3 |
| 4.2.2 Application and proposed benefits | |
| 4.2.3 Ethical Social and legal issues | |

Semester IV Syllabus details

| Course Code | Title | Credits |
|--|----------------------------|--|
| PS BCH 402 | Advanced Immunology | 4 |
| <p><u>Unit I:</u> <u>1.0 Cytokines</u></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</p> <p><u>1.6 Immune Responses</u> 1.6.1 Inflammation mediators of inflammation and process of inflammation 1.6.2 Hypersensitivity Gell and coombs classification types I to IV with mechanisms 1.6.3 Clinical methods to detect allergens in Type I hypersensitivity reactions. Skin testing method. Determination of total IgE, RIST, RAST.</p> | | <p>Number of Lectures 6</p> <p style="text-align: center;">9</p> |
| <p><u>Unit II:</u></p> <p><u>2.0 Immune Response to infectious diseases</u> 2.1 Viral, Bacterial, Fungal and Protozoal diseases 2.2 Helminthes (parasitic worms) infections- effector mechanisms</p> <p><u>2.3 Immune Response in Transplantation</u> 2.3.1 Types of graft, immunological basis of graft rejection- 1st set, 2nd 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 style="text-align: center;">7</p> <p style="text-align: center;">8</p> |
| <p><u>Unit: III</u></p> <p><u>3.0 Immunological Tolerance</u> 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 style="text-align: center;">3</p> <p style="text-align: center;">12</p> |

Unit : IV

4.0 Tumour Immunology

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, causes, Structure, process of infection, destruction of CD₄ T cells.

4.7.3 Immunological abnormalities

4.7.4 Clinical Diagnosis

4.7.5 Development of vaccine and preventive measures

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Semester IV Syllabus details

| Course Code | Title | Credits |
|---|----------------------------|--|
| PS BCH 403 | Advanced Metabolism | 4 |
| Unit I: <u>1.1 Water and Electrolyte Balance, Mineral Metabolism and related disorders. Vitamin/ Mineral Interaction</u> 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 ₃ , B ₆ and Zn. 1.1.5 Metabolism of Sulfur and Trace elements (Micro minerals): Cu, Cr, Co, F, I, Fe. Mn, Mo, Se, Zn, Cd. | | 15 |
| Unit II: <u>2.1 Hemoglobin Metabolism, Hemoglobinopathies, Porphyrins, Acid base balance</u> 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 ₂ affinity-High affinity (Polycythemia)Low affinity (Cyanosis) 3) Hb with structural and synthetic Variation in globin chains : Sickle cell Anemia , Alpha and Beta Thalassemia 2.1.3 Disorders of Heme synthesis and degradation , Hyperbilirubinemias (Jaundice), Porphyrins. <u>2.2Acid Base Balance</u> 2.2.1 Acid Base balance: Role of Blood buffers, Kidney, Lungs 2.2.2 Acidosis & Alkalosis and Compensatory Mechanisms 2.2.3 Blood Gas Analysis (pH, pO ₂ , pCO ₂ , Bicarbonate) and interpretation | | 8 7 |

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| <p>Unit : III</p> <p>3.1 Cancer</p> <p>3.1.1 Cancer: Origin, characteristics of Benign and Malignant Tumours classification of Malignant Tumour types, Cancer Metastasis, Carcinogens (Physical, Chemical & Biological). Mechanism of action, Proto-oncogenes, oncogenes, oncogenic viruses. Genetic defects, tumour viruses, inherited genetic defects, acquired chromosomal defects, defects in or suppression of immune response, hormonal factors, growth factors, tumour markers.</p> <p>3.1.2 Molecular basis of cancer cell behaviour: Mutation in cancer critical gene regulating cell cycle proliferation. Tumour progression with specific gene mutation. For eg. Mutation in gene regulating apoptosis p53. Blocking of tumour suppressor gene by tumour virus. Role of epigenetics in cancer</p> <p>3.1.3 Cancer treatment: Present and Future trends. Traditional theory – loss of cell cycle check point responses. New theories – Inhibition of oncogenic proteins. e.g. Gleevec in CML treatment. Gene expression profiling – tailor treatment to individual patient. Enhancement of immune response against tumour.</p> | <p>15</p> |
| <p>Unit: IV</p> <p>4.1 Stem Cell</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>4.2 Aging</p> <p>4.2.1 Aging: Definition, Symptoms, Aging theories (Free Radical theory, Glycation Theory). Molecular, Biochemical Mechanisms.</p> <p>4.2.2 Mitochondria and ageing protein damage & maintenance, neurodegeneration, DNA Damage & Repair, Telomeres, Telomerase, Cellular senescence and Apoptosis in ageing</p> <p>4.2.3 Longevity Genes. Sirtunis, Deacetylases, hormones, Immune system, Inflammation, Cancer & Aging. Biomarkers of aging, method to show Aging. Regenerative medicine, stem cells and rejuvenation.</p> <p>4.2.4 Change of metabolities in aging</p> | <p>8</p> <p>7</p> |

Semester IV Syllabus details

| Course Code | Title | Credits |
|--|--|-----------|
| PS BCH 404 | Clinical and Pharmaceutical Biochemistry, Human Nutrition and Dietetics | 4 |
| <p>Unit I:</p> <p><u>1.1 Organ Function Tests. Biochemical Assessments and Changes in Endocrine Disorders</u></p> <p>1.1.1 Liver Function test</p> <p>1.1.2 Renal Function test including mechanism of urine formation</p> <p>1.1.3 Gastric and Pancreatic Function test</p> <p>1.1.4 Thyroid Function test</p> <p>1.1.5 Cardiac Profile</p> <p>1.1.6 Biochemical assessment and changes in Endocrine disorder (Pituitary, Thyroid, Adrenal Medulla, Adrenal Cortex, Ovaries, testes).</p> | | 15 |
| <p><u>Unit II:</u></p> <p><u>2.0 Mechanism of Drug Action and structure-Function Relationship and New Drug Investigation and Application</u></p> <p><u>2.1 Mechanism of Drug Action and structure-Function Relationship</u></p> <p>2.1.1 Molecular basis of drug action & pharmacological selectivity</p> <p>2.1.2 Drug receptor theory, stimulus response, classification of receptors & strategy in receptor binding studies, receptor preparation & receptor binding kinetics</p> <p>2.1.3 Structure-function relationship with respect to proteins, enzymes, ion, channels and other drug targets, computer-based drug designing.</p> <p><u>2.2 New Drug Investigation (NDI) and Application</u></p> <p>2.2.1 New Drug Investigation: Documents/ Information too filing NDI-animal pharmacology & toxicology studies, manufacturing information, clinical protocols and investigator information.</p> <p>2.2.2 New Drug Application (NDA): Introduction to NDA, NDA forms, contents of NDA, Preparation & Submission of documents, guidance documents for NDAS</p> | | 15 |
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| <p>Unit: III</p> <p><u>3.1 Diet in Health and Disease</u></p> <p>3.1.1 Nutrition during pregnancy, lactation, infancy, childhood, adolescence, adulthood, ageing.</p> <p>3.1.2 Nutrition for health & weight management.</p> <p>3.1.3 Nutrition for Exercise and Sport performance.</p> <p>3.1.4 Nutrition for bone health.</p> <p>3.1.5 Nutrition for therapeutic condition: Hypertension, CVD, GI disorders, (peptic ulcer. <i>H. Pylori</i>), Diabetes mellitus, anemia, Renal disorders, CRF, ARF, Jaundice</p> | <p style="text-align: right;">2</p> <p style="text-align: right;">3</p> <p style="text-align: right;">3</p> |
| <p>Unit: IV</p> <p><u>4.1 Techniques in Nutrition</u></p> <p>4.1.1 Assessment of Nutritional Status: A B C D, i.e. Anthropometry, Biochemical Indices, Clinical; Examination, Dietary Assessment</p> <p>4.1.2 Role of National and International Agencies in combating malnutrition WHO, FAO, UNICEF, ICAR, NIN, ICMR, Food Nutrition Board, CFTRI, NSI, IDA, ICDS.</p> <p>4.1.3 Recommended Dietary allowances (RDA), factors affecting RDA, Methods used to calculate RDA, Practical application of RDA, Reference man and woman.</p> | <p style="text-align: right;">10</p> <p style="text-align: right;">3</p> <p style="text-align: right;">2</p> |

M.Sc. (Part II)

Syllabus details for Semester –III practicals

PS BCH P301

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_m 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

PS BCH P302

1. Blood grouping test.
2. Haematological test- Bleeding time, clotting time, PCV, Hb by Sahli'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.

Demonstration Experiments

1. Immunofluorescence
2. Flow Cytometry
3. RIA, ELISA

PSBCHP303:

1. Glucose Tolerance Test
2. Lipid Profile: Estimation of serum Total cholesterol, Estimation of HDL, Estimation of Triglycerides, Estimation of LDL by calculation.
3. Adenosine Deaminase estimation
4. Serum Uric Acid Estimation (Caraway method)

Demonstration experiments

1. Estimation of Blood Ammonia

PSBCHO 304

1. Gastric Function Tests
2. Estimation of CSF – Glucose, Protein & Chlorides
3. Estimation of Malondialdehyde (MDA), (Thiobarbituric Acid Method)
4. Urine Protein estimation
5. Haemoglobin (Drabkins Method)
6. Estimation of Aspirin (Volumetric Method)
7. Preparation of Methyl Salicylate
8. Isolation and Estimation of Oxalates from spinach/ Aloe vera

Demonstration Experiments

1. Glycemic Index Determination

Syllabus details for Semester –IV practicals

FOR PSBCH P 401

GUIDELINE TO CARRY OUT PROJECTWORK

1. The main purpose of introduction Project Work at MSc Part II 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.

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 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 |
| <u>TOTAL</u> | | 50 |

Syllabus details for Semester –IV practicals

Practical paper II- Advanced Immunology

PS BCH P402

1. Serological tests- Rheumatoid arthritis factor, c- reactive protein, vidal, VDRL, Pregnancy test

Demonstration experiments

1. Allergen Testing
2. HLA typing
3. HIV detection- screening tests
4. Karyotyping. Slides for detection.

PSBCHP403:

1. Estimation of serum Acid Phosphatase.
2. Estimation of serum Electrolytes. (Na & K).
3. Estimation of Vitamin C From food sample (Dichlorophenol indophenols Dye method)
4. Estimation of Iron and Iron Binding Capacity
5. Estimation of Magnesium and Phosphorus, from serum

Demonstration Experiments:

1. Estimation of Serum Glycosylated Haemoglobin
2. Arterial Blood Gas Analysis
3. Estimation of Vitamin A and Vitamin D
4. Microbial assay of Vitamin B12

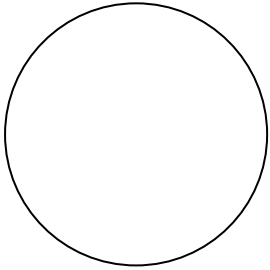
PSBCHO 404

1. Liver Function Tests: Estimation of serum ALT, AST, Total & Direct Bilirubin, Alkaline Phosphatase. Estimation of serum Total Proteins, Albumin & determination of A/G ratio.
2. Renal Function Tests: Urea and Creatinine Clearance Test with Clinical Interpretation
3. Urine Report- Abnormal constituents
4. Pancreatic Function Tests: Estimation of Serum Amylase Activity.

Demonstration Experiments:

1. Antibiotic Assay
2. Multidrug resistance & sensitivity assay.

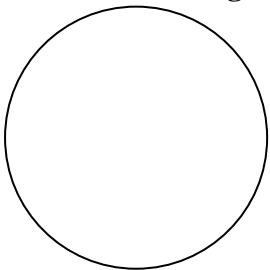
Format of Mark sheet to be prepared for entering the marks of internal Assessments of the project work done by MSc. Part II students

| MARKSHEET OF PROJECT WORK AT MSc PART II (SEM IV) IN BIOCHEMISTRY FOR 20 20 | | | | | |
|---|------------------------|----------------------------|---|-----------|-------------------|
| Course code No. PSBCHP 401 | | | | | |
| Name of College:- | | | | | |
| Date(s) of Internal Assessment of Project:- | | | | | |
| Name of Head of Dept. | | | | | |
| Name of the invited Examiner | | | | | |
| College/ Institute of Invited Examiner:- | | | | | |
| Sr. No. | Univ. Seat No.* | Name of Candidate * | Marks scored out of 50 (To be added to the marks of Pract 401) | | |
| | | | 30 | 10 | 10 |
| | | | | | Total (50) |
| | | | | | |
| | | | | | |
| Circular seal of college  | | | | | |
| | | | | | |

*To be filled in by the University Examination House.

** To be arranged on the alphabetical order of surname.

7. For each college, three copies of such mark sheets, duly signed by the Invited Examiner, will be prepared. Two copies of these marksheets will be sealed in an envelope and sent to the Mumbai, Kalina Campus, Mumbai- 400 098, at least two weeks before the commencement of the University Practical Examination.
8. The remaining third copy of the marksheet will be retained by the HOD of the respective Colleges in the sealed envelope as a “ Confidential Record”
9. The following details will be clearly written on the sealed envelope to be submitted to the Controller of Examinations.

| | |
|---|--|
| MARKSHEET OF PROJECT WORK (AS PARCT 401) AT MSc. PART II IN BIOCHEMISTRY FOR 20 20 COURSE CODE NO PSBCHP 401 | |
| Name of College:- | |
| Date(s) of Internal Assessment of Project:- | |
| Name of Head of Dept. | |
| Name of the invited Examiner | |
| College/ Institute of Invited Examiner:- | |
| Circular seal of college  | Signature of Invited Examiner with Date |

10. The same details will be entered on the sealed envelope kept as a Confidential Record in the department, which will be preserved for at least next 2/3/5 academic years.
11. **The marks scored by a candidate in Project Work will be carried forward for subsequent examination if he/ she appear for more than one attempt at the University Practical Examination.**
12. **Under no circumstances will there be re- assessment/ re- evaluation of the Project Work and the marks assigned there for (out of 50 as part of Pract 401) will be final.**

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. Mitra Snadhya, 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, 5th 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, 2nd Ed., ELBS and Oxford.
6. Ivan, Immunology Method Manual, Vol. 4 1997, Academic Press, Sani Diego.
7. Roitt Ivan and others, Immunology, 6th Ed., Mosby, Edinburg.
8. Kuby, Janis, Immunology. 3rd Ed., 1997, W.H. Freeman Co.
9. Hood Leroy E., Immunology, 2nd Ed., 1976, Benjamin Cummings Publication
10. Topley Wilson, Topley and Wilson's Principle of Bacteriology, Virology and immunity Edward Arnold Ltd., London
11. Bruce Alberts. Molecular Biology of Cell. 5th edition. Publisher Garland Science
12. Ian R. Tizard. Immunology: An Introduction. Saunders College publishing.

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

1. Greenberg David M – Metabolic Pathways. Vols 2 and 3, 3rd editions. Academic Press, New York
2. Henry Richard et al – Clinical Chemistry, Principles and Techniques, 2nd edition, Harper and Row, New York
3. Kamal SH – Clinical Biochemistry for Medical Technologies, Churchill Livingstone, London
4. Todd et al – Clinical Diagnosis and Management, 17th edition, WB Saunders, Philadelphia
5. Stokes Joan et al – Clinical Microbiology, Edward Arnold, London
6. Gill CV – Short cases in clinical biochemistry, Churchill Livingstone, Edinburgh, 1984
7. Rao Ranganathan – Text book of biochemistry 3rd edition, Prentice Hall, New Delhi
8. Rodrigues Fred K Carbohydrate chemistry with clinical correlations, New Age International, New Delhi
9. Bayens Dominiczak – 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, 17th ed., 1982, J.B. Lippincott Co.,
2. Anita F.P., Clinical Dietetics and Nutrition's, 4th 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, 7th Ed., 2000, Delmer Publishers
5. Gopalan C et al, Dietary Allowances for Indians, NIH, Hyderabad.
6. Gopalan C et al, Nutritive Value of Indian Foods, 1988, NIH, Hyderabad.
7. Halpern S.L., Quick reference to Clinical nutrition, 2nd Ed., 1987, J.B.Lippincott Co.
8. Kinney J.M. et.al, Nutrition and Metabolism in Patient Care, 19th 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, 16th 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, 2nd Ed., 1985, Ganesh and Co.
13. Williams S., Nutrition and Diet Therapy, 4th Ed., The C.V. Mosby Co., Missouri.
14. Essentials of Pharmacotherapeutics, 3rd Ed., By F.S.K. Barar, S chand & Company Ltd. 2005.
15. Pharmaceutical chemistry, G Melentyeva L L Antonova Mir Publishers, Moscow
16. Chemical Pharmacology, R B Barlow, 2nd Ed, Methven and CO. New Fethers Lane
17. Medicinal Chemistry, Vol I, 3rd Ed, Alfred Burga, Wiley Inter sciences
18. Textbook of paramedical chemistry, Jayshree Ghosh, S chand and company, New Delhi
19. Pharmacology, B Suresh, 1st Ed. Shanti, Publication.

Scheme of Theory examination M.Sc. Part I & part II (Sem I to Sem IV)

- 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]

Experiments Marks

- | | |
|---|----|
| a) Any Two Experiments (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, 302,303, 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 st | Morning | PS BCH P 101 or 201 or 301 |
| 1 st | Afternoon | PS BCH P 102 or 202 or 302 |
| 2 nd | Morning | PS BCH P 103 or 203 or 303 |
| 2 nd | 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 St | Morning | PS BCH P 402 |
| 1 st | Afternoon | PS BCH P 403 |
| 2 nd | Morning | PS BCH P 404 |

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