NIMS UNIVERSITY

SYLLABUS

OF

BACHELOR OF SCIENCE (MICROBIOLOGY)

VERSION 2.0

DIRECTORATE OF DISTANCE EDUCATION

Shobha Nagar, Jaipur-Delhi Highway (NH-11C), Jaipur- 303121
Rajasthan, INDIA

BACHELOR OF SCIENCE (MICROBIOLOGY)

Eligibility	:	10+2 with PCB
Program Duration	:	3 Years
Program Objectives	:	Our Bachelor of Science in microbiology program is a versatile degree that provides students with the optimal balance between a defined sequence of study and flexible course option. Our unique program will give you an understanding of the basis of immune recognition and vaccine design infectious diseases and methods of control – microbial biotechnology and Parasitological. You will also develop an understanding of the importance of microbiology in environmental, agricultural and industrial setting Microbiology is a discipline of enormous importance and research in this discipline has been revolutionized by new and exciting technologies such as proteomics, genomics, bioinformatics and genetic engineering.
Job Prospects	:	Our B.Sc. in Microbiology 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 medical, public health and environmental microbiology. Exciting career possibilities exist as research work is strongly gaining importance in laboratories in universities, biotechnology companies and agricultural, medical and veterinary institutes. Common job profiles of students after completing B.Sc. in Microbiology include: Research Microbiologists, Industrial Microbiologists, Clinical Microbiologists, and Environment Microbiologists.

YEAR I

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
ENG14102	Communication for Professionals	70	30	3
BIO14102	Cell Biology	70	30	4
BOT14104	Bioinformatics	70	30	4
BCH14103	Biochemistry	70	30	3
BML14106	Bacteriology	70	30	4
MBL14107	Fermentation Technology	70	30	4
BIO14102P	Cell Biology (P)	35	15	3
BOT14104P	Bioinformatics (P)	35	15	3
BCH14103P	Biochemistry(P)	35	15	4
	Total	**750**		**32**

YEAR II

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
MBL14211	Instrumentation and Techniques	70	30	4
GNT14202	Molecular Genetics	70	30	4
MBL14212	Immunology	70	30	4
MBL14213	Food and Dairy Microbiology	70	30	4
MBL14214	Phycology and Virology	70	30	3
GNT14202P	Molecular Genetics (P)	35	15	3
MBL14212P	Immunology (P)	35	15	3
MBL14213P	Food and Dairy Microbiology (P)	35	15	3
SEM14201	Seminar	100		4
			Total	**32**

YEAR III

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
WCH14302	Environmental Science and Ecology	70	30	5
MBL14308	Applied Microbiology	70	30	5
MBL14309	Medical Microbiology	70	30	4
BIO14304	Bionanotechnology	70	30	4
MBL14308P	Applied Microbiology (P)	35	15	4
MBL14309P	Medical Microbiology (P)	35	15	4
PRJ14301	Project Work/ Industrial Training	200		**6**
	Total	**700**		**32**

DETAILED SYLLABUS

INSTRUCTIONAL METHOD: Personal contact program Lectures (virtual and in-person), Assignments, Labs and Discussions, Learning projects, Industrial Training Program and Dissertation.

YEAR I

COMMUNICATION FOR PROFESSIONAL – ENG14102

UNIT	CONTENT
1	**Essentials of Grammar:** Parts of Speech; Vocabulary building; Sentence; Articles; Pronouns; Quantity; Adjectives; Adverbs; Prepositions, Adverb particles and phrasal verbs, Verb; Verb tenses; Imperatives; Active and passive voice; Direct and indirect speech; The infinitive; Conditional sentences; Synonyms and antonyms; Singular and Plural; Figures of Speech; Punctuation and Phonetics.
2	**Nature, Scope and Process of Communication:** Defining Communication; Nature of Communication; Objectives/Purpose of Communication; Functions of Communication; Process of Communication; Elements of Communication Process; Process of Communication: Models; Working of the Process of Communication; Forms of Communication.
3	**Channels and Networks of Communication:** Channels of Communication; Communication Flow in Organizations: Directions/Dimensions of Communication; Patterns of Flow of Communication or Networks; Factors Influencing Organizational Communication.
4	**Principles of Effective Communication:** Communication Effectiveness: Criteria of Evaluation; Seven Cs of Effective Communication; Four Ss of Communication.
5	**Barriers in Communication:** Categorization of Barriers; Semantic Barriers; Organizational Barriers Interpersonal Barriers (Relating to Superior-subordinate); Individual or Psycho-sociological Barriers; Cross-cultural/Geographic Barriers; Physical Barriers/Channel and Media Barriers; Technical Aspects in Communication Barriers; Overcoming the Barriers in Communication; Measures to Overcome Barriers in Communication.
6	**Non-verbal Communication:** Characteristics of Non-verbal Communication; Relationship of Non-verbal Message with Verbal Message; Classification of Non-verbal Communication.
7	**Oral Communication: Informal Conversation:** Oral Communication; Informal Conversation; Learning Informal Conversation; How to Go About Learning Other Tricks?; Learning Conversational Skills; Internet Chat.
8	**Communication in Business Organizations:** Meaning of Business Communication; Types of Information Exchanged in Business Organizations; Role of Communication in Business Organizations; Importance of Communication in Management of Business Organizations; Scope of Communication in Organizational Setting; Characteristics of Effective Business Communication; New Communication Environment; Ethical challenges and Traps in Business Communication; Role of Communication in Three Managerial Roles Defined by Henry Mintzberg.
9	**Formal Conversations: Meetings, Interviews and Group Discussions:** Meetings; Duties of Participants; Interviews; Group Discussions.
10	**Greetings and Introduction:** Basics of greetings and introduction; formal and informal introduction; Reading comprehension, Vocabulary; Pronunciation: Falling and rising tone; Speaking: Body language; Listening: body language.
11	**Listening Skills:** Importance of Listening; Listening versus the Sense of Hearing; Listening as Behavior; Payoffs for Effective Listening; Actions Required for an Effective Listener; Approaches to Listening; Misconceptions and Barriers that Impair Listening; Planning for Effective Listening; How to be a Good Listener?; What Speakers can do to Ensure Better Listening?.
12	**Formal and Informal Letters:** Distinction between Formal and Informal Letters; Writing Formal Letters; Informal Letters.

13	**Communication on the Net:** E-Mail; Netiquettes; Blog Writing; Web Writing.
14	**Report Writing: Business Reports:** Significance; Types of Reports; Five Ws and one H; Report Planning; Report Writing Process; Outline of a Report; Guidelines for Writing Report; Technicalities of Report Writing; Visual Aids in Reports; Criteria used for Judging the Effectiveness of a Report; Illustrations.
15	**Job Applications and Resume Writing:** Job Application/Covering Letter; Resume/CV Writing.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Harvard Business School Press (2003), Business Communication: Harvard Business Essentials, Boston, Massachusetts.

B. Krizan, A.C. Buddy, Merrier, Patricia, Logan, Joyce and Williams, Karen (2008), Business Communication, Thomson South-Western.

C. Guffey,m Mary E. (2000), Business Communication: Process and Product, South-Western College Publishing.;

WEB LINKS:

A. http://www.commissionedwriting.com/GRAMMAR%20ESSENTIALS.pdf.

B. http://www.esf.edu/fnrm/documents/FNRM_Communications_Handbook2008.pdf.

C. Http://books.google.co.in/books?id=RETE15K43qsC&printsec=frontcover&dq=essentials+of+english+grammer+pdf&hl=en&sa=X&ei=XlpSU6PEKY2HrgfyqoDoAQ&ved=0CDIQ6AEwAQ#v=onepage&q&f=false.

CELL BIOLOGY – BIO14102

UNIT	CONTENT
1	**Cell Structure and Cell Organelles:** What is Cell Biology? Significant Events in Cell Biology, Careers in Cell Biology; Types of Cells, Prokaryotic Cells, Eukaryotic Cell; Plasmalemma or Cell Membrane, A Historical Perspective, Basic Membrane Architecture, Lipids, Membrane Polarity, Membrane Skeleton, Carbohydrates, Proteins, Models of the Plasma Membrane, Mosaic Properties of Cell Membranes: Structure and Functions of Cell Organelles; Nucleus, History, Structures, Function, Evolution; Mitochondria, Structure, Organization and Distribution, Functions, Origin; Ribosomes, Structure, Function, Regulation, Structure Linkage, Function Linkage, Regulation Linkage; Golgi Bodies, Evolution, Discovery, Structure, How does the Golgi Apparatus Form? Function, Vesicular Transport, Transport Mechanism; Lysosomes, Enzymes, Functions; Endoplasmic Reticulum, Structure, Rough Endoplasmic Reticulum, Smooth Endoplasmic Reticulum, Sarcoplasmic Reticulum, Functions; Vacuole, Bacteria, Plants, Fungi, Animals
2	**Structure of Chromosome:** Historical background of chromosome, Number of Chromosomes, Size of chromosomes; Structure of Chromosome, Chemical Structure of Chromosome, Molecular Structure of Chromosomes; Euchromatin and Heterochromatin; Types of chromosome on the basis of centromere position, Karyotype; Functions of Chromosome; Special Types of Chromosomes, Lampbrush Chromosome, Polytene Chromosomes, B-Chromosomes
3	**Structure of DNA and Types of DNA:** Systemic Position of DNA in a cell; History of DNA, Gregor Mendel, Frederick Griffith, Oswald Avery, Erwin Chargaff, Roslind Franklin

	and Maurice Wilkins, Jamis Watson and Francis Crick; DNA is the Genetic Material, The Avery Macleod Mc Carty Experiment, The Hershey-Chase Experiment; Structure of Nucleic Acid, Nucleosides, Nucleotides; Components of Nucleic Acids; Differences between Prokaryotic and Eukaryotic DNA; Molecular structure of Deoxyribonucleic Acid, Deoxyribose, Nitrogenous Bases, Phosphate; Types of DNA, On the basis of Number of Strands, On the Basis of Nucleotide Residues, On the Basis of Shape, On the Basis of the Nature of Nucleotide Sequence in Duplex DNA; Properties of DNA, The Size of DNA Molecule, Denaturation, Fragility of DNA Molecule, Renaturation, Effect of pH on DNA, Stability, Hyper Chromic Effect; Functions of DNA, Chemistry of DNA, Double-Helical DNA and RNA can be Denatured, DNA Use in Technology
4	**Types of RNA:** Molecular structure of RNA; Chemical structure of RNA; Comparison with DNA; Strategies for analyzing RNA structure; Synthesis of RNA (Transcription); Types of RNA, Messenger RNA, Ribosomes and Ribosomal RNA (rRNA), Transfer RNA (tRNA), Ribozymes, Antisense RNAs, Viral Genomes, Other RNAs; Functions of RNA.
5	**Cell Cycle: Mitosis and Meiosis:** Cell cycle; Regulation of the Cell Cycle, Regulators of the cell cycle, Protein Degradation; Cell Cycle Regulation in Development, Cell Cycle Variation, Embryonic Cell Cycles, Larval Somatic Cell Cycles, Endoreduplication Cycles, Meiotic Cell Cycle, Checkpoint Control, DNA damage induced Checkpoint, DNA replication induced Checkpoint, Spindle assembly Checkpoint, Cell Cycle Entry and Arrest; Interphase; Mitosis, Cytokinesis, Significance of Mitosis; Meiosis, Significance of Meiosis; Comparison of Mitosis and Meiosis; Gametogenesis, Spermatogenesis, Oogenesis, Significance of DNA
6	**DNA Replication:** DNA Replication: An overview; DNA polymerase; Central Dogma Statement, Overview, DNA; Replication process; Transcription, Initiation, Elongation, Termination; Translation, Activation, Initiation, Elongation, The Mechanics of it all.
7	**DNA Repair:** DNA Damage and Repair Mechanisms; Sources of DNA damage; Types of DNA damage; Mechanisms of DNA Repair; Global response to DNA damage, DNA Damage Checkpoints, Prokaryotic SOS Response, Eukaryotic Transcriptional Responses to DNA Damage; DNA Repair and Aging, Pathological Effects Poor DNA Repair, Longevity and Caloric Restriction
8	**Cell Adhesion:** Cell adhesion: An overview, Physical Connections between Cells, Forming the Connections between Cells; Process in Eukaryotes and Prokaryotes, Eukaryotes, Prokaryotes; Differential adhesion hypothesis, Background, Overview, Applications; Clinical Implications of Cell Adhesion.
9	**Cell Biology Laboratory Manual:** Microscope, Aberrations, Angle of Incidence, Alignment, Bright Field, Dark Field and Phase Contrast; Types of Microscope, Electron Microscope, Scanning Electron Microscope; Histochemistry, Fixation, Dehydration, Embedding, Paraffin, Plastic, Sectioning, The Ultramicrotome, The Cryostat; Cell Fractionation, Homogenization, Osmotic Alterations, Mortars and Pestles, Blenders, Compression/Expansion, Ultrasonification, Gravity Sedimentation, Centrifugation, Physical Properties of Biological Materials, Sedimentation Velocity, Sedimentation Coefficient, Diffusion Coefficient, Sedimentation Equilibrium; Electrophoresis, Cationic vs. Anionic Systems, Tube vs. Slab Systems, Continuous vs. Discontinuous Gel Systems, Agarose Gels; Cell Cycles, Interphase G1-S-G2, Prophase, Metaphase, Anaphase, Telophase, Meiosis, Prophase-I: Leptotene 1, Prophase I: Zygotene, Prophase I: Pachytene, Prophase I: Diplotene, Prophase I: Diakinesis, Metaphase-I, Anaphase-I, Telophase-I: Interphase, Prophase-II: Telophase II, Damage Induced during Division; The central dogma.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Cell Biology, Third Edition, By S C Rastogi, 2005

B. Cell Biology, By Melissa Stewar, 2008

C. Molecular Biology, By David P. Clark, Nanette Jean Pazdernik, 2013

D. Lodish, Harvey, et al. (2003) Molecular Cell Biology 5th Edition. W. H. Freeman, pp.659-666.

WEB LINKS:

A. http://biology.unm.edu/ccouncil/Biology_124/Summaries/Cell.html
B. http://biologyclc.uc.edu/courses,bio104/cells.htm
C. www.edu.pe.ca/gray/class_pages/rcfleming/cells/notes.htm

CELL BIOLOGY (P) – BIO14102P

1. Microscopic Examination of Cells
2. Dilution Techniques
3. Measurement of Solutes
4. Sampling and Isolating Bacteria
5. Staining and Counting Bacteria
6. Physiological Processes of Bacteria
7. Comparison of Normal and Transformed cells
8. Mitosis & Meiosis
9. Inheritance
10. Analysis of Proteins by Chromatography and Electrophoresis

BIOINFORMATICS – BOT14104

UNIT	CONTENT
1	**Introduction to Bioinformatics:** Definition of Bioinformatics; Aims of Bioinformatics; Applications of Bioinformatics, Sequence Alignment, Multiple Sequence Alignment; Prediction of RNA Secondary structure; Protein secondary structure prediction; Microarray, Types of Microarrays; Computer added drug designing, Pharmacogenomics, Evolutionary Analysis.
2	**Biological Databases:** Databank, Database; Classification of Biological Database; Types of Database, Sequence Databases, Macromolecular Structure Database, Proteomic Databases, Protein Sequence Databases, Structure Database, Conserved Domain Database, Interaction Databases, MINT, RNA Database, Gene Expression Databases, Ontology Databases; Database of genetic and proteomic pathways, Expression, Regulation and Pathways Databases, KEGG Pathway Clinical Databases, Microarray Databases; Literature database, PubMed, PubMed Central, OMIM, Bookshelf, List of other Biological Databases, Types of Biological Databases: At NCBI
3	**Phylogenetic Analysis:** Fundamental elements of phylogenetic models; Tree interpretation-The Importance of Identifying Paralogs and Orthologs; Phylogenetic data analysis: The Four Steps, Alignment: Building the Data Model; How much Computer dependence, Phylogenetic Criteria Preferred, Alignment Parameter Estimation, Mathematical Optimization and Analysis of structures, Alignment: Extraction of a Phylogenetic Data Set, Determining the Substitution Model, Which Substitution Model to Use; Tree Building methods, Distance based Methods, Unweighted Pair Group Method with Arithmetic Mean (UPGMA), Neighbor Joining (NJ), Fitch Margoliash (FM), Minimum Evolution (ME), Character based Methods, Maximum Parsimony (MP), Maximum Likelihood (ML); List of some Specific software for phylogenetic analysis, PHYLIP, MEGA, VOSTORG, COMPROB, PAUP, MARKOV Puzzle; Phylogenetic Activity, Exercise 1: Relatives of Relatives, Exercise 2: Understanding Historical Relationships, How did You Do? Exercise 3: Comparing Trees, Exercise 4:

	Multiple Sequence Alignment; DNA sequencing; Protein Sequencing, Hydrolysis, Separation, Quantitative Analysis, N-terminal Amino Acid Analysis, C-terminal Amino Acid Analysis, Edman Degradation, Mass Spectrometry, Importance of Sequencing.
4	**Application of Bioinformatics Websites:** Website, Static Website, Dynamic Website; Computers in biochemical research, Biochemical Computers, Biomechanical Computers, Bioelectronic Computers; Data collection; Data storage, Hierarchy of Storage; National centre for Biotechnology information (NCBI 2001), Path to the Bioinformatics, Role of Bioinformatics, Applications of Bioinformatics; Cheminformatics and drug design, Molecular Phylogenies; Partnership in bioinformatics, Importance of databases; Types of databases; What is GenBank?, Updating or Revising a Sequencing a Sequence, New Developments; EMBL, EMBL Nucleotide Sequence Database; Biological annotation, Data Distribution Searching and Sequence Analysis; EMBnet, Citing the EMBL Database; DDBJ, Specialized Databases Developed at DDBJ, Uniprot; Derived database, Using a WHERE Clause to Specify Selection Conditions; MySQL, Installing the MySQL DBMS, Setting up MySQL, Using the MySQL Client Program, Using the MySQLadmin Client Program to set up MySQL, safe_MySQLd and Securing your MySQL Server; Steps of Model designing, Template and Sequence Alignment, Fragment Assembly, Segment Matching; Satisfaction of Spatial restraints, Loop Modelling; Sequence alignment, Interpretation, Alignment Methods, Representations; Global and Local Alignments; BLASTA and FASTA.
5	**Homology Modeling:** What is Homology?, General Procedures; PAM Matrices, BLOSUM Matrices; Identification of structurally conserved and structurally variable regions, Generating Coordinates for the Unknown Structure; Evaluation and refinement of the structure, Class-Directed Structure Determination; Steps in model production, Model Generation; Structural comparison methods, Benchmarking, Accuracy, Sources of Error.
6	**Drug Designing:** What is in silico drug design?, Why in silico drug design is significant?; Drug discovery methods, Types; Major steps in the drug design process, Find What is Known, Develop and Assay, Consider Financial Issues, Find Lead Compounds, Isolate the Molecular basis for the Disease, Refine Drug Activity, Drug Testing, Formulation, Production, Marketing, Non Prescription Sales, Genetic Production; Drug designing steps, Other Sites.
7	**Networking and Website:** Communication models; Protocols; Basic network terminologies, Bridges, Routers, Switches, Gateways, Hubs, Content Filters, Firewalls, Modems, Satellites; Network interface cards, Network Monitors; Security, Antiviral Utilities, Authentication, Firewalls, Encryption, Cryptography; Databases.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Jeremy Ramsden-2009, Bioinformatics: An introduction, Second Edition.

B. Brown TA. Oxford: Wiley-Liss; 2002, Second Edition, Genomes.

C. Michael M. Miyamoto, Joel Cracraft-1991, Phylogenetic Analysis of DNA Sequences.

D. Mohammed J. Zaki, Christopher Bysroff-2008, Protein structure prediction.

WEB LINKS:

A. http://www.informit.com/articles/article.aspx?

B. http://www.rackspace.com/information/hosting101

C. http://compnetworking.about.com/od/basicnetworkingconcepts/

BIOINFORMATICS (P) – BOT14104P

1. Retrieve the protein or DNA sequence and convert it into FASTA format
2. Find out the similarity search of unknown protein sequence using BLAST
3. Find out the similarity search of unknown protein sequence using FASTA

4. Open Reading Frame prediction for different protein out of some given nucleotide sequences
5. Gene finding related search for a given nucleotide sequences in order to predict the Gene
6. Secondary structure prediction for Amino acid sequence of a given protein
7. Predict and visualize the 3D structure of any protein
8. Prepare sequence file in FATSA format and multiply, align them using web based CLUSTALW
9. Molecular modeling using Modeler Software
10. Docking studies using Auto dock Software

BIOCHEMISTRY - BCH14103

UNIT	CONTENT
1	**Biochemistry:** Definition of Biochemistry; History of Biochemistry; Scope of Biochemistry; Composition of Living Matter, Nucleic Acids, Proteins, Polysaccharides, Lipids; Introduction to Bioenergetics, Laws of Thermodynamics, Exergonic and Endergonic Reactions, Enthalpy.
2	**Carbohydrate Metabolism:** Carbohydrate nomenclature; Monosaccharides, Classification of Monosaccharides, Properties of Monosaccharides, Chemical Properties of Monosaccharides, Derivatives of Monosaccharides, Glycosidic Linkage, Biological Significance of Monosaccharides; Oligosaccharides; Disaccharides; Higher Oligosaccharides; Polysaccharides, Homopolysaccharides, Heteropolysaccharides; Glycosaminoglycans; Glycoconjugates: Proteoglycans, Glycoproteins and Glycolipids; Biological functions of carbohydrates; Carbohydrate metabolism, Glycolysis, Tricarboxylic Acid Cycle, Electron Transport Chain Makes Energy.
3	**Lipids:** Fatty acids, Saturated and Unsaturated Fats, Sources of Saturated and Unsaturated Fats, Essential Fatty Acids; Classification of lipids; Simple lipids, Triacylglycerols, Waxes, Biological Significance of Fats; Compound lipids, Glycerophospholipids, Sphingolipids; Derived lipids, Isoprenoids, Terpenes, Dolichols, Steroids; Biologically important cholesterol derivatives, Fat-soluble Vitamins, Eicosanoids; Lipoproteins, Chylomicrons, Very Low density Lipoproteins (VLDL), Low density Lipoproteins (LDL), High density Lipoproteins (HDL); Biological functions of Lipids, Cellular Energy Source, Storage of Triglyceride in Adipose Cells, Mobilization of Fatty Acids, Membrane Component.
4	**Amino Acids:** Amino Acids: An overview; Classification of Amino acids, Classification of the basis of R group and Essential & non essential amino acids; Roll of all the 20 amino acids, Alanine, Arginine, Asparagine, Aspartic Acid, Cysteine, Glutamic Acid, Glutamine, Glycine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Proline, Serine, Threonine, Tryptophan, Tyrosine, Valine.
5	**Proteins:** Classification of proteins on the basis of shape and solubility, Simple and Globular Proteins, Conjugated Proteins, Derived Proteins; Biological functions of proteins; Composition of Proteins, α-Amino Acids, Properties of Amino Acids, Standard Amino Acids, Essential and Non essential Amino Acids, Titration of Amino acids, Absorption of UV-light by Aromatic Amino Acids; The peptide bond; Overview of protein structure, Primary structure, Secondary Structure, Tertiary Structure, Quaternary Structure; Fibrous proteins, α-Keratin, Fibrain and β-Keratin β Sheet Proteins, Collagen: A Triple Helix.
6	**Nucleic Acids:** Chemical composition of nucleic acids, Nitrogenous Bases, Pentoses of Nucleotides and Nucleic Acids, Nucleosides, Nucleotides, Polynucleotides; Structural organization of Nucleic acid, Chargaff's Rule; Classes of nucleic acids; Deoxyribonucleic acid (DNA), Structure of Double Stranded DNA, Features of B form of DNA (Watson-Crick Model), Alternative Forms of DNA, DNA Topology, Denaturation and Renaturation of DNA, Biological Significance of DNA; Ribonucleic acid (RNA), Structure of Ribonucleic Acid, Types of RNA; Comparison between DNA and RNA.
7	**Enzymes:** Properties of Enzyme; Nomenclature of Enzyme, Enzyme Commission System of Classification, Major Classes of Enzyme; Enzyme action, Unit of Enzyme Activity, Turnover Number, Enzyme Specificity, Catalytic Mechanism of Enzyme Action; Enzyme kinetics,

	Michaelis-Menten Approach to Enzyme Kinetics, Steady State Assumption, Line Weaver-Burk Plot or Double Reciprocal Plot, Significance of Km and Vmax Values, Significance of Kcat and Kcat/Km; Factors determines the rate of an enzymatic reaction, Effect of Substrate Concentration, Effect of Enzyme Concentration, Effect of Temperature, Effect of pH, Effect of Inhibitors, Effect of Activators; Enzyme inhibition; Types of enzymes, Allosteric Enzymes, Isoenzymes, Zymogens, Lysozymes; Regulation of enzyme activity, Reversible Covalent Modification, Irreversible Covalent Modification, Regulation of Activity by Anchoring of Enzymes in Membranes: spatial relationship, Regulation of Activity by Enzyme Synthesis and Degradation, Regulation of Activity by Other Means: specialized controls, Regulation of Activity by Feedback Inhibition, Other Regulatory Mechanisms.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Voet & Voet Text Book of Biochemistry, 3rd Edition
B. Lehninger, Principles of Biochemistry, 4th Edition
C. Charles M. Grisham, Biochemistry: Reginald Garret
D. Hiram F. Gilbert, Basic Concept in Biochemistry: A Student Survival Guide

WEB LINKS:

A. http://www.worhington-biochem.com/introbiochem/enzymes.pdf.
B. http://courses.chem.psu.edu/chem112/materials/enzymes.pdf.
C. http://www.biologymad.com/resources/Ch%204%20-%Enzymes.pdf.

BIOCHEMISTRY (P) - BCH14103P

1. Preparation of Solutions
2. Preparation buffer
3. Estimate the concentrations of reducing sugar present in given sample by DNSA method
4. Estimate the concentrations of sugar present in given sample by Anthrone method
5. Estimate the concentration of amino acids in given sample by Ninhydrin method
6. Estimate the concentration of protein in given sample by Biuret method
7. Estimate the concentration of protein in given sample by Folin-Lowry's method
8. Estimate the concentration of protein in given sample by Bradford's method
9. Estimate the amylase activity present in the given sample
10. Investigate the effect of temperature on amylase activity and find out the temperature optima for amylase

BACTERIOLOGY – MBL14106

UNIT	CONTENT
1	**Overview of Bacteriology:** History of Bacteriology, Father of Bacteriology, Bacteriology(Second Era), Smallpox Vaccine from Cowpox Blisters – Edward Jenner, New Era; Useful Bacteria for Humans, What is Good Bacteria?; Classification of Higher Groups of Bacteria, Mueller's Classification of Vermes (1773); General Systematic of Bacteriology, Mueller's Classification of Protozoa, etc (1786), Classification by Boryde St. Vincent,

	Ehrenberg's Classification of the Infusoria (1838), Dujardin's Classification of Vibrionia (1841), Perty's Classification of the Vibrionida (1852); Applications of Bacteriology, Use of Bacteria in Industry, Molecular Bacteriology: A Diagnostic Tool for the Millennium, Detection, Isolation and Identification of Pathogens, Applications of High performance Liquid Chromatography in Bacteriology, Determination of Metabolites, Fluorescent Antibody Techniques in Diagnostic Bacteriology.
2	**Structure and Function of Prokaryotes:** Prokaryotic Cell, Arrangement of Bacterial Cells According to Size and Shape; External Cell Wall Structure, Glycocalyx, Flagella, Axial Filaments, Fimbriae and Pili; Cell Wall, Composition and Characteristics of Cell Wall, Gram-positive Cell Walls, Gram-negative Cell Walls, Functions; Structures Present Internal to Plasma Membrane Cytoplasm; Endospores.
3	**Nutrition and Growth of Bacteria:** Requirements for Oxygen, Carbon and Hydrogen, Bacterial Requirements on the Basis of their Growth; Classification of Bacteria on the Basis of Modes of Nutrition, Typical Autotrophs, Typical Heterotrophs; Bacterial Growth, Culture Media for the Growth of Bacteria, Types of culture media, Physical and Environmental Requirements for Microbial Growth; Methods for Growing and Measuring Microbial Growth, Petroff-Hausser Counting Chamber Method, Bacterial Growth Curve.
4	**Growth of Bacterial Populations:** Measurement of cell mass, Methods that are used for Measurement of Cell Numbers, Bacterial Growth Curve; Continuous Culture, In Vivo Models, In Vitro Models, Continuous-culture Chemostat System; Microbial Cell Fermenters: Chemostat/Trubidostat; Materials and Methods, Device Design and Fabrication, Experimental Setup, Strain and Culture, Cell Loading, Synchronous Growth of Bacteria.
5	**Control of Microbial Growth:** Methods of Sterilization; Control of microbial growth by physical agents; Control of microbial growth by chemical agents, Types of Antimicrobial Agents, Antimicrobial Agents used in the Treatment of Infectious Disease; Bacterial resistance to antibiotics, Basic of Bacterial Resistance to Antibiotics, Medical Problem of Bacterial Drug Resistance; Determining the level of antimicrobial activity, Dilution Susceptibility Tests, Disk Diffusion Tests; Measurement of drug concentrations in the blood.
6	**Prokaryotic Metabolism:** Energy-Generating metabolism, ATP, NAD, Coenzyme A; ATP synthesis in prokaryotes; Heterotrophic types of metabolism, Fermentation, Respiration; Lithotrophic types of metabolism, Phototrophic Metabolism; Autotrophic CO_2 Fixation; Biosynthesis.
7	**Regulation of Metabolic Activity:** Adaptation to the nutritional and physical environment, Conditions Affecting Enzyme Formation in Bacteria; Regulation of enzyme reactions, Allosteric proteins, feedback inhibition enzyme repression, enzyme induction, catabolite repression.
8	**Prokaryotes in Environment:** Fungi (Molds and Yeast); Oxygen cycle; Carbon cycle, Overall Process of Biodegradation; Nitrogen cycle, Overall Process of Nitrification; Sulfur cycle; Phosphorus cycle; Ecology of a stratified Lake.
9	**Important Prokaryotes:** Archaea; Bacteria, Photosynthetic purple and green Bacteria; Cyanobacteria; Other spiral shape and curved bacteria; Other groups of Bacteria, Lithotrophs, Pseudomonads, Enterics, Nitrogen fixing Organisms, Endospore-forming Bacteria, Actionomycetes, Rickettsias and Chlamydiae, Mycoplasmas, Plant-pathogenic Bacteria.
10	**Bacterial Cultures:** Methods for establishment and maintenance of a culture collection; Alternative methods, Freeze-drying, Cryogenic Storage, Liquid Nitrogen, Preparation of Bacterial Glycerol Stocks; Recover the Bacteria; Making a long term stock of Bacteria.
11	**Classification of Bacteria:** Autotrophs; Chemotrophs; Bergey's Classification of Bacteria, Kingdom Procaryotae.
12	**Importance of Bacteria:** Origin of life; Applications of bacteria in industry and biotechnology, Exploitation of Bacteria by Humans, Biotechnological Applications of E. coli; Bacterial pathogens, Spirochetes, Spirilla and Other Curved Bacteria, Vibrios, Gram negative Aerobic Rods and Cocci; Applied bacteriology: Use of Bacteria in Industry; Relation of Bacteria to agriculture, Sprouting of Seeds, Silo, Fertility of the Soil; Basic microbiology, Microorganisms, HACCP, starter cultures.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Gerard J. Tortora, Microbiology: An Introduction, 11th Edition.

B. A.J. Salle, Fundamentals Principles of Bacteriology, 7th Edition.

C. R. Vasanthakumar, Textbook of Microbiology.

D. Stanley Falkow, The Prokaryotes: A Handbook on the Biology of Bacteria, Volume 5

WEB LINKS:

A. http://www.rapidmicrobiology.com

B. http://www.cabri.org/guidelines/

C. http://wolfson.huji.ac.il/expression/procedures/

FERMENTATION TECHNOLOGY – MBL14107

UNIT	CONTENT
1	**Microbial Fermentations:** Meaning of Microbial Fermentation, Importance of Microbial Fermentation, Advantages of Microbial Fermentation; Metabolic Pathways, Changing the Activity of a Pre-existing Enzyme, Changing the Amount of an Enzyme, Cellular Respiration; Metabolic control mechanism, Concept of Control and Regulation, Control of Metabolism, Levels of Metabolic Regulation; Industrial production, Citric Acid, Lactic Acid, Enzymes, Acetone-butanol, Lysine, Glutamic Acid.
2	**Microbial Production of Therapeutic Compounds:** Microbial production of therapeutic compounds, Lactam, Aminoglycosides, Ansamycins, Peptide Antibiotics Quinolinones; Biotransformation of Steroids, Vitamin B 12; Riboflavin Fermentation.
3	**Modern Trends in Microbial Production:** Bioplastics: Microbial Production, Polyhydroxyalkanoates (PHAs), Polyhydroxybutyrate; Microbial Production of Biopolymer, Dextran, Aglinate, Pullulan, Xanthan; Biofertilizers, Nitrogen Fixer Azotobacter, Phosphate Solubilizing Microorganisms; Biomass and Single Cell Protein, Single Cell Protein Production; Biological Weapon Production; Bt (Bacillus Thuringiensis)- A Microbial Insecticide, Advantage of Microbial Insecticides, Disadvantages of Microbial Insecticides, Bacteria for Bt Production.
4	**Chemistry of Fermentation:** History; Lactic acid fermentation; Aerobic respiration, Glycolysis, Oxidative Decarboxylation of Pyruvate, Citric Acid Cycle, Oxidative Phosphorylation, Efficiency of ATP Production; Hydrogen Gas Production in Fermentation; Methane Gas Production in Fermentation.
5	**Introduction to Fermentation Process:** Batch culture, List of Reagents and Instruments, Procedures; Fed batch fermentation, Fixed Volume Fed Batch, Variable Volume Fed batch, Advantages and Disadvantages of the Fed batch Reactors, Equipment, Control Techniques for Fed batch Fermentation; Modeling fed batch fermentation, Fixed volume Fed batch, Variable Volume Fed batch, Models of Possible Situations that may Occur in a Fed batch Fermentation; Parameters used to control fed batch fermentations, Calorimetry, Specific Growth Rate, General Feeding Mode, Proton Production, Fluorescence; Parameters to start and finish the Feed, and Stop the fed batch fermentation, Preliminary Knowledge Required to Implement Fed-batch, Eventual Inhibitions from the Substrate and Product, Open-loop Performance, Feed-back Control Algorithm; Examples of Fed batch use in industry.
6	**Fermenter Condition:** Fermentor; Microorganisms used and fermentation process, Importance and Uses; Process of Fermentation; Control and monitoring fermentation system, Temperature, Temperature Measuring Devices, Temperature Controlling Device, Gas Flow Rate, Gas Flow Rate Controlling Device, Liquid Flow Rate, Liquid Flow rate Controlling Device, Pressure Measuring and Controlling Devices, Agitation Measuring and Controlling Device; Foam Sensing; Dissolved Oxygen Monitoring; pH Monitoring Devices; PID Control Systems.
7	**Types of Fermenters:** Air Lift Fermenter; Fluidized Bed Bioreactor; Packed Bed Bioreactor; Continuous Culture; Fed Batch Culture, Fixed Volume Fed-batch, Variable Volume Fed-batch;

	Advantages and Disadvantages of the Fed-batch Reactors; Continuous flow stirred-tank reactor.
8	**Special Fermenters:** Fluidized Bed Reactor, Basic Principles, History and Current Uses, Advantages, Disadvantages; Current Research and Trends, Tubular Reactors, Gas Feed system, Liquid metering pumps, Back pressure Regulators, Cooling condensers, Gas/Liquid separators, Control and data acquisition Systems.
9	**Computer Application in Fermenters:** Pre lab; Fermenter and Sensors; Control system, Functions; Methods, Sample experiments and discussion.
10	**Fermented Products:** Introduction to Fermented food products, History of Fermentation, Benefits and Pitfalls of Fermentation; Introduction of Zymology, History of zymology; Different types of Fermented foods, Bean Based Fermented Foods, Cereal/Grain Based Fermented Foods, Vegetable and Unripe Fruits Based Fermented Foods, Fruit Based Fermented Products, Honey Based Fermented Foods, Dairy Based Fermented Food, Meat Based Fermented Food, Fish Based Fermented Food, Tea based Fermented Food.
11	**Risk of consuming Fermented Foods:** Benefits and risks of consuming fermented food; Effect of fermented foods in human body, Nutrition and Health Bonus; Introduction of Ethyl carbamate (Urethane), Hazards Identification, Hazard Characterization, Kinetics and Metabolism; Carcinogenicity, Observation in Human; WHO guideline for Fermented food, Assessment of Benefits and Risks, Interventions for Improving the Safety and Nutritional Value of Fermented Foods, Research Needs; Support services to promote fermented foods and beverages, Public Policy, Technical Training, Business Skills Developments, Financial Services, Technology Transfer, Future Priorities and Research, Advisory Roles.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Robert W. Hutkins (2006) Microbiology and Technology of Fermented Foods, Wiley
B. Edward R.(Ted) Farnworth (2003) Handbook of Fermented Functional Foods (Google eBook), CRC Press
C. B.J. Wood (1997) Microbiology of Fermented Foods, Volumes 1 and 2, Springer.

WEB LINKS:

A. http://articles.sun-sentinel.com/2011-04-18/health/
B. http://www.cookinggodsway.com/
C. http://www.shape.com/blogs/shape-yourlife/should-you-be-eating-more-fermented-foods-comsumption-article/

YEAR II

INSTRUMENTATION AND TECHNIQUES–MBL14211

UNIT	CONTENTS
1	**Introduction to Separation Techniques:** Centrifugation, Analytical/Preparative Centrifugation, Ultracentrifugation / Low Speed Centrifugation, Moving Boundary / Zone Centrifugation, Basic Theory of Sedimentation; Electrophoresis, Gel Electrophoresis, Understanding Isoelectric Focusing; Chromatography – Basic Operation, Different Types of Chromatography Methods, Theory of Chromatography, Ion & Molecule Exchange Chromatography, Instrumental Components
2	**Basic Separation Techniques:** Immobilized Metal Ion Affinity Chromatography, Recombinant Proteins; Lectins; Electrophoresis, Theory, Electrophoresis Apparatus being used to Separate Proteins by Molecular Weight ,Instrumentation, Detection, Modes of Separation, Efficiency and

	Resolution, Related Techniques; Paper Electrophoresis; Iso Electric Focusing
3	**Microscope:** Invention of Glass Lenses, Birth of the Light Microscope, Light Microscope, Parts of Microscope and their Specifications; Microscopy, Electron Microscopy, Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), Phase Contrast Microscopy, Confocal Microscopy: Fluorescence: 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; Radioactivity, 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, Liquid Scintillation Spectrometry: External Factors Interfering with β-decay Detection by LSC, Optical Cross Talk
4	**Advance Spectroscopy:** Spectroscopy, What Do Photo biologists Use Spectroscopy For?, What Spectroscopy are Available to the photo biologist?; Photo thermal Techniques, Time-resolved vs. Steady-state Techniques, Ground-state Absorption; Transient Absorption, The pump-and-Probe Approach, From Milliseconds to Hours; Steady-state Spectrophotometers, From Milliseconds to Nanoseconds: Nanosecond Laser Flash Photolysis, Sub-nanosecond Domain: The Two-pulse pump-and-Probe Technique, Emission Spectroscopes; Steady –state Emission Spectroscopy, Time-resolved Photo acoustics, Photorefractive Techniques, ESR and NMR Spectrometers: Nuclear Magnetic Resonance Spectrometer, Continuous Wave NMR Instruments, Fourier Transform NMR Instruments, Microtomy; EPR Spectroscopy, Theory, Experimental Apparatus; Circular Dichroism (CD) Spectroscopy, Physical Principles of CD, Secondary Structure from CD Spectra, CD of Peptides
5	**Atomic Spectroscopy:** Spectrophotometer, UV Spectrophotometer, IR Spectrophotometer, UV Vis Spectrophotometer; Densitometry Scanner, Differential Scanning Calorimeter, Atomic Absorption Spectroscopy; Instrumental Details, Light Source, Atomizer, Light Separation and Detection, Isoelectric Focusing, Ampholytes; Isotachophoresis,Basic Principle of Isotachophoresis; Requirements of Isotachophoresis, Buffer Additives, Hydrogen Bonding Agents,Surfactants,SDS is the Detergent Most Commonly Employed in Protein Electrophoresis, Reducing Agents; Beer-Lambert Law, Instrumentation, Derivation of the Beer-Lambert Law, Limitations of the Beer-Lambert Law; Horizontal and Vertical Gel Systems, The Horizontal Gel System, Casting a Horizontal Agarose Gel, Slab Gels
6	**Application of Spectroscopy:** Application of Spectroscopy in Various Fields; Applications of UVV is Spectroscopy; Applications of Infrared Spectroscopy, Biological Applications, Industrial and Environmental Applications; Applications of Circular Dichroism (CD) Spectroscopy, Instrumentations, Biological Molecules; Applications of Nuclear Magnetic Resonance (NMR)Spectroscopy
7	**Applications of Chromatography:** Application of Chromatography in Various Fields, Test for Homogeneity of Substances Liable to Contamination with Chemically Similar Substances, Identification of Pharmaceutical Substances and Preparations, Determination of the Individual Components of Complex Mixtures or of Substances in Dilute Solution; Application of Paper Chromatography; Application of Affinity Chromatography, Biomolecules Purified by Affinity Chromatography, Current Techniques involving Affinity Chromatography, immunoglobulin Purification (Antibody Immobilization), Recombinant Tagged Proteins, Protein A, G, and L Purification, Biotin and Biotinylated Molecules Purification, Affinity Purification of Albumin and Macroglobulin Contamination, Lectin Affinity Chromatography; Application of Gel Filtration Chromatography, Fractionation by Size, Separation of Monomers from Dimers and Higher Aggregates, MW Estimation, Native and Others Forms, Determination of Molecular Weight Distribution of Polymers, Determination of Equilibrium Constants; Applications of Ion Exchange Chromatography, In the Laboratory, In Industry and Medicine
8	**Application of Centrifugation:** Applications of Centrifugation in Different Processes; Applications of Micro centrifuge; Applications of Ultracentrifuge, Types of Ultracentrifuges; Clarification and Stabilization of Wine
9	**Application of Electrophoresis:** Applications of Electrophoresis in Various Fields; Application of Affinity Electrophoresis, Capillary Electrophoresis; Applications of Dielectrophoresis; Applications of Electrophoresis; Applications of Electro focusing; Applications of Gel Electrophoresis; Applications of Immunoelectrophoreses; Applications of Isotachophoresis; Applications of Pulsed Field Gel Electrophoresis

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Wootton, David. Bad medicine: doctors doing harm since Hippocrates. Oxford: Oxford University Press: 2006
B. Knoll, Max. "Aufladepotentiel and Sekundaremission elektronenbestrahlter Korer". Zeitschrift fur technische Physik 16:467-475. 1935
C. Harrison, Roger G., Todd, Paul, Rudge, Scott R. Petrides D.P. Bioseparations Science and Engineering. Oxford University Press, 2003
D. Holladay LA. "Simultaneous rapid estimation of sedimentation coefficient and molecular weight". Biophys Chem. 1980, 11(2) PubMed.

WEB LINKS:

A. http://www.lenntech.com/library/clarification/centrifugation.htm.
B. http://www.sigmaaldrich.com/content/dam/sigma-aldrich/docs/Sigma-Aldrich/Brochure/1/biofiles_v6_n5.pdf.
C. http://www.westfalia-separator.com/applications/beverage- technology/wine/winemaking.html.

MOLECULAR GENETICS– GNT14202

UNIT	CONTENTS
1	**Nucleic Acid:** Chemical Basis of Heredity; Bacterial Transformation Experiments, Griffith Experiment, Avery, Colin MacLeod and MacLyn McCarty Experiments, Hershey and Chase Experiment; Deoxyribonucleic Acid (DNA),Genes are made of DNA, Chemistry of DNA, Structure of DNA, Key Features of DNA Double Helix, Variants of DNA; Structure of RNA,RNA Content of the Cell
2	**Genome Organization:** Genome of Organisms, Physical Structure of the Prokaryotic Genome, Eukaryotic Genome; Repetitive DNA Sequences, Repetitive DNA, Non- Repetitive DNA; Gene Families, Multigene Families, Simple (Classical) Multigene Families, Complex Multigene Families; Homologous Genes; Pseudogenes; Mitochondrial an Chloroplast Genome; Comparison between Prokaryotic and Eukaryotic Genomes
3	**Replication of DNA & Chromosome:** Replication of DNA, Meselson-Stahl Experiment, Basic Chemistry of Replication, Enzymes Involved in DNA Replication; Mechanism of DNA Polymerase, Nick Translation, DNA Polymers in Prokaryotes, Proofreading; Rolling Circle Replication; Replication of Eukaryotic Chromosome; Eukaryotic DNA Polymerase, Duplication of Nucleosome, Origin of Replication in Eukaryotes, Eukaryotic Replication Fork, Steps Involved in the Process of Replication of Eukaryotes; Regulation of Initiation of DNA Replication; Replication of Heterochromatin Region of DNA, Replication of Telomeric Region of DNA; Replication of Mitochondrial and Chloroplast DNA
4	**Genetic Code and Transcription:** Genetic Code; Salient Features of Genetic Code, Codon Degeneracy, Non-overlapping Nature of Codons, Genetic Code is almost Universal, Genetic Code is Unambiguous; Transfer of Information via Genetic Code, Reading the Genetic Code
5	**Gene Expression and its Regulation:** Central Dogma, Major Steps of Central Dogma; Control of Gene Expression; Principle of Gene Regulation, Regulatory Proteins Involved in Gene Regulation, Gene Regulation in Prokaryotes, Positive and Negative Gene Regulation, Regulation of Gene Expression in Eukaryotes, Regulation of Chromatin Modification, Regulation of Transcription, Regulation of RNA Processing, Regulation of Transportation of

	RNAs in to Cytoplasm, Regulation of Translation, Regulation by Signal Transduction
6	**Mutation:** Discovery of Chromosome; Eukaryotic Chromosome; Structure of a Chromosome; Morphological Forms of Chromosomes, Nucleolar Chromosomes, Sat-Chromosome; Chromosome Abnormalities and Karyotype; Variations of the Chromosome Structure; Variations of the Chromosome Number, Human Abnormalities due to Alterations in Chromosome Number, Non-disjunction Involving Autosomes, Chromosomal Rearrangements and Speciation; Chromosomal Theory of Inheritance
7	**Gene Interaction:** Genetic Linkage; Linked Genes; Types of Linkage, Complete Linkage, Incomplete Linkage; Arrangement of Genes; Crossing Over, Types of Crossing Over, Types of Crossing Over, Theories of Crossing Over, Cytological Basis of Crossing Over, Crossing Over and Linkage Maps; Map Units; Three-Locus Mapping; Interference and Coincidence; Applications of Genetic Mapping
8	**Recombinant DNA Technology:** Development of Recombinant DNA Technology, Enzymes Involved in Recombinant DNA Technology, Restriction Endonucleases; Step Involved in DNA Cloning, DNA Isolation, Cutting of DNA, Joining DNA, Transfer of Recombinant Plasmid DNA to a Bacterial Host, Amplification Recombinant DNA, Screening; Different Types of Cloning Vectors, Plasmid DNA as a Vector, Cloning Vectors Based on Viral DNA, Cloning Vector Based on λ Phage, Replacement λ Vectors, Insertion λ Vectors, Cosmids, Cloning Vector Based on M13 Phage, Phagemid Vectors, Yeast Artificial Chromosome (YAC) Vectors; Methods of Recombinant DNA Technology, Finding the Gene of Interest, Gel Electrophoresis, Radiolabelling, Nucleic Acid Hybridisation, Northern and Southern Blotting; DNA Libraries, DNA Sequencing; Sanger "Dideoxy" DNA Method of Sequencing, Automated DNA Sequencing, Polymerase Chain Reaction, Expression Vectors, Restriction Mapping; Restriction Fragment Length Polymorphism (RFLP), RFLPs can Serve as Markers of Genetic Diseases; Applications of Recombinant DNA Technology, Gene Therapy, Vaccine Production, Agricultural Applications, Herbicide Resistance, Nitrogen Fixation, Insect Resistance, Farm Animals

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Watson, Molecular Biology of the Gene.

B. Harvey F. Lodish, Molecular Cell Biology, 4th Edition.

C. Benjamin Lewin, Gene VII.

D. Benjamin Lewin, Cells.

WEB LINKS:

A. http://www.chem4kids.com/files/bio_nucleicacids.html

B. http://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/nucacids.htm.

C. http://biology.about.com/od/molecularbiology/a/nucleicacids.htm.

D. http://chemed.chem.purdue.edu/genchem/topicreview/bp/1biochem/nucleic8html

MOLECULAR GENETICS (P) – GNT14202P

1. PCR amplification of DNA
2. Restriction enzyme digestion of DNA
3. Ethanol precipitation of DNA
4. Agarose gel electrophoresis
5. Transformation of E. coli by electroporation
6. Preparative DNA Fragment Isolation from an Agarose Gel
7. Ligations of plasmid DNA to insert DNA

8. Transfection of mammalian cells using Lipofectamine
9. Cycle Sequencing Protocols For ABI 3100
10. One Step Gene Assembly (Gene Synthesis)

IMMUNOLOGY –MBL14212

UNIT	CONTENT
1	**Overview of Immunology:** Immune System, Functions of the Immune System; Types of Immunity, Innate Immunity, Adaptive Immunity, Passive Immunity, Natural Immunity, Acquired Immunity, Humoral vs. Cellular Immunity; Organs of the Immune System – Bone Marrow; Cells of the immune system, T-Cells, B Cells, Dendritic Cells; Immune Response; Measures of Immune Function.
2	**Immune Response:** Antigens, Chemical Nature of Antigens, Epitopes of an Antigen, Recognizing and Antigen as Foreign; Antibodies, Basic Immunoglobulin Structure, Structure of a Typical Antibody Molecule, Basic Immunoglobulin Function, Generation of Antibody Diversity, Immunoglobulin Production; Factors Influencing Immunogenicity, Contribution of the Immunogen, Contribution of the Biological System, Chemical Nature of Immunogens, Types of Antigens; Superantigens, Determinants Recognized by the Innate Immune System; Structure of an Antibody, Antibody Isotypes; Antigen-Antibody Interactions, Affinity and Avidity, Specificity and Cross Reactivity; Factors affecting Measurement of Antigen-antibody Reactions, Agglutination Tests, Precipitation Tests; Tests for Cell Associated Antigens, Immunofluorescence, Flow Cytometry, Complement Fixation.
3	**Immuno Chemistry:** Humoral Immunity; Cell Mediated Immunity; Purification of Antigens, Affinity Purification vs. Other Methods; Magnetic Particles, Antibody Purification, Antibody Characterization, Pull-down Assays, Fusion Tag Protein Purification, Avidin-Biotin Systems, Class Enrichment and Isolation, Containment Removal; Conjugation and Labeling of Antibodies; Immunocolloidal Conjugates; Enzyme Linked Immunosorbent Assay, ELISA Formats; Radioimmunoassay (RIA), The Technique, Separating Bound from Free Antigen.
4	**Cell Response to Stress:** Cell Death Machinery, Caspases as Death Effectors, Mitochondria and Activation of Caspases, Death Receptors and Activation of Caspases, Inhibitors of Caspase-Action:IAP Proteins, Ligation of Death Receptors and Cellular Stress-Induced Apoptosis, Caspase-independent Apoptosis; Cellular Stress and Apoptosis, JNK Signaling and Cellular Stress-Induced Apoptosis, Endoplasmic Reticulum and Cellular Stress-Induced Apoptosis, p53 and Cellular Stress-Induced Apoptosis, Ceramide and Cellular Stress-Induced Apoptosis; Apoptosis; Cancer, Causes of Cancer, What are the Symptoms of Cancer? How is Cancer Classified? How is Cancer Diagnosed and Staged?
5	**Techniques in Autoimmunity:** ELISA Technique, Applications, History, Types; Autoimmune Disorders, Causes, Symptoms; Mechanism of HIV Infection, HIV Replication and Transcription; Description of the HIV Screening Simulation, Steps in the Indirect Elisa, Materials, Procedure; Radioimmunoassay, The Technique.
6	**Serological Techniques:** Types of Serological Tests, Complement Fixation Test (CFT), Enzyme-Linked Immunosorbent Assay (ELISA), Agar Gel Immunodiffusion (AGID), Serum Agglutination Test (SAT); Some Basic Tests – RA Factor; Blood Grouping, Rh Blood Types; Coombs Test, Direct Coombs Test, Indirect Coombs Test, Coombs Reagent; New Serological Techniques; Classification of Antigen-Antibody Interactions-Serological Tests; Agglutination/Hemagglutination – Agglutination Tests; Passive Hemagglutination, Coomb's Test (Antiglobulin Test); Hemagglutination Inhibition, Precipitation Tests; Complement Fixation Test, Enzyme-Linked Immunosorbent Assay (ELISA); Widal Test; VDRL Test; Cold Agglutination Titer, Objectives, Principle, Materials, Procedure, Interpretation, Limitations of the Procedure.

7	**Advance Techniques in Autoimmunity:** Gel Electrophoresis; Coomassie Brilliant Blue Staining, Work of Alkaline Phosphatase; Chromatography – Basic Operation; Different Types of Chromatography Methods, Paper Chromatography, Thin Layer Chromatography, Gas Chromatography, FPLC; Optimizing Protein Purification; Different Modules and their Operation.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Stefan Dubel (edition), Handbook of Therapeutic Antibodies.
B. H. Zola, Monoclonal Antibodies.
C. F. Breitling an d Stefan Dubel, Recombinant Antibodies.
D. Monoclonal Antibody Index: Cancer Diagnosis and Therapy (Volume 1)
E. Monoclonal Antibody Index: Transplant, Infection, Heart (Volume 2)

WEB LINKS:

A. http://www.biomed.drexel.edu/new04/content/academics/CourseMaterials/BMES212_2009WINTER/ImmuneResponse.pdf
B. http://www.uta.edu/biology/britton/classnotes/1442/CH43.pdf.
C. http://www.nature.com/jid/journal/v133/n9full/jid2013287a.html
D. http://wwwlabdserotec.com/an-introduction-to-elisa.html.

IMMUNOLOGY (P) –MBL14212

1. Isolation and structure of immunoglobulins,
2. Monoclonal antibodies: production, purification and enzymatic fragmentation
3. To Produce Polyclonal Antibodies
4. ELISA (Enzyme Linked Immunosorbent Assay)
5. Dot- ELISA (Enzyme Linked Immunosorbent Assay)
6. Radial Immuno Diffusion Test (RID)
7. Inheritance: Consequences of Clonal Selection Immunofluorescence
8. Detection of a Single Antibody Producing Cell (Jerne Plaque Assay)
9. MHC Polymorphism: HLA Typing by PCR
10. Phagocytosis

FOOD AND DAIRY MICROBIOLOGY– MBL14213

Unit	Content
1	**Foods as a Substrate for Microorganisms:** Introduction to Microorganisms Growth in Foods; Intrinsic Factors Influencing Microbial Growth, Hydrogen ion Concentration, Water Activity, Oxidation Reduction Potential, Nutrient Content; Extrinsic Factors; Natural Flora of Foods; Moulds, General, Moulds Occurring in Foods; Yeasts, General characteristics; Bacteria, General characteristics; Contamination of Foods.
2	**Microbial Spoilage of Various Foods:** Introduction to Microbial Spoilage, Principles of

	Food Spoilage; Classification of Food Based on the Degree of Spoilage, Common Genera of Yeast Causing Food Spoilage, Common Genera of Bacteria Causing Food Spoilage; Spoilage of Vegetables and Fruits, General Types of Microbial Spoilage, Bacterial Agents; Spoilage of Meat, General Principles Underlying Meat Spoilage, Tissue Invasion by Microorganisms, Growth of Microorganism in Meat, General types of spoilage in Meats, Spoilage in the Absence of Air; Spoilage of Eggs, Spoilage in the Broken Eggs, Changes during Storage, Changes Brought by Non Microbial Causes, Changes due to the Microorganisms; Spoilage of milk, Milk Spoilage Process, changes in Milk Fats, Spoilage of Milk at Different Temperature; Spoilage of Butter; Spoilage of Breads; Spoilage of Canned Foods, Appearance of the Unopened Container.
3	**Principles and Methods of Food Preservation:** Introduction to Food Preservation; Principles of Food Preservation, Prevention or Delay of Microbial Decomposition, Prevention or Delay of Microorganisms; Physical Methods of Preservation, Asepsis, Removal of Microorganisms, High Temperature, Canning, Drying, Using Low Temperature3, Irradiation, Aseptic Packaging, Microwave Processing; Chemical Methods of Food Preservation, Organic Acids and their salts, Nitrites and Nitrates, Sulphur Dioxide, Ethyene Oxide, Sugar and salt, Antibiotics, Bacteriocins.
4	**Fermented Foods:** Introduction to Dairy Starter Culture; Starter Culture Microorganisms, General Characteristics of Lactic Acid Bacteria, Characteristics of Starter Culture Genera and Species, Enumeration of Dairy Starter Cultures; Fermented Dairy Products, Yogurt; Acidophilous Milk, Production of Acidophilous Milk, Drawbacks of Acidophilous Milk, Advantages of Acidophilous Milk; Kumis, kumis production, Benefits of Kumis; Keir, Commercial Production of Kefir, Health Benefits of Kefir; Production of Dahi, Manufacture of Dahi, Drawbacks of Dahi Production, Benefits of Dahi; Cheese, Cheese Making Process; Other Fermented Dairy Products, Dosa, Sauerkraut, Soy Sauce, Tempeh, Probiotics.
5	**Food borne Disease:** Food borne Diseases, Food borne infection, Food borne Intoxication, Clinical Features of Food borne Illness; Causative Agents, Classification by Mode of Pathogenesis; Food Composition imbalance; Symptoms of Food borne Illness; Preventive Measures; Food Intoxication; Staphylococcus Aureus, Staphylococcal Food Intoxication, Incidence o the Disease, Symptoms of Staphylococcal Food Intoxication, Prevention of Outbreak; Clostridium Botulinum, Botulism, Organism, Pathogenesis and Clinical Features, Infant Botulism, Wound Botulism, Conditions Necessary for an Outbreak, Prevention of Outbreaks; Mycotoxins; Food Infections, Bacillus Cereus, Vibrio Parahaemolyticus, E. coli, Salmonellosis, Shigella, Yersinia Enterocolitica, Listeria Monocyutogenes, comphylobacter Jejuni.
6	**Food Sanitation and Control:** Introduction to Waste Water; Waste Water Collectin and Treatment, Chemical Treatment, Biological Treatment and Disposal; Ecological Sanitation; Sanitation and Public Health; Hazard Analysis Critical Control Point System, Definitions, HACCP Principles, Application of HACCP Principles; Food Preparations; Indices of Food Sanitary Quality; Sanitizers, Hypochlorites, Chlorine Dioxide, Iodophors, Peroxyacetic Acid (PAA), Quaternary Ammonium Compound.
7	**Water Portability:** Public water system; Treatment and Safety of Drinking Portable Water; Methods of Treatment of Water, Screening, Sedimentation, Filtration, Coagulation, Chlorination, Use of Ozone and Ultra violet Rays; Methods to Detect Portability of Water Samples, Bacteria, E Coli, Most Probable Number Test for Coliforms; Membrane Filter Technique; IMViC Tests, Indole Test, Methyl Red Test, Voges Proskauer Test, Citrate Utilization Test.
8	**Nature of Soil:** Soil as Microenvironment for Microorganisms, Physico-chemical Properties of Soil; Soil Organic Matter, Nature of Soil Organic Matter; Humus, Nature and Characteristics of Humus, Factors Affecting Organic Matter Decomposition; Soil and Surface Environment; Soil Pores and AMovement of Gases for Microbial Activity, chemical Factors, Physical Factors, Biological Factors; Microbes in the Soil Surface and Different Zones of Soil, Microorganisms in Different Zones of Soil; Decomposition of Plant and Animal Resudues by Microorganisms in Soil, Microorganism and Plant Decomposition.
9	**Microorganisms in the Rhizosphere, Root Surfaces and Phylloplane:** Microbial

	fertilizers; Nitrogen Fixing Bacteria as Microbial Biofertilizers, Symbiotic N2 Fixing Bacteria, Free Living N2 Fixing Bacteria or Asymbiotic; Mass Production of Rhizobium, Mass Culture of Azotobacter, Mass Culture of Cyanobacteria; Biological Nitrogen Fixation; Nitrogen Fixing Bacteria, Process of N2 Fixation, Biochemical Steps in Nitrogen Cycle; Phosphate Solubilizing Bacteria; Soil Anaerobic Methanogens in Rice Fields.
10	**Plant Disease:** Introduction to Plant Diseases; Mode of Entry of Pathogens; Disease Symptoms; Description of Plant Diseases and their Pathogens, Diseases caused by Algae; Fungal Diseases, Some Plant Pathogenic Fungi; Bacterial Diseases; Diseases Caused by Mycoplasma like Organisms; lant Diseases Caused by Nematodes, Examples of Some Plant Pathogenic Nematodes; Plant Diseases Caused by Viurs, Examples of Viral Plant Diseases; Some Diseases Caused in Plants, Brown Spot of Rice, Black Stem Rust of Wheat, Stem Rot of Jute, Rice Disease by Tungro Virus, Grey Blight of Tea, Red Rot of Sugercane, TMV, Blast of Rice, Leaf Blight of Potato, Downy Mildew of Cucurbits.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Michael T. Madigan, Thomas D. Brock (2009) Brock biology of microorganisms, Pearson/ Benjamin Cummings
B. Michael Pelczar (1993) Microbiology McGraw-Hill Companies; 6th Edition
C. William C Frazier and Dennis C Westhoff (1998)
D. Food Microbiology McGraw-Hill College; 4 Sub editions.

WEB LINKS:

A. http://www.en.wikipedia.org/wiki/Food_microbiology
B. http://www.ww4.msu.ac.zw/elearning/material/1189175201ch301lectnotes06.pdf
C. http://www.biotech.kth.se/bioprocess/enfors/Downloads/FoodMicrobiology.pdf
D. http://biotech.iisuniv.ac.in/content/food-and-dairy-microbiology

FOOD AND DAIRY MICROBIOLOGY (P) – MBL14213P

1. Determination of Reducing Sugars by Nelson-Somogyi Method
2. Determination of Glucose by Glucose Oxidase Method
3. Determination of Total Carbohydrate by Anthrone Method
4. Estimation of Crude Fibre
5. Quantitative estimation of amino acids by Ninhydrin Method
6. Detection of Arsenic by microbiological methods
7. Detection of nicotinic acid by bioassay
8. Determination of quality of a milk sample by methylene blue reduction test
9. Microbiological examinations of foods.
10. Alcohol Fermentation

PHYCOLOGY AND VIROLOGY– MBL14214

UNIT	CONTENT
1	**Phycology:** History of Phycology; Types of Algae; Living Environment of Algae, Ecosystem of Algae, Algae Growth Conditions; Morphology of Algae; Microscopic structure of Algae; Importance of Algae, General Uses, Algae in Medicine, Role of Algae in Industries, Negative role of Algae.
2	**Culture of Algae:** Algaculture Growth Conditions, Physical and Chemical Conditions, Growth Dynamics, Isolating/Obtaining and Maintaining of Cultures, Sources of Contamination and Water Treatment; Growing, Harvesting and Processing Algae, Monoculture, Growing Algae, Harvesting, Oil Extraction; Seaweeds, Green Algae(Chlorophyta), Brown Algae(Phaeophyta), Red Algae(Rhodophyta); Importance of Algaculture, Fuel Source, Food Supplement, Stabilizing Agent, Fertilizer, Role of Algae in Pollution Control.
3	**Uses of Algae:** Algae in Food, Chemical Composition of Algae, Algae as a source of Polyunsaturated Fatty Acids (PUFAs), Algae as a source of Vitamins and Minerals, Algae as a source of Antioxidants, Algae as a source of Natural Colorants, Algae as a Component of Functional Food, Algae in Human Nutrition, Algae in Animal Nutrition; Algae as Fertiliser, Time Tested Fertiliser, Seaweed Fertiliser Advantages, Homemade Seaweed Fertiliser; Algae in Agar, uses; Algae and Pollution, Algae as Water Pollutants, Algae as Pollution Indicators, Algae in Pollution Control, Microalgae for Wastewater Treatment; Algae for Biofuel, Biodiesel, Bioethanol, Biogas, Advantages of using Algae as Biofuel; Other Uses of Algae, Radioactive Protection, Seaweeds as Medicine, Algae Therapeutic Solutions, Beauty Products.
4	**History of Microbes:** Classification of Living World, What are Systems of Classification? , Study of Phylogenetic Relationships, Systems of Classification, Three Domains, Scientific Nomenclature; Taxonomic Hierarchy, Classification of Prokaryocyte, Classification of Eukaryocytes, Classification of Viruses; Methods of Classifying and Identifying Microorganisms, DNA Chips.
5	**The World of Bacteria:** General Properties of Bacteria; Structure of Bacteria, External Structure, Internal Structure, Appendages; Classification of Bacteria, Classification of Bacteria According to the Shape of the Bacteria, Classification Based on Cell Wall, Classifying Bacteria on Cellular Respiration.
6	**Microbial Growth and Nutrition:** Methods for Measurement of Cell Mass; Methods for Measurement of Cell Numbers, Disadvantages; Bacterial Growth Curve; Growth Rate and Generation Time, Calculation of Generation Time, Measurement of Growth Fields; Effect of Environmental Factors on Growth, Effect of Oxygen, Effect of pH on Growth, Temperature, Pressure, Radiation.
7	**Structure of Viruses:** Origin of Viruses, Survivors of Pre-cellular First Living Inhabitants of the Earth, Derived from Normal Constituents of the Cell; Biological Status – Nature of Viruses, Definition; Properties of Viruses; Host Factors for Viral Infections; Transmission of Viruses; Structural Components of Viruses, Viral Structure; Morphology, Icosahedral (or Cubic) Symmetry, Helical Symmetry, Complex Symmetry; Viral Envelope; Nucleocapsid Proteins, Core or Internal Proteins; Structure and Complexity of Virus Genomes; RNA Virus Genomes, Positive-strand RNA Viruses, Negative-strand RNA Viruses, Ambisense Genome Organization; 'Small' DNA Genomes; 'Large' DNA Genomes, Herpesvirus Genomes, Adenovirus Genomes; Segmented and Multipartite Virus Genomes, Importance of Knowing Viral Genome – Molecular Genetics, Applications; Epidemics and Pandemics; Plant Viruses, Modes of Transmission of Virus; Classification of Viruses, ICTV Classification, Baltimore Classification; Particle Morphology, Genome Properties, Biological Properties, Serological Properties, Viruses that Multiply only in Plants; General Symptoms of Viral Diseases of Plants (Symptomatology), External Symptoms of Viral Diseases of Plants, Internal Symptoms of Viral Diseases of Plants; Classification of Plant Viruses, Rice Black Streaked Dwarf Viruses; Purification (or Isolation) of Plant Viruses; Tobacco Mosaic Virus (TMV),

	Structure of TMV, Life-Cycle (Replication) of TMVs, Disease Cycle and Epidemiology, Disease Management, Significance; Potex Virus, Potato Latent Disease (Potato Virus X), Alomae and Bobone, Cyanophages, Mycoviruses, Mycoplasma Viruses, Acholeplasma Viruses.
8	**Multiplication of Viruses:** Lytic Cycle, Penetration, Biosynthesis; Gene Regulation Biochemistry, Maturation and Lysis; Lytic Cycle without Lysis, Penetration, Biosynthesis, Maturation and Lysis, Lytic Cycle without Lysis, One Step Growth Curve, Infection of Host Cells; Phage Multiplication Cycle, Lytic or Virulent Phage, Lysogenic or Temperature Phage, Lytic and Lysogenic Cycle Differences, Compare and Contrast Lytic Cycle and Lysogenic Cycle; Immunity

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Phycology, By Robert Edward Lee, 4th Edition, 2008
B. An Introduction to Phycology, By G.R. South, A Whittick, 2009
C. Algae: An introduction to Phycology By Christiaan Hock, D.G. Mann, H.M. Jahns, 1995
D. Phycology: Principles, Processes and Applications edited by Amrik Singh Ahluwalia, 2003

WEB LINKS:

A. http://www.algaeindustrymagazine.com/algae/medical-solution-part-1
B. http://www.fao.org/docrep/012/i1141e01.pdf
C. http://en.wikipedia.org/wiki/Phycology
D. http://en.wikipedia.org/wiki/Virology

GUIDELINES FOR SEMINAR – SEM14201

1. The seminar will be conducted in B.Sc. Second Year and will be of 100 Marks
2. Students have to select a topic of their interest relevant to Advance Science or any areas of interdisciplinary approach in the biological sciences
3. The seminar should cover the relevant information on current scenario of last 3 years
4. There will be an internal evaluation by internal evaluating committee of the relevant department
5. Evaluation will be done on the basis of
   a) Relevance of topic selected
   b) Way of presentation (language, ppt format, confidence, eye contact, body language and other qualities of presentation)
   c) Response to queries
6. The committee will submit the marks to the university.
7. An external evaluation will also be done at the end of term and the evaluation pattern will remain same as that of internal.

ENVIRONMENTAL SCIENCE AND ECOLOGY– WCM14302

UNIT	CONTENT
1	**Renewable and Non renewable Resources:** Renewable Energy, Agricultural Products, Biomass, Water, Fossil Fuel, Radioactive Fuel; Renewable Resources; Economic Models; Non renewable Energy, Humans Depend on Plants and Animals for Food, Nutrients as Food for Plants, Mode of Intake of thirteen Essential Nutrients by the Plants; Manures and Fertilizers, Manures, Types of Manures, Fertilizers, Bio fertilizers, Water; Fuel; Petroleum, Importance of Petroleum, Levels and Flows Limits and Alternatives, Environmental Effects; Fiber, Textile Fiber, Natural Fiver, Manmade Fiber Mineral Fiber, Polymer Fiber, Polyurethane Fiber; Microfiber.
2	**Conventional Fuel:** Wind Energy; Solar Energy; Geothermal Energy; Biomass; Air Pollution; Green house Gases; Implications for Agriculture and Forestry; Hydropower, Historical Development; Firewood, Energy content, Heat Output, Measurement of Firewood, Combustion by products, Combustion by product effects on Human health, Environmental Impact, Environmental Concerns; Hilt's Law, Early Uses as Fuel; Coal as Fuel, Coking Coal and Use of Coke, Gasification, Liquefaction; Refined Coal, Industrial Processes, Cultural Usage; Petroleum, Etymology Composition.
3	**Modern Fuel:** Liquid Fuels for Transportation; First Generation Biofuels, Bioalcohols, Biodiesel, Vegetable Oil, Bioethers, Biogas, Syngas, Solid Biofuels; Second Generation Biofuels; Biofuels by Region, Issues with Biofuel Production and Use; Greenhouse Gase Emissions, Factors Affecting Biogas Production, Design of Digester and Distribution of Anaerobic Microorganisms, Effect of Metals on Biogas Production, Ammonia on Methanogens and Methanogenesis, Alternate Feed stocks, Other Wastes, Use of Spent Slurry, Advantages of Biodiesel; Biodiesel Scenario in India, Biodiesel Experiments.
4	**Microbes in Food Production:** Fibers Produced by Bacteria, Bacterial Cellulose, Bacterial Polyester, Applications of Bacterial Polyester; Developments in Wool, Biological Wool Shearing; Developments in Silk, Ready Colored Yarns from Silkworm, Shape memory Silk Yarn, Bio cosmetics from Silk Protein; Deodorant Fibres, Chitin, Chitosan; Alginate Fibres, Collagen, Food Safety, Fermentation, Probiotics; Microbial Biopolymers, Xanthan, Alginate, Cellulose, Poly Y glutamic acid, Levan, Exopolysaccharides; Foodborne Pathogens, Enteric Viruses, Protozoan Parasites; Mycotoxins; Food Authenticity.
5	**Biofertilizer:** Different Types of Biofertilizers, Rhizobium, Azotobacter, Axospirillum, Cyanobacteria, Azolla, Phosphate Solubilizing Microorganisms, AM Fungi, Silicate Solubilizing Bacteria, Plant Growth Promoting Rhizobacteria, Liquid Biofertilizers; Characteristics of Different Liquid Bio fertilizers, Rhizobium, Physical Features of Liquid Rhizobium, Axosirllium, Azotobacter, Acetobacter; Mass Production of Bacterial Bio fertilizer, Culturing of Microorganisms, Inoculums Preparation; Mass Production of Mycorrhizal Biofertilizer; Mass Production and Field Application of cyanobacteria, Multiplication in Trays, Multiplication under Field Condition, Method of Inoculation of BGA in Rice Field; Mass Production and Field Application of Azolla, Mass Multiplication of Azolla under Field Conditions; Applications of Bio fertilizers, Seed Treatment, Seedling Root Dip, Main Field Application; Azolla- The Best Feed for Cattle and Poultry, Inputs Required, Process Overview, Activated Sludge, Surface aerated Basins, Constructed Wetlands, Filter Beds, Soil Biotechnology, Biological Aerate3d Filters, Rotating Biological Contactors, Membrane Bioreactors, Secondary Sedimentation, Tertiary Treatment, Filtration, Lagooning, Nutrient Removal Nitrogen Removal, Phosphorus Removal, Disinfection, Odour Control, Package Plants and Batch reactors, Sludge Treatment and Disposal, Anaerobic Digestion, Aerobic Digestion, Composting, Incineration, Sludge Disposal, Treatment in the Receiving Environment, Sewage Treatment in Developing Countries; H2 Production, Biophotolysis of Water by

	Microalagae and Cyanobacteria, Hydrogenase dependent Hydrogen Production, Nitrogenase dependent Hydrogen Production; Bio fertilizers and Bio pesticides; Solid Wastes, Sources of Solid Waste, Management of Solid Waste; Management of Biomedical Wastes, Worm culture, Methane Production; Single Cell Protein; Global Environmental Problems; Global Warming, How to Combat Global Warming, Green house Effect and Acid Rain, Greenhouse Gases; Ozone Depletion, Impact of Ultraviolet Light, Issue, Ozone Depleting Substances, Ozone Hole.
6	**Ecology:** History of Ecology; Ecosystem, Understanding Ecosystems, Ecosystem Degradation, Resource Utilization, components of Ecosystem; Energy Flow, Water Cycle, Carbon Cycle, Oxygen Cycle, Nitrogen Cycle, Energy Cycle, Integration of Cycle in Nature; Food Chains and Food Webs, Food Chains, Food Webs; Environment and Its Components, Natural Environment, Manmade Environment.
7	**Environment Pollution:** Air pollution, Types of Air Pollutants, Global Warming and Greenhouse Effect, Acid Rain, Prevention and Control of Air Pollution; Water Pollution, Sources of Water Pollution, Ground Water Pollution, Eutrophication, Methods for Control of Water Pollution and Water Recycling; Noise Pollution, Sources of Noise Pollution, Effects of Noise Pollution, Prevention and Control of Noise Pollution; Solid Waste Pollution, Control of Solid Waste Pollution.
8	**Global Environmental Issues:** Environmental Degradation, Climate change, Ozone Layer Depletion, Global Warming, Loss of Biodiversity, Land Degradation, Soil Degradation; Other Environmental Issues, Conservation of Species, Energy Crisis, Nuclear Issues, Overpopulation, Waste Management; Environmental Health; Genetic Engineering Risks and Impacts, GE Health Risks, GE Environmental Impacts; Nanotechnology; Intensive Farming.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Ackerman, F., 2000, Waste Management and Climate Change, Local Environment, 5(2), pp. 223-229

B. Austrian Federal Government, 2001, Third National Climate Report of the Austrian Federal Government, Vienna, Austria.

C. Gerben J Zylstraa and Jerome J Kukor, What is environmental biotechnology? Current Opinion in Biotechnology 16(3): 243-245,2005

D. Chanton, J. and K. Liptay, 2000, Seasonal variations in methane oxidation in a landfill cover soil as determined by an in situ stable isotope technique, Global Biogeochemical Cycles, 14,pp. 51-60

WEB LINKS:

A. http://www.eschooltodya.com/energy/non-renewable-energy/what-is-non-renawable-energy.html

B. http://www.conserve-energy-future.com/

C. http://ecosystems.psu.edu/youth/sftrc/environ-series/rnr-mat.

D. http://en.wikipedia.org/wiki/Environmental_science

APPLIED MICROBIOLOGY –MBL14308

UNIT	CONTENT
1	**Microbiology of Air:** Introduction to Microbiology of Air, Components of the Environment; Composition of Air; Outdoor and Indoor Microflora, Outdoor Microflora, Indoor microflora; Distribution and Sources of Microorganisms in Air; Air as a Carrier for Microorganisms, Bioaerosol, Resistance of Microorganisms, Relative Humidity, Temperature, Solar Radiation; Droplet; Droplet Nuclei, Infectious Dust; Techniques of Microbial Analysis of Air, Air Sampling Methods; Significance of Air Flora in Human Health, Hospitals and Industries, Human Health, Hospitals, Industries; Air borne Diseases, Bacterial Diseases, Diseases Caused by Streptococcus Pyogenes, Airborne Fungal Diseases, Airborne Viral Disease, Adeno Viral Disease; Air Pollution, sanitation, Chemical Agents, Mechanical Methods
2	**Microbiology of Water and Wastewater Management:** Water Zonation, Types of Waters are Inhabited by Microorganisms; Upwelling; Eutrophication; Microbial Communities in Natural Water, Plankton, Periphyton, Bernthos; Determining Sanitary Quality of Water; Bacteriological Evidence of Faecal Pollution; Indicators of Faecal Pollution, Types of Indicator Bacteria used to Assess the Health Quality of Water; Significance of Indicator Index Organisms, Coliforms, Faecal Streptococci, Bacilli of Clostrideium Genus, Pseudomonas Aeruginosa, Staphylococci, Uses of Indicator Organisms; Faecal and Non faecal Coloforms, IMViC Tests, Elevated Temperature Tests; Bacteriological Examination of Water, Standard Plate Count, Most Propable Number, Membrane Filtration Technique; Water Pollution, Surces of Water Pollution, Control of Human Waterborne Disease.
3	**Microbiology of Sewage:** Microbiology of Sewage, The Sewage Microorganisms; Difinition of Sewage, Types of Sewage; Chemical Composition of Sewage; Microbiology of Sewage Treatment, Objectives of Wastewater Treatment, Methods of Purification and Stages, Biological Methods of Wastewater Treatment; Small Scale Sewage Treatment, Septic Tanks; Evapotranspiration, Factors Affecting Evapotranspiration; Imhoff's Tank, Design considerations, Applicability; Municipal Sewage Treatment Process, Primary Treatment , Secondary Treatment, Steps Involved in the Treatment of waste water, Tertiary treatment; Chemical Treatment of Municipal Sewage; Disposal of Treated Sewage, Anaerobic Digestion, Aerobic Digestion, Composting, Incineration, Sludge Disposal.
4	**Microbiology of Soil:** Soil as an Environment for Microorganisms, Edaphon; Microbiota of Soil and Their Activities, Characteristics of soil Microorganisms; Microbial Interactions Seen in Sil, Symbiosis, Mutualism, commensalism, Competition, Syntrophism, Protocooperation, Predation, Parasitism, Amensalism; Microbiological Examination of Soil, Soil Dilutions and Plate Count; Major biochemical Cycles, Carbon Cycle; Nirogen Cycle, Nitrogen Cycle in Soil, Atmospheric Nitrogen Fixation, Free Living N2 Assimiliators; Phosphorous Cycle; Sulphur Cycle; General Account of Microbes used in Biofertilizers, N2 Fixing Bacteria as Microbial Bio fertilizers, Symbiotic N2 Fixing Bacteria, N2 Fixing Associated Bacteria; Plant Growth Promoting Rhizpbacteria; Phosphate Solubilizing Bacteria; Rhizosphere, Rhizosphere Effect, R:S Ratio; Phyllosphere Microorganisms.
5	**Microbiology of Milk:** Definition and Composition of Milk, Description Composition of Milk; Sources of Microorganisms in Milk; Desirable and Undesirable Microorganisms; Types of Microorganisms, Biochemical Types, Temperature Characteristic Types; Changes in the Flora of Raw Milk Stored at Room temperature, Microflora of Raw Milk, Changes at Room Temperature; Microbiological Examination of Milk, Standard Plate count, Organoleptic Tests, Clot on Blotting, Pasteurization, Dye Reduction Tests, Phosphatase Test; Sterilization; Cheese, Cheese Description, Main Steps involved in Cheese manufacture, Types of Cheeses.
6	**Microbiology of Food:** Food as a Substrate for Microorganism; Major Groups of Microorganisms in Food, Bacteria; Sources of Contamination of Foods; Factors Affecting

	the Growth of Microorganisms in Food, Intrinsic Factors, Extrinsic Factors, Changes are Observed in Foods; Microbiological Examination of Foods, Direct Examination, Cultural Techniques, Enumeration Methods; Principles of Food Preservation, Prevention or Delay of Microbial Decomposition, Prevention or Delay of Self decomposition of Food; Microbiostatic and Microbicidal Methods, Microbicidal Agents, Microbiostasis Agents; Methods of the Preservation of Food, Asepsis, Removal of Microorganisms, Maintenance of Anaerobic Condeitions, High Temperature, Using Low Temperature, Drying, Chemical Preservatives, High Osmotic Pressure, Irradiation, Smoking; Microbial Spoilage of Foods, Classification of Foods by Ease of Spoilage, Factors affecting Kinds and Numbers of Microorganisms in Food, Factors Affecting the growth of Microganisms in Food; Chemical Changes caused by Microorganisms in Food, Changes are observed in Goods, Changes in Non nitrogenous organic Compounds; Causes of Spoilage in Canned and Non canned Food; Food borne Diseases, Staphylococcus Aureus, Clostridium Botulinum, Salmonellosis, Mycotoxins.
7	**Bioreactors and Fermenters:** Design of Fermenter, Components of Fermenter; Types of Fermentation in Laboratory Scale, Batch Culture, Continuous Culture, Fed Batch Culture; Fermentation Pilot Scale Production; Types of Fermenters; Constantly Stirred Fermenter, Mechanically Stirred Tank Fermenter; Tower Fermenter; Fixed Bed Bioreactor; Fluidized Bed Bioreactor; Airlift Fermenter.
8	**Isolation of Industrially Important Microbial Strains:** Primary Screening, Objectives of Primary Treatment, Steps of Primary Treatment, Aeration; Secondary Screening, Aerobic Processes, Anaerobic Processes; Strain Development, Strain Improvement, Natural Recombination, Mutagenesis: A Conventional Tool for Strain Improvement; Genetic Engineering of Microorganisms; Cultural Preservation, Method of Preservations; Maintenance of Industrial Strains.
9	**Downstream Processing and Industrial Products:** Microorganisms Involved in Production in Production; Media Used, Fermentation Conditions; Downstream Processes and Uses, Cell Harvesting, Broth Conditioning, Foam Separation; Separation of Cells and Insoluble Products, Sedimentation, Filtration, Centrifugation, Cell Disruption; Separation of Soluble Products, Liquid-Liquid Extraction; Aqueous Two Phase Extraction, Precipitation, Adsorption, Dialysis, Reverse Osmosis; Supercritical Fluid Extraction; Purification Techniques, Membrane Filtration, Chromatography; Product Polishing, Crystallization, Drying by conduction, Drying by Convection, Lyophilization, Diafiltration; Production of Citric Acid; Production of Ethanol; Production of Penicillin, Mechanism of Penicillin; Production of Glutamic Acid; Production of Riboflavin, Structure of Riboflavin, Production Process of Riboflavin; Production of Enzymes, Amylase; Production of Cellulose, Protease, Lipase, Glucose Isomerase, Glucose Oxidase; Production of Wine, Hops; Beer, Grains; Bioinsecticides; Steroid Transformations.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. K.R. Aneja (2008) A Textbook of Basic and Applied Microbiology, New Age International

B. A. Durieux, J.-P. Somon (2001) Applied Microbiology, Springer,

C. Google e book (2005), Advances in Applied Microbiology, Volume 56, Academic Press.

D. Michael. J. Pelczar (2001) Microbiology, Tata McGraw-Hill Education.

WEB LINKS:

A. http://www.books.google.co.in/books/about/microbiology.html

B. http://upendrats.blogspot.in/2009/08/air-microbiology.html

C. http://wwwscribd.com/doc/19079015/Air-Microbiology-2009

D. http://www.springer.com/life+sciences/microbiology/journal/253

APPLIED MICROBIOLOGY (P) – MBL14308P

1. Isolation of microorganisms from air - air sampler techniques - settle plate method.
2. Isolation and counting of fecal bacteria from water.
3. Detection of bacteria in milk by Dye reduction test; Detection and quantification of bacteria in milk.
4. Litmus milk reaction.
5. Isolation of lactobacilli and staphylococcus from curd.
6. Azolla - Morphological study; seed inoculation with rhizobia.
7. Isolation of bacteria and fungi from spoiled food.
8. Isolation of fungi from molting leaves.
9. Measurement of fungal growth by mycelia weight determination.
10. Determination of bacterial growth by turbidity measurements.

MEDICAL MICROBIOLOGY –MBL14309

UNIT	CONTENT
1	**Introduction to Medical Microbiology:** History of Medical Microbiology; Scope of Medical Microbiology, Microbiology and Patient, Predicting Antibiotic Sensitivity, Microbiology and Community, Branches of Microbiology; Applications of Medical Microbiology; Classification of Microorganisms, Bacteria, Fungi, Viruses, Protozoa, Helminths; Discovery of Pathogenic Microorganism, Pre Pleistocene, Pleistocene, Holocene, Middle Ages, Scientific History.
2	**Clinical Specimen Collection:** Clinical Specimens; Preservations of Specimens, Processing; Respiratory Tract, Upper Respiratory Tract; Types of Specimens, Respiratory Tract Specimens, Central Nervous System Specimens; Other Specimens, Genital Tract Specimens, Gastrointestinal Tract Specimens, Urinary Tract Specimens; Sample Transportation; Blood Specimens, Veni puncture, Capillary Puncture; Preservation of Blood, Anticoagulants.
3	**Normal Flora of Human Body:** Flora of the Human Body, Mutualistic Relationship; Composition of the Normal Flora, Normal Flora of the Skin, Normal Flora of the Respiratory Tract, Normal Flora Organisms of the Nose, Nasopharynx and Oropharynx, Normal Flora of the Human Oral Cavity, Normal Flora of the 0+, Normal Flora of the Rrogenital Tract, Normal Flora of the Gastrointestinal Tract.
4	**Antibiotic Susceptibility Test:** Principles of the Test, Factors Influencing Antimicrobial Susceptibility Testing pH; Methods of Antimicrobial Susceptibility Testing, Disk Diffusion, Dilution Methods, Dilution and Diffusion; Susceptibility of Fastidious Bacteria, Disc Diffusion for Fastidious Organisms; Inoculation of the Susceptibility of the Strains; Determination of MIC for Fastidious Organisms, Agar Dilution Method; Errors in Interpretation and Reporting Results; Quality Control in Antibiotic Susceptibility Testing, Standard Methods for the Detection of Antibacterial Resistance; Application of Computers in Antibacterial Susceptibility Testing.
5	**Infection and Control:** Methods of Surveillance of HAI, Incidence and Privalence of HAI; Methods of Control of Nosocomial Infection, National or Regional Program, Hospital Program; Infection Control Committee, Infection Control Professionals, Infection Control Manual; Infection Control Responsibility, Role of Hospital Management, Role of the Physician, Role of the Hospital Pharmacist, Role of the Nursing Staff, Role of the Central Sterilization Service, Role of the Food Service, Role of the Laundry Service, role of

	Maintenance, Role of the Infection Control Team.
6	**Disease Transmission:** Classification of Disease; Transmission of Disease; Prevention from the Transmission of Infectious Disease; Different Types of Disease- An overview, Mycobacterium Tuberculosis, Disease Tuberculosis, History of Smallpox, Quarantine, Vibrio Cholerae Strains, Typhoid, Gastroenteritis, Bovine Tuberculosis, Foot and Mouth Disease, Anthrax, Rabies, Cow Pox, Undulant Fever, Actionomycosis, Digestive Disturbances, Cholera, Typhoid or Enteric Fever, Paratyphoid Diphtheria, Streptococcal Infections, Streptococcus Pyogenes, Shigellosis, Listetious, Bacillus Cereus Poisoning, Aflatoxicosis.
7	**Quality Control:** Microbiological Testing of Non sterile Products, Facilities, Equipments and media; Sterility Testing, Methodology and Validation of Test Procedures, Management Review; Contract Testing, Laboratories, Physical Parameters, Microbiological Parameters.
8	**National Program:** National TB Program, Political and Administrative Commitment; National AIDS/HIV Control Program, National AIDS Control Program NACP-I, NACP-II(1999-2007), NACP-III(2007-2012); Collaborations, Mainstreaming, Surveillance; History of NLEP, Milestones in NLEP, Background, National Malaria Control Program; Geographic Spread of Urban Malaria, Development of Regional/National Facilities for In service Training of Senior Professional Staff.
9	**Etiology:** Etiology; Laboratory Diagnosis of Infectious Disease, Complexity of Bacterial Ecology; Laboratory Diagnosis of Respiratory System, Upper Respiratory Tract Infections, Lower Respiratory Tract Infections; Culture Set up of Different Specimens, Key Organisms; Laboratory Diagnosis for Digestive System; Urinary Tract Infection Diagnosis.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Fritz H. Kayser (2005), Medical Microbiology, Thieme.

B. Cedric A. Mims (2004), Medical Microbiology, Mosby.

C. William L. Irving, Dlawer A. A. Ala Asdeen, Tim Boswell(2005)

D. W. John Spicer (2008), Clinical Microbiology and Infectious Disease: An Illustrated Colour Text, Elsevier Health Sciences

WEB LINKS:

A. http://www.slideshare.net/MMASSY/intro-to-medical-microbiology-lecture-notes

B. http://www.myplace.frontier.com/dffix/medmicro/mmintro.htm

C. http://www.mona.uwi.edu/biochem/courses/BC10m/documents_IntrodMedMicrobiol.pdf

D. http://en.wikipedia.org/wiki/Medical_microbiology

MEDICAL MICROBIOLOGY (P) – MBL14309P

1. Demonstration of the bacterial flora of the skin.
2. Testing of antimicrobial activity of the skin on bacteria
3. Pathogenic fungi of the skin Direct examination of infected tissues for dermatophytes
4. Isolation of dermatophytes for their identification
5. Determination of dental caries susceptibiligy
6. Examination of sputum for tuberculosis
7. Microorganisms of the gastrointestinal tract
8. Primary Isolation of enteric pathogens- Salmonella and Shigella

9. Preliminary identification of enteric pathogens using triple sugar iron agar (TSIA) medium
10. Microorganisms of the urinary tract (urine)

BIONANOTECHNOLOGY– BIO14304

UNIT	CONTENT
1	**Introduction to Bionanotechnology:** Bionanomachines, Manufacturing Bionanodevices, Applications; Nano devices; Molecular Bionanotechnology, Nano robots, Cell Repair Machines, biomedical Nanotechnology, Nanonephrology, Providing Oxygen, Drug Development; History of Bionanotechnology, Rechard Feynman and his contributions, Eric Drexler: Molecular Manufacturing, 1981; Nanobiotechnology versus Biotechnology; Natural Bionanomachines.
2	**Properties and Characterizations of Techniques in Bionanotechnology:** UV visible spectroscopy, Basic Principle, UV Visible Absorption Spectra, Applications; Fluorescence Spectroscopy, Basic Principle, Applications; X ray Diffraction and Electron Microscopy, Powder Diffraction, X ray Crystallography, Transmission Electron Microscope, Scanning Electron Microscope, Light Scattering, Zeta Potential; Surface and composition, Energy Dispersive X ray Analysis, Atomic Force Microscopy, Scanning Tunneling Microscope; Vibrational Spectroscopy, FT-IR, Raman Spectroscopy.
3	**Biosensors as Precursors of Bioelectronics:** Functionalization of Sensor Substrates, Biofunctionalization by Non covalent Assembly, covalent Route; Biochips, Historical Perspective Current State, Nano sensors- Miniaturization of Biosensors, Nanosensors, Nanotaterial based Biosensors; Electron Transfer of Biomecules, Electron Transfer in Proteins, Long Range Electron Transfer in Proteins, Protein based Radicals; Nano particle Biomaterial Hybrid Systems, Bio electronic Systems based on Nano particle Enzyme Hybrids, Bio electronic Systems for Sensing of Bio recognition Events Based on Nano particles.
4	**Applications of Nano materials in Biosystems:** Protein Targeting with Small Molecules, Small Molecule Immobilization, Binding of a Phage Expressed Proteome Library to a Small Molecule, Panning the Eluter Phage, Target Protein Validation; Protein Interactions, Protein binding, Ligand mediated Interactions, Interactions during Intracellular Processing; Nano material Cell Interaction; Nano material Manifestation of Surface Modification, Choice of Ligands, Nanomaterial Surface Functionalization.
5	**Nanomaterials and Diagnostics/ Drug Delivery and Therapeutics:** Magnetic Resonance Imaging, Performing MRI, Applications, Risks/Benefits; Surface Modified Nanoparticles; MEMS/ NEMS based on Nano materials, Pressure Sensor, Inertial Sensor Optical MEMS, RF MEMS; Lipid Nanoparticles for Drug Delivery, Nano structured Lipid Carriers, Lipid drug Conjugates; Inorganic Nanoparticles for Drug Delivery; Metal Oxide Nano particles, Alumina Nano particles, Copper Oxide Nano particles, Gold Nano particles, Iron Nano particles, Magnesium Oxide Nano particles; Anisotropic Nano materials, Bio conjugation and Labeling, Optical Contrast Agent, Photothermal Therapy, Cancer Cell Imaging.
6	**Structural Principles of Bionanotechnology**: Environment in which the Bionanomachines Functions, Gravity and Inertia are Negligible at the Nanoscale, Nano machines Show Atomic Granularity, and Thermal Motion is a Significant Force at the Nanoscale, Bionanomachinses Require a water environment, Natural Bionanomachinery is designed for a Specific Environment; Principles behind Design of Natural Bionanomachines, Molecules are Composed of Atoms Linked by Covalent Bonds, Dispersion and Repulsion Forces Act at Close Range, Hydrogen Bonds Provide Stability and Specificity, Electrostatic Interactions are Formed Between charged atoms, The Hydrophobic Effect Stabilizes Biomolecules in Water; Hierarchical Strategy in Construction of Bionanomachines, Self assembly, Self organization, concept of Molecular Recognition.

7	**Functional Principles of Bionanotechnology:** Information Storage Nucleic Acid; Ribosomes construct Proteins; Energetic, Energy from Light, Electron Transport Pathways, Electrochemical Gradients; Enzymes and its Regulation, Enzymes Reduce the Entropy of a Chemical Reaction, Enzymes Create Environments that stabilize Transition States, Enzymes Use Chemical Tools to Perform a Reaction, Regulation; Biomaterials, Helical Assembly of Subunits, Micro scale Infrastructure, Minerals are Combined with Biomaterials for Special Applications, Cells Make Specific and General Adhesives; Biomolecular Motors, ATP Powers Linear Motors, ATP Synthase and Flagellar Motors are Rotary Motors, Brownian Ratchets Rectify Random Thermal Motions;; Biomolecular Sensing, Smell and Taste Detect Specific Molecules, Light Sensing, Mechanosensory Receptors.
8	**Tools and Techniques Required for Bionanotechnology:** Recombinant DNA Technology, Site directed Mutagenesis, Fusion Proteins; X ray Crystallography; NMR Spectroscopy; Electron Microscopy; Atomic Force Microscopy; Molecular Modeling, Visualizing Bionanomachines, Docking, Computer assisted Molecular Design.
9	**Applications of Bionanotechnology:** Nano medicine, Immunotoxin, Liposomes, Gene Therapy Personalized Medicine, Computer aided Drug Design; Hybrid Material, Nanoscale Conductive Metal Wires, Patterned Aggregates of Gold Nan particles, DNA Flexes, Bio mineralization; Biosensors, Antibodies, Biosensors Detect Glucose Levels for Management of Diabetes, Nanopores; Artificial Life, Artificial Photocells Reproduce by Budding, Self replicating Molecules are an Elusive Goal, ATP is Made with an Artificial Photosynthetic Liposome, Poliovirus has been Created with only a genetic Blueprint.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Vencatesan Renugopalakrishnan and Randolph V. Lewis, Bionanotechnology: Proteins to Nanodevices, 2006
B. David S. Goodsell, Bionanotechnology: Lessons from Nature, 2004
C. Elisabeth S. Papazolou, Bionanotechnology, 2007
D. Q. Ashton Acton, Advances in Bionanotechnology Research and Application: 2013 Edition.

WEB LINKS:

A. http://www.saylor.org/site/wp-content/uploads/2011/06/Nanobiotechnology.pdf
B. http://www.slideshare.net/tabirsir/applications-of-bionanotechnology-5380799
C. http://en.wikipedia.org/wiki/Nanobiotechnology
D. http://www.ks.uiuc.edu/Training/Tutorials/nanobio/bionano-tutorial.pdf

PROJECT WORK/ INDUSTRIAL TRAINING – PRJ14301

The topic of the project should be selected by the students themselves in consultation with the industry as well as the faculty guide. The project work is to be submitted to the training coordinator by before the end of final year examinations.

The project work (including the contact details of the project guide) is to be forwarded to the Training Coordinator. **Candidate will come to college to get their project checked by their training coordinator.**

Project Work: The synopsis should be, mention the project title, indicate the problem identification and approach towards the project the following points

1. Brief profile of Industry
2. Purpose / Objectives of the Project / Research
3. Scope
4. Methodology
5. Need for study.
6. Organization's benefit / gain as a result of the project
7. Name, Contact Address, Telephone no., Cell no., e-Mail ID of the project guide in the organization in order to seek timely confidence reports about the project progress / conduct from the training organization.
8. Lastly, following information is to be included in the end on a separate page, for:
    a. Guest Lectures
    b. Event Sponsorships
    c. Industrial Visits
    d. Management Development Programs Faculty