

# **FOURTH SEMESTER**

## **BTPG16 Laboratory Course IV**

**Number of Hours / Week: 4**

**Credits: 4**

1. DNA isolation
2. RNA isolation
3. Conjugation
4. cDNA preparation
5. Competent cell preparation
6. Transformation
7. Plasmid isolation
8. Restriction enzyme digestion
9. Ligation
10. Screening of recombinants
11. Expression and purification of recombinant proteins
12. Blotting techniques
13. RFLP,
14. Amplification of selective gene by PCR
15. Molecular marker studies: RAPD, SCAR, AFLP, SNP
16. Basics of Bioinformatics

## **Elective Papers in Fourth Semester**

*In the revised Credit and Semester System three electives are being offered in the fourth semester programme. The student can select three electives, from the following list. The electives are being scheduled as twenty topics which includes specific Biotechnology related topics along with certain fundamental topics. The content of each course is carefully scheduled so as to bring out the latest trends in the subject for student review. The title and the syllabus content has been primarily formulated by the faculties of the Biotechnology post graduate programme in various affiliated colleges of Mahatma Gandhi University **The student should register for three electives selected from the list of the twenty electives as per the advice given by their concerned course coordinator. All the electives carry 4 credits***

## **ELECTIVES**

- 1. Advanced methods in molecular diagnostics**
- 2. Biotechnology in molecular pathogenesis and clinical diagnosis**
- 3. Biotechnology in forensic medicine**
- 4. Genomics, Proteomics and Nanotechnology**
- 5. Molecular Breeding**
- 6. Molecular markers in cancer**
- 7. Cancer Biology**
- 8. Project management, Pharmacoeconomics and pharmacogenomics**
- 9. Biopharmaceuticals and applications of Nanotechnology**
- 10. IPR, Biosafety and Biodiversity**
- 11. Biotechnology and IPR**
- 12. Microbial Biotechnology**
- 13. Microbial food safety**
- 14. Food Biotechnology**
- 15. Nutritional Biochemistry**
- 16. Neurobiochemistry**
- 17. Developmental Biology**
- 18. Physiology**
- 19. Environmental Science**
- 20. Evolution and behavior**

## **ELECTIVE 1**

### **BTPG19E ADVANCED METHODS IN MOLECULAR DIAGNOSTICS**

#### **Unit I**

Introduction. Nucleic Acid Extraction: Human Genomic DNA-Phenol Chloroform Extraction, Salting-Out Method, Solid-Phase Adsorption, Magnetic DNA Extraction; RNA Isolation- Phenol-Chloroform Extraction, Other Chemistries.

Electrophoretic Methods for mutation detection: SSCP, heteroduplex analysis, DGGE, Chemical Cleavage of mismatched nucleotides, Ribonuclease cleavage of mismatched DNA: RNA duplexes

#### **Unit II**

PCR based methods: Polymerase Chain Reaction (PCR), DNA Polymerases, Multiplex Amplification, Labeling PCR, Allele-Specific PCR, Real-Time PCR, Quantitative fluorescent PCR, Rolling-Circle Amplification (RCA) and Multiple Displacement Amplification (MDA), ARMS-PCR, Oligonucleotide Ligation Assay, Primer Extension, Isothermal Amplification: TMA, NASBA, SDA, Multiple Thermal Amplification: Linked Linear Amplification, Ligase Chain Reaction, Representational Difference Analysis (Rda), Serial Analysis Of Gene Expression (SAGE), Differential Display, Sequencing Of Expressed Sequence Tags (EST)

#### **Unit III**

Signal Amplification Methods (enzymatic & non-enzymatic): Branched DNA Amplification, Hybrid Capture, In situ hybridization, Invader Technology, Cleavage reactions, Ramification Amplification.

Methods for Detecting miRNA: Preparation of RNA Sample Containing miRNA, miRNA Detection Methods SNP detection methods and Applications

#### **Unit IV**

The Lab-on-a-Chip Approach: On-Chip Sample Preparation for Molecular Diagnostics, On-chip Extraction of Cell Contents (Protein and Nucleic Acid), PCR-Based Genetic Analysis:

Miniaturization of PCR Devices, Microfluidic DNA Synthesizer , Microfluidic DNA Sequencer; Single Molecule Detection (SMD), Electrokinetic Molecule Focusing, Alternative Three-Dimensional Focusing for SMD Using the Microfluidic Drifting Technique

## **Unit V**

Next-Generation Sequencing: Massively Parallel Sequencing Platforms, 454 GS FLX Titanium, Illumina Genome Analyzer II, SOLiD 3 System; Genomic Isolation Techniques; Paired-End Sequencing; DNA Bar coding Data Analysis and Storage; Clinical Potential and Utility

## **Reference**

1. Molecular Diagnostics : Techniques and Applications for the Clinical Laboratory  
Edited by: Contributors, Wayne W. Grody, M.D., Ph.D., Robert M. Nakamura, M.D., Charles M. Strom, M.D., Ph.D., and Frederick L. Kiechle, MD, PhD. ISBN: 978-0-12-369428-7
2. Molecular Diagnostics: For the Clinical Laboratorial William B. Coleman, Gregory J. Tsongalis
3. Next-Generation Genome Sequencing: Towards Personalized Medicine Michal Janitz
4. Molecular Biomethods Handbook. John M. Walker, Ralph Rapley

**ELECTIVE 2**  
**BTPG20E BIOTECHNOLOGY IN MOLECULAR PATHOGENESIS AND**  
**CLINICAL DIAGNOSIS**

**Unit I**

**Microbes and parasites:** Historical introduction; Bacteria, Fungi, Viruses, Protozoas, Helminthes and Arthropods, Prions; Host-parasite relationship; Infection-mode of transmission in infection, factors predisposing to microbial pathogenecity, types of infectious diseases

**Unit II**

**Invasion of Microbes:** Adsorption to the potential sites, membrane trafficking in eukaryotic cells, routes of invasion and selection of intracellular niche, bacterial manipulation of host cell cytoskeleton, nosocomial infection; Normal microflora of human body; Bacterial toxins and virulence genes; Strategies of host defense.

**Unit III**

**Methods of Disease Diagnosis:** Sampling site-normally sterile and with normal microflora; Sample collection-method of collection, transport and processing of samples, interpretation of results; Diagnostic methods- cultured: microscopy, microbial antigen; non-cultured: PCR based microbial typing: Eubacterial identification based on 16s rRNA sequences-Amplified ribosomal DNA Restriction analysis(ARDRA)-Culture independent analysis of bacteria-DGGE and TRFLP; Molecular diagnosis of fungal pathogens based on 18s rRNA sequences; Detection of viral pathogens through PCR; Monoclonal antibodies.

**Unit IV**

**Diagnosis of Infections :** Bacteria- *Streptococcus*, Coliforms, *Salmonella*, *Shigella*, *Vibrio* and *Mycobacterium*; Fungi-Major fungal diseases, Dermatophytoses, Candidiosis and Aspergillosis  
DNA and RNA Viruses- POX virus, Rhabdo Virus, Hepatitis Virus and Retro Virus.

**UNIT V**

**Diagnosis of Infections** Viruses-AIDS Virus; Protozoan diseases-Amoebiosis, Malaria, Trypanosomiosis, Leishmaniasis; Helminthis diseases-*Fasicola hepatica* and *Ascaris lumbricoides*; Filariasis and Schistomiosis.

## Reference

1. Bailey and Scott's Diagnostic Microbiology (2002). Betty A. Forbes, Daniel F. Sahm, Alice S. Weissefeld, Ernest A Trevino. Published by C.V. Mosby
2. Medical Microbiology (1997). Edited by Greenwood. D, Slack. R and Peutherer. J, ELST Publishers.
3. Fundamental of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Saunders group.
4. Henry's Clinical Diagnosis and Management by Laboratory Methods (2007). Mepherson.
5. Molecular Diagnostics for the Clinical Laboratorian 2nd ed. (2006). W.B.Coleman. Humana Press.



### **ELECTIVE 3**

## **BTPG21E BIOTECHNOLOGY AND FORENSIC MEDICINE**

### **Unit I**

Immunoglobulin- types, physico-chemical properties and function, raising of anti-sera, Lectins - their forensic significance. Buffers and serological reagents, methods of sterilization employed for serological work. Composition of blood, Formation of blood, Blood groups – history, biochemistry and genetics of ABO, Rh, Mn and other systems. Methods of ABO blood grouping (absorption-inhibition, mixed agglutination and absorption elution) from blood stains and other body fluids/stains viz. menstrual blood, semen, saliva, sweat, tear, pus, vomit, hair, bone, nail etc., blood group specific ABH substances. Secretors and non- secretors. Blood groups that make racial distinctions. Lewis antigen, Bombay Blood groups. HLA antigens and HLA typing . Role of sero-genetic markers in individualization and paternity disputes. Pitfalls in red cell typing.

### **Unit - II**

Determination of human and animal origin from bones, hair, flesh, nails, skin, teeth body tissue, fluids/ stains viz. blood, menstrual blood, semen, saliva, sweat, tear, pus, vomit, etc., through immunodiffusion and immuno - electrophoresis, cross reactivity among closely related species. Individualization of blood stains: Determination of blood groups, sex age and racial origin from dried bloodstains

### **Unit III**

Red cell enzymes : Genetics , polymorphism and typing of PGM, GLO-I, ESD, EAP, AK, ADA etc. and their forensic significance. Serum proteins: Genetics, polymorphism and typing of - Hb, HP, Tf, Bf, C3 etc. and their forensic significance.

### **Unit IV**

Concept of sequence variation - VNSTR, STRs, Mini STRs , SNPs. Detection techniques - RFLP, PCR amplifications, Amp-FLP, sequence polymorphism, Y-STR, Mitochondrial DNA. Evaluation of results, frequency estimate calculations and interpretation, Allele frequency determination, Match probability – Database, Quality control, Certification and Accreditation.

## **Unit –V**

History of DNA profiling applications in disputed paternity cases, child swapping, missing person's identity, civil immigration, veterinary , wild life and agriculture cases . legal perspectives – legal standards for admissibility of DNA profiling – procedural & ethical concerns, status of development of DNA profiling in India & abroad. Limitations of DNA profiling. Population databases of DNA markers –STRs, Mini STRs, SNPs. New & Future technologies: Analysis of SNP, DNA chip technology- Microarrays Cell free DNA , Synthetic DNA.

### **Reference**

1. Rudin, Norah; An Introduction to Forensic DNA Analysis, CRC Leviw Publishers, (2002)
2. Kobiinsky, Lawrence; DNA, John Wiley & Sons, (2005)
3. Newton, David E. ; DNA Evidence and Forensic Science, Viva books private limited, (2010)
4. Kirby, Lorne; DNA fingerprinting, W H Freeman and Co,(1992)
5. T.Burke, Terry; DNA Fingerprinting: Approaches and applications., Birkhauser Verlage, (1991)
6. Singh, Yashpal; DNA tests in Criminal Investigation Trial & Paternity Disputes, Alia Law Agency,(2006)
7. J. Thomas Mcclintock; Forensic DNA analysis, Lewis Publications, (2008)
8. Boorman, Kathleen E, Churchill ; Blood group serology Livingstone,1977

## **ELECTIVE 4**

### **BTPG22E GENOMICS, PROTEOMICS AND NANOTECHNOLOGY**

#### **Unit I**

Overview: Genomes of Bacteria, Archaea, and Eucarya; Genome and topology; chromatin, supercoiling and packaging; Study of genomes- Mapping; Genetic and Physical mapping, Single Nucleotide Polymorphism and RFLP's. Human Genome project.

#### **Unit II**

Biological information of macromolecules. The central dogma of molecular biology. Introduction to Databases, Types of Databases- Flat file database and Relational database. NCBI, Genome and organism specific database-retrieval, Entrez, SRS; Similarity search, amino acid substitution matrices- FASTA, BLAST. Various types of protein family-protein domain families.

#### **Unit III**

Gene finding and annotation; sequence annotation and bioinformatics tools for genomics and genome comparison; analyzing gene expression-DNA microarray-design, analysis and visualization of data. Application of DNA microarrays in prokaryotes, Microarray data analysis. Prediction tools, Bioinformatics in Drug discovery. ESTs.

#### **Unit IV**

Protein structure and function- Methods to quantitative proteins; densitometry and classical methods; two dimensional gel electrophoresis, mass spectrometry - ESI, MS and MALDI; protein expression profiling, protein - protein interactions; RNA interference, Genetic analysis of biomedical diagnostics. Application of bioinformatics for development of vaccine.

#### **Unit V**

Nanotechnology: Basic concepts and introduction; Nanomechanics- Nanotribology; Scanning probe microscopy; nanomaterials and its handling; nanobots and nanofuture, nano-fying Electronics, nanofibres and nanotubes.

## Reference

1. Genomes. Brown, T.A., Wiley - Lis Publications, 2002.
2. Mount David W. Bioinformatics Sequence and Genome Analysis. Cold Spring Harbor Lab Press, CSH New York, 2002.
3. Stephen Misener and S. A. Krawetz. Bioinformatics Methods and Protocols. Humana Press. 2000.
4. Rastogi, S.C, N. Mendiratta, P. Rastogi. Bioinformatics Methods and Applications. Prentice Hall of India, 2004.
5. Bharat Bhushan., Nanotribology and Nanomechanics - An introduction, Springer, Ist edition, 2002

## **ELECTIVE 5**

### **BTPG23E MOLECULAR BREEDING**

#### **Unit I**

Plant Genome – Nuclear and cytoplasmic; Significance of organelle genomes; Genome size and sequence components; Modern gene concept - Gene structure, structural and functional genes.

#### **Unit II**

Molecular markers – Restriction based and PCR based; DNA profiling using different assays- RFLP, RAPD, AFLP, ISSR, SNP etc. Development of SCAR and SSR markers.

#### **Unit III**

Gene flow in plants – Development of mapping population - Marker Assisted Selection (MAS), screening and validation; Trait related markers and characterization of genes involved; Mapping genes on specific chromosomes; QTL mapping; Gene pyramiding; Transcript mapping techniques. Development of ESTs.

#### **Unit IV**

Molecular markers for plant genotyping and germplasm analysis; Fidelity analysis; settling IPR issues; Marker Assisted Breeding in transgenics – herbicide resistance; Pest and disease resistance; Quality enhancement etc.

#### **Unit V**

Recent advances – Non gel based techniques for plant genotyping – Homogenous assays – Qualitative/RealTime assays; DNA Chip and its technology.

#### **Reference**

1. Anolles, G. C. and Gresshoff, P.M., DNA markers – protocols, applications and overviews. Wiley – Liss, New York, 1997
2. Clark, D. P., Molecular Biology, Elsevier, USA, 2005.
3. Henry R. J., Plant Genotyping: The DNA fingerprinting of plants. CABI, New Delhi, 2005.
4. Patterson, Molecular dissection of complex traits, CRC Publications, Washington, 1998.
5. Purohit, S. S., Biotechnology – Fundamentals and Applications, 8th Edition, Agrobios, India, 2007.

**ELECTIVE 6**  
**BTPG24E MOLECULAR MARKERS IN CANCER**

**Unit I**

Introduction and Modern Concepts of Cancer; Biomarkers: single versus multiple; Epigenetics : Methylation of CpG Island

**Unit II**

The Role of Micro-RNAs in Cancer: Concept of RNA Interference (RNAi), Difference between miRNA and siRNA, Role of miRNAs in Cancer, Epigenetics and miRNAs, Expression Profile of miRNA in Various Types of Cancer, Methods for Detecting miRNA, Potential Therapeutic Applications of miRNA in Cancer Treatment

**Unit III**

Current cancer markers: Nucleic-acid-based markers, Cancer-associated mutations., Loss of heterozygosity and microsatellite instability, Single Nucleotide Polymorphisms (SNPs), DNA methylation, Mitochondrial DNA mutations, Viral DNA, RNA-based approaches, Protein markers, Immunological markers, Metabolic biomarkers, Suppressor Genes , MiRNA as a Molecular Tumor Marke, Telomerase, Circulating DNA (Cell-Free), Circulating Nucleic Acids and Proteomics of Plasma/Serum, Serologic Tumor Markers , Glycans as Possible Biomarkers of Tumor

**Unit IV**

Molecular Diagnostic Techniques for Cancer: Genomic technologies: RFLP, LOH, SSCP, sequencing based approaches, PCR, RT\_PCR, Real Time PCR, COLD PCR; Gene expression profiling, cancer cytogenetics, Detection of biomarkers of DNA methylation, PET, Proteomic technologies: Antibody microarray, Aptamers, Phage display, Protein chip technology; Detection of tumour cells in body fluids; Modifications of Mass spectrometry; Assays based on proteins and enzymes: p53, telomerase, survivin

**Unit V**

Examples of Molecular Markers for the early Detection of Cancer: Predictive Markers in Breast and Other Cancers; Circulating Serum/Plasma Tumor DNA, Colorectal Carcinoma, Pancreatic Carcinoma, Lung Carcinoma, Cervical Carcinoma

## Reference

1. The Handbook of Biomarkers By Kewal K. Jain
2. Molecular Diagnostics :**Techniques and Applications for the Clinical Laboratory Edited by:** Contributors, Wayne W. Grody, M.D., Ph.D., Robert M. Nakamura, M.D., Charles M. Strom, M.D., Ph.D., and Frederick L. Kiechle, MD, PhD.
3. Biotechnology- Applying genetic revolution. David P Clark , Nanette J Pazdernik.Elsevier, New York
4. Lewin's Cells. Lynne Cassimeris,Viswanath R, Lingappa, George Plopper Jones . Bartlett Publishers, London
5. The Cell – A molecular Approach. Geoffrey M Cooper, Robert E Hausman, ASM Press, Washington.

## **ELECTIVE 7**

### **BTPG25E CANCER BIOLOGY**

#### **Unit I**

Fundamentals of cancer biology: Introduction to Cancer Biology, Tumor suppressor genes, modulation of cell cycle in cancer, Different forms of cancers, Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

#### **Unit II**

Principles of carcinogenesis: Theory of Carcinogenesis, Chemical carcinogenesis, principles of physical carcinogenesis, X-ray radiation-mechanisms of radiation carcinogenesis, Diet and cancer.

#### **Unit III**

Principles of molecular cell biology of cancer: Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes, Oncogenes/proto oncogene activity, Growth factors related to transformation, Telomerases.

#### **Unit IV**

Principles of cancer metastasis : Clinical significances of invasion, Metastatic cascade, Basement membrane disruption, proteinase and tumor cell invasion.

#### **Unit V**

New molecules for cancer therapy: Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.

#### **Reference**

1. Maly B.W.J, "Virology A Practical Approach", IRLI Press, Oxford, 1987.
2. Dunmock N.J And Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 1988.
3. Biotechnology- Applying genetic revolution. David P Clark , Nanette J Pazdernik.Elsevier, New York
4. Lewin's Cells. Lynne Cassimeris,Viswanath R, Lingappa, George Plopper Jones . Bartlett Publishers, London
5. The Cell – A molecular Approach. Geoffrey M Cooper, Robert E Hausman, ASM Press, Washington.



## **ELECTIVE 8**

### **BTPG26E PROJECT MANAGEMENT AND PHARMACOECONOMICS AND PHARMACOGENOMICS**

#### **Unit- I**

Research Methods Module, Overview of research methods. Planning a research project, Literature searching and systematic reviews, Quantitative and qualitative research methods, Data collection and analysis, Critical appraisal of published research articles. Presentation skills (written and oral).

#### **Unit- II**

Sponsor's Perspective: Managing a Clinical Trial, Selecting Investigators and Monitors, Maintaining and Managing Essential Documents (e.g. FDA Form 1572); Case Report Form Data Transmission and Generation of the Clinical Study Report.

#### **Unit- III**

Overview of Medicinal Product Research and Development Drug Discovery and Pre-Clinical Research; the Clinical Research and New Drug Application Approval Process; the Biologics Research, Development, and Licensing Process; Medical Device Research, Development, and Marketing.

#### **Unit- IV**

Drug Development Processes: History of drug development, Discovery and selection of compounds for human investigation, Toxicological requirements, Pharmacokinetics and pharmacodynamics, Pharmacogenomics and its application in clinical research.

#### **Unit V**

Regulatory Affairs and Pharmacovigilance, Regulatory requirements in Europe, the USA and Japan, Regulatory requirements for biotechnology products, medicinal devices and veterinary products, Regulatory requirements for the preparation, packaging, labeling and storage of clinical trial drugs, Health economics; Pharmacoeconomics and quality of life

assessment, Safety reporting. Methods of monitoring drug safety, responding to drug safety alerts, Post marketing surveillance.

### **Reference**

1. Introduction to Applied Pharmacoeconomics by F. Randy Vogenberg - Medical - 2000
2. Strategies in Pharmacoeconomics and Outcomes Research by Reinhard Rychlik - Medical - 2002
3. Pharmacogenomics: Methods and Applications by Federico Innocenti - Medical - 2005

## ELECTIVE 9

### BTPG27E BIOPHARMACEUTICALS AND APPLIED NANOTECHNOLOGY

#### Unit I

##### General pharmacology

Introduction of pharmacology, sources of drugs, route of administration, Pharmacodynamics and Pharmacokinetics: absorption, distribution, metabolism and excretion of drugs, GMP

#### Unit II

**Drug discovery** : Overview of the drug discovery process, Modern methods of drug discovery, Various phases of Drug discovery, Computer aided drug design, Drug Receptor interactions.

#### Unit III

**Biopharmaceutical & novel drug delivery system**: Various categories of therapeutics like vitamins, antibiotics, hormones and biological, Transdermal delivery system, liposomes and Nanoparticles.

#### Unit IV

**Production and characterization of nanoparticles**: Introduction to Nanoscience Techniques used in Nanobiotechnology: Optical Microscopy, Atomic Force, Microscopy, SEM; Production of nanoparticles: Collision / Coalescence mechanism of primary particle formation, nanoparticles agglomerates & aerogels, Biological production of nanoparticles: fungi, bacteria, yeast and actinomycetes

#### Unit V

**Applications of nanoparticles**: DNA nanotechnology-structural DNA assembly-Nanopore, Use of nanoparticles as molecular imaging probes, Nano biotechnology for human health: nanoparticles for drug delivery, gene delivery, Understanding the mechanism of macromolecular interactions; Use of nanoparticles as sensors

#### Reference

- 1 Medical pharmacology , K.D.Tripathi
2. Pharmacology and therapeutics-Satoskar
3. Pharmaceutical dosage forms:tablets volume-3 by liberman and lachman.
4. Theory and practice of industrial pharmacy by lachman.
5. Nanobiotechnology- next big idea by Mark, Ratner Daniel Ratner

## **ELECTIVE 10**

### **BTPG28E IPR, BIOSAFETY & BIODIVERSITY**

#### **Unit I**

##### **Introduction to Intellectual Property**

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP. Invention in context of “prior art”; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and report formation

#### **Unit II**

Types of patents; Indian Patent Act 1970; Recent Amendments; Patent application- forms and guidelines, fee structure, time frames; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to existing schemes.

#### **Unit III**

##### **Biosafety**

Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India;

#### **Unit IV**

Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

#### **Unit V**

##### **Biodiversity**

Biodiversity Legislation in India; Indian Biodiversity Act and provisions on crop genetic resources. Convention on Biological Diversity (CBD) and Cartagena protocol on Biosafety;

Biodiversity Act 2002; Agricultural biodiversity; International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA); Conservation strategies for seed gene bank; Climate change and conservation of plant genetic resources; Global efforts for management of crop genetic resources; Strategies on PVFR and Biodiversity Acts; Impact of GE crops on Biodiversity. Functions of International union for the protection of new varieties of plants (UPOV); International treaties relating to Biodiversity; Tutorials shall comprise of Seminars, Group Discussions based on recent case studies.

## **Reference**

1. P. Narayanan, Intellectual Property Laws, Eastern Law House.2001
2. Meenu Paul, Intellectual Property Laws, Allahabad Law Agency.2009
3. Intellectual Property Law containing Acts and Rules, Universal Law Publication Company.
4. John E. Smith, Biotechnology, 3<sup>rd</sup> Ed. Cambridge University Press.
5. Prithipal Singh, **An Introduction to Biodiversity**, Ane Books India, 2007.
6. B R Goel, **An Introduction to Biodiversity**, Arise Pub, 2006.
7. Nirmal Chandra Pradhan, **Basics of Biodiversity**, Anmol, 2008.
8. Padmanabh Dwivedi; S K Dwivedi and M C Kalita, **Biodiversity and Environmental Biotechnology**, Scientific, 2007.

## **9. Important Links**

<http://www.w3.org/IPR/>

<http://www.wipo.int/portal/index.html.en>

[http://www.ipr.co.uk/IP\\_conventions/patent\\_cooperation\\_treaty.html](http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html)

[www.patentoffice.nic.in](http://www.patentoffice.nic.in)

[www.iprlawindia.org/](http://www.iprlawindia.org/) - 31k - Cached - Similar page

<http://www.cbd.int/biosafety/background.shtml>

<http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm>

<http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html>

## **ELECTIVE 11**

### **BTPG29E BIOTECHNOLOGY AND IPR**

#### **Unit-I**

GM crops- versus organic and traditional crops, global status of GM crops, genetic engineering of Bt brinjal and Bt cotton , advantages and disadvantages of GM foods, Biosafety and environmental safety concerns, Public perceptions, Regulatory bodies of India-RCGM and GEAC.

#### **Unit-II**

Ethical and legal implications of biotechnology, Human genome project, genetic testing and screening, Gene therapy, edible vaccines, stem cell research, Vaccine trials. Antiviral Drug designing, phases of drug trials, Bioweapons and bioterrorism.

#### **Unit-III**

Biosafety - definitions - biosafety levels - framework of biosafety regulation in India; Structure and functions of Committees; DBT guidelines on biosafety rules, regulations, guidelines and protocols. Guidelines in conducting research in biology / biotechnology. - Regulations of Genetically modified Organisms in India - Biosafety regulation for transgenic plants and animals - labeling of GM foods.

#### **Unit-IV**

IPR and copyrights, Importance of protecting scientific discoveries, Qualification for a Patent – Novel, Commercial & Non-obvious, Jurisdiction of Patent laws, Patent applications- Rules and regulations. fees structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures Filing of a patent application; Precautions before patenting-disclosure/non-disclosure

#### **Unit V**

IPR policy of Government of India, Indian & International Patent laws, Indian Patent Act 1970; Recent Amendments; Financial assistance for patenting-introduction to existing schemes. Role of patents in Bbiotechnology. The patentability of microorganisms - IPR and

WTO regime - consumer protection and plant genetic resources-GATT and TRIPS, Patenting gene. Issues and case studies.

## **Reference**

- 1.P. Narayanan, Intellectual Property Laws, Eastern Law House.2001
- 2.Meenu Paul, Intellectual Property Laws, Allahabad Law Agency.2009
- 3.Intellectual Property Law containing Acts and Rules, Universal Law Publication Company.
- 4.John E. Smith,Biotechnology,3<sup>rd</sup> Ed.Cambridge University Press.

## ELECTIVE 12

### BTPG30E MICROBIAL BIOTECHNOLOGY

#### **Unit I: Microbial Biotechnology**

Historical perspectives, Scope and applications. Industrially important microbes, Strain improvement and selection. Isolation and cultivation of microbes and their preservation methods, Growth of microorganisms; batch and continuous culture.

#### **Unit II: Application of Microbes in Agriculture**

Bio-fertilizers - Mass inoculum production of Rhizobium, Azospirillum, Azatobactor. Mycorrhizal inoculants, Blue green algae, **Azolla**, Probiotics and synbiotics, bioinsecticides, biopesticides, SCP. Microbial biotechnology in Phytotransgenics (Abiotic stress tolerant plants – drought, flooding, salt and temperature. and biotic stress resistant to insects, fungi, bacteria, viruses, weeds).

#### **Unit III: Application of Microbes in Bioremediation of Pollutions**

Biological monitoring of environmental pollution. Biosensors and Biochips. Bioremediation of hydrocarbons and xenobiotic compounds, *In situ* and *ex-situ* bioremediation. Application of microbial biotechnology in sewage and wastewater treatment, Biodegradation, Bioleaching, Biomining, Biopaints, Bioantifouling agents, Bioelectricity, Biodetergents, **Biopolyesters**, Biocement and Bioplastics.

#### **Unit IV: Application of Microbial Biotechnology in Medicine**

Recombinant proteins, vaccines, antibiotics, hormones, interferons, lycopene (pigment), melanin and microbial biosensors. Bioweapons.

#### **Unit V: Industrial Microbial Biotechnology**

Production of enzymes, ethanol, organic acids, vitamins, fatty acids, amino acids, bioflavours, biofuels. Microbes in renewable energy production: Hydrogen, methane and hydrocarbons. Biopolymers, Biocosmetics (hyaluronic acid)



## Reference

1. Fermentation Microbiology and Biotechnology ,E.M.T. Mansi, C.F.A . Bryce. A.L..Dmain, A.R.Alliman. ,2009, Taylor and Francis. New York
2. Environmental Biochnology, Christopher.F Forster, D.A.John Wase, 1987 Ellis Harwood.
3. Comprehensive Biotechnology. Second edition, Elsevier, 2011, Murray Mor. Young ( Editor in chief). ISBN-978-0-08-088504-9
4. Microbial Ecology. Fundamentals and Applications. Atlas and Bartha, Pearson Education , Benjamin Cummings publishing company.Inc.New Jersy
5. Industrial Microbiology, Cassida L.E. 1968.John Wiley and Sons Publishers.
6. Microbiology,Prescott, Hasley and Klein, Wiley Publications
7. Soil Microbiology – N.S. Subha Rao, 1999
8. Agriculture Microbiology – Rangaswamy
9. Microbial control and pest Management – S. Jayaraj.

## **ELECTIVE13**

### **BTPG31E MICROBIAL FOOD SAFETY**

#### **Unit I Role of Microbes in Food**

General concepts of food safety: adulteration, filth, microorganisms, chemical additives and genetically manipulated organisms; Types of microorganisms (yeast, bacteria, molds, viruses) and their possible roles (fermentation, bioreactors, disease, spoilage) in foods; Microbial growth in foods: intrinsic and extrinsic parameters.

Significance of food safety assessments & surveillance; emerging food safety challenges: new pathogens, emerging foodborne diseases, food safety of ready-to-eat (RTE) foods and minimally processed foods and antibiotic resistance.

#### **Unit II Microbiological Hazards in Food**

Foodborne diseases: infections, poisoning, toxico-infections; Sources and transmission of bacteria in foods: human, animal, and environmental reservoirs; cross-contamination; Microbiological hazards: *Clostridium botulinum*, *Vibrio*, *Salmonella*, *Hepatitis A*, *E. coli* O157:H7, *Campylobacter*, *Listeria*, *Bovine Spongiform Encephalopathy*; Fungal Toxins.

#### **Unit III Control of Microbes in Food**

Means of control: food formulations, cooking, preservatives, Hurdle Concept; Food Processing: Irradiation -Packaging - Bioprocessing of meat, fisheries, vegetables, dairy products; enzymes and chemicals used in food processing;

#### **Unit IV Food Quality Regulations**

Quality control; case studies on Biotechnology in the evolution of food quality, HFCS (High Fructose Corn Syrup) and mycoproteins. Microbial detection and indicator organisms: approach and techniques; pathogen indicators: indicators of human contamination;

Government regulatory agencies and food policies -Food and Drug Administration, The Centers for Disease Control and Prevention, The Environmental Protection Agency; significance of surveillance; HACCP concepts and risk assessment.

## **Unit V Genetically Engineered Foods**

GM food: Risks, public perception- facts and myths; labeling of GM food; Bovine Somatotropin in Milk; Chymosin -Lite beer; Transgenic plants-tomato; Methionine-enriched oil; Frost-resistant food; Insect Resistance-*Bacillus thuringiensis* toxin - B.t. maize; Fungal Resistance potatoes; Virus Resistance; Plant Pharmaceuticals -beta -carotene in rice -transgenic "heart-healthy" canola oil; Edible vaccines -Hepatitis B vaccine in maize-Cholera vaccine in potatoes; Transgenic Animals -Growth hormone gene in pigs - alpha-lactalbumin and lactoferrin in milk; Transgenic Fish -Atlantic salmon.

### **Reference**

1. Potten N.M. "Food Science" The AVL Publishing Co. 2002
2. Piefzer F.M. "Food Microbiology" Academic Press, 1989
3. Lindsay, Willis Biotechnology, "Challenges for the flavour and food industries", Elsevier Applied Science, 1988
4. Roger A., Gorden B., and John T., " Food Biotechnology", 1989
5. George J.B., "Basic Food Microbiology", CBS Publishers & Distributors, 1987
6. James M.J. "Modern Food Microbiology", CBS Publishers & Distributors, 1987

## **ELECTIVE14**

### **BTPG32E FOOD BIOTECHNOLOGY**

#### **Unit I**

Micro organisms in food production- Bread making, cheese production-process, starter culture, types of cheese, other fermented dairy products- buttermilk, acidophilus milk, yoghurt, butter, paneer, marine fermented foods, koji, tempeh, fermented bevarages- beer and wine.

Applications of enzymes in food processing: amylase, protease, lipase, cellulase, hemicellulase, pectinase, pectin lyase, catalase, glycosidase, invertase, glucose oxidase, glucose isomerase

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#### **Unit II**

Single cell protein- from bacteria and algae, probiotics, prebiotics, mushroom production, microbial production of vitamins-riboflavin, vitamin c.

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#### **Unit III**

Food production through biotechnology- Bovine Somatotropin in Milk; Chymosin -Lite beer; Transgenic plants-tomato; Methionine-enriched oil; Frost-resistant food; - Starlink corn, B.t. maize; Fungal Resistant potatoes; Plant Pharmaceuticals, Biopharming -beta -carotene in rice; Edible vaccines -Hepatitis B vaccine in maize-Cholera vaccine in potatoes; HFCS (High Fructose Corn Syrup) and mycoproteins. Growth hormone gene in pigs - alpha-lactalbumin and lactoferrin in milk; Transgenic Fish -Atlantic salmon.

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#### **Unit IV**

Food preservation:, contamination of milk, Preservation of milk, microbial contamination and spoilage of food, foodborne illness- salmonellosis, listeriosis, botulism, staphylococcal infection, preservation methods: E ffect of low temperature, freezing, effect of heat, drying, concentration, fermentation, canning, radiation, chemical prteservatives. 12

#### **Unit V**

Significance of food safety assessments & surveillance GM food: Risks, possible danger to individuals, society or nature, labeling of GM food; Terminator genes, loss of biodiversity

Government regulatory agencies and food policies -Food and Drug Administration, The Centers for Disease Control and Prevention, The Environmental Protection Agency; HACCP concepts and risk assessment. 10

**Reference:**

1. Biotechnological innovations in foodprocessing: Editor : Dr. J Green, Butterworth-Heinman Pub.
2. Food-Facts and PrinciplesII Ed: N Shakuntala Manay, M. Shadakshara Swamy. New Age International Pub:
3. Bioprocess Technology: P T Kalaichelvan, I Arul Pandey : MJP Publishers.
4. George J.B., "Basic Food Microbiology", CBS Publishers & Distributors, 1987
5. Roger A., Gordon B., and John T., " Food Biotechnology", 1989

## ELECTIVE 15

### BTPG33E NUTRITIONAL BIOCHEMISTRY

#### Unit I

**Basic concepts:** Energy content and thermogenic effect of foods; measurement of energy expenditure; direct and indirect calorimetry; Factors affecting energy expenditure and requirements, - Energy imbalance. Calorific value, definition of BMR and SDA and their affecting factors,,Respiratory quotient, RDA, thermal equivalent of oxygen, calorogenic action of the foods .

**Nutritional assessment:** Direct parameters- Anthropometry, Clinical examination, Biochemical, Biophysical, Dietary surveys. Indirect parameters - vital statistics

Ecological - cultural influences, food production, socioeconomic factors, health and educational services.

#### Unit II:

**Nutrients -Role of Carbohydrates in diet:** dietary types, requirements, physiological action, non-starch polysaccharides, Resistant starch, Fructose oligosaccharides (FOS), Glycemic index: Factors affecting GI of foods and GI in chronic diseases, Dietary fiber, Physiological effects and Potential health benefits.

**Role of lipids in diet:** dietary types, dietary needs of lipids; essential fatty acids Tran's fatty acids, Role of omega 3 and omega 6 fatty acids, Deriving nutritional requirements of fats and oils for different age groups.

**Role of proteins in diet:** nutritive value of proteins and the methods for its determination, Protein reserves of human body; nitrogen balance studies and factors influencing nitrogen balance; essential amino acids and concepts of protein quality; cereal proteins and their limiting amino acids; Improvement of quality of protein in diet, amino acid imbalance, Methods of estimating and assessing protein requirements.

#### **Role of vitamins, minerals, water and electrolytes in diet**

**Food components other than essential nutrients:** Functional food- Probiotics, prebiotics, GM food, organic foods, Therapeutic foods, Nutraceuticals. Bioactive substances from protein foods, Non glycerides in edible oils. Phytoestrogens. Dietary sources and physiological effects.

Naturally occurring Anti-nutrients, Diet derived antioxidants .Loss of nutrients during processing and cooking.

Brief introduction to Nutritional supplements, food additives, artificial sweeteners and, fat replacers

### **Unit III**

#### **Nutritional requirements of different age group in the life cycle**

**Balanced diet-** Definition, Recommended dietary allowances for different categories of the human beings.

**Nutrition in Pregnancy & lactation:** Importance of nutrition prior to (pre maternal period) and during pregnancy (pre natal period), Intra-uterine growth retardation, Congenital malformation and gestational diabetes mellitus, factors affecting breastfeeding and fertility.

**Nutrition in Infancy:** Nutritional requirements, Breast feeding - Reasons for encouraging breast feeding, artificial feeding - Comparative composition of human & bovine milk, humanization of bovine milk. Formula foods, Weaning and supplementary feeding, Feeding of premature and immature babies, feeding problems.

**Nutrition in school children and Adolescents:** Nutritional requirements, Nutritional issues, problems and common diseases.

**Geriatric Nutrition:** Nutritional requirements of the elderly & dietary management to meet nutritional needs.

**Vegetarianism:** Importance of vegetarian diet, Principles of planning nutritionally adequate vegetarian diet, Role of vegetarian food in health & diseases.

### **Unit IV:**

#### **Nutrition in prevention and treatment of diseases:**

**Disorders related to nutrition-** Starvation, underweight, Obesity, genetic and environmental factors leading to obesity, management of obesity, Malnutrition- Causes, Measure to combat malnutrition. Food allergy- cause, symptoms, pathophysiology

**Role of diet-up nutrition in the prevention and treatment of diseases:** Diabetes: metabolism, factors affecting blood sugar levels, meal management, dietary treatment, oral hypoglycemic drugs, sweeteners- nutritive and non-nutritive, role of exercise, Prevention of diabetes. Dietary management in acute and chronic Renal Diseases, Diet in cardiovascular diseases:

cardiovascular risk factors Dyslipidemia , atherosclerosis, angina pectoris, myocardial infarction, rheumatic heart disease, prevention of CVD. Diet for hypertension. Diet and cancer.

## **Unit V**

### **Trends in nutrition science**

Nutrigenetics, Nutrigenomics, its aims and advantages, Nutrient-gene interactions, The effect of nutrients in genetic and epigenetic events, Nutrigenomics and personalized nutrition, The challenges in applying nutrigenomic data to nutrition, Nutrition and metabolomics, Ayurvedic nutrition.

### **Reference**

1. A Text Book of Medical Biochemistry- M.N.Chatterjea and R.Shindea, Jaypee pub.
2. Harper's Illustrated Biochemistry- R.K.Murray, D.K.Grannes and V.W.Rodwell, McGraw Hill
3. Medical Physiology- A.C.Guyton and J. E. Hall, Saunders pub.
4. Human Physiology- C. C. Chatterjee, Medical Allied Agency
5. Nutritional Biochemistry- Swaminathan
6. Life span nutrition: Conception through life – S R Rolfes, L K DeBruyne and E N Whitney
7. Normal and Therapeutic nutrition – C H Robinson and M R Lawler
8. Understanding normal and clinical nutrition – E N Whitney C B Cataldo and S R Rolfes



## **ELECTIVE 16**

### **BTPG34E NEUROBIOCHEMISTRY**

#### **Unit 1**

Structure of neurons. Central, peripheral and autonomic nervous system- Classification and properties. Metabolism and functions of nerve fibre.

#### **Unit II**

Mechanism of conduction of nerve impulse. Synapse- properties and functions. Mechanism of synaptic transmission. Myoneural junction. Disorders associated with conduction of nerve impulse.

#### **Unit III**

CNS- Composition, Chemistry, Structure and Functions. Neurotransmitters of CNS- Serotonin, Histamine, Glutamine, Aspartate, GABA, Glycine, Nitric oxide, Substance P- Chemistry, metabolism and function. Nervous system in regulation of endocrine function and vice versa, disorders associated with CNS.

#### **Unit IV**

ANS- Sympathetic and Parasympathetic neurotransmitters- Ach, Adrenaline, Noradrenaline. Chemistry, metabolism and functions. Disorders associated with ANS.

#### **Unit V**

Biochemistry of learning and memory. Aging, circulation and energy metabolism of brain. Blood – Brain-Barrier. Molecular biology of hearing, vision, olfaction and taste. Neurodegenerative disorders- Parkinson's, Alzheimer's disorders, ALS, Senile dementia etc

#### **Reference**

1. Basic Neurobiochemistry- G.J. Siegel et al.
2. Neuron to brain- J.G. Nicholls et al
3. The pharmacological basis of therapeutics- Goodman and Gillman.

4. Lewin's Cells. Lynne Cassimeris, Viswanath R, Lingappa, George Plopper Jones . Bartlett Publishers, London
5. The Cell – A molecular Approach. Geoffrey M Cooper, Robert E Hausman, ASM Press, Washington.

## ELECTIVE 17

### BTPG35E DEVELOPMENTAL BIOLOGY

#### Unit-1

**Basic concepts of development :** Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

#### Unit-II

**Gametogenesis, fertilization and early development:** Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

#### Unit-III

**Morphogenesis and organogenesis in animals :** Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

#### Unit IV

**Morphogenesis and organogenesis in plants:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*

#### Unit V

##### **Programmed cell death, aging and senescence**

Necrosis, Apoptosis, caspases, Extrinsic and intrinsic pathway, aging, theories of aging mitochondrial stress, senescence

## Reference

1. Lewin's Cells. Lynne Cassimeris, Viswanath R, Lingappa, George Plopper Jones . Bartlett Publishers, London
2. The Cell – A molecular Approach. Geoffrey M Cooper, Robert E Hausman, ASM Press, Washington.
3. Scott F. Gilbert, Developmental Biology, Seventh Edition, 2003, Sinauer Associates, Inc., Sunderland, MA, ISBN 0-87893-258-5
4. John Gerhart and Marc Kirschner, Cells, Embryos, And Evolution, 1997, Blackwell Science, ISBN 0-86542-574-4,
5. Fred H. Wilt & Sarah C. Hake, Principles of Developmental Biology, 2004, W.W. Norton & Company, Inc., New York, NY, ISBN 0-393-97430-8
6. Sally A. Moody, Editor, Cell Lineage and Fate Determination, October 1998, Academic Press, Inc., ISBN 0-12-505255-3
7. Lewis Wolpert, Rosa Beddington, Thomas Jessell, Peter Lawrence, Elliot Meyerowitz, Jim Smith, Principles of Development, Second Edition, 2002, Oxford University Press, ISBN 0-19-924939-3

## ELECTIVE 18

### BTPG36E PHYSIOLOGY

#### **Unit I: Circulatory System, Respiratory System and Excretory System**

**Circulatory System:** Circulation. Composition and functions of blood. Haemopoiesis and formed elements. Plasma - function, Blood volume, Blood volume regulation, Blood groups, Haemoglobin, , Haemostasis– mechanisms. Blood groups: ABO system, determination, importance, Rh. Structure of Heart, Myogenic heart, Specialized tissue, ECG – its principle and significance, Cardiac cycle, blood pressure, Neural and chemical regulation. **Respiratory System:** Functional anatomy, Phases of respiration transport of gases, Exchange of gases, Neural and chemical regulation of respiration. **Excretory System:** Physiology of excretion, Kidney, Urine formation, Urine concentration, Micturition, Regulation of water balance, electrolyte balance, acid-base balance.

#### **Unit II: Nervous and Hormonal Coordination, Reproductive System.**

**Nervous system** - Neurons, Action potential, Gross neuro – anatomy of the brain and spinal cord, Central and peripheral nervous system, Neural control of muscle tone and posture. **Sense organs** - Vision, Hearing, Smell, Taste and Tactile response. **Endocrinology and reproduction** - Endocrine glands, Basic mechanism of hormone action, Hormones and diseases; Reproductive processes, Gametogenesis, Ovulation, Neuroendocrine regulation.

#### **Unit III: Photosynthesis and Respiration**

**Photosynthesis** - Light harvesting complexes, mechanisms of electron transport, photo protective mechanisms, CO<sub>2</sub> fixation-C<sub>3</sub>, C<sub>4</sub> and CAM pathways. **Respiration** – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis, photorespiration. Transpiration.

#### **Unit IV: Plant Physiology**

Absorption and transport of water, Macro & micro nutrients, Plant hormones, plant movements, photoperiodism, vernalization, **Stress physiology** – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

#### **Unit V: Microbial Physiology**

Growth yield and characteristics, strategies of cell division, stress response.

## Reference

1. Vander's Human Physiology- The Mechanism of Body function. Widmaier, Raff, Strang
2. Text book of Medical Physiology. Arthur. C. Guyton & John. E. Hall
3. Physiological basis of Medical Practice. John. B. west
4. Review of Medical Physiology. William. F. Ganong
5. Essentials of Medical Physiology. K. Sembulingam & Prema Sembulingam

**ELECTIVE 19**  
**BTPG37E ENVIROMENTAL SCIENCE**

**Unit 1**

Principles and scope of environmental science, autecology, synecology, habitat, niche, fundamental and realized niches, trophic levels, food chains, foodweb, ecosystem, biotic and abiotic components, pyramid of numbers ,pyramid of biomass, energy transfer in ecosystem.

**Unit II**

Biogeochemical cycles- nitrogen, sulfur, phosphorus, carbon, calcium, significance of microorganisms in biogeochemical cycling, microorganisms in extreme environment

**Unit III**

Conservation of biodiversity: Biodiversity status, monitoring and documentation Biodiversity management approaches, principles of conservation and wild life management, ex situ and in situ methods of conservation , biological parks, nature reserves, sanctuaries, cryopreservation, gene bank, germplasm conservation, Hotspots of biodiversity

**Unit IV**

Environment protection-issues and problems, International and national efforts for environment Protection. Global environmental problems-Ozone depletion, global warming ,climatic change, acid rain, pollution by oil spillage, desertification, eurtrophication , underground water pollution, heavy metal poisoning, hazards of radio activity, bioweapons.

**Unit V**

Biomes: tropical rain forest, grassland, desert, estuaries and sea shores. Ecological succession –hydrosere, Edges and ecotones, pollution in extreme environment, Endangered and Threatened Species .

**Reference**

1. Chapman and Reiss, Ecology principles and applications. Cambridge University.
2. Jobes A. M., Environmental biology, Routledge, London.

3. Odum E. P and Barret G W .Fundamentals of ecology. W. B Saunders company, Philadelphia.
4. Odum E. P. Basic ecology. Saunders College.
5. A textbook of environmental sciences, Arvind kumar.
6. Alleby M.Basics of environmental science. Routledge, Newyork
7. Cunningham, W. P and Siago, B. W ,Environmental science.
8. Kewin T. P and Owen C. A., Introduction to global environmental issues. Routledge, London.Chiras,D.D, Environmental science
9. Microbial Ecology. Fundamentals and Applications. Atlas and Bartha, Pearson Education, Benjamin Cummings publishing company.Inc.New Jersey



## **ELECTIVE 20`**

### **BTPG38E EVOLUTION AND BEHAVIOUR**

#### **Unit 1 Emergence of evolutionary thoughts**

Lamarck; Darwin—concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

#### **Origin of cells and unicellular evolution:**

Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

#### **Unit 11 Paleontology and Evolutionary History:**

The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms;

#### **Unit 111 Molecular Evolution:**

Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.

#### **Unit 1V The Mechanisms:**

Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

#### **Unit V Brain, Behavior and Evolution**

Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism;

Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care;

## **Reference**

1. Principles of Genetics, A.G.Gardner, Wiley Publications
2. Raven Biology,*Raven* et. al. Biology. Ninth Edition. Eighth Edition. ©2010 McGraw-Hill Higher Education, a division of The McGraw-Hill Companies, Inc. All rights reserved.
3. Fundamentals of Ecology by Eugene Odum and Gary W. Barrett (Jul 27, 2004)
4. Title Ecology: Theories and applications AuthorPeter D. StilingEdition2, illustrated Publisher Prentice Hall, 1996 Original from the University of California Digitized
5. Animal Behavior; An Evolutionary approach, John Alcock, Ninth edition, Sinauer Associates Inc.sunderland, Massachusetts
6. Animal Behavior, mechanism, Development, Function and Evolution, Christopher J Bernard, Pearson Education, 2004.
7. Animal behavior, mechanisms, ecology, evolution.,Lee.C.Drickamer, Stephan H Vessen, Elizabeth M. Jakob, Mac Graw-Hill, 2001