

Curriculum

DNB Broad Specialty



Biochemistry

- ◆ Objectives of the Programme
- ◆ Teaching and Training Activities
- ◆ Syllabus
- ◆ Competencies
- ◆ Log Book
- ◆ Recommended Text Books and Journals

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I. OBJECTIVES OF THE PROGRAMME:

1. Programme Goal

The postgraduate courses in Biochemistry should enable a medical graduate through exhaustive knowledge in biochemical technology both in theory and in practical so as to be in a position to apply the same and correlate the various biochemical parameters in health and disease.

2. Programme Objectives

A candidate upon successfully qualifying in the DNB (Biochemistry) Examinations should be able to:

- i. Be a competent Biochemist
- ii. Work as a teacher in medical faculty both at undergraduate & postgraduate level.
- iii. Independently able to work on basic as well as high end automated equipment.
- iv. Supervise modern laboratory techniques & procedures along with total quality assurance in clinical Biochemistry in the hospital
- v. Pursue her/his interest to undergo further specialization.
- vi. Carry out & conduct various research problems both at basic and applied level
- vii. Guide thesis at both post Graduate and Doctoral level
- viii. Suggest, evaluate, interpret Biochemical investigation in a given clinical situation and apply knowledge in clinical problems

3. Specific Learning Objectives

- i. Understand the concept of Biochemistry regarding Biomolecules Carbohydrates, proteins, lipids, Nucleic acids, Enzymes, Minerals
- ii. Have knowledge of intermediary metabolism of the above & regulation of individual metabolism
- iii. Possess the knowledge of the impairment of metabolism including inborn errors of metabolism.
- iv. Understand the role of nutrition in health & disease
- v. Apply biochemical knowledge in normal & diseased states
- vi. Have knowledge regarding the analysis of biological fluids for its chemical constituents & correlating the same in health& disease

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- vii. Develop skills of performing biochemical, & interpreting the data
 - viii. Suggestive technique to learning ELISA, Molecular Biology techniques, electrophoresis, chromatography and chemiluminescence
 - ix. Basic laboratory techniques
 - x. Biomedical waste management
 - xi. Knowledge of basics of educational technology

II. TEACHING AND TRAINING ACTIVITIES:

The fundamental components of the teaching programme should include:

1. Case presentations & discussion- once a week
2. Seminar – Once a week
3. Journal club- Once a week
4. Grand round presentation (by rotation departments and subspecialties)- once a week
5. Faculty lecture teaching- once a month
6. Clinical Audit-Once a Month
7. A poster and have one oral presentation at least once during their training period in a recognized conference.

The rounds should include bedside sessions, file rounds & documentation of case history and examination, progress notes, round discussions, investigations and management plan) interesting and difficult case unit discussions.

The training program would focus on knowledge, skills and attitudes (behavior), all essential components of education. It is being divided into theoretical, clinical and practical in all aspects of the delivery of the rehabilitative care, including methodology of research and teaching.

- i. **Theoretical:** The theoretical knowledge would be imparted to the candidates through discussions, journal clubs, symposia and seminars. The students are exposed to recent advances through discussions in journal clubs. These are considered necessary in view of an inadequate exposure to the subject in the undergraduate curriculum.
- ii. **Symposia:** Trainees would be required to present a minimum of 20 topics based on the curriculum in a period of three years to the combined class of teachers and students. A free discussion would be encouraged in these symposia. The topics of the symposia would be given to the trainees with the dates for presentation.

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- iii. **Clinical:** The trainee would be attached to a faculty member to be able to pick up methods of history taking, examination, prescription writing and management in rehabilitation practice.
 - iv. **Bedside:** The trainee would work up cases, learn management of cases by discussion with faculty of the department.
 - v. **Journal Clubs:** This would be a weekly academic exercise. A list of suggested Journals is given towards the end of this document. The candidate would summarize and discuss the scientific article critically. A faculty member will suggest the article and moderate the discussion, with participation by other faculty members and resident doctors. The contributions made by the article in furtherance of the scientific knowledge and limitations, if any, will be highlighted.
 - vi. **Research:** The student would carry out the research project and write a thesis/ dissertation in accordance with NBE guidelines. He/ she would also be given exposure to partake in the research projects going on in the departments to learn their planning, methodology and execution so as to learn various aspects of research.

III. SYLLABUS:

1. Cell Biology-

Structure of the cell and different sub cellular organelles, Structure of cell membrane Movement of substances across cell membranes, Interaction between cells and environment, Glycoprotein's and proteoglycans, Extracellular matrix, Integrins, Cell-cell interaction-selectins, Cadherins, Tight junctions ,Gap junctions, Intracellular traffic and sorting of proteins-endoplasmic reticulum, Golgi complex, Vesicle transport, Endocytic pathway, Protein targeting to cell surface, Nucleus, Lysosomes, Mitochondria, peroxisomes, Cytoskeleton and cell motility, Cell cycle, Muscle contraction, Hemoglobin and Myoglobin,

2. Biostatistics/Research Methodology-

Types of study design, Calculation of adequate sample size, Students 't' test, paired 't' test, Chi square test, Fisher's exact test, Nonparametric tests of significance, one way and two-way analysis of variance, Multivariate analysis, Survival analysis-

logrank test, Relative risk Calculation-Odd's ratio, commonly used statistical software's, ROC, Multiple regression, coefficient of correlation and linear regression, Bioinformatics.

3. Biochemical Techniques-

Centrifugation- ultracentrifugation, Optical techniques- spectrophotometry, reflectance photometry, flame photometry, atomic absorption spectrophotometry, fluorimeter, phosphorescence, chemiluminescence, turbidimetry and nephelometry, Electrochemistry- chemical sensors and biosensors, Electrophoresis, Chromatography, Immunochemical techniques-immunoassays, Spectroscopic techniques-circular dichroism, electron spin resonance, nuclear magnetic resonance, Mass spectrometry and tandem mass spectrometry, Nanotechnology and microfabrication, Techniques to study in vivo metabolism-NMR,SPECT,PET scans, Radioisotope techniques like PCR, DNA Extraction technique and RFLP etc.

4. Enzymes

General properties, classification and nomenclature, kinetic model, Km value, factors influencing enzymes action, specificity, mechanism of enzymes action, enzymes kinetics, regulation of enzyme action, isolation, isoenzymes, diagnostic and therapeutic uses of enzymes

5. Vitamins:

Structure, sources, daily requirements, physiological role and deficiency manifestation of vitamins, hypo and hyper vitamins and vitamins Mechanism of action of coenzymes.

6. Metabolism-

- i. Chemistry and metabolism of carbohydrates, lipids, proteins, and amino acids in human system with clinical implications
- ii. Inborn errors of metabolism: Inborn errors of carbohydrates, lipids amino acids, protein nucleic acids, mineral metabolism.

7. Human Nutrition:

- i. Principal food components, general nutritional requirements, energy requirements, biological value of proteins, specific dynamic action, balanced diet, diet formulation in health and disease, mixed diet, nutritional supplements, food toxins and additives, parental nutrition, disorders of

nutrition, obesity, protein and protein energy, malnutrition dietary fibers, under-nutrition, laboratory diagnosis of nutrition disorders, national nutritional program

ii. Mineral metabolism and role of micro and macronutrients

8. Molecular Biology

i. Chemistry and Metabolism of nucleotides/nucleic acids, replication, transcription and translation, regulation of gene expression, protein targeting, recombinant DNA and other molecular biology techniques, Human genome project, functional genomics, proteomics,

ii. Principles of human genetics- Transmission of genetic disease-mutations and their functional consequences, alleles, genotypes, haplotypes, phenotypes, genetic linkage, identification of disease causing gene, chromosomal disorders, monogenic Mendelian disorders, mitochondrial disorders, nucleotide repeat expansion disorders, polygenic disease and complex genetic traits, imprinting disorders, methods of mutation detection, gene therapy, gene library and uses of recombinant DNA technology, restriction enzymes, mechanism of antibiotics and anti-cancer drugs, differences between Eukaryotic and Prokaryotic gene expression.

iii. Stem cells in clinical medicine.

9. Immunology

Overview-innate and acquired immunity, cells and organs of the immune system- T and B cells, macrophages, dendritic cells, NK cells, granulocytes, antigens, epitopes and haptens, immunoglobulins classes, isotypes, allotypes, idiotypes, monoclonal antibodies, organization and expression of immunoglobulin genes, immunoglobulin gene rearrangement, class switching, antigen-antibody interaction- 5 immunochemical techniques, MHC, antigen processing and presentation, T cell and B cell receptor, toll like receptors, cell maturation/activation/differentiation, B cell generation /activation/ differentiation, cytokines, complement system, cell mediated immunity, T regulatory cells, Hypersensitivity, immune response to infections, vaccines and newer approaches, immunodeficiency, autoimmunity, transplantation immunology, cancer and immune system, immunodiagnosics and immunotherapy.

10. Hematopoietic disorders-

Iron deficiency and other hypoproliferative anaemias-iron metabolism, laboratory tests of iron status, iron therapy, anemia of chronic disease, anaemia of renal disease

Hemoglobinopathies- sickle cell anaemia, methaemoglobinemias, thalassemia syndromes, Megaloblastic anaemias, RBC membrane and metabolism, Hemolytic anaemias-inherited defects in RBC membrane and enzymes-G6PD deficiency, immunologic causes of hemolysis, ABO blood group system-biochemical basis, transfusion biology, Plasma cell disorders-multiple myeloma, MGUS.

11. Hemostasis and thrombosis-

Biochemical mechanisms of coagulation, related laboratory tests, antiplatelet /anticoagulant / fibrinolytic therapy.

12. Cardiovascular system-

Cardiac biomarker's diagnostic and prognostic implications and risk stratification
Atherosclerosis- pathogenesis, risk factors, its prevention and treatment
Heart failure, acute coronary syndrome, cardiac biomarkers, cardiomyopathies.
Hypertension-essential and secondary, genetics, laboratory evaluation, approach to therapy.

13. Respiratory system-

Gaseous exchange in lungs-physiological features and disturbances, arterial blood gases. Pathogenesis of asthma, cystic fibrosis, emphysema, α 1AT deficiency etc.

14. Kidney-

Kidney function tests, Pathophysiology, biochemistry, laboratory findings and management in acute renal failure, chronic renal disease and failure/uremia, Estimation of GFR, Glomerular diseases-pathogenesis and mechanisms of glomerular injury, Nephrotic syndrome, Diabetic nephropathy, Tubular disorders, Renal tubular acidosis, Proteinuria, Nephrolithiasis, Kidney transplant etc.

15. Gastrointestinal system-

Alimentary tract-gastric physiology, pathophysiology of peptic ulcer disease, role of H.pylori ,gastric function tests, Zollinger Ellison syndrome, nutrient digestion and absorption, evaluation of malabsorption, celiac sprue, inflammatory bowel disease, steatorrhea, lactose intolerance, protein losing enteropathy, investigation of maldigestion / malabsorption, GIT regulatory peptides , Neuroendocrine tumors. Liver- liver function tests, hyperbilirubinemias, viral hepatitis, serologic /virologic markers, alcoholic liver disease, fatty liver, chronic liver disease, cirrhosis and its complications, pathogenesis of ascites, hepatic encephalopathy, metabolic diseases affecting liver, Reye's syndrome, diseases of gall bladder/bile ducts-

pathogenesis of gallstones. Pancreas-acute and chronic pancreatitis, cystic fibrosis, pancreatic function tests

16. Disorders of Immune system, connective tissue and joints-

Immune tolerance, mechanisms of immune mediated damage to host tissues, primary immune deficiency diseases-laboratory evaluation and management of autoimmune diseases, hypersensitivities and immune deficiency disorder like SLE, AIDS, rheumatoid arthritis, Sjogren's syndrome, Asthma, gout

17. Bone and mineral metabolism-

Bone structure and metabolism, calcium, phosphate and magnesium metabolism, regulation and abnormalities, vitamin D, calcitonin, PTH, osteoporosis-pathophysiology, markers of bone turnover.

18. Nervous system and Neurologic disorders-

Neurotransmitters and their receptors, ion channels and channelopathies, memory and learning-signaling pathways, neurotrophic factors, apoptosis, protein aggregation and neurodegeneration, genetic disorders of CNS, pathophysiology of ischemic stroke, Alzheimer's disease, Parkinson 'disease, Huntington 'disease, Inherited ataxias, Amyotrophic lateral sclerosis and other motor neuron diseases, Multiple sclerosis. Prions and Prion diseases, Guillain-Barre syndrome-immunopathogenesis, Myasthenia gravis-pathophysiology, Hereditary myopathies-Duchenne muscular dystrophy, Inherited disorders of muscle energy metabolism, mitochondrial myopathies. Biochemistry of olfaction taste, vision and touch.

19. Psychiatric disorders-

Anxiety, depression, schizophrenia-pathophysiology. Neuropsychiatric drugs biochemical basis of mode of action, biochemical basis of drug addiction and abuse, CSF analysis.

20. Cancer-

Cancer genetics, clonal origin and multistep nature, oncogenes, tumour suppressor genes, familial cancer syndromes, chromosomal instability in solid tumours, viruses in human cancer, epigenetic regulation in cancer, gene expression profiling in cancer, cancer cell biology, cell cycle abnormalities, telomerase, apoptosis, metastasismolecular basis and therapeutic strategies, tumour angiogenesis-

molecular events and antiangiogenic therapy, biological basis of cancer chemotherapy, multidrug resistance, molecularly targeted cancer therapy, cancer immunotherapy.

21. Environmental Biochemistry-

Xenobiotic metabolism, pesticide organophosphorous poisoning, water and air pollution.

22. Clinical Biochemistry-

Investigative aspects-principles of laboratory analysis and safety, specimen collection and processing, automation, point of care testing, evidence based laboratory medicine, selection and analytical evaluation of methods, clinical evaluation of methods-sensitivity and specificity, ROC curves, establishment and use of reference values, preanalytical variables, clinical laboratory informatics, Total quality management, Biomedical waste disposal. Analytes-Amino acids/peptides/proteins, plasma proteins, enzymes, clinical enzymology, tumour markers, carbohydrates, lipids / lipoproteins / apolipoproteins, cardiovascular, risk factors, electrolytes, blood, gases, hormones, catecholamines / serotonin, vitamins, and, trace elements, hemoglobin, iron and bilirubin, porphyrins and their disorders, Therapeutic drug monitoring. Pituitary, adrenal and thyroid function, Reproductive related disorders-infertility, Pregnancy-maternal and fetal health, Inborn errors of metabolism, Clinical toxicology, Molecular diagnostics. Accreditation of labs NABL, ISO etc.

23. Endocrinology-

Diabetes mellitus etiopathogenesis, diagnostic and prognostic marker's, short and long term complications, risk factors and principle management.

Thyroid hormones, synthesis and mechanism of action, hyper and hypo thyroidism
Derangement of structure and functions of hypothalamus, pituitary, parathyroid glands, adrenal cortex, adrenal medulla and gonads.

24. Miscellaneous-

Biological oxidation, bioenergetics, and High energy phosphate compounds, Digestion and absorption of food and other nutrients, Detoxification/ xenobiotics, Cytochrome P450 system, Free radical's formation, scavenging oxygen free radicals, Antioxidants. Role in diseases. Respiratory chain and oxidative phosphorylation, components of respiratory chain control, site specific inhibitors, uncouplers, Muscular contraction, nerve conduction, coagulation of food

Metabolism in specialized tissues like erythrocytes, lens nervous tissues etc. Fluid and electrolyte balance and Acid-Base balance-regulation and disturbances.

25. Practical

26. Clinical Biochemistry-

Estimation in blood of glucose, GTT, glycosylated Hb, urea creatinine, uric acid, ammonia, clearance tests, cholesterol, triglycerides, HDL, LDL, bilirubin, total proteins, albumin, AST, ALT, ALP, GGT, acidphosphatase, amylase, LDH, CK total, CKMB, calcium, Phosphorus,serum electrolytes- sodium and potassium, blood gas analysis, Apo A ,ApoB, copper, ceruloplasmin, iron ,TIBC, ferritin, troponin, myoglobin. Urine analysis, microalbuminuria. Analysis of CSF and other body fluids. Chemiluminescence based immunoassays, Cell culture, HPLC, Mass spectrometry.

27. List of suggested practical

Protein fractionation- Ion exchange chromatography, gel filtration chromatography TLC for lipids, amino acids Kinetic analysis of enzymes (Alkaline phosphatase) from a suitable source Separation and molecular weight determination of proteins by SDS-PAGE Western Blotting Purification of IgG by protein A-Sepharose affinity column chromatography Estimation of proteins by Lowry and Bradford methods Separation of LDH isoenzymes by PAGE Serum protein electrophoresis on agarose gel and densitometric scanning .Immunodiffusion techniques-radial immunodiffusion, ouchterlony Immunofixation Lipoprotein electrophoresis Paper chromatography for separation of amino acids Separation of peripheral blood lymphocytes on Ficoll Hypaque Subcellular fractionation by ultracentrifugation Isolation of high molecular weight DNA from tissues/blood Restriction enzyme digestion of DNA Isolation of plasmid and agarose gel electrophoresis PCR ELISA for hormones/tumour markers radioactivity measurements, RIA Biostatistics, Research Methodology and Clinical Epidemiology Ethics Medico legal aspects relevant to the discipline Health Policy issues as may be applicable to the discipline.

IV. COMPETENCIES:

1. Based on the available facilities, department can prepare a list of postgraduate experiments pertaining to basic and applied biochemistry.
2. Active learning should form the mainstay of postgraduate training there should be lectures for postgraduates (at least 20 per year).

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3. Along with seminars, symposia, group-discussions, journal clubs. The postgraduate students should regularly take the ward rounds of various clinical departments and learn cases of interest for discussion with the Biochemistry faculty.
 4. They should render special investigative services in their respective area of specialization. Each institute should have a medical education unit to generate teaching resource material for UG and evolving of problem solving modules.
 5. Micro teaching and problem based learning
 6. Horizontal and vertical integration

V. LOG BOOK:

A candidate shall maintain a log book of operations (assisted / performed) during the training period, certified by the concerned post graduate teacher / Head of the department / senior consultant.

This log book shall be made available to the board of examiners for their perusal at the time of the final examination.

The log book should show evidence that the before mentioned subjects were covered (with dates and the name of teacher(s)) The candidate will maintain the record of all academic activities undertaken by him/her in log book.

1. Personal profile of the candidate
2. Educational qualification/Professional data
3. Record of case histories
4. Procedures learnt
5. Record of case Demonstration/Presentations
6. Every candidate, at the time of practical examination, will be required to produce performance record (log book) containing details of the work done by him/her during the entire period of training as per requirements of the log book. It should be duly certified by the supervisor as work done by the candidate and countersigned by the administrative Head of the Institution.
7. In the absence of production of log book, the result will not be declared.

VI. RECOMMENDED TEXT BOOKS AND JOURNALS:

Text Books-

1. Biochemistry Ed. Lubert Stryer. W.H. Free man and Company, New York

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2. Principles of Biochemistry. Ed. Lehninger, Nelson and Cox. CBS Publishers and Distributors.
 3. Harper's Biochemistry. Ed. R.K.Murray, D.K.Granner, P.A. Mayes and V.W.Rodwell. Appleton and Lange, Stamford, Connecticut.
 4. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin, Wiley- Liss Publishers.
 5. Genes VIII Ed Benjamin Lewin. Oxford University Press.
 6. Tietz Textbook of Clinical Chemistry and molecular diagnostics Ed Burtis and Ashwood. W.B Saunders Company.
 7. Principles and techniques of Practical Biochemistry. Ed Keith Wilson and John Walker. Cambridge University Press.
 8. Biochemistry. Ed. Donald Voet and Judith G. Voet. John Wiley & Sons, Inc.
 9. Molecular Cell Biology, H. Lodish, A, Berk, S.L.Zipursky, P. Matsudaira,
 10. D. Baltimore, J. Darnell.
 11. Medical Biochemistry by Bhagwan.
 12. KU BY's
 13. Roitt – Immunology
 14. Campbell – Biochemistry
 15. Harrison's – Principles of Internal Medicine
 16. William's – Concepts of Genetics
 17. Mosby's – Manual of diagnostics
 18. Basic & Advances Biostatistics – Manju Pandey
 19. Oxford Handbook of Medical Biostatistics

JOURNALS:

1. Annual Reviews of Biochemistry, Cell and Developmental Biology, Genetics, Genomics and Human Genetics
2. Archives of biochemistry and biophysics (Arch BiochemBiophys)
3. Biochemical and Biophysical Research communications (Biochem Biophys res Commun)
4. Biochemical journal (biochem J)
5. Biochemistry
6. European Journal of Biochemistry
7. Indian Journal of Biochemistry and Biophysics
8. Journal of Biological chemistry
9. Journal of Clinical Investigation
10. Journal of Lipid Research
11. Nature Genetics

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12. Proceedings of the National academy of Sciences USA
 13. Trends in Biochemical Sciences



आयुर्विज्ञान में राष्ट्रीय परीक्षा बोर्ड
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NATIONAL BOARD OF EXAMINATIONS IN MEDICAL SCIENCES

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