SEMESTER IV

GBMB 401 Applied Microbiology and Bacteriology

Course Objective

"On the completion of this course the students will be able to describe following subject matters: 1. Natural resources: Renewable and non-renewable resources: Forest resources; Water resources; Mineral resources; Food resources; Energy resource 2. Air pollution; Water pollution; Noise pollution; Waste Water treatment; Thermal Pollution; Marine pollution; Soil pollution; Global warming; Acid Rain; Ozone layer depletion 3. After completion of this course students will learn about the application of microbiology and bacteriology in the environment and living system. the students in bacteriology are studying which organisms live in the human colon and are necessary for proper digestion. The study of bacteria, especially in relation to medicine and agriculture.

Course Content

UNIT-I

Host parasite relationship of infectious diseases (General physical,chemical barriers andbiological barriers).Specific and non-spesific immune defencemechanisimsof host.

Introduction to pathogenic microbiololgy; Epidemiology of infectious diseases, infectiousdisease cycle, transmission of infectious agents , no of epidemics nosocomial infections,salient features of prevention,survillence and control of epidemics.

UNIT-II

Viral diseases such as influenza, measles, yellow fever, rabies, poliomyelitis and AIDS.

Microbial disease of humans caused by chalamydiae ,rickettsiae, human mycotic and paracitic infections.

UNIT-III

Introductory food and industrial microbiology: Food spoilage, food borne disease, assessingmicrobial contents of food, food preservation, food sanitation and microbiology of milk anddairy products.

Agriculture and soil microbiology, pesticides, microbial insecticides, ruminants andmicroorganisms,

Industrial microbiology, industrial fermentation of alcohol and alcoholic beverages, antibioticfermentation, vitamins and amino-acids, microbial bioconversions, enzymes production bymicroorganisms.

UNIT-IV

Cell size, shape and arrangements, capsule, flagella and pili, Composition and detailed structure ofgram- positive and gram- negative cell wall and archaeal cell wall, Structure, chemical compositionand functions of bacterial and archaeal cell membranes, Ribosomes, inclusions, nucleoid, plasmids,structure, formation and stages of sporulation.

Culture media: Components of media, Synthetic or defined media, Complex media, enriched media,selective media, differential media, enrichment culture media.

Pure culture isolation: Streaking, serial dilution and plating methods, cultivation,maintenanceandstocking of pure cultures, cultivation of anaerobic bacteria, Growth: Binary fission, phases of growth.

Suggested readings

1. Microbiology by pelczar*et al*
2. Pathology by Anderson. vol.I& II.
3. Text book of pathology by William Boyd.

GBMB-402 BASICS OF RECOMBINANT DNA TECHNOLOGY

Course Objective:

"At the end of this course the students will be able to describe: Vectors and Enzymes, Plasmids, Cosmids, Phasemids, Transposons, Artificial Vectors, Sticky and Blunt Ended ligation methods, Homopolymer tailing methods etc."

Course Content

UNIT I

Tools and techniques used in Genetic Engineering, Vectors and Enzymes, Plasmids, Cosmids, Phasemids, Transposons, Artificial Vectors, Transformation and Transduction.Competent cell making, Selectable markers.

UNIT II
Methods of making of recombinant DNAs: Sticky and Blunt Ended ligation methods, Homopolymer tailing method.
Gene transfer in Prokaryotes and Eukaryotes, Strategies of gene transfer: Liposome mediated; Electroporation, Shot Gun Cloning, Agrobacterium mediated gene transfer, Expression vectors, Concept of Gene/Germplasm bank.

UNIT III
Polymerase chain reaction, blotting techniques, DNA sequencing methods
Applications of Molecular markers; RAPD and RFLP.

UNIT IV
Transgenic plants and animals, Golden Rice, Bt Cotton, Antisense RNA technology, Production of transgenic mice.

UNIT V
Products of genetic engineering: proteins, hormones, immune modulators and vaccines. Gene therapy, Merits and demerits of GMOs.

Books Recommended:

1. "Gene Cloning and DNA analysis, An Introduction" by T.A. Brown, Willey Blackwell Publishers (John Wiley and Sons Ltd, U.K.).
2. "Analysis of Genes and Genomics" by Richard Reese, John Wiley and Sons Ltd, U.K.
3. "Modern Biotechnology, Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals" by Nathan S. Mosier & Michael R. Ladisch, John Wiley and Sons Ltd, U.K
4. "Molecular Cloning, A laboratory manual" by Sambrook and Russell. Cold Spring Harbor, New York.
5. Biotechnology by B.D. Singh.
6. Principles of Gene Manipulation, S.B. Primrose et al.

GBMB-403 PROTEOMICS & GENOMICS
Course Objective
(i) After the competition of the course, the student will have a basic understanding on the type and management of biostatistical data.
(ii) The student will understand how to analyze bio-statistical data, and its real-life examples in Biological Sciences
(iii) The student will understand the basics of bioinformatics, various databases that can be used to analyze computational data and how to organize the database.
(iv) The student will learn the use of bioinformatics tools in protein-biology and its association with in-vivo techniques.
(v) The student will learn how to use bioinformatics databases to solve proteomics and genomics problems.

Course Contents
UNIT I
Organization and structure of genome
Model organisms and genome size.Unicellular and multicultural genome: Lessons learned sequencing of genomes, evolution of genome. Genome identification.

Mapping of genome
Construction of genomic libraries, vector, mapping strategies (genetic maps, physical maps, cytological maps, comparative maps) and techniques (FISH, radiation hybrid mapping, finger printing)

UNIT II
cDNA library construction and screening
Methods development, justification for subtraction, normalization andfingerprinting; identification of cDNA's encoding rare messages, ESTprojects and their utility in research

Next generation sequencing techniques
Sequencing by synthesis: Solexa& 454.Sequencing strategies for human genome.

UNIT III
Genome annotation and bioinformatics
How to identify genes, inferring gene function, database construction andsearching.
Comparative genomics
Protein evolution from exon shuffling, protein structural genomics, genefunction by sequencing comparison.
Global expression profiling
Whole genome analysis of mRNA and protein expression, types of microarray and applications.

UNIT IV
Comprehensive mutant libraries
High throughput gene knockout, gene targeting, gene trapping, genome widemutagenesis.

The Rise of OMIC
Impact on other fields (toxicogenomics, chemical genomics,pharmagenomics).

Reference Books:
1. Gibson G., Muse S. V. (2009). A primer of genome science (Sinauer Associates, Inc. Sunderland, MA).
2. Igor Jurisica, Dennis Wigle. (2005). Knowledge discovery in proteomics (Edition Illustrated, Publisher CRC Press).
3. Pennington S.R. (Ed), Dunn M. J. (Ed) (2001). Proteomics: From protein sequence to function (Edition Illustrated, Publisher Taylor & Francis).
4. SrivastavaSudhir (Ed). (2005). Informatics in proteomics (Edition Illustrated Publisher CRC Press).
5. Akay M. (Ed). (2007). Genomics and proteomics engineering in medicine and biology (Wiley-Interscience John Wiley & Sons, Inc. Publication, USA).
6. Sensen C. W. (2002). Essentials of genomics and bioinformatics (Wiley- VCH, Weinheim).
7. Baxevanis, A.D., Davison, D.B., Page, R.D.M., Petsko, G.A. (2004). Current protocols in bioinformatics (John Wiley & Sons, Inc. Publications, New York).

Lab Course GBMB 401,402,403
Practical

1. Study of micro flora of skin
2. Koch postulates.
3. Preparation and preservation of plasma and serum
4. Extraction and estimation of DNA from plant samples.
5. Extraction and estimation of DNA from microbial cultures.
6. Extraction and estimation of plasmids.
7. Agarose Gel Electrophoresis.
8. Competent Cell formation.
9. Transformation of given microbial cells.
10. Phylogenetic analysis of given DNA Finger Print Data & calculation of similarity and dissimilarity Index, using NTSYS PC based software.

GBMB-404 BOTANY IV
(Ecology, Morphogenesis & Economic Botany)
Course Objective
"On the completion of this course the students will be able to describe, the students understand in advanced level of the diversity in plant life can be understood from the following topics of diversity: Diversity on The Basis of Habitat, plants classified into following groups students understand the geographical understanding respectfully: Hydrophytes: These plants may be: Hygrophytes: Halophytes: Mesophytes: Xerophytes: Geological time scale, theories of fossil formation, types of fossils, fossil gymnosperms. Life histories of Cycas &Pinus"

Course Content
Unit-1
1. Various disciplines of Ecology, A general concept of biotic and abiotic factors

2. Ecological concepts: Ecads, Ecotypes, Ecotone, Ecological niche and ecological equivalents.
3. Population Ecology: Characters of Population, survivorship curve, r and k selected populations.

Unit-II
1. Community Ecology: Qualitative and quantitative characters of the Community.
2. Concept of Ecosystem, Ecological Pyramids.
3. Concept of Bio-indicators and Succession.

Unit- III
1. Function of plant growth regulators: Auxins, Gibberellins, Cytokinins and Abscissic acid.
2. Physiology of flowering – Photoperiodism and vernalization.

Unit- IV
1.Origin of cultivated plants, centre of origin of some important crop plants.
2. A general account of cereals, fibres, oils, legumes, medicinal and timber yielding plants.

Practical
1. Estimation of Diversity indices (Simpson's Diversity Index) in various population samples.
2. Calculate the index of similarity and dissimilarity of sample community.
3. Estimation and analysis of frequency, density, abundance & Dominance in studied community.
4. Analysis of IVI (Importance Value Index) in various Community samples.
5. Analysis of Raunkiaer's law of frequency.
6. Analysis of Raunkiaer's life forms & biological spectrum.
7. Field survey to identify and list out different Biological Indicators.
8. Analysis of the effect of Plant Growth Regulators (PGRs) *in vitro*.
9. Collection, Identification and characterization of various economic crops and medicinal plants.
10. Analysis of soil samples for carbonates, chlorides, sulphates/Phosphates and nitrogen contents.

Books Recommended:
1. Bendre A and Kumar A. Economic Botany. Rastogi Publ. Meerut
2. Hill. R. Economic Botany (Indian Print).
3. Ecology by E.P. Odum.
4. Ecology and Environment, By P.D. Sharma, Rastogi Publications.
5. Plant Physiology by S.K. Verma, S. Chand Publishers.
6. Plant Physiology by Taiz and Zeiger.

GBMB-405 ZOOLOGY IV
(Developmental Biology and Evolution)

Course Objective

"On the completion of this course, this course will enhance the students to get the knowledge about the anatomy of different systems of higher chordates. On completion of this course, the students will gain in-depth knowledge related to excretory system, nervous system and structures of Brain, Eye and Ear."

Course Content

Unit I: Principles and basic concepts: Potency, commitment,specification, induction, competence, determination and differentiation;morphogenetic gradients; cell fate and cell lineages; stem cells; genomicequivalence and the cytoplasmic determinants; imprinting; roles ofmutants and transgenics in study of development.

Model Systems in Biotechnological studies: Definition of 'Model System',Introduction to some important model systems including *Saccharomycescerevisiae, Arabidopsis thaliana* (Plant); *D. melanogaster, C. elegans*(invertebrates); *Xenopuslaevis,* Chicken, Mouse, Zebrafish
(vertebrates).

Unit II: Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognitionin animals; zygote formation, cleavage, blastula formation, embryonicfields, gastrulation and formation of germ layers and their fates inanimals; embryogenesis.

Unit III: Morphogenesis and organogenesis in animals: Kinds ofcleavages, stages of embryo, proximal and distal pattern and axes formation in *Drosophila*,amphibia and chick; organogenesis; vulva formation in *Caenorhabditiselegans*;post-embryonic larval development andmetamorphosis; brief introduction to environmental factors that regulatenormal development; sex determination. Development of *Drosophila.*

Unit IV: Origin and evolution of life: Concept, process and sequence of evolution; chemical and organic evolution. Theories of evolution of life.Darwinism and modern synthetic theory.Naturalselection.Industrialmelanism.Origin of diversity and variation, mutation, migration, isolation and speciation.

Practical

1. Study of various developmental stages of *Amphioxus* through models.
2. Study of different types of eggs.
3. Development stages of housefly/honey bee.
4. Development stages of frog.
5. Study of various stages of chick embryo by permanent slide.
6. Effect of temperature and light on animal (Insect).
7. Study of population of any animal in a given time and space.
8. Study of the diversity of ecosystem in and around university campus.
9. Study of the environmental ecology with reference to air and water.
10. Application of ecological knowledge for the human and environmental welfare (a model exercise).
11. Study wild animals close to you and study their natural significance and suggest conservation methods (Lizards).
12. Preparation of temporary mount of chick epithelial tissue.
13. Study of Epithelial tissue by permanent slides.
14. Comments on types of epithelia by temporary mount of cheek cells.
15. Study of connective tissue from permanent slides.
16. Temporary mounts of Adipose and Areolar connective tissue from mammals.
17. Study of different kinds of muscle fibers by permanent slides.
18. Temporary mount of skeletal muscle cells of frog.
19. Study of nervous tissue by slides.

Recommended Books

1. Gilbert SF, 9th Edition. 2010. Developmental Biology. Sinauer Associates Free material online:http://9e.devbio.com/pdfs/Developmental_Biology_8e_Ch20.pdf
2. Fujimoto K, Ishihara S, Kaneko K (2008). Hogeweg, Paulien. ed. "Network Evolution of Body Plans". PLoS ONE 3 (7): e2772.
3. Christ B, Schmidt C, Huang R, Wilting J, Brand-Saberi B (January 1998). "Segmentation of the vertebrate body". Anat. Embryol. 197 (1): 1-8.
4. Wolpert L, Beddington R, Jessell T, Lawrence P, Meyerovvitz E, Smith J (2002). Principles of development (2nd ed.). Oxford university press.

GBMB-406 CHEMISTRY IV

Course Objective

"At the end of this course the students will be able to describe, the student will understand the modern view of atomic structure, and learn to fill configuration of elements (ii) The students will learn the physical chemistry concepts in gaseous states and its applications. (iii) The student will be able to understand the homogenous non-crystalline substance, generate application of colloids and nano-materials and their real-world applications. (iv) The students will learn different types of organic reaction mechanisms and their examples."

Course Contents

1. ***Coordination Compounds*** **:**Werner's theory, nomenclature, chelates, stereo-chemistry of coordination numbers 4, 5 and 6. Various types of isomerism in coordination complexes.Important applications of coordination compounds. Theories of metal-ligand bonding in transition metal complexes- Sidgwick effective atomic number concept, valence bond theory of coordination compounds.

2.Phase rule: Derivation of phase rule, stability of phases, phase diagrams, one component system, two component system, three component system, Nernst distribution law, Limitation and applications of distribution law.

3. Electrochemistry **:**Arrhenius theory of electrolytic dissociation, classification of electrolytes; Hydrolysis of salts, hydrolysis constant, buffer solutions, indicators and theory of acid-base indicators. Migration of ions : transference number and its determination (Hittorf and Moving Boundary methods). Conductance of solutions, variation of molar conductance with concentration (Kohlrausch square root law), Kohlrausch law of independent migration of ions, ionic mobility, hydration of ions, application of conductance measurements (degree of dissociation of weak electrolytes, dissociation constant of weak acids, determination of solubility of sparingly soluble salts, degree of dissociation of water, conductometric titrations).

4. Nuclear Chemistry **:**Isotopes : their separation and applications. Nuclear forces, nuclear binding energy, stability of nucleus, energy changes in nuclear reactions, Bethe notation, nuclear fission and fusion. Uses of nuclear radiations (radiation, sterilization, radiation energy for chemical synthesis).Radio isotopes as a source of electricity.

5.*Polymers and Polymerization* **:**Elementary treatment - Alkene polymerization and condensation polymers – polyethylenes, nylons and terylene.

6.*Active methylene compounds* **:**Preparation and synthetic applications of ethyl acetoacetate and diethyl malonate, Tautomerism.

7. Heterocyclic compounds: Five membered rings, Structure of pyrrole, Structure of furan, Structure of thiophene, electrophilic substitution in five membered rings, six membered ring, structure and reaction of pyridine, electrophilic and nucleophilic substitution in pyridine, basicity of pyridine.

Books Recommended

1. *"A New Concise Inorganic Chemistry",* **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.
2. *"Modern Inorganic Chemistry",* **R. C. Aggarwal**, 1st Edition (1987), KitabMahal, Allahabad.
3. *"Basic Inorganic Chemistry",* **F. A. Cotton, G. Wilkinson, and Paul L. Gaus,** 3rd Edition (1995), John Wiley & Sons, New York.
4. *"Organic Chemistry",* **R. T. Morrison and R. N. Boyd**, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
5. *"Organic Chemistry",* **S. M. Mukherjee, S. P. Singh, and R. P. Kapoor**, 1st Edition (1985), New Age International (P) Ltd. Publishers, New Delhi.
6. *"Organic Chemistry – Structure and Reactivity",* **Seyhan N. Ege**, 3rd Edition (1998), AITBS Publishers and Distributtors, Delhi.
7. *"Organic Chemistry",* **Paula Y. Bruice**, 2nd Edition , Prentice-Hall InternattionalInc, New Jersey, International Edition (1998).
8. *"Physical Chemistry",* **P. C. Rakshit,** 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.
9. *"Principles of Physical Chemistry",* **B. R. Puri, L. R. Sharma, and M. S. Pathania,** 37th Edition (1998), ShobanLalNagin Chand & Co., Jalandhar.
10.*"Physical Chemistry",* **K. J. Laidler and J. M. Meiser**, 3rd Edition, Houghton Mifflin Comp., New York, International Edition(1999).
11. "Principle of Nanoscience and Nanotechnology", (2010), **M. A. Shah and Tokeer Ahmad,** Narosa Publishing House, New Delhi.