NATIONAL UNIVERSITY

Syllabus
Department of Biochemistry

Detailed Syllabus of Third Year

Four Year B.Sc. Honours (Integrated) Course
Effective from the Session: 2009–2010
National University
Syllabus for Bachelor of Science (Honours)
Subject: Biochemistry

Year wise Courses, Marks and Credits distribution

<table>
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<tr>
<th>Subject code</th>
<th>Subject Title</th>
<th>Marks</th>
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<td>Metabolism of Lipids and Nitrogen Compounds</td>
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<td>2973</td>
<td>Molecular Biology II</td>
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<td>Endocrinology &amp; Clinical Biochemistry</td>
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<td>Human Nutrition</td>
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<tr>
<td>2980</td>
<td>Practical</td>
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1. **Lipid metabolism**: lipoprotein composition and metabolism, fatty acid oxidation, ketone body formation and utilization, fatty acid biosynthesis, regulation of fatty acid metabolism, storage of fatty acids as triglycerides, utilization of fatty acids for energy production, metabolism and functional role of polyunsaturated fatty acids; cholesterol metabolism, arachidonate metabolism: prostaglandins, prostacyclines, thromboxane, and leukotrienes, phospholipid and glycolipid metabolism.

2. **Disorders of lipid metabolism**: Obesity, diabetic ketoacidosis, stress, fatty acids and myocardial infarction: genetic deficiencies in carnitine or carnitine palmitoyl transferase, respiratory distress syndrome, atherosclerosis.

3. **Amino acid metabolism**: Overview, general reactions of amino acids, glucogenic and ketogenic amino acids, oxidative degradation of amino acids to specialized products, amino acid biosynthesis, regulation of amino acid metabolism, metabolism of branched chain amino acids, propionate and methylmalonate metabolism, urea cycle, nitrogen fixation, folic acid and one-carbon metabolism, glutathione metabolism, clinical correlations: phenylketonuria, alkaptonuria, folic acid deficiency, hyperamonemia and hepatic coma, deficiencies of the urea cycle enzymes.

4. **Nucleotide metabolism**: Overview, metabolic functions of nucleotides, synthesis of purine and pyrimidine nucleotides, formation of deoxyribonucleotides, nucleotide degradation, biosynthesis of nucleotide coenzymes, nucleotide metabolizing enzymes as a function of cell cycle and rate of cell division, antimetabolites of purine and pyrimidine nucleotide metabolism, heme metabolism, regulation of nucleotide metabolism, Lesch-Nyhan syndrome, gout, orotic aciduria.

5. **Metabolism of individual tissues (in brief)**: Skeletal muscle, cardiac muscle, adipose tissues, liver, kidney and blood cells.

6. **Metabolic interrelationship**: Overview, starve feed cycle, mechanisms involved in switching the metabolism of the liver between the well-fed state and the starved state, metabolic interrelationships of tissues in various nutritional and hormonal states, metabolism in exercise.

**Books Recommended:**

1. *Lehninger Principle of Biochemistry*
   By: D.L. Nelson and M.M. Cox
   W.H. Freeman and Company

2. *Biochemistry*
   By: L. Stryer
   Publisher: W.H. Freeman and Company
1. **DNA replication II**: Speed of replication, initiation, priming in Eukaryotes, Elongation, termination. Disentangling daughter DNAs, separate DNA polymerases for initiation and elongation, creating the replication fork at an origin methylation and at the origin of replication and regulation of replication.

2. **DNA damage and repair**: Damage by mutagens and repair by different enzymes.

3. **Nucleic acid hybridization principles and application**: Preparation of nucleic acid probes, fluorescence labeling and detection system, standard and reverse nucleic acid hybridization assays, Southern blotting.

4. **Genetic codes**: Introduction codons and triplet words, codon anticodon interactions, sporadic alterations in the genetic code, nonsense codon redundancy.

5. **Transcription**: Prokaryotic and eukaryotic transcription factors, polysomes, transport of eukaryotic mRNA, UTR. promoters, transcription activators and transcription factors, enhancers and terminators, mechanism of RNA splicing and RNA processing, mRNA structure and its relation to stability. Transcriptional and posttranscriptional regulation. Introduction to protein - protein and other macromolecular interaction.

6. **Protein biosynthesis**: Ribosome structure, active sites in each subunits, protein synthesis- initiation, elongation and termination, control of translation in both prokaryotes and eukaryotes, peptidyl transterase activity of 23s rRNA.

7. **Protein localization**: Introduction, passage across membrane, protein translocation, chaperons, signal sequences of translocation.

**Books Recommended:**

3. *Lehninger Principle of Biochemistry*
   By: D.L. Nelson and M.M. Cox
   Publisher: W.H. Freeman and Company

4. *Biochemistry*
   By: L. Stryer
   Publisher: W.H. Freeman and Company

5. *Molecular Biology of the Gene*
   Publisher: The Benjamin/Cummings Publishing Company

6. *Gene IX*
   *Molecular Cell Biology*
   By: Lewin
   Publisher: W.H. Freeman and Company
Course Title: Molecular Genetics

1. Host controlled restriction and modification, plasmid incompatibility

2. **General nature of mutation:** types of mutation, physico-chemical mutagens, molecular mechanism of mutation, in vitro mutagenesis, site-directed mutagenesis, transposons and insertional elements, repair mechanism in mutation.

3. **Recombination:** Various models for recombination, Rec system, conjugation, transduction, transformation and transfection, restriction mapping, chromosome walking, restriction fragment length polymorphism (RFLP), genetics of lambda phage, assembly of T phage.

4. **Gene expression:** Lac and Trp operon, positive and negative control systems of gene expression for both prokaryotic and eukaryotic systems.

5. Genetic engineering in bacteria, yeast and plants.

**Books Recommended:**

7. *Lehninger Principle of Biochemistry*
   By: D.L. Nelson and M.M. Cox
   W.H. Freeman and Company

8. *Biochemistry*
   By: L. Stryer
   Publisher: W.H. Freeman and Company

9. *Molecular Biology of the Gene*
   Publisher: The Benjamin/Cummings Publishing Company

10. *Gene IX*
    *Molecular Cell Biology*
    By: Lewin
    Publisher: W.H. Freeman and Company
1. **Overview of history of Microbiology** – Biogenesis and abiogenesis; Contributions of Redi, Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch [Germ Theory], Edward Jenner and Flemming [Penicillin] in Microbiology; Scope of Microbiology.

2. **Classification and basic concepts of microbes** - Systems of classification; General properties and principles of classification of microorganisms; General characteristics and functions of Microbes; Physical and Chemical Structures of different Microbes.

3. **Microscope**: Microscopy and different types of microscope (light microscope, phase contrast microscope, fluorescence microscope, electron microscope)

4. **Stains and staining techniques** – Definition of auxochrome, chromophores, dyes; Classification of stains; Theories of staining; Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

5. **Bacteria** – Bacterial cell structure; General classification of bacteria; Nutritional aspects of bacterial cultivation media, composition; growth and reproduction; Male and femaleness in bacteria (F\(^+\), F\(^-\) and Hfr); environmental factors affecting growth - temperature, pH, osmotic pressure; isolation of pure culture from natural sources, enumeration; steps to maintain microbial culture in an aseptic & sterile environment (how to inoculate, preserve & maintain).

6. **Basic concepts of virology** - General characteristics of viruses; differences between bacteria and viruses; Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry – enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Viroids, prions, Virus of plants (TMV), HIV, H1N1 virus

7. **Bacteriophages**: E.coli phage lambda; E. coli PhageT4; Stages in the Lytic Life Cycle of a typical phage; Properties of a phage infected bacterial culture; Specificity in phage infection; The lysogenic Cycle.

8. **Beneficial microbial interaction with human**: Normal microbial population of healthy human body- skin, mouth, respiratory tract, urino-genital tract, eye.

9. **Harmful microbial interactions with human**: Entry of pathogen into the host; Types of bacterial pathogens; Mechanism of bacterial pathogenicity; Colonization and growth; Virulence; Virulence factors- exotoxins, enterotoxins, endotoxins, neurotoxins- avoidance of host defense mechanisms, damage of host cell, Host factors for infection and innate resistance to infection.

10. **Control of pathogens**: Definition and classification of antibiotics on the basis of structure and mode of action, antibiotics produced by bacterial (bacteriocin, antibiotic); semi-synthetic antibiotic, drug toxicity, drug resistance.

11. **Industrial microbiology**: Examples of industrially important microbes; their isolation from natural habitat; Basic concepts on fermentation technology; Bioconversion (Bio-gas, Bio-fuel); Microorganisms in Agriculture waste water treatment; Microbial pesticides; commercial products from microorganisms enzymes, antibiotics); Bioremediation (chemical degradation, heavy metals).

12. **Food microbiology**: Microbiology of milk, cheese, yogurt, spoilage of food, pasteurization

13. **Agricultural microbiology**: Microbes in soil surface and different zones of soil, symbiosis, nitrifying, nitrfying ammonifying and photosynthetic bacteria.

**Books Recommended:**

1. *Microbiology*  
   Concepts & Application  
   Micael J. Pelczar, Jr. ECS, Chan & Nocl R. Krieg  

2. *Microbiology*  
   Bern D. Davies, Renato Dulbecco  
   Herman N. Eisen and Harold S. Ginsberg  
   Harper and Row.
1. **Blood**: Blood cells, lymph, serum, plasma, total count (TC), differential count (DC), origin of the blood cells, blood grouping (types).

2. **Hemostasis, biochemistry of blood clotting.**

3. **Circulatory System**: Heart - structure and functions, Arteries, veins, capillaries, heart sound, cardiac cycle, basic properties of cardiac muscles, blood pressure and measurement.


5. **Digestive system**: Digestive enzymes, digestion of carbohydrates, proteins and lipids and absorption of digested products.

6. **Kidney**: Excretory system, role of kidney in water, electrolyte and acid-base balance of the body, buffers of the cells, regulation of extra cellular fluid composition and formation and excretion of urine.

7. **Liver**: Structural organization and function.

8. **Reproductive system**: male reproductive system: spermatogenesis, hormonal factors that stimulate spermatogenesis, regulation of male reproductive functions by various hormones. Female reproductive system: monthly ovarian and uterine cycle and function of gonadotropic hormones, pregnancy, function of the placenta, hormonal factors in pregnancy, lactation, menopause.

9. **Nervous system**: Nerve cells, ionic basis of excitation and conduction, synaptic transmission, reflex action, the sense, sense receptors, hypothalamus and temperature regulation.

**Books recommended:**

1. **Human Biology**
   By: Sylvia S. Mader
   Publisher: Wm. C. Brown Publishers

2. **Test Bookl of Physiology**
   By: A.c. Guyton
   Publishers: W.B. Sannders Publishing Company

3. **Human Physiology**
   By: G.J. Tortosa, R.L. Evans & N.P. Ananosakus
   Oulishers L Harper & Row.
1. **Characteristics of the hormone system**: Introduction, function of hormones, endocrine glands, target gland concept, negative and positive feed back, hormone receptors and its abnormalities. Classification of hormones, intracellular messengers.

2. **Pituitary, Hypothalamic, Thyroid and Parathyroid hormones**: structure, synthesis, physiological and biochemical actions.

3. **Hormones of the adrenal cortex, adrenal medulla, gonads and Pancreas**: Their structure biosynthesis, regulation, transport, mechanism of action and pathophysiology.

4. **Gastrointestinal hormones**: Gastrin, cholecystokinin (CCK), secretin, glucagon, gastric inhibitory polypeptide (GIP), vasoactive intestinal polypeptide (VIP), glicentin, neurotensin, substance P and somatostatin.

5. **Hormone assay techniques**: Assay of peptide and steroid hormones by radioimmunoassay (RIA) and enzyme-linked immunosorbent assay (ELISA).

6. **Clinical application of enzymes and metabolites as diagnostic tools**: Basic approach to diagnosis involving handling and processing of samples, acquisition and interpretation of biochemical data, investigation of CSF, Tumor markers, Biochemical aspects of mental handcrafts. enzymes in diagnosis, use of enzymes e.g. alanine aminotransferase (ALT), aspartate aminotransferase (AST), creatine kinase (CK), lactate dehydrogenase (LDH), amylase, acid phosphatase (ACP) and metabolites e.g. bilirubin, uric acid, blood urea nitrogen (BUN), cholesterol and electrolytes in diagnosis.

7. **Biochemistry of various diseases**: Atherosclerosis, Macrophage lipid metabolism in atherosclerosis, vascular dysfunction and its contribution to atherosclerosis, oxidative stress and platelet function in Atherosclerosis, lipoprotein influx and efflux lipoproteins in Atherosclerosis, protein oxidation in Atherosclerosis, and other diseases hepatitis, diabetes, rheumatoid arthritises, obesity, gout, malabsorption syndromes, acidosis and alkalosis, Thyroids dysfunction, HRT.

8. **Biochemical interpretation & certain genetic disorders**: PKU, Fructose intolerance, Glycogen storage diseases sickle cell anemia, hemolytic anemia, thalassemia, hypercholesterolemia, lipid storage disease, muscular dystrophy.

9. **Antioxidant intervention studies in human beings, anti-oxidents and co-antioxidation.**

10. **Genotherapy.**

11. **Xenobiotics**: Introduction, general properties of xenobiotic metabolites, role of livers in such metabolism, characteristics of Cyt.b450, conjugation, reduction, hydrolysis and oxidation as methods of xenobiotic metabolism.

**Books Recommended:**

1. *Text Book of Biochemistry with Clinical Correlations*
   By: J. M. Devlin  
   Publisher: John Wiley & Sons.

2. *Horper’s Biochemistry*
   By: R.K. Murray, D.R. Granner, P.A. Mayer and V.W. Rodwell  
   Publisher: Appleton and Tanys

3. *Clinical Chemistry*
   By: A.I. Kaplan & A.I. Pesu  
   Publisher: Uea & Feburger

4. *The Metabolism Basis of Inherited Diseases*
   By: J.S. Slanbury, J.B. Wyngarden and D.s. Fred Rickson  
   Publisher: McGraw Hill

5. *Applied Biochemistry of Clinical Disorders*
   By A. Gernell  
   Publisher: Bippincott
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<th>Course Code</th>
<th>2978</th>
<th>Marks: 100</th>
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1. **Components of an adequate diet:** Carbohydrate, fat, protein, vitamins and minerals in diet, interrelationship between fat, protein and carbohydrate metabolism.

2. **Role of carbohydrates in human nutrition:** Different forms of starch in food, their changes during food processing and cooking.

3. **Role of proteins in human nutrition:** Essential amino acids, limiting amino acids, mutual supplementation, protein quality and its evaluation, protein requirement.

4. **Fats and oils in human nutrition:** Saturated, monounsaturated and polyunsaturated fatty acids, omega-3 and omega-6 fatty acids in health, essential fatty acids.

5. **Vitamins:** Fat soluble and water soluble vitamins, coenzyme activities of vitamins (where known).

6. **Mineral and trace elements:** Ca, P, Mg, Mn, Fe, Cu, I, F, Zn, Se and other trace elements, role of trace elements in enzyme functions.

7. **Energy metabolism:** Energy requirement and energy expenditure, obesity, basal metabolic rate, specific dynamic action of foods, measurement of energy metabolism, respiratory quotient.

8. **Protein energy malnutrition:** Kwashiorkor, Marasmus and their management.

9. **Balance diet:** Diet in altered physiological conditions, pregnant and lactating mothers, growing children and elderly persons.

10. **Dietary management of diseases:** Such as diabetes mellitus, gout, atherosclerosis, obesity, jaundice and other liver diseases, mental illness and cancer.

11. **Assessment of nutritional status:** Of a population, nutritional problems of Bangladesh and their possible remedies.

**Books Recommended:**

1. *Human Nutritions & Dietetics*
   By: S. Davidson, R. Passmore, J.T. Brock and A.s. Transwell
   Publisher: Churchhill L Vingistone

2. *Modern Nutrition in Health and disease (Part I & Part II)*
   Edited by M.I. Stitles, J. A. Olsen and M. Shuhe
   Publisher: Lea & Febiger Publishers.

   By: M. Swammathan
   Publisher: BAPPCO Publishers.
Course Code: 2979  Marks: 100  Credits: 4  Class Hours: 60

Course Title: Computer Fundamentals

A. Theory (50 Marks):
1. **Introduction** Brief history and type of computer application areas, working principle of a computer system.
2. **Hardware**: Organization and architecture, mother-boards and microprocessors, memory units- primary memory, secondary memory I/O devices, ISA and PCI Bus architecture.
3. **Software**: Classifications, system software, operating system – importance, types and basic functions, introduction to Windows and UNIX operating systems, application of software, database, spreadsheet and word processing software.
4. **Programming in C**: Levels of programming languages, assembler compiler and interpreter, constants, variables and data types, programs with simple input output operations, decision making, branching and looping.
5. **Applications**: Multimedia systems, computer networks, basic concepts on LAN, WAN and internet systems, internet services.
6. **Maintenance**: Power supply stability, grounding effects of surge and sag and their protection, stabilizer and UPS, effect of static charge and handling of computer cards and chips, computer viruses and their protections.

B. Practical (50 Marks):

**Programming and computer applications:**
Simple exercises on WINDOWS and UNIX operating systems, development of programmes in C, programming languages. The students will also acquire practical experience on word-processing, spreadsheet analysis, database and statistical packages and their applications.
Course Code 2980  Marks: 100  Credits: 4  Class Hours: 60

Course Title: Practical

(6 hours/day)

1. Liver glycogen extraction and estimation.
2. Thin layer chromatographic separation of amino acids.
3. Estimation of acetoaminophen and salicylate in serum.
4. Determination of serum GOT and GPT activity.
5. Study of the activity of salivary amylase.
6. Determination of Km and Vmax of bovine kidney alkaline phosphatase.
7. Determination of serum acid phosphatase.
8. Determination of total globulin in serum by precipitation.
9. Effect of pH on protein solubility (precipitation of serum albumin and globulin at their respective pi).
10. Isolation of casein by precipitation at its isoelectric point.
11. Determination of nonesterified fatty acids from serum.
12. Separation of components of a lipid mixture by TLC.
13. Determination of total fatty acids in a lipid extract.
15. Determination of cholesterol in a lipid extract.
17. Isolation of plasmid DNA from *E. coli*.
18. Agarose gel electrophoresis of DNA.
19. Isolation and assay of bacteriophage
20. Amplification of DNA by polymerase chain reaction (PCR).

Books Recommended:

1. *Practical Clinical Biochemistry*
   By: A.H. Gowenlock
   Publisher: CBS Publishers and distributors

2. *Clinical Chemistry Interpretation and Techniques*
   By: A. Kaplan and L.I. Szabo
   Publishers: Lea and Laborger

3. *Data for Biochemical Research*
   Publishers: Onferd Sciences Publications.

4. *An Introduction to Practical Biochemistry*
   By: David R.T. Plummer
   Publisher: Tata – McGrawhill