NIMS UNIVERSITY

SYLLABUS
OF
MASTER OF SCIENCE (BIOCHEMISTRY)

VERSION 2.0

DIRECTORATE OF DISTANCE EDUCATION

Shobha Nagar, Jaipur - Delhi Highway (NH-11C), Jaipur (Rajasthan) PIN - 303121
INDIA
MASTER OF SCIENCE (BIOCHEMISTRY)

Eligibility : Graduate in related fields Program

Duration : 2 Years

Program Objectives : The foremost aim of this course is to provide a detailed understanding of the molecular events that control growth and development of all living things. This Master Level programme from Nims University is designed to assist the students to enhance their knowledge and expertise in the field of biochemistry.

Our curriculum is designed in such a way that it will provide in depth knowledge of various significant topics, such as:

- Cell Biology
- Microbiology and Immunology
- Bioenergetics and Metabolism
- Genetic Engineering and Enzymology
- Molecular Biology
- Clinical, Plant and Environmental Biochemistry
- Biochemical and Biophysical Techniques

Biochemistry has wonderful career opportunities. More importantly, the new and exciting disciplines of proteomics, genomics, bioinformatics, genetic engineering, and drug design all rely on the knowledge of and competency in biochemistry. The programme will enable the students to develop an integrated approach for understanding the various life science problems at the molecular level.

Job Prospects : Our M.Sc. in Biochemistry degree is one of the most versatile degrees you can obtain because of the fundamental nature of the discipline, and also because it can be combined with so many other sciences, leading to powerful and sought-after skills.

After the completion of our program, you will find a challenging career in the pharmaceutical industry, environmental testing, or forensic science laboratories. You will find exciting opportunities in laboratories in universities, biotechnology companies and agricultural, medical and veterinary institutes as well opportunities with analytical and research laboratories in areas such as the food & beverages or fuel production from waste products by fermentation. New opportunities have recently risen in hospitals and government agencies, in specialist areas, such as forensics, biosecurity, and quarantine.

Common job profiles of students after completing M.Sc. in Biochemistry include: Research Biochemist, Industrial Biochemist, Clinical Biochemist, Biochemists/Molecular Biologists, Academic positions.
## YEAR I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Theory/Practical</th>
<th>Continuous Assessment (Internals)</th>
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<td>Immunology</td>
<td>70</td>
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<td>Bioenergetics and Metabolism</td>
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## YEAR II

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<td>BCH16207</td>
<td>Biochemical and Biophysical Techniques</td>
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<td>BCH16208</td>
<td>Plant Biochemistry</td>
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### YEAR I

#### CELL BIOLOGY – BIO16102

<table>
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<tr>
<th>UNIT</th>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Introduction to Cell Biology</strong>: Cell theory; Classification of Cells; Structure of Prokaryotic Cells, Cell Organelles; Structure of Eukaryotic Cells, Cell Organelles; Prokaryotes versus Eukaryotes.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Cell Membrane</strong>: Cell Membrane; Cell Membrane/Plasma Structure, Theories, Lipid Bilayer, Membrane Polarity, Membrane Structure, Cytoskeleton, Functions; biochemistry of the Cell Membrane, Membrane Lipids; Role of Lipid Molecules in Maintaining Fluid Property of Membrane, Types of Movements of Lipid Molecules, Role of Unsaturated Fats in Increasing Membrane Fluidity, Role of Cholesterol in Maintaining Fluidity of Membrane; Membrane Proteins.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Cell Motility</strong>: Cell Motility, Elements of Cell Movement, Cilia and Flagella, Occurrence of Cilia and Flagella, Structure of Cilia and Flagella, Movement of Cilia and Flagella, The Overall Structure of Bacterial Flagella; Molecular Events and Model, Amoeboid Movement, Pseudopodia, The Sliding-Filament Model of Bending, The Primary Cilium; Cellular Responses to Environmental Signals in Plants and Animals, Cell Signaling can be divided into three stages; Signal Transduction; Signal Amplification; Rhizobium Legume Symbiosis, The Role of Nod Signal Structures in the Determination of Host Specificity in the Rhizobium-legume Symbiosis.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Cell cycle and regulation</strong>: Review of cell cycle, Divisional Control; Regulatory Proteins; Cell Cycle Regulation; Cyclin/Cdk complexes, positive and negative regulation; The Restriction Point, A Knot of Mitogen and Inhibitory Signaling, cis-Acting Regulatory Sequences: Promoters and Enhancers.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Cell communication I</strong>: General Principles of Cell Communication; Extracellular signals and their receptors; Autocrine signaling; Role of gap junctions; Types of cell receptors; Relay of Signals; Intracellular signal proteins; Regulated proteolysis dependent signaling pathways, The Pathway mediated by the receptor protein notch, The pathway activated by secreted WNT Proteins, The Pathway activated by Secreted Hedgehog Proteins, The Pathway Activated by Latent Gene Regulatory Protein NF-κB.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Cell communication II</strong>: Informational transactions in eukaryotic cells; Cyclic AMP facet, Functions of cAMP; Study of G-proteins, Types of G-protein, Conformational Changes Occur in G-protein during Nucleotide Exchange, Role of G-protein in signal Transduction, G-protein linked cell surface receptor, Role of G-protein Coupled receptor; Signaling through Enzyme-linked cell-surface receptor; Calcium Messenger System-Calcium Ion Flux, Role of Calcium in cell signaling, Properties of Calcium Ion (Ca^{2+}), Function of Ca^{2+} in cell, Signaling via GMP.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Stem Cell</strong>: Properties of stem cell, self renewal, Totipotent, Pluripotent; Introduction and applications of embryonic stem cells, foetal cells, adult stem cells, muse stem cells, amniotic stem cells.</td>
</tr>
<tr>
<td>8</td>
<td><strong>Stem Cell Therapy</strong>: Medical uses of stem cells; Treatment of Brain Damage; Stem cell technology; Use in cancer therapy; spinal cord injury treatment; Treatment of heart failure; Blindness and vision impairment; Neural and behavioral birth defects; Wound healing; Infertility; Embryonic stem cell controversy.</td>
</tr>
<tr>
<td>9</td>
<td><strong>Cancer</strong>: Causes and types of cancer, Types of Cancer, Viral carcinogenesis; Tumor suppressors; Oncogenes and signal transduction; Growth and spread of cancer; Molecular basis of cancer therapy; Molecular markers programmed cell death and its regulation in normal physiology, apoptosis and cancer development, physiologic apoptosis; Regulation and execution of mammalian apoptosis, Cytokine signaling and role of apoptosis in tumor genesis.</td>
</tr>
</tbody>
</table>

**LEARNING SOURCE**: Self Learning Materials

**ADDITIONAL READING**:


WEB LINKS:
B. https://en.m.wikipedia.org/wiki/infertility
C. http://en.m.wikipedia.org/wiki/musecell

**CELL BIOLOGY (P) – BIO16102P**

1. The bright field microscope
2. Measurements: ocular and stage micrometers (Measuring area and volume)
3. Measurement of cell organelles
4. The phase contrast and inverted phase microscope
5. The transmission electron microscope
6. Comparison of electron micrographs
7. Microscopic Examination of Cells
8. Dilution Techniques
9. Measuring Enzyme Activity
10. Physiological Processes of Bacteria
11. Photosynthesis
12. Comparison of Normal and Transformed cells
13. Blood smear preparation

**MICROBIOLOGY – MBL16108**

<table>
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<tr>
<th>UNIT</th>
<th>CONTENT</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>The World of Bacteria:</strong> General Properties of Bacteria, Structure of Bacteria, External Structure, Plasma Membrane, Internal Structure; Ribosomes, Structure, Function, Regulation; Structure Linkage, Function, Storage Granules; Endospores, Formation and Destruction, Appendages; Classification of Bacteria, Bergey’s Classification of Bacteria, Kingdom Procaryotae, Classification of Bacteria according to the Shape of Bacteria, Classification Based on Cell Wall, Classifying Bacteria on Cellular Respiration, Classifying Bacteria by Growth Factors; Nutritional Requirements’ of Bacteria and the Properties of Growth Media, Growth Media, Selective Media, Different Types of Media, Media Requirements, Media Sterilization, Differential Media, Transport Media, Enriched Media,</td>
</tr>
<tr>
<td>2</td>
<td><strong>History and Scope of Microbiology:</strong> History of Microbiology, Ancient, Modern; Fermentation, Germ Theory of Disease, Immunization; Classification of Microbes, Scopes of Microbiology, Classification of Microbes; Anatomy of Prokaryotes, Eukaryotic Cells; Morphology and Ultra Structure of Virus, Morphology, Bacteriophages; Protozoa,</td>
</tr>
</tbody>
</table>
### Microbial Metabolism:
Different Media with Nutrient Composition, Differential Media, Transport Media, Enriched Media; Classification of Bacteria based on Nutritional Requirement, Autotrophs, Heterotrophs; Transport across Membranes, Structure of Cell Membrane, Movement across Cell Membranes, Vesicles.

### Staining Techniques:
Procedure and principle of staining, Gram’s staining; Acid fast staining techniques, Principle; Flagella stain, Materials; Endospore staining, Dorner method of staining endospores, Schaeffer-Fulton Method for Staining Endospores.

### Microbial Growth and Nutrition:
Methods for Measurement of Cell Mass, Methods for measurement of Cell numbers; Bacterial Growth Curve, Four characteristic phases of the growth cycle are recognized, Growth rate and generation time, Calculation of generation time; Measurement of growth fields, Synchronous growth, Continuous culture or Batch Culture method.

### Microbial Ecology:
Role of microbes on the earth; Symbiosis, Mutualism, Commensalism, Parasitism; Plant growth promoting microorganisms (PGPM) with biocontrol activities; Biological Control agents (BCA) with growth promoting activities, biological Interactions; Nitrogen fixation, Nitrogen Uptake, Nitrogen Mineralization; Microbial Bio-deterioration, Bio-deterioration of Wood Pulp and Paper.

### Learning Source:
Self Learning Materials

### Additional Reading:

### Web Links:
A. [http://faculty.college-prep.org/~bernie/sciproject/project/kingdoms/Bacteria4/Final/properties%20of%20bact.htm](http://faculty.college-prep.org/~bernie/sciproject/project/kingdoms/Bacteria4/Final/properties%20of%20bact.htm).

### Immunology – MBL16109

<table>
<thead>
<tr>
<th>UNIT</th>
<th>CONTENT</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Mechanism of Immune Response:</strong> Types of Immunity, Immune System, Primary Lymphoid Organ, Secondary Lymphoid Organ; Antigen, Immunoglobulin Structure.</td>
</tr>
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<td>2</td>
<td><strong>Biology of Complement System:</strong> MHC structure, Nomenclature; HLA typing, Serologic Methods, Microcytotoxicity Assay; Cell mediated immunity, Macrophage Activation; Cell mediated cytotoxicity, NK Cells, K Cells; Hypersensitivity, Type I Hypersensitivity, Type II Hypersensitivity, Type III Hypersensitivity, Type IV Hypersensitivity; Allergen immunotherapy, Treatment; Immunodeficiency disorders; Transplantation, Pre-transplantation Screening; Suppression of the immune system, Heart Transplantation, Kidney Transplantation, Stem Cell Transplantation; Classical Complement Pathway, Alternative</td>
</tr>
</tbody>
</table>
### Pathway, Lectin Pathway (MBL-MASP)

#### 3

**Antigen and Antibodies:** B cells, Rosetting Techniques; Antibody production, Chinese Hamster Ovary (CHO), Other Cell lines; Screening of cell lines, Steps in a Fed-Batch Process; Monoclonal antibody production, Conventional Method of Antibody Production, Hybridoma Technology, Monoclonal Antibody Production by Hybridoma Technology, Preparation of Cells; Isolation of antibodies, Immunotoxins, Chimeric Immunotoxins, Humanized Antibodies, CDR Grafted Antibodies, Heteroconjugate Antibodies; Steps in a western blot, Tissue Preparation, Gel Electrophoresis, Transfer, Blocking, Detection; Western Blot using radioactive detection system, Analysis, Colorimetric Detection, Chemiluminescent Detection; 2-D Gel Electrophoresis, Two-dimensional Gel Electrophoresis, Medical Diagnostic Applications, Dot Blot, ELISA.

#### 4

**Study of Blood Cells:** Isolation of mononuclear cells by Ficoll-Hypaque, Gradient Centrifugation, Depletion of Monocytes/Macrophages from Mononuclear Cells using Adherence Method, Depletion of Contaminating Cells from Mononuclear Cell; B-Cells, Development of B-Cells, Immune Tolerance; Fluorescence Activated Cell Sorting (FACS), Quantifying FACS Data, Mixed-Lymphocyte Reaction.

#### 5

**Cytokines:** Cytokine, Effect; Cytokine receptors, Disease; Cytokine assays, Cytokine Flow Cytometry, Principles of Flow Cytometry; Mechanism of killing, Perforin/Granzyme Killing, Fas/L/Fas Killing; Natural killer cells, Activation; History and Discovery, Edward Jenner, Cowpox and Vaccination; Elusive vaccine and the ethics of vaccine research, DNA Vaccines, Current Use, Plasmid Vectors for Use in Vaccination; Delivery methods, Immune Response Raised by DNA Vaccines; Mechanistic basis for DNA raised immune responses, DNA Uptake Mechanism, Antigen Presentation by Bone Marrow-Derived Cells, Alternative Boosts; Additional methods of enhancing DNA- Raised immune responses, Formulations of DNA, Alphavirus Vectors.

#### 6

**Immune Response:** Commensal microorganisms; Pathogens, Viruses, Bacteria, Fungi, Protozoa; Innate immune response; Adaptive immune response.

#### 7

**Hypersensitivities:** Types and mechanism of hypersensitivity, Type I Hypersensitivity Immediate Hypersensitivity, Type II Hypersensitivity, Type III Hypersensitivity, Type IV Hypersensitivity or Delayed Hypersensitivity; Immune to Microbes, Susceptibility to Extracellular Bacterial Infections, Susceptibility to Intracellular Bacterial Infections, Susceptibility to Fungal Infections, Susceptibility to Viral Infections, Susceptibility to Protozoa; Immune to tumors.

#### 8

**Cancer:** Systemic symptoms, Causes, Definitions; Types of cancer; Breast cancer, Causes, Symptoms, Tests, Treatment; Lung Cancer, Causes, Symptoms, Tests, Treatment; Skin cancer, Causes, Symptoms, Tests, Treatment; Prostate cancer, Causes, Symptoms, Tests, Treatment.

**LEARNING SOURCE:** Self Learning Materials

**ADDITIONAL READING:**


**WEB LINKS:**


C. [http://textbookofbacteriology.nit/immune.htm](http://textbookofbacteriology.nit/immune.htm)
**IMMUNOLOGY (P) – MBL16109P**

1. Detection of a Single Antibody Producing Cell (Jerne Plaque Assay)
2. MHC Polymorphism: HLA Typing by PCR
3. Phagocytosis
4. Analysis of negative selection in the T cell repertoire (Central tolerance)
5. Antibody interactions with antigens
6. Antibodies as probes
7. Immunoassay
8. Isolation of cells
9. Phagocytosis, complement and antibody-dependent cytotoxicity
10. Lymphocyte structure
11. Lymphocyte function
12. The cytokines
13. Immunological manipulations in vivo

**BIOENERGETICS AND METABOLISM – BIO16103**

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<th>UNIT</th>
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<tbody>
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<td>1</td>
<td><strong>Bioenergetics</strong>: Concept of free energy, Standard-State free energy of formation ($\Delta G^\circ$); Determination of a Reaction Relationship between Standard Free Energy Change and Equilibrium Constants; Biological standard state and standard free energy change in coupled reactions.</td>
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<td>3</td>
<td><strong>Coenzymes and Cofactors</strong>: Role and mechanism of action of NAD+/NADP+, Relationships between NAD and NADP; FAD; Lipoic acid, Mechanism of Action, Pharmacokinetics, Indications and Usage; Thiamine Pyrophosphate; Pyridoxal Phosphate – PALP Pyridoxamine Phosphate – PAMP; Tetrahydrofolate, Mechanism of Action; Metal Ions with Specific Examples; Biotin, Mechanisms of Action, B12 – Coenzymes.</td>
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<td><strong>Carbohydrate</strong>: Carbohydrates; structure of carbohydrate, Monosaccharide, Classification of Monosaccharides, Disaccharides; Role of carbohydrate in nutrition, Classification; Carbohydrate chemistry.</td>
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<td><strong>Carbohydrate Metabolism</strong>: Glycolysis, Various forms of fermentations in microorganisms; Citric acid cycle, Entry of Pyruvate into the Cycle, Cycle Itself, Measuring the Rate of the Citric Acid Cycle; Pentose Phosphate Pathway and its Regulation, Oxidation Phase, Isomerization Phase, Rearrangement Phase, Regulation; Gamma Aminobutyrate Shunt Pathway; Cori Cycle, Significance; Anaplerotic Reactions; Entner – Doudorff Pathway; Glucuronate Pathway; Metabolism of Disaccharides, Hormones Regulation of Carbohydrates, Energetics of Metabolic Cycle.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Amino Acid</strong>: Introduction to Amino Acids; General Structure, Isomerism, Zwitterions, Isoelectric Point; Occurrence and Functions in Biochemistry, Essential Amino Acids, Non-Standard Amino Acids, In Human Nutrition; Classification of Amino Acid, Non Protein Functions; Chemical Synthesis of Peptides; Biosynthesis of Amino Acid, Non essential</td>
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</table>
Amino Acids, Essential Amino Acids, Biosynthesis of Aromatic Amino Acids, Feedback Inhibition; Amino Acid Catabolism, Inborn errors of Amino Acid Metabolism, Heme Biosynthesis.

**Amino Acid Metabolism:** General reactions of amino acid metabolism, Transamination Reactions, Oxidative Deamination, Decarboxylation; Amino Acid Metabolism, Methionine Metabolism; Urea Cycle, Pathway, Link between the Urea Cycle and the Citric Acid Cycle, Regulation.

Lipid: Fatty Acids, Saturated Fat and Unsaturated Fat; Glycerolipids; Glycerophospholipids; Sphingolipids, Types of Sphingolipids; Sterol Lipid, Types; Prenol Lipids; Saccharolipids; Polyketides; Biological Functions – Membrane, Energy Storage and Signaling, Chemical Messengers, Lipids as an energy Reserve, Maintenance of Temperature, Membrane Lipid Layer Formation, Cholesterol Formation, Prostaglandin Formation and Role in Inflammation, Fat-soluble Vitamins.

**Lipid Metabolism:** Hydrolysis of triacylglycerols (TAG), β-oxidation of fatty acids, Regulation of β-oxidation, Odd Numbered Fatty Acids; Fate of propionic acid, Role of Carnitine, Degradation of complex lipids; Fatty acid biosynthesis, Acetyl-CoA Carboxylase, Fatty acid synthase; ACP structure and function; Biosynthetic pathway for tri-acylglycerols Phosphoglycerides; Metabolism of Sphingolipids and Prostaglandins, Sphingoglycolipids, Prostaglandin; Cholesterol Metabolism and Its Regulation Energetics of Fatty Acid Cycle.

**LEARNING SOURCE:** Self Learning Materials

**ADDITIONAL READING:**
A. Garby Lars, Bioenergetics, Cambridge University Press, 1995
B. Lowen Alaxder, Bioenergetics, Penguin/Arkana, 1994 Health & Fitness

**WEB LINKS:**
C. [http://biology.clc.uc.edu/courses/bio104/lipids.htm](http://biology.clc.uc.edu/courses/bio104/lipids.htm)

## GENETIC ENGINEERING – GNT16102

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<th>UNIT</th>
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<td>1</td>
<td><strong>Tools of Genetic Engineering:</strong> Mechanism of Gene Transfer by Agrobacterium, Formation of the T-pilus, Transfer of T-DNA into the Plant Cell; Enzymes used in genetic engineering, Restriction Engineering, Nucleases, DNA Ligase, Kinase, Alkaline Phosphatases, Reverse Transcriptase, Terminal Deoxynucleotide Transferase, RNase P; Cutting and joining DNA molecules, Cutting DNA Molecule, Joining DNA; Cloning vehicles and their properties, Characteristics of a Cloning Vector, Plasmid Vectors, Phage Vectors, Phagemids, Cosmids, Bacterial Artificial Chromosomes (BAC); Co-integrated Vectors: T-DNA-based-Hybrid-Vectors, Necessary Vectors of Co-integrated Vectors, Drawbacks of Co-integrated Vectors…</td>
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<tr>
<td>2</td>
<td><strong>Transposable Genetic Elements:</strong> Cloning vectors for recombinant DNA, M13 Phage, Phagemids; Restriction Endonucleases on cloning; cDNA library Construction, mRNA Extraction, cDNA Construction, cDNA Library uses; cDNA Library vs Genomic DNA Library, Cloning cDNA Molecules, DNA Sequencing, A Short Stretch of DNA, From Copying to Sequencing, Stopping DNA Polymerization, DNA Sequencing, Large Scale Sequencing; RFLP, Analysis Technique; Analysis and Inheritance of Allelic RFLP</td>
</tr>
<tr>
<td>3</td>
<td><strong>Expression Analysis and Application:</strong> Gene cloning, Requirements for Protein Production from Cloned Genes; Host organism for protein production, Vectors for Gene Expression: Promoters for Expression; Monitoring protein expression, Low levels of protein, Insolubility of the Expressed Protein, Beyond E.Coli: Protein Expression in Eukaryotic Systems, Expression in Yeast; Protein Purification; Intellectual property rights and patents; International legal framework for the management of biological resources; Biological Diversity Act, Plant Variety Act, The Patents (Amendment) Act of 2002; Property Rights and Biological Resources in India in the TRIPS Era, Processes that were not Patentable in India; Genetically modified crops and issues, How useful are GM crops? Criticisms against GM foods, environmental Hazards, Human Health Risks, Economic Concerns, GM Foods regulation and the Government’s Role in this process, GM Foods Labeling.</td>
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<tr>
<td>4</td>
<td><strong>E. coli Vectors:</strong> Plasmid, Structure, Replication, Plasmid Transfer, Evolution, Applications; Gene Markers, Background, Types, Uses, Insulin Production; pBR322; Filamentous Phage, Phage Particles, Phage Life-cycle; Cosmid, Features and Uses; Phasmid; Bacillus Subtilis, Pathogenesis, Reproduction, Chromosomal Replication, Model Organism, Uses, Genome; Bacterial Transformation.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Gene Expression in Eukaryotes:</strong> Yeast Artificial Chromosome; SV40; Streptomyces, Genome Structure, Cell Structure and Metabolism, Life Cycle, Ecology, Pathology, Phages, Medicine; cDNA, Making cDNA; Incorporating cDNA into the Vector, Screening, Designing a Probe, Test for Specificity, Getting Full Length cDNAs; Other Methods of Isolating cDNAs, Cloning from Expression Libraries, Complementation, Expression on the Cell Surface with Antibody Screening, Homology Screening, Two Hybrid Screening, Screening by Databases; cDNAs and Experimental Design.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Plant Cloning Vector:</strong> Bacterial Colonization, Induction of Bacterial Virulence System, Generation of T-DNA Transfer Complex, Two Models for the Translocation of T-DNA Complex; Integration of T-DNA into Plant Genome, Plant Transformation Mediated by Agrobacterium Tumefaciens; Ti Plasmid, Production of Transformed Plants with the Ti Plasmids; Ri Plasmid, Limitations of Cloning with Agro bacterium Plasmids; Cloning genes in plants by Direct Gene Transfer, Direct Gene Transfer into the Nucleus, Transfer of Genes into the Chloroplast Genome, Attempts to Use Plant Viruses as Cloning Vectors; Cloning Vectors, Cloning Vectors for Animals, Cloning Vectors for Insects, R Inverted Repeats ‘Wings-clipped’ Element Plasmid DNA, Cloning Vectors Based on Insect Viruses, Cloning Vectors for Mammals, Gene Cloning without a Vector; Baculovirus, Life Cycle, Relative Effectiveness, Appearance, Habitat, Pests Attacked, The Baculovirus Expression System; Expression Vectors, Phage Promoters.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Bio safety and Bioethics:</strong> Potential hazards; Horizontal Gene Transfer and Genetic Engineering, Hazards of Horizontal Gene Transfer from Transgenic Crops Released into the Environment, Specific Hazards from the Transgenic Sugar Beet Released in the Field-Trial; Biological Weapons, Biological Warfare Agents; Bio safety of GM Foods and GMOs, Safety Testing, Concept of Substantial Equivalence; The Human Genome Project, Objectives of HGP; Genomics and Genome Prospecting – The Controversies, Gene Patents, Genetic Testing, Genetic Discrimination, Genetic Privacy, Genetic Modification (GM), Justice and the Genome; Technology Protection System, Terminator Technology.</td>
</tr>
<tr>
<td>8</td>
<td><strong>Intellectual Property Right:</strong> Intellectual property rights, Main IP Laws: Enacted by the Legislature, Objective of IPR, Financial Incentive, Economic Growth, Morality; Patent; Trademarks; Copyrights and related rights; Cyber crimes, Different Types of Cyber Tort, Establishment of Tortious Liability in Cyber Crimes; Piracy- copyright infringement; Gene patents, Chakrabarty Patent, Myriad Genetics Case; Patenting of life, History of Patenting Life, How does it work? What does it do?</td>
</tr>
</tbody>
</table>

**LEARNING SOURCE:** Self Learning Materials
ADDITIONAL READING:

WEB LINKS:
A. http://www2.fiu.edu/~gantarm/Ch.%2010%20Genetic%20Engineering.html.

GENETIC ENGINEERING (P) – GNT16102P
1. Isolation of RNA from Plant Material by SDS-phenol Method
2. To Determine the Molecular Weight of DNA/Plasmid DNA by Agarose Gel Electrophoresis
3. Purification/Elution of DNA Fragment from Agarose Gel Using Silica
4. To Perform PCR Amplification of Specific Target Sequence from Genomic DNA and to Analyse the Amplified Product by Agarose Gel Electrophoresis
5. Restriction Endonuclease Digestion of Vector DNA and DNA Samples
6. Dephosphorylation of Vector DNA Digested with Restriction Enzyme
7. Construction of Recombinant DNA after Restriction Endonuclease Digestion
8. Transformation of E. Cole Cells
9. Southern Blotting of DNA Fragments from Agarose Gel
10. Western Blotting of Proteins from SDS-Polyacrylamide Gel.
11. Isolation of antibiotic resistant bacterial population by gradient plate method
12. Isolation of streptomycin resistant mutants by Replica plating technique
13. Demonstration of genetic recombination in bacteria by conjugation

ENZYMOLOGY – EZY16102

<table>
<thead>
<tr>
<th>UNIT</th>
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<tbody>
<tr>
<td>1</td>
<td>Classification and Purification of Enzymes: Nomenclature and classification of enzymes, General Principles, Scheme for the Classification of Enzymes and the Generation of EC Numbers, Rules for Classification and Nomenclature, Rules and Guidelines for Particular Classes of Enzymes; Enzyme Isolation; Purification of Enzyme, Criteria of Purity of the Enzyme Protein; Enzyme Units, Specific Activity, Ideal Characteristics for a specific Enzyme assay, Catalytic Activity and the Katal; Enzyme Activity, Two-point Assays, Kinetic Assays.</td>
</tr>
<tr>
<td>2</td>
<td>Active Sites of Enzymes: Determination of active site of amino acids, Binding, Chemical Probes, Affinity Label; Site-directed Mutagenesis, Nono-protein Enzymes.</td>
</tr>
<tr>
<td>3</td>
<td>Enzyme Kinetics: Enzyme Kinetics; Single-substrate Reactions, Michaelis-Menten kinetics, Importance of $V_{max}$, $K_m$, MM Equation and Turnover Number, Lineweaver-Burk Plot, Eadie-Hofstee Plot, Hanes-Woolf Plot; Allosteric Enzymes; Multi-substrate Reactions, Ternary-complex Mechanisms, Ping-pong bi-bi Mechanisms; Chemical Mechanism, Hill Equation,</td>
</tr>
<tr>
<td>4</td>
<td><strong>Enzyme Catalysis and Inhibition:</strong> Mechanism of enzymic action; General acid-base catalysis; Role of metal ion in enzyme catalysis; Mechanism of Serine Proteases, Chymotrypsin; Ribonucleases.</td>
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<tr>
<td>5</td>
<td><strong>Enzyme Inhibition:</strong> Irreversible Inhibitors; Reversible Inhibitors, Competitive Inhibitor, Uncompetitive Inhibitor, Non-Competitive Inhibitor; Quantitative Description of Reversible Inhibitors; Mixed Substrate Inhibition; Allosteric Inhibition; Irreversible Inhibition, Group Specific Reagents, Affinity Label, Suicide Inhibitors; Discovery and Design of Inhibitors; Applications of Inhibitors, Chemotherapy, Metabolic Control, Pesticides and Herbicides, Natural Poisons.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Coenzymes:</strong> Classification of Coenzymes, Vitamins and Derivatives, Non-vitamins; Oxidative Decarboxylation; Nonoxidative Decarboxylation; Transketolase, Mechanism; FMN and FAD; Metabolism of NAD and NADP, Relationships between NAD and NADP; Pyridoxal Phosphate (PALP) Pyridoxamine Phosphate (PAMP); Coenzyme A; Biotin Carboxylation Reaction; Vitamin B₁₂ – Cobalamin – Antianemic; Vitamin C – Ascorbic Acid; CoEnzyme Q; Nucleoside Triphosphate-dependent Restriction Enzymes.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Isozymes:</strong> Multiple Molecular Forms of Enzymes or Isoenzyme, Distinguishing Isozymes, Lactate Dehydrogenase, Alleles; Alloenzymes; Isozymes and Allozymes as Molecular Markers, Allozymes as Molecular Markers; Cytochrome P450.</td>
</tr>
<tr>
<td>8</td>
<td><strong>Control of Activity of Enzymes:</strong> Enzyme production, Transcription, Translation; Compartmentalization of Enzymes; Enzyme Inhibitors and Activators, Enzyme Inhibitors, Enzyme Activators; Post Translation Modification and Whole Activity of Enzyme Control, Characteristics of Post-translational Modifications.</td>
</tr>
<tr>
<td>9</td>
<td><strong>Industrial and Clinical Uses of Enzymes:</strong> Industrial uses of Enzymes; Sources of Enzymes; Thermophilic Enzymes, Amylase, Glucose Isomerase, Cellulose Degrading Enzymes, Lipase, Proteolytic Enzymes in Meat and Leather Industry; Clinical Enzymology, Enzymes as Thrombolytic Agents, Anti-inflammatory Agents, Therapeutic Use of Asparginase Streptokinase Enzyme, Isoenzyme in Diagnosis-LD, CK, Transaminases, Phosphatides, Amylase and Cholesterolase; Immobilization of Enzymes and their Applications, Why Immobilize Enzymes? Application of Immobilization.</td>
</tr>
</tbody>
</table>

**LEARNING SOURCE:** Self Learning Materials

**ADDITIONAL READING:**


**WEB LINKS:**

A. http://www.chem.qmul.ac.uk/iubmb/enzyme/rules.html

# MOLECULAR BIOLOGY – MBL1611

<table>
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<tr>
<th>UNIT</th>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Recombinant DNA Technology:</strong> Development of Recombinant DNA Technology; Techniques Involved in Recombinant DNA Technology; Enzymes Involved in Recombinant DNA Technology; Discovery of Restriction Endonucleases; Restriction System, Restriction Endonuclease Nomenclature, Major Classes of Restriction Endonucleases, Recognition Sequences for Type II Restriction Endonucleases, Sites of Cleavage, Frequency of Recognition Sequences; Restriction-Modification System; DNA Ligases; End-modification Enzymes; DNA Cloning, Steps Involved in Cell-based DNA Cloning, Vector DNA, Different Types of Cloning Vectors, Plasmid DNA as a Vector, Bacterial Artificial Chromosome (BAC), Cloning Vectors based on Viral DNA, Cloning Vector based on ( \lambda ) Phage, Replacement ( \lambda ) Vectors, Insertion ( \lambda ) Vectors, Cosmids, Cloning Vectors based on M13 Phage, Phagemic Vectors, Yeast Artificial Chromosome (YAC) Vectors, Transfer of Recombinant Plasmid DNA to a Bacterial Host, Amplification and Purification of Recombinant Plasmid DNA, Applications of DNA Cloning, Transfer of Colonies to a DNA binding Membrane, Expression Libraries; Restriction Mapping, Restriction Fragment Length Polymorphism (RFLP), RFLPs can serve as Markers of Genetic Diseases; DNA Sequencing, Manual DNA Sequencing by the Sanger “Dideoxy” DNA Method, DNA Sequencing by Maxam-Gilbert Method (Chemical Degradation Method), Automated DNA Sequencing; Applications of RDT in Medical and Health Care; Gene Therapy; Vaccine Production.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Blotting Techniques and their Applications:</strong> Molecular hybridization; Types of Blotting Techniques, Southern Blotting, Northern Blotting, Western Blotting, Dot and Slot Blotting.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Nucleic Acid Amplification Techniques:</strong> Target amplification system; Emergence of the amplification techniques; Detection of specific bacterial pathogen, Cycling Amplification Technologies, Isothermal Amplification Technologies, Cycling Probe Technology, Detection of Bacterial Pathogens by Multiple Targets or Universal Targets, Detection of Bacterial Pathogens by Nucleic Acid Amplification Techniques; Fluorescence in Situ Hybridization (FISH); Peptide Nucleic Acid – FISH; Line Probe Assay (LiPA); Hybridization Protection Assay (HPA); Mass Spectrometry (MS); Relevance of Nucleic Acid Amplification Techniques in the Clinical Laboratory; Applications of Nucleic Acid Amplification Techniques in Identification of Various Diseases, Central Nervous System (CNS) Diseases, Hepatitis, Gastroenteritis, Sexually Transmitted Diseases, HIV Infection and AIDS, Bacterial Antibiotic Resistance and Virulence Factor Genes, Methicillin-resistant Staphylococcus Aureus, Respiratory Infections; Precautions of using Nucleic Acid Amplification Technologies; Future Trends for Nucleic Acid Amplification Technologies.</td>
</tr>
<tr>
<td>4</td>
<td><strong>PCR &amp; its Applications in Diagnostics:</strong> Basic mechanism of PCR; Primary Requirements of PCR Experiments; DNA polymerase enzymes; Primer Design; Paraffin-wax-embedded Material; Key Factors Affecting the PCR; Different Types of PCR, RT-PCR, Real-time Quantitative PCR, Long Accurate PCR (LA-PCR); Analysis of products by PCR, Basic Analysis, Single-stranded Conformational Polymorphism Analysis, Restriction Fragment Length Polymorphism, Heteroduplex Analysis, Sequence Analysis; Applications of polymerase chain reaction; Application of PCR in Diagnostics, Role of PCR in Detecting Infectious Agents, Role of PCR in Cancer Diagnostics, Role of PCR in Genetic Diseases and Paternity Testing, Role of PCR in Histopathology, Role of PCR in Forensic Sciences; Future Prospective of Polymerase Chain Reaction.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Genotyping of Bacteria and Virus:</strong> What is Genotype? Genotype and Genomic Sequence, Genotype and Phenotype, Genotype and Mendelian Inheritance, Genotype and Genetics, Genotype and Mathematics; Genotype Determination, Single Nucleotide Polymorphisms (SNP) Genotyping Techniques, SNP Genotyping; Allele Discrimination Method,Allele-specific Single-base Primer Extension, Allele-specific Enzymatic Cleavage; Detection of Allele-specific Products, Methods Utilizing Fluorescent Labels, Fluorescence Polarization (FP); Mass Spectrometry, SNP-based Mass Spectrometry Methods for Microbial and Viral Detection and Identifications, Mass Spectrometry in Clinical Microbiology, Comparative...</td>
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<td>LEARNING SOURCE: Self Learning Materials</td>
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<tr>
<td>Sequence-based Mass Spectrometry Methods for Microbial and Viral Detection and Identification, Multilocus Sequence Typing with MALDI-TOF Mass Spectrometry, Quasispecies Analysis with MALDI-TOF mass Spectrometry; Pyrosequencing; Molecular Detection and Genotyping of Pathogens; Bacterial Pathogens, Bacterial Strain Typing, Bacterial Resistance Testing; Viral Pathogens, Viral Detection, Viral Genotyping.</td>
<td><strong>Transposable Genetic Elements:</strong> Types of Transposons; Retroviruses as Transposable Elements; Transposons Causing Diseases; Evolution of Transposons; Applications; P Element Structure; Hybrid Dysgenesis, Population Biology, Transposition; Transposase, Fate of the Donor Site, Regulation of P Element Mobility, Tissue Specificity, Cytotype and Repressors, Type I Repressor, Type II Repressor Elements, P Elements as Molecular Biological Tools, Mutagenesis, P Element Mediated Transformation; Enhancer Trapping, Making Flanking Deletions, Ac/Ds Transposable Elements of Corn.</td>
</tr>
</tbody>
</table>
ADDITIONAL READING:

WEB LINKS:
B. http://www.pnas.org/content/80/15/4679.full.pdf

MOLECULAR BIOLOGY (P) – MBL16111P
1. Cell Fractionation
2. Differentiation
3. Nucleic Acids
4. Preparation of genomic DNA from bacteria
5. PCR amplification of DNA
6. Restriction enzyme digestion of DNA
7. Phenol/chloroform extraction of DNA
8. Ethanol precipitation of DNA
9. Transformation of E. coli by electroporation
10. Preparative DNA Fragment Isolation from an Agarose Gel
11. Ligations of plasmid DNA to insert DNA
12. Southern blotting
13. Western Blot analysis of His-tagged proteins

BIOINFORMATICS AND BIOSTATISTICS–BOXI6202

<table>
<thead>
<tr>
<th>UNIT</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Introduction to Bioinformatics</strong>: Bioinformatics as Combination of Sciences; Challenges for Bioinformatics Industry; Bioinformatics Partnerships ; KDD Applications; XML for Data Representation; Bioinformaticians vs. Biotechnologists; Bioinformatics and a Bioinformatician; Roles and Responsibilities of Bioinformatics Team; Problem faced in Bioinformatics Area; Database Type.; Relational Database, Terminology, Relations or tables, Base and derived Relations, Domain, Constraints, Stored Procedures, Indices; Relational Operations, Normalization; Object oriented Database, Comparison to Relational Databases; Specialized Databases, Database structure: Records and fields; Data Mining; Identifications of Protein sequence from DNA Sequence; Input and output; calculation f Sequence Alignment for</td>
</tr>
<tr>
<td>Page</td>
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<tr>
<td>2</td>
<td><strong>Techniques in Bioinformatics</strong>: Visualization of Structure information, Database similarity searching, Searching of Database for similar new sequence; Examine the Alignment Scores and Statistics; Multiple Alignment and Database Searching, Sequencing and Assembling Genome using computer; Some other Methods of Genome sequencing and Assembly, Eulerian Path, Align-Layout-Consensus, BAC-by-BAC(Hierarchical) Sequencing; Genome, Genomics; Gene Therapy, Gene Splicing, Gene Silencing, Bio information and Human Genome, Functional Genomics; Functional annotation for Genes, Genome Annotation, Rosette Stone Approach, Functional Genomics and Bioinformatics, Structural Genomics</td>
</tr>
<tr>
<td>3</td>
<td><strong>Introduction to Biostatistics</strong>: Definition and Functions of Statistics, Functions of Statistics; Limitation of Statistics; Classification of Data, Types of Classification, Quantitative Classification or classification According to Variables; Statistical Series, Qualitative and Quantitative Series; Some Biostatistical Terms; Organization of Data; Summarizing Data, Frequency Distribution, Grouped Frequency Distribution, Variables; Graphic Representations, Bar Graph, Pie Chart, Histograms; Measures of Central Tendency, Mean, Medium, Mode, Measuring Dispersion, Coefficient of Variance, Skewness, Karl Pearson’s Coefficient of Skewness</td>
</tr>
<tr>
<td>4</td>
<td><strong>Measures of Depression</strong>: Classical Definition; Counting Techniques, Fundamental Principle Of Counting, Permutation; Statistical or Empirical Definition of Probability, Definition (R.Von Mises); Axiomatic or Modern Approach to Probability, Sample Space, Events; Sampling; Tree Diagrams, Theorems on Probability; Theoretical Probability Distributions; Discrete Probability Distribution, Probability Histogram, Mean and Variance; Binomial Distribution, Probability Function or Probability Mass function, Fitting of Binomial Function, Features of Binomial Distribution, Uses of Binomial Distribution; Poisson Distribution, Poisson Process, Features of Poisson Distribution, Uses of Poisson Distribution; Normal Distribution, The conditions of Normality, Probability Density Function, Shape of normal Probability Curve, Properties of Normal Probability Curve, probability of Normal Variant in an Interval, Fitting a Normal Curve; Chi-square $\chi^2$ Distribution, Features of $\chi^2$ Distribution, sampling Distribution of Variance; Types of Data Collection, Census, Sample survey, administrative Data; Theory of Estimation, Point Estimation (Properties of Good Estimator), Methods of Point Estimation; Two Types of Error, Power of a Test; Critical Region and One Tailed Vs. Two Tailed Test, Test of Hypothesis Concerning Mean; Paired T-Test, Test of Hypothesis Concerning Standard Deviation, Test of Hypothesis Concerning Correlation Coefficient, Uses of Chi-square $\chi^2$ Test</td>
</tr>
<tr>
<td>5</td>
<td><strong>F-Statistics</strong>: Features of F-distribution; The Fisher’s Exact Test, Fisher’s Exact Test for a 2x2 Table, Fisher’s Exact Test for an n x m Matrix, Fisher’s Exact Test as an Alternative to Chi-Squared Test; Chi-square Test of Independence, The Logic of Chi-squared, Chi-squared Test of Association, chi-squared Test of Homogeneity; F-Test and T-Test, F-distribution, T-distribution; Parameter Estimation, Regression Equation; Linear Regression and Least Squares; T-Test of the Regression Coefficient, Examinations Of Assumptions; Transformations, Variance-stabilizing Transformations, Method to Calculate Regression Coefficient</td>
</tr>
<tr>
<td>6</td>
<td><strong>Introduction to Database Concept</strong>: Basics of Computers, Need for Computer, Generations of Computer; Types of Computers, Computer sizes and Power, Super Computer and Mainframe, Minicomputer, Workstation, Personal Computer; Components of a Computer system; Computer Hardware Devices, Central processing Unit(CPU), Memory, USB Driver /Flash Memory, Random Access Memory(RAM), Read Only Memory(ROM); Input Devices; Output Devices; Storage Devices; Ms-Office, Word, Ms-Excel, MS-Power Point, MS Access; Relational Database, Real World Example of Database Applications; Office Automation Tools; internet, How Internet Works, Advantages of Internet, Equipment Needed for Internet, Electronic Mail(E-Mail), Chatting, Managing Clients through E-Mail; Web Browsers</td>
</tr>
<tr>
<td>7</td>
<td><strong>Computer Oriented Statistical Techniques using Excel</strong>: Frequency Function; Calculating the Mean and Standard Deviation with Excel, Setup the Variance Calculations</td>
</tr>
</tbody>
</table>

**LEARNING SOURCE**: Self Learning Materials
ADDITIONAL READINGS:
B. Cristianini, N. and Hahn, M. Introduction to Computational Genomics, Cambridge University Press, 2006

WEB LINKS:
A. http://www.nature.com/naturejobs/science/jobs/405301-bioinformatician-crg-bioinformatics-core-facilities
B. http://www.biomickwatson.wordpress.com/2013/04/23/a-guide-for-the-lonely-bioinformatician/
C. http://www.people.ysu.edu/~gchang/EXCEL/EXCEL_sd.pdf

BIOINFORMATICS AND BIOSTATISTICS (P) – BOX16202P
1. Finding motif in a sequence from an external file using Perl script
2. Reading sequence from an external file using Perl script
3. Retrieve the protein or DNA sequence and convert it into FASTA format
4. Find out the similarity search of unknown protein sequence using BLAST
5. Find out the similarity search of unknown protein sequence using FASTA
6. Open Reading Frame prediction for different protein out of some given nucleotide sequences
7. Exon identification using available software for a given nucleotide sequences
8. Gene finding related search for a given nucleotide sequences in order to predict the Gene
9. Secondary structure prediction for Amino acid sequence of a given protein
10. Predict and visualize the 3D structure of any protein
11. Prepare sequence file in FASTA format and multiply, align them using web based CLUSTALW
12. Molecular modeling using Moddler Software
13. Docking studies using Autodock Software

CLINICAL BIOCHEMISTRY BCH16206

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<tr>
<td>1</td>
<td>Disorders of Carbohydrate Metabolism: Carbohydrate Metabolism Disorders, Diabetes Mellitus, Glycohemoglobins (AIC), Hypoglycemias, Galactosemia, Ketone Bodies, Various Types of Glucose Tolerance Tests, Glycogen Storage Diseases, Physiology of Lipids/Lipoproteins, Lipidosis, Clinical Inter-relationships of Lipids (Sphingolipidosis and Multiple Sclerosis), Lipoproteins and Apolipoproteins, Diagnostic Tests for HDL-cholesterol, LDL-cholesterol and Triglyceride Disorders; Inborn Errors of Metabolism,</td>
</tr>
</tbody>
</table>
Disorders of Amino Acid Metabolism, Phenylalanemia, Homocystinuria, Tyrosinemia, MSUD or Maple Syrup Urine Disease, Alkaptonuria, Albinism, Animoacidurias, Disorders of Nucleic Acid Metabolism - Disorders in Purine/Pyrimidine Metabolism.

**Evaluation of Organ Function Tests:** Assessment and Clinical Manifestations of Organ Functions, Renal Function, Hepatic Functions, Pancreatic Functions, Gastric Functions, Intestinal Functions, Clinical Importance of Bilirubin; Diagnostic Enzymes, Clinical Significance of Aspartate Amino Transferase, Alanine Aminotransferase, Creatine Kinase, Aldolase and Lactate Dehydrogenase, Enzyme Tests in Determination of Myocardial Infarction, Enzymes of Pancreatic Origin and Biliary Tract.

**Hormonal Disturbances:** Hormonal Disorders, Protein Hormones (Anterior Pituitary Hormones, Posterior Pituitary Hormones), Steroid Hormones, Adrenocorticoстерoids, Reproductive Endocrinology, Disturbances in Thyroid Function; Disorders of Mineral Metabolism, Hypercalcaemia, Hypocalcaemia, Normocalcaemia, Hypophosphataemia, Hyperphosphataemia.

**Disorders of Lipids:** Plasma Lipoproteins, Cholesterol, VLDL, LDL and Cholesterol Metabolism, Lipoproteins and Disease, High-density Lipoprotein and Cholesterol Metabolism; Triglycerides and Phospholipids in Health and Disease, Hyperlipidemia, Hyperlipoproteinemia, Gaucher’s Disease; Tay-Sachs and Niemann-Pick Disease, Tay-Sachs Disease, Niemann-Pick Disease; Ketone Bodies; Abetalipoproteinemia.

**Inborn Errors of Metabolism:** Phenylketonuria; Alkaptonuria; Albinism; Tyrosinosis; Maple Syrup Urine Disease (MSUD), Lesch-Nyhan Syndrome, Sickle Cell Anemia, Histidinemia.

**Digestive Diseases:** Overview of Digestive Diseases, Inflammatory Bowel Disease (IBD), Peptic Ulcer Disease, Economic Impact and Scope of Digestive Diseases; Malabsorption and Malabsorption; Creatorrhoea; Diarrhoea; Steatorrhoea.

**Electrolytes and Acid base Balance:** Regulation of Electrolyte Content of Body Fluids and Maintenance of pH, Reabsorption of Electrolytes

**Diagnostic Enzyme:** Enzymes in Health and Diseases; Biochemical Diagnosis of Diseases by Enzyme Assays, SGOT, CPK, Cholinesterase, LDH

**Abnormalities in Nitrogen Metabolism:** Nitrogen Metabolism Disorder, Uremia, Hyperuricemia, Porphyria; Factors Affecting Nitrogen Balance

**Cancer:** Causes – Chemicals, Diet, Infection, Heredity, Radiations and Physical Agents, Pathology, Classification, Diagnosis; Prevention, Dietary, Medication and Vaccination, Cellular Differentiation and Carcinogens, Cancer Therapy.

**Biochemical Aspects of Hematology:** Disorders of Erythrocyte Metabolism, Hemoglobinopathies, Thalassemia, Thrombosis, Anemia, Laboratory Tests to Measure Coagulation and Thrombolysis; Detoxification in the Body, Enzymes of Detoxification, Mechanism of Drug Action and Channels of Its Excretion, Disorders of Vitamins and Trace Elements.

**LEARNING SOURCE:** Self Learning Materials

**ADDITIONAL READINGS:**

B. VP Acharya, PK Mohanty, A Complete Workbood on Clinical Biochemistry, 2010 JPH
C. N Haridas, Biochemistry Made Easy: A Problem-Based Approach, 2012, Jaypee Brothers
D. Takkella Nagamma, MCQs in Biochemistry with Explanation, 2013

**WEB LINKS:**

A. http://www.faculty.ksu.edu.sa/52876
C. http://www.allbookez.com/basic-biochemistry-lecture-notes
D. http://en.wikipedia.org/wiki/Clinical_chemistry
CLINICAL BIOCHEMISTRY (P) – BCH16206P

1. Analysis for Abnormal Constituents in Urine
2. Analysis of Normal Urine
3. Scheme for Identification of Biologically Important Substances
4. Collection of Specimens for Analysis
5. Estimation of Serum Cholesterol
6. Estimation of Blood Sugar
7. Estimation of Serum Protein
8. Estimation of Blood Urea
9. Estimation of Serum Bilirubin
10. Estimation of Serum Uric Acid
11. Estimation of Serum Alkaline Phosphatase Activity
12. To Estimate the Hemoglobin Content of Human Blood
13. To Determine the Number of WBC per cubic mm in the Human Blood

BIOCHEMICAL AND BIOPHYSICAL TECHNIQUES –BCH16207

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<tr>
<th>UNIT</th>
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<tr>
<td>1</td>
<td><strong>Nature of Biological Material:</strong> Some Important Properties of Organic Compounds, Electron Theory of Valency, Shapes of Molecules on the Basis of VSEPR Theory; Molecular Orbital Theory; Meso Compounds, Identification, Other Samples of Meso Compounds; Some Other Biological Compounds Free Radicals; Antioxidants, Uric Acid, Ascorbic Acid; Potential of Antioxidant Supplements to Damage Health, Enzyme Systems; Oxidative Stress in Disease; Health Effects, Disease Treatment, Disease Prevention; Isomerism, Structural Isomers; Chirality</td>
</tr>
<tr>
<td>2</td>
<td><strong>Biological Macromolecules:</strong> General Strucure, Isomerism, Zwitterions; Isoelectric Point; Occurrence and Functions in Biochemistry, Standard Amino Acids, Non-standard Amino Acids, In Human Nutrition, Non-protein Functions; Use in Technology, Expanded Genetic Code, Chemical Building Blocks, Biodegradable Plastics; Reactions, Chemical Synthesis, Peptide Bond Formation; Biosynthesis; Catabolism; Physicochemical Properties of Amino Acids, General Principles, Enzyme Assays; Single-substrate Reactions; Practical Significance of Kinetics with Intermediate, Multi-substrate Reactions, Ternary-complex Mechanisms, Ping-pong Mechanisms, Non-Michaelis-Meten Kinetis, Pre-steady-state Kinetics, Chemical Mechanism, Enzyme Inhibition and Activation, Reversible Inhibitors, Irreversible Inhibitors, Mechanisms of Catalysis; Antigen-Antibody Interactions, Affinity; Antigen-Antibody Ratios, Cross Reactivity; Cell Mediated Immunity, Macrophage Activation, Cell Mediated Cytotoxicity; Components and Functions of the Complement System, Activation of the Complement Cascade</td>
</tr>
<tr>
<td>3</td>
<td><strong>Energetics of Living Body:</strong> Spectrophotometer, UV Spectrophotometer, IR Spectrophotometer, UV VIS Spectrophotometer; Colorimetry, Colorimeter Setup, Factors Affecting Colorimetric Measurements, Colorimetry Chemistry; Densitometry Scanner, Differential Scanning Calorimeter, Atomic Absorption Spectroscopy, Instrumental Details, Isoelectric Focusing; Isoachophoresis; Buffer Additives; Beer-Lambert Law, Instrumentation; Derivation of the Beer-Lambert Law</td>
</tr>
<tr>
<td>4</td>
<td><strong>Intermolecular Interaction:</strong> Centrifugation, Analytical/Preparative Centrifugation, Differential Centrifugation, Density Gradient Centrifugation; Basic Theory of Sedimentation; Electrophoresis; Gel Electrophoresis; Chromatography – Basic Operation; Theory of</td>
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<td>5</td>
<td><strong>Principle and Application of Microscope:</strong> Invention of Glass Lenses; Birth of the Light Microscope, Anton van Leeuwenhoek (1632-1723), Robert Hooke, Charles A. Spencer, Beyond the Light Microscope; Electron Microscopy; Transmission Electron Microscope (TEM), Morphology; Scanning Electron Microscope (SEM), Phase Contrast Microscopy, Confocal Microscopy; X-ray Crystallography, X-rays and the Production of X-rays, Continuous and Characteristic X-ray Spectra, X-ray Diffraction and Bragg’s Law, X-ray Powder Method</td>
</tr>
<tr>
<td>6</td>
<td><strong>Chromatography:</strong> Paper Chromatography, Carrying out Paper Chromatography, Rf Values, Two Way Paper Chromatography; Essential Structure of Paper, Plate Preparation; Analysis; Applications; Ion-exchange Chromatography; HPLC Separation Modes, Separations-based on Polarity; Normal-phase HPLC, Reversed-phase HPLC</td>
</tr>
<tr>
<td>7</td>
<td><strong>Biophysical Methods:</strong> Spectrophotometer, UV Spectrophotometer, IR Spectrophotometer, UV Vis Spectrophotometer; Colorimetry, Colorimeter Setup, Factors Affecting Colorimetric Measurements, Colorimetry Chemistry; Turbidity; Densitometry Scanner; Atomic-absorption (AA) Spectroscopy, Instrumental Details; Isotachophoresis, Requirements of Isotachophoresis; Beer-Lambert Law, Instrumentation, Casting a Horizontal Agarose Gel, Slab Gels; Microtomy; EPR spectroscopy, Theor;</td>
</tr>
<tr>
<td>8</td>
<td><strong>Radioactivity:</strong> Radioisotopes; Radioactive Decay; Nuclear Reaction, Writing a Nuclear Reaction Equation; Radioactive Decay and Half Life; Carbon Dating; Scintillation Counter; Scintillation Counter Apparatus; Liquid Scintillation Counting, Counting Liquid, Counting Vials</td>
</tr>
</tbody>
</table>

**LEARNING SOURCE:** Self Learning Materials

**ADDITIONAL READINGS:**


**WEB LINKS:**


**PLANT BIOCHEMISTRY– BCH16208**

<table>
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<tr>
<th>Unit</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Introduction to Plant Biochemistry:</strong> Plant Physiology; plant Morphology, Principal Problems and Methods, Brief Historical Survey, Significance to the National Economy; Phytochemistry, Evolution of Natural Products; Plant Nutrition, Essential versus Beneficial, Mineral Elements, Elements of Complete Plant Nutrition; Environmental Stress Physiology, Basic Concepts of Plant Stress, Acclimation and Adaptation; Seed Germination and Dormancy, Types of Seed Dormancy and the Roles of Environmental Factors</td>
</tr>
<tr>
<td>2</td>
<td><strong>Plant Hormones:</strong> Plant Hormones; Biosynthesis, Structure and Biochemical Mode of Action, Auxins, Gibberellins, Cytokinins, Abscisic Acid, Ethylene</td>
</tr>
<tr>
<td>4</td>
<td><strong>Nitrate Assimilation:</strong> Nitrate Assimilation, Structural Features of Nitrate Reductase and Nitrite Reductase, Incorporation of Ammonia into Organic Compounds; Regulation of Nitrate Assimilation, Nitrogen Remobilization: A Key Factor Nitrogen use Efficiency, pH and Ionic Balance during Nitrogen Assimilation</td>
</tr>
<tr>
<td>5</td>
<td><strong>Photosynthesis:</strong> Photosynthetic Apparatus, pigments of Photosynthesis, Role of Carotenoids; Photosystems I and II, their Location, Hill Reaction, Photosynthetic Electron Transport and Generation of NADPH &amp; ATP, Cyclic and Non-cyclic Photophosphorylations, Complexes Associated with Thylakod Membranes, Light Harvesting Complexes, Path of Carbon in Photosynthesis, Photorespiration</td>
</tr>
<tr>
<td>6</td>
<td><strong>Secondary Metabolites:</strong> Secondary Metabolism, History of Secondary Metabolism, Primary vs. Secondary Metabolism, Types of Secondary Metabolites; Classification and Biosynthesis of Secondary Metabolites, Classification and Biosynthesis of Terpenes, Classification and Biosynthesis of Lignin, Classification and Biosynthesis of Tannins, Classification and Biosynthesis of Pigments, Classification and Biosynthesis of Phytochrome, Classification and Biosynthesis of Alkaloids, Biosynthesis of Nicotine, Functions of Alkaloids, Cell Wall Components</td>
</tr>
<tr>
<td>7</td>
<td><strong>Toxins of Plant Origin:</strong> Plant Toxins, Insecticides, Saponins, Mycotoxins, Phytohemagglutinins, Lathyrogens, Nitriles, Protease Inhibitors, Protein Toxins</td>
</tr>
<tr>
<td>8</td>
<td><strong>Stress Metabolism in plants:</strong> Environmental Stresses, Salinity, Water Stress, Heat, Chilling, Anaerobiosis, Pathogenesis, Heavy Metals, Radiations and their Impact on Plant Growth and Metabolism; Criteria of Stress Tolerance, Developmental and Physiological Mechanisms against Environmental Stress</td>
</tr>
<tr>
<td>9</td>
<td><strong>Anti-oxidative Defense System in Plants:</strong> Reactive Oxygen Species and their Generation, Types of Reactive Oxygen Species, Cellular Defense against ROS, Generation of ROS, Regulation of ROS Production; Enzymic and Non-enzymic Components of Anti-oxidative Mechanism, Non-enzymatic Antioxidants, Anti-oxidative Defense under Salt Stress, ROS and their Production under Normal Conditions, Scavenging of ROS under normal Conditions, Non-enzymatic Antioxidants</td>
</tr>
</tbody>
</table>

**LEARNING SOURCE:** Self Learning Materials

**ADDITIONAL READINGS:**


**WEB LINKS:**

A. http://www.systemsx.ch/
B. Philip M. Gilmartin and Chris Bowler, Molecular Plant Biology- volume 1&2, Oxford University Press.2005
C. http://faculty.plpa.cfans.umn.edu/neviny/cfan1501/handouts/1%20Cloning&Transgenic-white.pdf
PLANT BIOCHEMISTRY (P) – BCH16208P

1. To learn the preparation of stock solutions and their maintenance.
2. To learn the preparation of MS medium (liquid / semi-solid)
3. To learn the sterilization techniques for different explants.
4. Initiation of callus cultures from different explants.
5. To initiate the organogenesis in the callus cultures.
7. Rooting of micropropagated shoots on liquid and semisolid media in vitro.
8. Initiation of indirect somatic embryogenesis in elite plants. (Callus culture)
9. Establishment of the suspension cultures.
10. Pollen / Anther culture for the production of haploid plants.
11. Conservation of germplasm through artificial seed production.
12. Isolation of protoplasts.
13. Measurement of cells in cultures with the help of stage and ocular micrometer.

ENVIRONMENTAL BIOCHEMISTRY–BCH16209

<table>
<thead>
<tr>
<th>UNIT</th>
<th>CONTENT</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Environment:</strong> Basic Concepts and Issues, Basic Concepts, Basic Issues, Limiting Factors; Energy Transfer and Biogeochemical Cycling in Ecological System, Biogeochemical Cycles, Nature of Elements Transported in Biogeochemical Cycles, Importance of Biogeochemical Cycles, Lifespan and Rate of Biogeochemical Cycles; Response of Microbes, Plant and Animals to Environmental Stresses, Individual Level, Population and community Level; Concept of Ecosystems and Ecosystem Management; Pillar of the Ecosystem Management; Concept of Food Chain and Food Web.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Air Pollution:</strong> Classification and Effects of air pollutants on Human Health, Outdoor Air pollution, Indoor Air Pollution, Causes of Air Pollution, Sources of Air Pollution, Process Flow, WHO’s Classification of Outdoor Air Pollution as Carcinogenic, Gases containing the Oxides of Carbon, Sulphur and Nitrogen, Ozone and CFC, Main Environmental Effects of Air Pollution, Air Pollution Impacts; Measures to Control Air Pollution and Suspended Particulate Matters in Air, Process Controls, Control of Particulates; Green House Effects and Global Warming, Sources of Global Warming, Main Causes of Global Warming, Consequences of Global Warming, Remedial Measures of Global Warming.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Water Pollution:</strong> Sources and Effects of Water Pollutants on Human Health, Causes and Effects of Water Pollution, Types and Sources of Pollution in Selected Cities, Health Impacts of Microbial Pollution, Health Impacts of Chemical Pollution, Environmental Impacts; Quality Standards for drinking Water, WHO Policy Frame work, Waste Water Treatment and Recycling; Concept and Significance of BOD, COD and Dissolved Oxygen, Significance of BOD, Difference between BOD, Difference between BOD, COD or TOC, Chemical Oxygen Demand(COD), Total Organic Carbon(TOC).</td>
</tr>
<tr>
<td>4</td>
<td><strong>Noise Pollution:</strong> Noise Pollution: Sources, Measurement, Health Hazards, Prevention and Control, Sources, Measurement, Human Health Effects, Prevention and Control of Noise Pollution; Legal Status Regarding Noise Pollution, Noise and the Law, Noise Regulation</td>
</tr>
</tbody>
</table>
LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:
A. World Resources Institute 1989 World Resources Institute, Washington DC

WEB LINKS:
A. http://www.onlinelibrary.wiley.com/journal/10.1111(ISSN)1462-2920
B. http://www.epa.gov/methane/
C. http://en.wikipedia.org/wiki/Microbiology
D. http://www.eawag.ch/forschung/umik/index_EN

M.Sc. (Advance Science/Life Science) dissertation is a substantial investigation of a challenging topic in the subject area of M.Sc. (Advance Science/ Life Science). It is intended to give M.Sc. student a major opportunity to exercise their new understanding and advanced skills acquired on their programme by applying them to a significant and advanced practical problem. Students are supervised by a qualified academic with expert knowledge in the subject area while they are doing the M.Sc. dissertation.

The Dissertation must meet international standard in terms of quality and actual bench work. Preparations for the M.Sc. dissertation begin at beginning of 2nd year of the course. Students are expected to consult with
their supervisors throughout the second year for guidance and assistance in researching the background to
their dissertation.

The role of consult advisor is primarily to advise and provide all sort of scientific and technical support.
Your advisor should, of course, guide you to a specific, well-defined dissertation topic and will typically
also suggest some initial background reading you should do. Your advisor may also suggest a structure to
follow in writing your dissertation proposal. Your advisor may also propose one or more potential solution
strategies/methodologies for the work you will propose. It is your responsibility to do the necessary
background reading to be able to clearly and concisely summarize the work related to your proposal. You
must ensure that this summary is complete and that all work discussed in it is relevant to your proposal.
Your proposal should be written by you (with your advisor’s input if you want it). You are advised to
submit proposal by \( \text{(NAME OF STUDENT)} \).

Key components of your dissertation proposal (Synopsis) include:

- An abstract of the proposed work
- A clearly specified problem statement (where “problem” is taken in the broadest sense)
- An introduction to the problem and your proposed solution
- A review of related work describing how it relates to your proposed work (this review is not
  intended to be exhaustive but rather representative of existing work in the area)
- A statement of how you propose to solve your problem including sufficient methodology to
  convince the committee that your proposed solution is likely to be successful
- A description of precisely how you will evaluate the success of your work

The dissertation will carry 200 marks and evaluation of dissertation will be done by external expert of the
centre, head of the department and supervisor of the student.

\textbf{Dissertation Report}

The text of the Dissertation could be arranged in the following sequence.

- An abstract of the proposed work
- Introduction (should include literature review and justification for
  the study)
- Objectives (general and specific)
- Materials and Methods
- Results
- Discussion (last paragraph of discussion may include conclusions /
  Recommendations / suggestions for future work if any)
- References
- Appendices (if any)

You must use your own words and are not allowed to copy directly from books, technical reports, etc. The
University takes a very strong view on plagiarism. The centre will be conducting a plagiarism check upon
receiving your final report.