BSc 3rd Year Syllabus

3rd Year Theory – Paper-III: Physiology, Clinical Biochemistry and Immunology

90 hrs
(3 hrs/week)

Unit- I : Physiology — 24 hours

Digestion and absorption of carbohydrates, lipids and proteins. Composition of blood and coagulation of blood. Hemoglobin and transport of gases in blood (oxygen and CO_2).

Heart- structure of the heart, cardiac cycle, cardiac factors controlling blood pressure.

Muscle- kinds of muscles, structure of myofibril, organization of contractile proteins and mechanism of muscle contraction.

Nervous system- structure of neuron, resting potential, action potential, propagation of nerve impulse, synapse, synaptic transmission, excitatory and inhibitory neurotransmitters.

Physiology of vision- visual pigments and visual cycle.

Endocrinology- organization of endocrine system. Classification of hormones. Outlines of chemistry, physiological role and disorders of hormones of pancreas, thyroid, parathyroid, gonads, placenta, adrenals, pituitary and hypothalamus. Introduction of gastrointestinal hormones. Mechanism of hormonal action- signal transduction pathways for adrenaline, glucocorticoids and insulin.

Unit- II : Nutrition — 21 hours

Balanced diet. Calorific values of foods and their determination by bomb calorimeter. BMR and factors affecting it. Specific dynamic action of foods. Energy requirements and recommended dietary allowance (RDA) for children, adults, pregnant and lactating women. Sources of complete and incomplete proteins. Biological value of proteins. Role of essential fatty acids in human nutrition. Malnutrition- Kwashiorkar, Marasmus and PEM.

Vitamins- sources, structure, biochemical roles, deficiency disorders of water and fat soluble vitamins. Introduction to neutraceutical and functional foods. Bulk and trace elements-Ca, Mg, Fe, I, Cu, Mo, Zn, Se and F. Obesity and starvation.

Unit- III : Clinical Biochemistry — 23 hours

Plasma proteins in health and disease. Disorders of blood coagulation (haemophilia). Types of anemias, haemoglobinopathies-sickle cell anemia and thalassemias.

Structure and functions of the liver. Liver diseases-jaundice, hepatitis, cirrhosis. Liver function tests- conjugated and total bilurubin in serum, albumin: globulin ratio, hippuric acid and bromsulphthalein tests. Serum enzymes in liver diseases- SGPT, GGT and alkaline phosphatase.

Kidneys-structure of nephron, urine formation, normal and abnormal constituents of urine. Biological buffers. Role of kidneys in maintaining acid-base and electrolyte balance in the body. Renal function tests- creatinine and urea clearance tests, phenol red test.
Disorders of carbohydrate metabolism- hypoglycemia, hyperglycemia, glycosuria, renal threshold value. *Diabetes mellitus*-classification, glucose tolerance test (GTT), diabetic ketoacidosis.
Disorders of lipid metabolism- plasma lipoproteins, lipoproteinemias, fatty liver, hyper cholesterolemia, atherosclerosis.
Biochemical tests for the diagnosis of heart diseases- HDL/LDL cholesterol, SGOT, LDH, CK, C-reactive protein, cardiac troponins.

Unit- IV : Immunology **22 hours**

Organization of immune system. Organs and cells of immune system. Innate and acquired immunity. Cell mediated and humoral immunity (T- and B- cells). Classification of immunoglobulins, structure of IgG. Epitopes / antigenic determinants. Concept of haptens. Adjuvants. Theories of antibody formation- clonal selection theory. Monoclonal antibodies.

Antigen-antibody reactions- agglutination, immunoprecipitation, immunodiffusion. Blood group antigens. Immunodiagnostics-RIA, ELISA. Vaccines and their classification. Traditional vaccines-live and attenuated, toxoids. Modern vaccines- recombinant and peptide vaccines. Outlines of hypersensitivity reactions. Fundamentals of graft rejection and MHC proteins.

3rd Year – Practical -III: Nutritional and Clinical Biochemistry

90 hrs
(3 hrs/week)

List of Experiments:

1. Estimation of calcium by titrimetry
2. Estimation of iron in apple juice by phenanthroline method.
3. Estimation of sodium by flame photometry.
4. Estimation of vitamin C by 2, 6 -dichlorophenol indophenol method.
5. Isolation of total lipids by gravimetric method.
6. Determination of iodine value of an oil.
7. Determination of acid value of an oil.
8. Estimation of hemoglobin in blood.
9. Total count - RBC and WBC. Differential count.
10. Determination of blood group and Rh typing.
11. Visualization of antigen antibody reactions (Ouchterlony technique).
12. Urine analysis for albumin, sugars and ketone bodies.
13. Estimation of urinary creatinine.
14. Estimation of blood urea.
15. Estimation of serum total cholesterol.
16. . Determination of serum alkaline phosphatase activity.
17. Determination of SGOT and SGPT activity

3rd Year Theory – Paper-IV: Microbiology and Molecular Biology

90 hrs (3 hrs/week)

Unit- I : Microbiology — 24 hours

Introduction to brief history of microbiology. Classification of microorganisms- prokaryotic and eukaryotic microorganisms. Isolation and cultivation of bacteria. Selective media and enriched media. Bacterial growth curve and kinetics of growth. Batch, continuous and synchronous cultures. Gram's staining- Gram positive and Gram negative bacteria, motility and sporulation.

Industrial uses of *Aspergillus niger*, yeast and Spirulina.

Structure and composition of viruses. One-step growth and determination of plaque forming units (PFU). Isolation and cultivation of bacterial plaques. Lytic and lysogenic life cycle of λ phage. TMV, Retro viruses- HIV. Prions and Mycoplasma.

Unit- II : DNA Replication and Transcription — 21 hours

Organization of genome in prokaryotes and eukaryotes. Experimental evidences to prove nucleic acids as genetic material. Nature and structure of the gene. DNA replication- models of replication, Meselson-Stahl's experimental proof for semi-conservative model. DNA polymerases I, II and III of *E.coli*, helicase, topoisomerases, primase, ligase. Bidirectional replication model. Okazaki fragments, leading and lagging strands of DNA synthesis. Inhibitors of DNA replication.

Transcription - RNA synthesis, RNA polymerases of prokaryotes. Promoters, Initiation- sigma factors and their recognition sites. Elongation- role of core enzyme. Termination- rho dependent and rho independent. RNA polymerase I, II and III of eukaryotes.

Transcriptional events in eukaryotic m-RNA synthesis, post-transcriptional modifications of eukaryotic m-RNA. Inhibitors of RNA synthesis.

Unit- III : Protein Synthesis and Regulation of Gene Expression — 21 hours

Introduction to protein synthesis- Genetic code, structure of t-RNA, deciphering of genetic code, Nirenberg's and Khorana's experiments, wobble hypothesis, degeneracy of genetic code.

Protein synthesis- activation of amino acids (aminoacyl t-RNA synthetases). Ribosome structure. Initiation, elongation and termination of protein synthesis. Post- translational modifications- signal hypothesis. Inhibitors of protein synthesis.

Regulation of prokaryotic gene expression- induction and repression. Lac operon, catabolite repression. Tryptophan operon and attenuation.

Unit- IV : Recombinant DNA technology — 24 hours

Outlines of cloning strategies. DNA sequencing- Maxam Gilbert and Sanger's methods. Tools of r-DNA technology: Enzymes- Restriction endonucleases, ligase, phosphatases, reverse transcriptase, polynucleotide kinases, terminal transferase nucleases-S_1 and RNAase H. Restriction mapping. Cloning vectors- Plasmids, Ti plasmids, Cosmids, λ phages, shuttle vectors, expression vectors. Host- *E.coli*, *Sacchromyces cereviciae, Agrobacterium tumifaciens.*

Construction of c-DNA and genomic libraries. Isolation and sequencing of cloned genes- colony hybridization, nucleic acid hybridization, hybrid released translation (HRT) and hybrid arrested and released translation (HART) using reporter genes [β- galactosidases, green fluorescent proteins (GFP)].

Polymerase chain reaction- principle and applications. Outlines of blotting techniques-Southern, Northern and Western.

Applications of gene cloning- production of insulin and human growth hormone, production of Bt cotton and edible vaccines.

Introduction to Bioinformatics- definitions of proteomics and genomics. Gene bank, NCBI, DDBJ, Swissprot, PDB. Sequence alignments- BLAST and FASTA.

3rd Year Practical – Paper-IV: Microbiology and Molecular Biology

90 hrs
(3 hrs/week)

List of Experiments:

1. Preparation of culture media and sterilization methods.
2. Isolation of pure cultures: (i) Streak plate method.
   (ii) Serial dilution method.
3. Gram staining.
4. Motility of bacteria by hanging drop method.
5. Bacterial growth curve.
6. Antibiotic sensitivity by paper disc method.
7. Isolation of DNA from onion/liver/coconut endosperm.
8. Isolation of plasmids.
9. Determination of purity of nucleic acids by UV-spectrophotometric method.
10. Estimation of DNA by diphenylamine method.
11. Estimation of RNA by orcinol method.
12. Electrophoresis of nucleic acids and visualization by methylene blue staining.
13. Restriction mapping: λ- DNA with any two restriction enzymes.
14. Sequence alignments of insulin/BSA with other proteins using BLAST and FASTA.

Recommended Books for UG Course (Biochemistry)

General Biochemistry

1. Lehninger's Principles of Biochemistry – Nelson.D.L. and Cox.M.M., Freeman & Co.
2. Biochemistry – Berg.J.M., Tymoczko.J.L. and Stryer.L., Freeman & Co.
3. Biochemistry – Voet.D and Voet., J.G., John Wiley & Sons
4. Textbook of Biochemistry – West.E.S.,Todd.W.R,Mason.H.S..and. Bruggen, J.T.V., Oxford & IBH Publishers.
5. Principles of Biochemistry: General Aspects-Smith, E. L., Hill, R.L. Lehman, I. R. Lefkowitz, R.J. Handler, P., and White, A. McGraw-Hill
6. Outlines of Biochemistry – Conn.E.E.,Stumpf.P.K., Bruening, G and Doi.R.H., John Wiley & Sons .
7. Harper's Illustrated Biochemistry – Murray, R.K., Granner.D.K. & Rodwell,V.W., McGraw-Hill 8. Bichemistry-Lippincott's Illustrated Reviews. Champe, P.C. and Harvey, R. A. Lippincott
9. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.
10. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Ltd.
11. Biochemistry – Rama Rao. A and Ratna Kumari. D, Kalyani Publishers.
12. Biochemistry- The Molecular Basis of Life – McKee. T and McKee, J. R, McGraw-Hill.

Enzymology

1. Fundamentals of Enzymology – Price.N.C.and Stevens.L., Oxford University Press.
2. Understanding Enzymes – Palmer.T., Ellis Harwood.
3. Enzymes – Biochemistry, Biotechnology, Clinical Chemistry – Palmer.T., Affiliated East-West Press

Biochemical Techniques

1. Principles and Techniques of Practical Biochemistry- Wilson, K. and Walker, J. Cambridge Press.
2. The Tools of Biochemistry- Cooper, T. G. John Wiley & Sons Press.
3. Physical Biochemistry- Friefelder, D. W.H. Freeman Press.
4. Analytical Biochemistry – Holme.D.J. and Peck.H., Longman.
5. Biophysical Chemistry: Principle and techniques- Upadhyay A, Upadhyay K and Nath. N. Himalaya Publishing House.
6. Experimental Biochemistry- Clark Jr. J.M and Switzer, R. L. Freeman & Co..

Physiology, Nutrition and Clinical Biochemistry:

1. Textbook of Biochemistry and Human Biology – Talwar, G.P. and Srivastava. L.M., Printice Hall of India
2. Review of Medical Physiology-Ganong. McGraw-Hill.
3. Human Physiology – Chatterjee.C.C, Medical Allied Agency
4. Textbook of Medical Physiology – Guyton.A.G and Hall.J.E., Saunders
5. William's Textbook of Endocrinology – Larsen, R. P. Korenberg, H. N. Melmed, S. and Polensky, K. S. Saunders
6. Mammalian Biochemistry- White, A. Handler, P. and Smith, E. L. McGraw-Hill.
7. Textbook of Human Nutrition- Bamji, Pralhad Rao and Reddy V. Oxford & IBH Publishers.
8. Foods: Facts & Principle- Shakuntala and Shadaksharaswamy. Wiley Ester Press.
9. Essentials of Food and Nutrition – Swaminathan.M. Bangalore Press.
10. Human Nutrition and Dietetics. Davidson, S. and Passmore, J. R. ELBS.
11. A Textbook of Biochemistry: Molecular and Clinical Aspects. Nagini, S. Scitech Publishers.
12. *Tietz* Fundamentals of Clinical Chemistry- Burtis, A. A. and Ashwood, E. R. Saunders-imprint Elsevier Pub.
13. Textbook of Biochemistry with Clinical Correlations – Devlin.T.M.,Wiley – Liss
14. Textbook of Medical Biochemistry – Chatterjea.M.N. and Shinde.R, Jaypee Brothers Medical Publishers.
15. Textbook of Medical Biochemistry- Ramakrishnan, S., Prasannan, K. G. and Rajan, R. Orient Longman

Immunology:

1. Immunology. Tizard, I. R. Thomson Press.
2. Kuby Immunology – Kindt.T.J., Goldsby.R.A. and Osborne.B.A., Freeman & Co.
3. Roitt's Essential Immunology – Roitt.I.M. and Delves.P.J., Blackwell Science.
4. Immune system- Parham. Garland Publishing.

Microbiology:

1. Introduction to Microbiology: A Case History Approach- Ingraham and Ingraham. Thomson Press.
2. Textbook of Microbiology – Ananthanarayan, R and Jayaram Paniker, C.K., Orient Longman.
3. Microbiology – Prescott.L.M.,Harley.J.P. & Klein.D.A, McGraw-Hill.
4. Microbiology: An Introduction- Tortora, G. J. Funke, B. R. and Case, C. L., Pearson-Benjamin-Cummings Co.
5. Microbiology – Pelczar Jr,.M.J., Chan.E.C.S. and Krieg.N.R., Tata McGraw-Hill.
6. Textbook of Microbiology- Dubey, R. C. and Maheshwari, D. K. S. Chand & Co.

Molecular Biology and Biotechnolgy:

1. Protein Biochemistry & Biotechnology- Walsh. John Wiley & Sons Press.
2. Molecular Biology of Cell- Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, J. D. Garland Publishing.
3. Recombinant DNA and Biotechnology: A Guide for teachers- Helen and Massey. ASM Press.
4. Genes VIII – Lewin. B, Oxford University Press .
5. Molecular Biology- Freifelder. D. Naroasa Pub. House
6. Molecular Biology of the Gene- Watson. J.D., Baker, T.A, Bell, S.P.,Gann.A, Levine, M. and Losick.R, Pearson Education.
7. Molecular Biotechnology- Glick, B. R. and Pasternak, J. J. ASM Press
8. Principles of Gene Manipulation: An Introduction to GE- Old, R. V. and Primrose, S. B. Blackwell Sci. Pub.
9. A Textbook of Biotechnology-Dubey, R. C. S. Chand & Co.
10. Gene Biotechnology- Jogdand. Himalaya Pub. House.
11. Introduction to Biotechnology: An Agricultural Revolution-Herren. Thomson Press.
12. Molecular Cell Biology- Lodish, H., Berk, A., Matsudaira, P., Kaiser, C. A., Krieger, M. Scott M. P., Zipursky, S. L. and Darnell, J. Freeman & Co.

Bioinformatics

1. Instant Notes-Bioinformatics- Westhead *et al.*, Viva Books (P), Ltd
2. Introduction to Bioinformatics- Attwood T K and Parry-Smith, D. J. Pearson Education.
3. Introduction to Bioinformatics- Lesk, A.M. Oxford University Press

Practical Biochemistry:

1. Experimental Biochemistry: *A Student companion*- Sashidhar Rao, B and Deshpande, V. IK International (P) Ltd. Pub.
2. Modern Experimental Biochemistry- Boyer. R. Pearson Education
3. Biochemical Methods –Sadasivam, S and Manickyam, A.- New Age International publishers
4. An Introduction to Practical Biochemistry- Plummer, D. T. Tata McGraw-Hill.
5. Introductory Practical Biochemistry (ed) Sawhney, S. K. Randhir Singh- Narosa Publications House
6. Lab Manual in Biochemistry, Immunology and Biotechnology- Arti Nigam and Archana Ayyagari- Tata McGraw-Hill New Delhi

7. Enzyme Assays – A Practical Approach – Eisenthal,.R and Dawson, M.J., IRL Press
8. Practical Biochemistry – Rameshwar. A, Kalyani Publisher.
9. Experiments and Techniques in Biochemistry – Sheel Sharma, Galgotia Publications.
10. Practical Clinical Biochemistry-Varley,H. CBS Publishers.
11. Practical Clinical Biochemistry –Methods and Interpretations –Ranjna Chawla-Jaypee
12. Manipal Manual of Clinical Biochemistry-Shivande Naik, B - Jaypee Brother Medical publications, New Delhi
13. Hawk's Physiological Chemistry- (ed) Oser, O. Tata-McGraw-Hill
14. Laboratory Manual in Biochemistry. Jayaraman, J. Wiley-Eastern
15. Biotechnology: A laboratory Project in Molecular Biology- Thiel, Bissen and Lyons. Tata McGraw-Hill.
16. Methods in Biotechnology- Hans-Peter Schmauder. Taylor & Francis.

Practical Microbiology:

1. Microbiology – A Laboratory Manual- Cappuccino, J. G. and Sherman, N. Pearson Education.
2. Laboratory Experiments in Microbiology- Gopal Reddy, M ,.Reddy, M.N., Sai Gopal D. V.R.and. Mallaiah, K.V.
3. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom cultivation-Aneja, K. R - New Age International publishers.
4. Microbiology – A Laboratory Manual- Reddy, S. M. and Ram Reddy, S. Sri Padmavathi Pub.
5. Practical Microbiology- Dubey, R. C. and Maheshwari, D. K. S. Chand & Co.

Mathematical Problems in General Biochemistry:

1. Biochemical Calculations- Segel, I.H. John Wiley & Sons.

Lab Reference Book:

1. Lab Ref A Hand book of Recipes, Reagents and Other Reference Tools for Use at the Bench- (ed) Roskams, J. and Rodgers, L.- I.K International Pvt. Ltd, New Delhi.