

Department of Biochemistry & Molecular Biology University of Dhaka

Website: www.bmbudhaka.net

Syllabus for One year **MS** Course (Group A & B) for the Session: **2000-2001 & 2001-2002**

There will be a total of six units for both Group A (General) and Group B (Thesis) students. The course distribution will be as follows

GROUP A GENERAL)

Theory	4 Units
Viva	½ Unit
Seminar	½ Unit
Practical	1 Unit

GROUP B (THESIS)

Theory	4 Units
Viva	½ Unit
Seminar	½ Unit
Thesis	1 Unit

The theory courses are as follows:

1. BMB 501: Advanced Molecular Biology
2. BMB 502: Biochemical, Molecular and Immunodiagnostics
3. BMB 503: Environmental and Agricultural Biochemistry
4. BMB 504: Biochemistry of Drugs
5. BMB 505: Advanced Nutrition and Nutritional Biochemistry
6. BMB 506: Chemistry of Natural Products

Among these courses BMB 501 and BMB 502 are mandatory. Out of the remaining four, BMB: 503, 504, 505 & 506, the students will choose two.

BMB 501 Advanced Molecular Biology

1. Gene regulation by RNA

Small RNAs and insights into a new level of gene regulation

Postranscriptional RNA silencing (PTGS) – RNA interference (RNAi) gene silencing role of dsRNA in triggering PTGS/RNAi; formation of dsRNA; role of Dicer (RNase III-type protein) and RISC (RNA Induced Silencing Complex) in RNAi gene silencing system
RNA silencing as a tool for knocking down genes and to counter foreign sequences

2. Genomics

Human Genome Project/brief mention of others

Physical mapping and sequencing of the genome; sequence analysis and annotations; linkage analysis; physical map-based cloning and mapping in silico; comparative homologies, evolutionary changes and single nucleotide polymorphism
DNA microarray– preparation of microarray slides, hybridization, interpretation and application

3. Proteomics

Proteomics – area and scope

Experimental approaches to proteomics: “classical proteomics” – 2D gel electrophoresis; Mass spectrometry; functional characterization of proteins: differential display, phage display, use of GFP to visualize proteins in live tissues. Human proteomics initiative: annotation of all human proteins in SWISSPROT and beyond, Role of proteomics in disease

4. Bioinformatics

Fundamentals of Bioinformatics – area and scope

Organization of data bases: genome, nucleotide and protein (primary, secondary and composite) sequences, macromolecular structure, integrated database, bibliographic databases, gene expression data

Search and analysis:

Text based searching

Nucleotide database searching (using Blast, Fasta, EMBL-EBI, DDBJ etc): retrieval of specific genes(s) from database; sequence alignment and estimation of homology (using CLUSTAL. W etc): searching restriction sites within the sequence; identification of transcription termination signal; primer design

Protein database searching (using SWISSPROT, PDB, PRF, PIR etc): amino acid sequence alignment and homology; conserved sequence; protein motif, secondary structure analysis: hydropathy analysis; dendrogram construction. Microarray database

Web-based resources for biologists; ExPasy, Pedros tool, BIOTOOLKIT, Medline workbench, TTIGR, Glinmer M. free full text journals

Recommended Books

1. Discovering Genomics, Proteomics & Bioinformatics

By A. Malcolm Campbell and Laurie J. Heyer

Cold Spring Harbor Laboratory Press

and Benjamin Cummings 2002

2. Proteomics from sequence to function

By Pennington and dunn

Springer-Verlag, New York, 2001

<http://www.bmbudhaka.net>

3. Functional Genomics: A Practical Approach

By Hunt, F.J. Livesey

Oxford University Press 2000

4. Bioinformatics: A Practical Guide to the analysis of Genes and Proteins

By Andreas D. Baxevanis, B.F. Francis Ouellette,

Ouellette B.F. Francis

BMB 502 Biochemical, Molecular and Immunodiagnosics

1. Collection and Preservation of Specimens: blood, urine, CSF, synovial, amniotic and other body fluids. Hazards in the clinical diagnostic laboratory

2. Quality Control in the Clinical Laboratory: precision, accuracy, reference values, interpretation of results

3. Clinical Biochemistry Analyses

Serum metabolites: glucose, urea, bilirubin, total cholesterol, HDL-cholesterol, LDL-cholesterol, TG, lipoprotein, uric acid, BUN, creatinine, total protein, albumin, A/G ratio

Enzymes in clinical diagnosis: enzyme profile in liver, kidney, bone, heart and muscle diseases (ALT, AST, ALP, γ -GT, CPK, CK-MB, LDH)

Plasma electrolytes: sodium, potassium, chloride, bicarbonate, water and acid-base balance.

Plasma minerals: calcium, phosphorus, iron, zinc, magnesium, iodine.

Organ system diseases: renal, gastrointestinal, pancreatic, hepatobiliary, cardiovascular, neurological and psychiatric diseases.

Laboratory automation: automatic and semiautomatic analyzers and their working principles.

4. Haematology: hemoglobin, erythrocyte sedimentation rate, total count, differential count, Hb-electrophoresis, HbA1c, blood group, Rh – factor, blood transfusion, haemostasis, cross-matching, tissue typing.

5. Molecular Diagnostics

Isolation of DNA from different specimens

PCR in molecular diagnostics: real time PCR, qualitative and quantitative PCR, PCR-ELISA, microsatellites in molecular diagnosis of genetic disorders, infectious diseases and cancer

DNA fingerprinting: microsatellites and other PCR-based finger printing for personnel identification, paternity dispute

Forensics: Y chromosome microsatellites in genome diversity, paternity testing and forensic applications, mitochondrial DNA

HBV- DNA detection, HIV-RNA and HCV-RNA detection, MTB

HLA-typing: SSP and SSOP methods, hybrid capture system for molecular diagnosis

6. Immunodiagnosics

Immunoassays: Enzyme immuno assay, microparticle enzyme immunoassays for detection of HBV, HCV and other viral infections, RIA, immunoturbidometry, microtiter-haemagglutination, flow cytometry
Assays for Antigens: HBsAg, HbeAg, HBcAg, immunoelectrophoresis, tumor markers, α -fetoprotein, cancer markers.

Assays for Antibodies: IgG, IgM, IgE, anti-HBV-DNA, IgM-anti-HBc, thyroid diseases (T_3 , T_4 assays), anti-double stranded and anti-single stranded DNA antibodies, autoimmune hemolytic anemia, autoimmune diabetes, pernicious anemia, diagnostic and prognostic value of autoantibodies, complement deficiencies, detection and quantitation of immune complexes, assay of C-peptide.

Diagnostic application of monoclonal antibodies: progression of treatment, side effects of antibody therapy.

Immunoassays of hormone: estrogen, progesterone, cortisone, prolactin, latex agglutination test for detection of HCG.

BMB 503 Environmental and Agricultural Biochemistry

Introduction to ecology and ecosystem

Environmental pollution (water, soil and air), noise and thermal pollution, their sources and effects

Pollution due to arsenic, tannery, textile, lead and sulphur- rich coal

Waste water (sewage and industrial effluents) treatments: anaerobic and aerobic treatment, conventional and advanced treatment technology, methanogenesis, methanogenic, acetogenic, and fermentative bacteria-technical process and conditions, emerging biotechnological processes in waste - water.

Solid waste management: landfills, composting, earthworm treatment, recycling and processing of organic residues.

Treatment of heavy metal wastes

Development of Industrial Waste Treatment System

Anaerobic digestion of agro-industrial byproducts & wastes

Bioremediations: Biotransformation of toxic wastes to harmless products.

Wasteland: Uses and management, bioremediation and biorestitution of contaminated lands.

Environmental genetics: Degradative plasmids, release of genetically engineered microbes in environment

Environmentally friendly biofertilizers & biopesticides

Biofuels & Biogas

Bioengineered foods: regulation and safety

Plant Environment & Agriculture

(A) Responses to plant pathogenesis

- (i) Ways in which plant pathogenesis cause disease.
- (ii) Plant defense systems
- (iii) Genetic basis of plant-pathogen interactions
- (iv) Biochemistry of plant defense reactions
- (v) Systemic plant defense responses
- (vi) Control of plant pathogen by genetic engineering

(B) Responses to Abiotic Stresses

- (i) Plant responses to abiotic stresses
- (ii) Stresses involving water deficit
- (iii) Osmotic adjustment and its role in tolerance to drought and salinity.
- (iv) Impact of water deficit and salinity on transport across plant membranes.
- (v) Additional genes induced by water stress.
- (vi) Freezing stress.
- (vii) Flooding and oxygen deficit

- (viii) Oxidative stress
- (ix) Heat stress

(C). Molecular Physiology of Mineral Nutrient Acquisition, Transport, and Utilization

- (i) Overview of essential mineral elements
- (ii) Mechanisms and regulation of plant K⁺ transport
- (iii) Phosphorus nutrition and transport
- (iv) The molecular physiology of micronutrient acquisition
- (v) Plant responses to mineral toxicity. Plants as bioreactors

(D). Crop Improvement and yield enhancement

(E). New edible uses of novel plant products

Uses and modifications of fatty acids & lipids, plants as sources of biodegradable plastics, plants as factories for chemical drug.

Recommended Books

Environmental Microbiology: W.D. Grant & P.E. Long, Blakie, Glasgow and London

Biotreatment Synthesis: D.L. Wise (Ed) CRC Press, Inc.

Standard Methods for the Examination of Water and Waste Water:
(14th Edition) 1985
American Public Health Association

Biochemistry and Molecular Biology Plants:
Bob B. Buchanan, Wilhelm Gruissem & Russell L. Jones.
Am. Soc. Plant Physiologists

Plant Biochemistry & Molecular Biology
Hans – Walter Heldt
Oxford University Press

BMB 504 Biochemistry of Drugs

1. Introduction

Drugs – basic features
Broad classification with specific examples

2. Some selected groups of drugs

Cardiovascular drugs
Immunosuppressive drugs & Immunotherapy
Antimicrobials e.g. Penicillin-Cephalosporin groups, Aminoglycosides, Tetracyclines etc.
Locally acting drugs e.g. Gastric antacids, Antiseptics, Disinfectants.
Enzymes inhibitors that act as drugs

3. Pharmacokinetics

Drug absorption
Drug distribution, bio-availability, half-life
Drug metabolism and its various aspects, factors affecting drug metabolism, methods of studying drug metabolism.
Drug excretion

4. Molecular mechanism of drug action

Basic aspects
Structure – activity relationship of drugs like, Antihistamines, Sulfa drugs and Psychiatric & antidepressants.
Drug receptors (e.g. ion channel receptors, G-protein coupled receptors, etc.) & their characteristics.
Non-receptor mediated drugs.
Agonists-antagonists with emphasis on drug and receptor interaction, drug-drug & drug-metabolite interaction.
Drug resistance and its implication
Drug toxicity and its effect, evaluation in lower animals, drug allergy & tests for its prediction, design of toxicity tests, antidote.

5. Drug design

Basic concepts; physico-chemical factors in designing of a drug e.g. thermodynamic, electrostatic & steric factors, topology, molecular interaction and kinetics
Molecular methods in drug design and development-targeting and pharmacogenomics

BMB 505 Advanced Nutrition and Nutritional Biochemistry

1. Malnutrition and Immunity

Role of nutrition in immune response to infection
Malnutrition and immunity
Nutrition and immunodeficiency disorders
Dietary modification in infection

2. Nutrition and Genomics

Genetic and environmental variations and nutrient composition of foods
Role of nutrients in gene expression and regulation
Ethnic differences and gene variants
Gene modified food: Use of molecular genetics to improve food properties

3. Nutrition – Drug Interaction

Effect of food on drug pharmacokinetics
Effects of drugs on nutrition: drugs which affect food intake, absorption, metabolism and excretion.
Nutritional status and drug toxicity

4. Nutrition and IT

Nutrition Information, Education and communication – IT offers a new approach
IT & Nutritional support for patients with chronic illnesses

5. Malnutrition and Psychosocial Development

Introduction: Definition and Terms
Malnutrition and brain and mental development
Impact of PEM on brain development and psychosocial development
Studies on nutritional rehabilitation and mental development
Malnutrition and cognitive development: A multifaceted problem

6. Current Topics in Nutrition

Eating disorders: Anorexia nervosa and Bulimia nervosa
Total parenteral nutrition (TPN)
Sports nutrition
Poverty and Nutrition
Nutrition in emergencies: famine, war, flood and natural disasters.
International nutrition: Nutrition in developing economics
Globalization and Nutrition
Nutritional enhancement of plant foods

7. Applied Nutrition

Diet, Nutrition – and lifestyle – related chronic non-communicable diseases (NCDS)
Low birth wt: increased risk of morbidity, mortality and retarded cognitive development
Nutrition and HIV/AIDS
Food and Nutrition Security in developing countries
Nutrition Interventions Programs in Bangladesh.

BMB 506 Chemistry of Natural Products

1. UV. IR Spectroscopy – a brief treatment

2. NMR Spectroscopy: Theoretical background of NMR: very brief treatment; the chemical shift, factors affecting the chemical shift: Induction effect, magnetic anisotropy, solvent, temperature, hydrogen bonds, spin-spin splitting – the coupling constant. Types of coupling constants and their importance in the determination of stereochemistry of compounds. Factors affecting coupling constants. Intensity and multiplicity. AB system and ABX system. ¹³C NMR spectroscopy. Nuclear overhauser effect (NOE). Two dimensional NMR – COSY, HMQC, HMBC. Application of NMR spectroscopy: Interpretations of NMR spectral data of some natural compounds. Application of ¹³C NMR in the elucidation of biosynthetic pathways of antibiotics, fermentation products etc. ³¹P NMR: Application of ³¹P NMR spectroscopy in diagnosis in intact organism and isolated organs such as muscle, heart, liver, kidney problems.

3. Mass spectroscopy: Theoretical background-very brief treatment, determination of molecular formula, fragmentation processes, mass fragmentation patterns of some natural products. McLafferty rearrangement. Application of mass spectroscopy for some biochemical molecules (proteins, nucleic acids). GC-MS – A powerful means of structure identification for the compounds of natural & synthetics sources. LCMS or HPLCMS.

4. Spectroscopy and structure of some natural products such as penicillins, N-methyl coclaurine, Liridine and others.

5. Chemistry of cephalosporin, chloramphenicol, tetracyclines, streptomycin, quinine, morphine, papaverine, cinchonine, vitamin B₁, Vitamin B₂, Ergocalciferol – Isolation, purification, structure determination. Mode of actions of some selected antibiotics, alkaloids and steroid drugs. Structure activity relationship.

6. Chemical synthesis of cholesterol, cortisone, juvenile hormone, vitamin A, testosterone, Aldosterone.

7. Flavonoids: sources, classification, isolation, purification, identifications and structure determination of Flavanol, flavone and isoflavones. Medicinal importance.

BMB 507 Practical

Molecular Biology

1. Restriction mapping of DNA
2. Generation of nucleic acid probes by oligolabelling
3. Detection of nucleic acid sequences by hybridization
4. Southern blotting and dot blotting
5. DNA fingerprinting of bacterial strains.
6. Introduction of foreign DNA into tissue cultured cells
7. Isolation and analysis of genomic DNA and RNA from tissue cultured cells.
8. Agarose gel electrophoresis of DNA and RNA
9. Polymerase chain reaction (PCR) of a specific target gene from genomic DNA
10. Gel electrophoresis of proteins from normal & stressed plants.

Bioinformatics

1. Retrieve at least 3 different types of gene sequences from database using name/accession number of the genes
2. Find ORFs, promoter sequences and transcription termination signals
3. Find restriction enzyme sites and construct restriction maps of the genes
4. Translate the nucleotide sequence into amino acid sequence. Analyze the amino acid content in the protein sequence.
5. Do multiple alignments of the proteins and analyze their homology and conserved sequences. Prepare dendrograms of the homologous proteins.
6. Design primers in order to clone a gene through PCR amplification.

Clinical Biochemistry

1. Determination of creatine clearance rate (CCR)
2. Determination of plasma lipid profile (total cholesterol, HDL- and LDL-cholesterol).
3. Determination of cardiac enzymes (CPK, CK-MB and LDH).
4. Determination of serum iron and iron binding capacity (TIBC).

Immunology

1. Determination of serum immunoglobulin G by ELISA method.
2. Detection of HBsAg by ELISA method.
3. Determination of serum complement C3 by immunoturbidometric method.
4. Immunoelectrophoresis of major serum immunoglobulins.

Natural Products

1. Chemical synthesis of phenacetin
2. Clinical synthesis of benzocaine
3. Estimation of dichlofenac sodium from pharmaceutical preparation
4. Estimation of metronidazole from pharmaceutical preparation
5. Estimation of tolbutamide from pharmaceutical preparation
6. Estimation of aciclovir from pharmaceutical preparation
7. Estimation of Al_2O_3 and $Mg(OH)_2$ from pharmaceutical preparation
8. Extraction & Identification of alkaloids from *Polyathia longifolia* (Devdaru) leave or bark.

Nutrition

1. Determination of toxin (ODAP) in Khesari seed
2. Field level estimation of blood hemoglobin
3. Determination of serum vitamin A and E by HPLC