



**Solapur University, Solapur**  
**M.Sc. Part-II Semester III & IV Genetics**  
**(Revised semester pattern syllabus)**  
**(w.e.f. June, 2014)**

## Syllabus for M.Sc. Part II Genetics

### SEMESTER- III (THEORY)

Code	Title of the paper	Marks
GEN - 301	Immunology	100
GEN - 302	Molecular Medicine	100
GEN - 303	Analytical Instruments and Techniques	100
GEN - 304	Bioinformatics and Research Methodology	100

### SEMESTER- III (PRACTICAL)

Code	Title of the paper	Marks
GEN PR- 305	Immunology and Molecular Medicine	100
GEN PR- 306	Analytical techniques, Bioinformatics and Research Methodology	100
	Seminar	25
	Total	625

### SEMESTER- IV (THEORY)

Code	Title of the paper	Marks
GEN - 401	Genetic Engineering	100
GEN - 402	Cancer Genetics and Animal Cell culture	100
GEN - 403	Agriculture Science and Seed Technology	100
GEN - 404	Industrial Biotechnology and IPR	100

### SEMESTER- IV (PRACTICAL)

Code	Title of the paper	Marks
GEN PR – 405	Genetic Engineering, Animal cell culture, Agriculture and Industrial Biotechnology	100
GEN PR – 406	Project	100
	Seminar	25
	Total	625

As per the credit system, the assessment of Theory paper of 100 marks weightage will be as: 70 marks theory assessment by University examination and 30 marks internal assessment by the Department. For internal assessment of candidate, periodical tests/seminars/ viva/oral / quiz etc. may be suitably adopted.

# GEN 301: Immunology

**Total Lecture - 45**

## **UNIT 1**

Antigen: Introduction; Antigenicity and Immunogenicity Properties; Epitope. Antibody: Structure, Function, Classes and its properties; Cells and Organs of Immune System.; Innate Immunity: Anatomical barriers, Chemical Barrier, Inflammation, Phagocytosis, Natural Killer Cells. Acquired immunity: Cell mediated Immunity, Endogenous and Exogenous, Antigen, Processing and presentation, Humoral immunity. (10)

## **UNIT 2**

Major Histocompatibility Complex: Introduction, Organization, MHC molecules and gene organization; B Cell Receptor, Organization of Immunoglobulin gene, Genetics of antibody diversity; T cell Receptor, Organization of T Cell Receptor. (9)

## **UNIT 3**

Complement system: Introduction, Alternate and Classical pathway, Regulation; Cytokines: Introduction, Properties and their functions; B Cell generation, activation and differentiation; T Cell maturation, activation and differentiation. (9)

## **UNIT 4**

Hypersensitivity: Autoimmunity: Organ specific and Systemic; Transplantation: Graft Rejection, Types of transplants, Immunosuppressive therapy; Cancer and Immune System. Vaccine: Various Types with their advantages and disadvantages, Recombinant vector vaccine; Aids and Other Immunodeficiency diseases; (10)

## **UNIT 5**

Immuno-assay methods: Affinity, Avidity, Immunoprecipitation, Agglutination, Complement fixation, Immunodiffusion, Immunoelectrophoresis, Immunofluorescence, RIA, ELISA, Flow cytometry. Monoclonal antibodies: Introduction, Steps in production, and Application. (7)

## **BIBLIOGRAPHY**

- Basic and Clinical Immunology; Stites et al., [Ed.] (1982) Lange.
- Roitt's Essential Immunology; Ivan, M. Roitt & Peter J Delves (2001) Blackwell Science
- Immune System; M.C. Connel et al., [Eds.] (1981) Blackwell Science.
- Immunology at a Glance; J.H.L. Playfare [ed.] (1987), Blackwell Science.
- Immunology; Jan Klein [Ed.] (1990), Blackwell Science.
- Introduction to Immunology; Kim Bell [Ed.] (1990) 3 Ed. McMillan.
- NMS for Immunology; Hyde and Patnide [Eds.] (1990) John Wiley.
- Microbiology; Prescott, Harley and Klein, (2003) McGraw-Hill.
- Kuby-Immunology; Goldsby et al., (2000), WH Freeman &Co.

## GEN 302: Molecular Medicine

Total lectures - 45

### UNIT 1: Human Molecular Genetics

Human genome project; Sequence Architecture of human genome; Blood and Blood group Antigens; MHC Antigen – HLA; Identification and isolation of disease genes – Positional cloning, Functional cloning, Microarray technology; Pre-natal diagnosis - Chorionic villus sampling, Amniocentesis; Forensic testing - DNA fingerprinting, Paternity testing. (9)

### UNIT 2: Genetic Diseases in Human

Cystic fibrosis, Duchenne muscular dystrophy, Haemoglobinopathies, Agammaglobulinemia, Marfan syndrome, Huntington's disease, Phenylketonuria, Down syndrome. (9)

### UNIT 3: Stem Cell as Regenerative medicine

Introduction; Stem cell sources; Unique properties of stem cells; Classification - Embryonic stem cells, Adult stem cells; Similarities and differences between adult and embryonic stem cells; Applications of Embryonic stem cells and ethical issues associated with it; Adult stem cell Differentiation, plasticity, types of adult stem cells; Stem cell specific transcription factors - Induced pluripotent stem cells (iPSC); Therapeutic applications as regenerative medicine. (10)

### UNIT 4: Gene Therapies

Introduction; Types of Gene therapy: Somatic and Germ line gene therapy, *In-vivo* and *Ex-vivo* gene therapy; Virus based vehicle for gene therapy, Non Viral Methods of Gene transfer. (8)

### UNIT 5: Pharmacogenetics

Steps involved in Drug Discovery/Design - Insilco method, Structure based method, Nature and Sources of drugs; Route of drug administration; Absorption and Bioavailability of drugs in system; Excretion of drugs from system; Pharmacogenetics study of drug. (9)

### BIBLIOGRAPHY

- Peter Sudbery, Ian Sudbery, 2009, Human Molecular Genetics, 3<sup>rd</sup> edition, Pearson education limited.
- Leaf Huang, Mien-Chie Hung, Ernst Wagner, 1999, Non viral vectors for gene therapy, Academic press.
- Max Levitan, Ashley Montagu, 1977, text book of Human Genetics, 2nd Ed. Oxford University press, N.Y.
- Tom Strachan & Andrew P. Read. 2004, Human Molecular Genetics, 2nd Ed. John Wiley & Sons. (Asia) PTE Ltd.
- Ricki Lewis. Human Genetics- Concepts and Applications, 3<sup>rd</sup> Ed. WCB, McGraw-Hill.
- Amita Sarkar. 2001, Human Genetics, Dominant Publishers, VOL No-1&2 New Delhi.
- Nagy A, Gertenstein M, Vintersten K, Behringer R (2003). Manipulating the Mouse Embryo, New York: Cold Spring Harbor Press.
- Gilbert SF. (2000) Developmental biology, 6th edition Sunderland, MA: Sinauer Associates, Inc.

## GEN 303: Analytical Instruments and Techniques

**Total Lectures - 45**

### **UNIT 1: Microscopy**

Introduction; Optical principles of Microscopy; Image formation by compound light microscope & electron microscope; Types of Microscopes - Inverted, Phase-contrast, Bright field, Dark field, Fluorescence microscope; Advanced Microscopy- Scanning electron Microscopy, Transmission electron Microscopy, Confocal Microscopy. (9)

### **UNIT 2: Radioactivity**

Nature of Radioactivity; Isotope, Production of isotopes, Synthesis of labeled compounds; Labeling procedures. Detection & Measurement of Radioactivity - A) Methods Based on Gas Ionization- Ionization Chamber, Proportional Counters, GM Counters B) Methods Based on Excitation- Solid Scintillation counting, Liquid Scintillation counting. C) Photographic method. Autoradiography; Applications of Radioisotopes in Biological Sciences; Safety measures. (9)

### **UNIT 3: Electrophoresis**

Basic principle of electrophoresis; Factors affecting electrophoretic mobility; Support Media. Types of electrophoresis; Theory & Applications of Paper, Starch gel, Agarose, Cellulose Acetate, High Voltage, Pulse field gel electrophoresis, Native PAGE, SDS-PAGE, Isoelectric focussing, Electrophoresis on cellular gels, Capillary Electrophoresis; Blotting Techniques: Southern, Northern, Western Blotting, Dot Blot. (9)

### **UNIT 4: Chromatography**

Introduction and types of chromatography – Plane, Paper, TLC, Column Chromatography. Principle, procedure and applications of Adsorption, Affinity, Gel Permeation, Ion Exchange, Gas Liquid chromatography, Fast Protein Liquid Chromatography(FPLC), High Performance Liquid Chromatography (HPLC), Gas Chromatography- Mass Spectrometry(GCMS), Liquid Chromatography- Mass Spectrometry(LCMS). (9)

### **UNIT 5: Spectroscopy**

Introduction; Instrumentation & Applications of Colorimetry, UV Spectroscopy, VIS. Spectroscopy, Atomic Absorption Spectroscopy, X- ray spectroscopy, IR Spectroscopy & Raman Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, Mass Spectroscopy. (9)

### **BIBLIOGRAPHY**

- Analytical Biochemistry; D.J.Holme and H. Pick, 3rd Ed.(1998) Longman.
- Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work (1969) Vol. I & II, North Holland.
- Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, (1993), Blackwell Science.
- Methods of Enzymatic Analysis; Berg Meyer (1974) Vol. 1-X,
- Practical Biochemistry ; Principles and Techniques; K.Wilson and J. Walker (1995) 4 thEdn.Cambridge University Press.
- Principles of Instrumental Analysis, (1980) 2nd Edn.Holt- Saunders.
- Principles and Techniques of Practical Biochemistry; Williams and Wilson (1981) 3rd Edn. EdwardArnold.
- Protein Purification Applications, S.L.V. Harris and Angal (1990) IRL Press.
- Protein Purification, Robert, K. Scopes (1988) 2 nd Edn. Springer-Verlag.
- Protein Purification Methods, S.L.V. Harris and Angal (1989) IRL Press.
- Techniques in Molecular Biology, Walker and Gastra (1983) Croom Helm.

# GEN 304: Bioinformatics and Research Methodology

Total lectures - 45

## UNIT 1 Biological Databases

Structural and Sequence databases of Protein and Nucleic acids; NCBI data model – PUBs, SEQ-Ids, BIOSEQs, BIOSEQ-SETs, SEQ-ANNOT, SEQ-ESCR; Database file format – GenBank, SwissProt; Entrez System. (9)

## UNIT 2 Sequence Alignments and Database Searching

Introduction and Types of alignments; The Evolutionary Basis of Sequence Alignment; The Modular Nature of Proteins; Optimal Alignment Methods; Substitution Scores and Gap Penalties; Statistical Significance of Alignments; Database Similarity Searching; FASTA; BLAST; Database Searching Artifacts; Position-Specific Scoring Matrices; Spliced Alignments; Method of Multiple Alignment; Tools to Assist the Analysis of Multiple Alignments; Collections of Multiple Alignments. (11)

## UNIT 3 Predictive Methods Using Sequences

Methods, Strategies and consideration for prediction of DNA Sequences; Tools – GRAIL, FGENEH/FGENES, MZEF, GENSCAN, PROCRUSTES; Prediction of Protein Sequence – Protein Identity Based on Composition, Physical Properties Based on Sequence, Motifs and Patterns, Secondary Structure and Folding Classes, Specialized Structures or Features, Tertiary Structure. (10)

## UNIT 4 Essential Steps in Research

Definition and importance of Research; Experimental designs – Objectives, Literature collection; Literature citation; Hypothesis designing, Basic principles of experiments; Laboratory safety – Biohazardous agents, risk to human health and environment, safety measures, Safety in genetic engineering and laboratory of animals; Socio-economic and ethical consideration. (8)

## UNIT 5 Research Report

Components of Research report; Use of tables and figures in research report; Formatting and typing of research report, Plagiarism. (7)

### BIBLIOGRAPHY

- Andreas D. Baxevas and B. F. Francis Ouellette, “BIOINFORMATICS: A Practical Guide to the Analysis of Genes and Proteins”, 2<sup>nd</sup> Edition, A John Wiley & Sons, Inc., Publication.
- Atwood, T. K. and Parry-Smith, D. J, “Introduction to bioinformatics”.
- David Mount, “Bioinformatics (Sequence and Genome analysis)”, Cold spring, Harbour Laboratory Press
- C. Stain Tsai, “An introduction to Computational Biochemistry”, A John Wiley & Sons, Inc., publications.
- N Gurumani, “Research Methodology for Biological Sciences, MJP Publishers, Chennai.
- H. S. Chawala, “Introduction to Plant Biotechnology”, 3<sup>rd</sup> Edition, Oxford & IBH publishing Co. Pvt. Ltd, New Delhi.
- NCBI Web site: <http://www.ncbi.nlm.nih.gov>

# Practicals

## SEMESTER- III (Practical)

### GEN PR 305 - Immunology and Molecular Medicine

1. Ouchterlony Immuno-diffusion.
2. Radial immuno-diffusion.
3. Blood typing
4. Rocket Electrophoresis
5. ELISA
6. WIDAL test
7. VDRL test
9. Differential staining of Blood.
10. RBC counting
11. WBC counting
12. Karyotyping Study of normal and abnormal cells
13. Study of Sickled RBCs.
15. Demonstration of Study of Flow cytometer
16. Case study of treatment of any disease using Gene therapy
17. Case study of treatment of any disease using Stem Cell Therapy
18. MTT Assay (Dimethylethiazole Diphenyltetrazolium Bromide)
19. Separation of serum from plasma
20. Estimation of alkaline & acid phosphatase activity in blood plasma

## **GEN PR 306 - Analytical techniques and Bioinformatics**

1. Detail study of Various parts of following microscopes
  - Compound Microscope
  - Inverted Microscope
2. Electrophoresis of Nucleic acid (DNA and RNA)
3. Electrophoresis of serum proteins.
4. Gel documentation & photography
5. SDS-PAGE for protein mol. wt. determination
6. Gel permeation chromatography
7. Separation of proteins by 2D gel electrophoresis.
8. UV spectra of protein/ Protein estimation using UV Spectroscopy
9. UV spectra of nucleic acid/ Nucleic acid estimation using UV Spectroscopy
10. Colorimetric estimation of inorganic phosphate.
11. Ascending Paper chromatography
  1. Leaf Pigment
  2. Amino Acids
12. TLC of Amino Acids.
13. Retrieval of amino acid/Gene sequence from NCBI/SRS from EBI and studying file format.
14. Studying of pair-wise alignment of given sequences by BLAST/FASTA.
15. Studying multiple alignment of given sequence by Clustalx/w (Offline tool)
16. Retrieval of 3D structure of proteins from PDB and visualization by RasMol/Chimera.
17. Identification of Gene structure in genomic DNA by GENSCAN.
18. Prediction of Physical properties of proteins by online resources.
19. Prediction of protein identity based on composition.
20. Prediction of secondary structure and folding classes of proteins.
21. 3D Structure prediction and validation of it.
22. Study of Plagiarism for given articles.
23. Practicals on Research methodology (Research papers/Posters etc.)



## SEMESTER- IV

### GEN 401: Genetic Engineering

Total Lecture – 45

#### UNIT 1 Introduction & Commonly used techniques in Genetic Engineering

Introduction; Commonly used techniques: Chromosome walking, Molecular markers: RFLP, RAPD, AFLP, PCR and types. (8)

#### UNIT 2 Enzymes, Vectors & Probes in Cloning

Restriction Enzymes - Exonucleases, Endonucleases; Restriction Endonucleases - Classification & Properties; DNA Manipulating Enzymes - Nucleases, DNA Polymerases, RNA Polymerases, Reverse Transcriptase; Nucleic Acid modifying enzymes - Ligases, Alkaline Phosphatases, Terminal Transferases, Kinases; Gene Cloning Vectors - Properties & Structure of Plasmids, Cosmids, Phagemids, Shuttle Vector, BAC, YAC, Bacteriophages ( $\lambda$  and M13); Vectors for plants, animals and yeast; Molecular Probes (Radioactive & non radioactive) - Preparation of genomic DNA probes, C-DNA probes, synthetic oligonucleotide probes, RNA probes, methods of labelling probes; Uses of probes. (10)

#### UNIT 3 Recombinant DNA Technology

Construction of r-DNA Molecules - Isolation of Vector and donor DNA and its purification; Assembly of gene of interest and vector DNA; Introduction to genomic library; Construction of Genomic library; C-DNA library construction; Preparation of primers and probes; Screening of Recombinant Cell - Direct Screening, Indirect Screening, Colony hybridization, Immuno-Screening; Expression of cloned DNA in *E.coli* - Designing of *E.coli* Expression vector, Promoter, terminator, origin of replication, regulation of gene expression by promoter. Fusion protein. (9)

#### UNIT 4 Cloning and Transformation methods

Methods of direct transformation - PEG mediated microinjection, particle bombardment, electroporation,  $\text{CaCl}_2$ ; Methods of indirect transformation - *Agrobacterium tumefaciens* and *A. rhizogenes*; DNA sequencing: Maxam's and Gilbert's method, Sanger's dideoxy method, Automated DNA sequencing. (8)

#### UNIT 5 Applications of Genetic Engineering

rDNA Technology in Human Health - Production of recombinant hormones, insulin, HGH, Hepatitis-B recombinant vaccine production; Synthesis of Human Interferon and Growth hormone; GE in Plants - Insect-resistant plants, Herbicide-resistant plants, Development of salt stress tolerant plants, plant as edible vaccines, Modification of food plants taste (Sweetness); GE in Animals - Transgenic sheep and mice (mice as model for Alzheimer disease and overproduction of proteins); GE in Microbes - Diagnosis of Malaria, *Trypanosoma cruzi* and sickle-cell anemia, Vector vaccines (Directed against viruses and bacteria), (10)

## BIBLIOGRAPHY

- An Introduction to Genetic Engineering, 2nd Edition, Desmond S.T. Nicholl, Cambridge University Press (2006)
- Molecular Biotechnology: Principles and Applications of Recombinant DNA, 3rd Edition, B.R. Glick and J.J. Pasternak, ASM Press (2007)
- Principles of Gene Manipulation and Genomics, 7th Edition, S.B. Primrose and R.M. Twyman, Blackwell Publishing (2006)
- Molecular Biotechnology, 2nd Edition, S.B. Primrose, Panima Publishing (2001)
- Introduction to Biotechnology, Low Price Edition, W.J. Thieman and M.A. Palladino, Peason Education (2007)
- Genetic Engineering : Principles And Practice, Sandhya Mitra, Macmillan India (1996)
- Genetic Engineering: Principles and Methods, Setlow J.K., Kluwer Academic, Publishers. (2000)
- Genetic Engineering, Yount L., Gale Group (2002)
- Molecular Cloning: A Laboratory Manual (Volume - I, II & III) Sambrook J., D.W. Russell, Cold Spring Harbor Laboratory Press (2001)
- Gene Cloning and DNA Analysis: An Introduction, 4th edition, Brown T. A., Blackwell Science Inc (2001)
- Recombinant DNA: Genes and Genomes - A Short Course, 3rd Edition, James D.

## GEN 402: Cancer Genetics and Animal cell culture

Total Lecture – 45

### UNIT 1 Introduction to Cancer Biology

Cancer cell vs. Normal cell; Hallmarks of cancer cell; Cell cycle - Regulation of Cell cycle and pRb tumor suppressor; P53 tumor suppressor; Tumor suppressor genes; Oncogenes and Proto-Oncogenes; Factors activating proto-oncogene to oncogene; Tumor Virus; Physical and Chemical Carcinogenesis; Introduction to Epigenetics, Epigenetics in cancer. (9)

### UNIT 2 Cancer Progression

Apoptosis mechanism, Apoptotic Pathways; Metastasis, Clinical significances of invasion, Metastatic cascade, Basement membrane disruption; Theory of invasion, Proteinases and tumour cell invasion; Angiogenesis and its sequence of events in detail. (9)

### UNIT 3 Diagnostic and Treatment

Methods of diagnosis - Chemotherapy, Radiation Therapy, Immunotherapy- use of immunotoxins in cancer therapy, Retroviral drugs, Anti-angiogenic Drug; Drugs based on Epigenetics (Acetylation of Histones and Methylation of DNA) (8)

### UNIT 4: Introduction of Animal Tissue Culture

Introduction; Infrastructure of Animal Tissue Culture Laboratory; Characteristics of cells in culture; Media - Natural & Synthetic Media; Primary culture- Cell line (Finite, Infinite, and Continuous); Disaggregation of tissue, Organ culture & its types; Cell culture – initiation, cultivation of animal cell in mass in Bioreactors; Biology of cell culture, evolution of culture dynamics and maintenance of cell lines. (10)

### UNIT 5: Viability & Micromanipulation

Viability – measurement of viability and cytotoxicity; Cell cloning – cell synchronization, cell cloning, micromanipulation, Cell Transformation and applications of animal cell culture; *In vitro* fertilization – embryo transplant techniques and their applications.

Commonly used cell line- MCF7, HeLa, CHO, BHK (9)

### BIBLIOGRAPHY

- The Biology of Cancer, Robert Weinberg, Garland Science; 2 edition; 2010
- King R.J.B., Cancer Biology, Addison Wesley Longman Ltd, U.K., 1996.
- Ruddon.R.W., Cancer Biology, Oxford University Press, Oxford, 1995.
- Bishop J. A. 1982, Retrovirus, Cancer genes, Advances in Cancer Research.
- Vogel F. Chemical mutagenesis Springer and Verlag.
- Sanberg A. A. 1980, The Chromosome in Human Cancer And Leukemia
- Stich H. F. Carcinogens and Mutagens in Environment CRC press.
- Animal Cell Biotechnology
  - Ian Freshney (4th Edition)
  - Buttlar. 2<sup>nd</sup> Edition

# **GEN 403: Agriculture Science and Seed Technology**

Total Lecture – 45

## **UNIT 1 Plant Physiology**

Plant physiology and its significance in agriculture; Physical properties and chemical constitution of protoplasm; plant cell water relation - imbibition, surface tension, diffusion, osmosis; Absorption and translocation of water and nutrients; Transpiration; Guttation; Mineral deficiencies and their symptoms; Photo respiration; Plant Growth hormones – Auxins, Gibberellins, Abscisic acid, Cytokinins, Pheromones; Growth inhibitors and their use in agriculture; Tropism in plants photoperiodism and vernalization; Seed dormancy and germination, Fruit ripening process and its control. Crops grown in India and their types

(10)

## **UNIT 2 Soil Science and Agricultural Chemistry**

Soil as a medium of plant growth and its composition; Soil Types in India; Mineral and organic constituents of soil and their role in crop production; Chemical, physical and microbiological properties of soil; Essential plant nutrients, Principles of soil fertility and its evaluation for judicious use of fertilizers;

(10)

## **UNIT 3 Responses of crops to nutrient deficiency and pathogens**

Phosphorous and Iron deficiencies, Heavy metal stress and non optimal pH-acid and calcareous soil; Physiological and molecular biology of heavy metal tolerance; Physiological and molecular responses of plants to water stress, salinity stress, temperature stress (heat and cold), Photo oxidative stress; Plant responses to pathogen and herbivores – biochemical and molecular basis of host plant resistance; Bio composting; Organic manure and Bio fertilizers; Water soluble fertilizers; Bio pesticides: microbes and plants, Biomineralization. Steps involved in Mushroom Cultivation.

(10)

## **UNIT 4 Seed Technology**

Seed technology and its importance; production processing and testing of seeds of crop plants; seed storage, seed certification; role of National Seeds Corporation (NSC) in production; New seed policy and seed control order, Terminator Technology.

(8)

## **UNIT 5 Animal Husbandry**

Importance of livestock in agriculture; relationship between plant and animal husbandry; mixed farming; animal breeding; breeds of indigenous and exotic cattle, buffaloes, goats, sheep, and poultries and their potential for milk, egg, meat and wool production.

(7)

## **BIBLIOGRAPHY**

- Edited by Garry C Whitlam and Karen J Halliday, Light and Plant Development, Oxford Ames, Iowa: Blackwell Pub., 2007.
- Esau's Plant Anatomy; Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development, 3rd Edition, John Wiley & Sons, 2006.
- Thomas L Rost, Michael G Barbour, Terence M Murphy and C Ralph, Stocking Plant

Biology (with InfoTrac), 2005.

- U. Chakraborty, Bishwanath Chakraborty, 2005. Stress biology, Vidhyasekaran, P. 2007. Narosa Publishing House
- Handbook of molecular technologies in crop disease management, Haworth Food & Agricultural Products Press, New York.462 p
- Taiz and Zeiger, Plant Physiology, 3rd Edition, Panima Publishing Corporation, New Delhi, 2003
- Gatehouse, A. M .R., Hilder, V. A. and Boulter, D., Plant Genetic manipulation for crop protection In: Biotechnology in Agriculture Series (Eds.) Vol. 7 CAB International, Wallingford, UK. 266p. 1992
- Panda N. and G.S.Khush, Host plant resistance to insects. CAB International, Walling Ford. 431p, 1995
- Slater, A., Scott, N. and Fowler, M., Plant biotechnology –The genetic manipulations of plants. Oxford University press. 346p, 2003.
- Vidhyasekaran, P., Fungal pathogenesis in plants and crops: Molecular biology and host defense mechanisms, Marcel Dekkar Inc., New York. 624p, 1997
- Vidhyasekaran, P., Bacterial Disease Resistance in Plants: Molecular Biology and Biotechnological Applications, Haworth Food & Agricultural Products Press, New York.452p, 2005.

## **GEN 404: Industrial Biotechnology and Intellectual Property Rights**

Total lectures - 45

### **UNIT 1 Bioprocessing in Industry**

Introduction; Basic design of fermenter and various parts of fermenter; Types of fermenter; Batch, Fed Batch, Continuous fermentation method; Media Formulation; Methods of preservation and improvement of Industrially Important organism; Microbes exploited commercially - *Saccharomyces*, *Lactobacillus*, *Penicillium*, *Acetobactor*, *Bifidobacterium*. (9)

### **UNIT 2 Upstream and Downstream Processing**

Upstream Process - Media formulation and Media Optimization; Sterilization of medium, fermenter, feed, liquid waste; Bioprocess control and monitoring variables such as temperature, agitation, pressure, pH; Downstream process - Filtration, Centrifugation, Cell disruption (Physical and Chemical), Liquid –Liquid Extraction, Supercritical fluid extraction; Purification by chromatography and ultra filtration; Drying, Crystallization; Steps Involved in Industrial production of Penicillin, Vitamin B12, Ethanol. (10)

### **UNIT 3 Industrial Impacts on Environment**

Sources and Pollutants of Air pollution; Control measures of air pollution; Sources and Pollutants of Water pollution; Concept of DO, COD, BOD. Dissolved oxygen concentration as an indicator of water quality; Chemical Toxicants from Industry; Treatment and disposal of effluents – Physical treatment, Chemical treatment, Biological treatment; Disposal site. (9)

### **UNIT 4 Bioremediation & Energy**

Bioremediation of soil and water; Biodegradation of toxic wastes from industry; Bioaugmentation; Biobleaching; Phytoremediation.

Energy Crisis and Non Conventional Sources – Energy crisis in India, Conventional sources, Non conventional sources. (8)

### **UNIT 5 Intellectual Property Rights (IPR)**

Introduction; Protection of intellectual property; World organizations; Forms of protection – Copyright, Trademark, Trade secrets and Patent; Patent application; Patenting of biological material; Patenting procedure in India; Geographical indications. Union for the Protection of New Varieties of Plants (UPOV), Advantages and disadvantages of Plant breeders right (PBR). (9)

### **BIBLIOGRAPHY**

- Gautam, N. C., Food Biotechnology in Comprehensive Biotechnology, Vol. 6.,
- Gutierrez – Lopez, G. F. et. al., Food Science and Food Biotechnology.
- Maheshwari, D. K. et. al., Biotechnological applications of microorganisms,
- Stanbury, P. F. et. al., Principles of Fermentation Technology, 2<sup>nd</sup> Edition,
- Waites, M. J. et. al., Industrial Biotechnology: An Introduction, N Gurumani, “Research Methodology for Biological Sciences, MJP Publishers, Chennai.
- H. S. Chawala, “Introduction to Plant Biotechnology”, 3<sup>rd</sup> Edition, Oxford & IBH publishing Co. Pvt. Ltd, New Delhi.

## **Practicals**

### **SEMESTER- IV (Practical)**

#### **GEN PR 405 - Genetic Engineering, cell culture, Industrial & Agriculture Technology**

1. Estimation of BOD from water sample.
2. Estimation of COD from water sample.
3. Effect of industrial effluents on seed germination and plant growth.
4. Crude protein purification using Filtration, Centrifugation and Dialysis.
5. Study of fermenter and its various parts
6. Isolation of Mitochondrial/ Chloroplast DNA
7. Isolation of genomic DNA from Yeast / Plant cell / Animal Cell and verify using electrophoresis
8. Isolation and quantification of total RNA from Yeast / Plant cell / Animal Cell and verify using electrophoresis
9. Molecular weight determination of digested DNA.
10. Construction of restriction map of plasmid DNA.
11. Ligation theory and ligation of DNA.
12. Southern blotting technique.
13. DNA amplification by PCR
14. Reporter gene assay (b- Gal)
15. DNA Fingerprinting: Using RAPD techniques
16. Aseptic Transfer technique in animal Cell Culture
17. Preparation of Balanced Salt Solution and  $P^H$  standards for animal cell culture.
18. Trypsinization methods in animal cell culture -  
A.Warm Trypsinization B.Cold Trypsinization
19. Chick Embryo Culture / Lymphocyte Culture.
20. Determination of growth curve of a microorganism - Compute specific growth rate
21. Laboratory techniques to measure water and nutrient uptake in plants.

### **SEMESTER- IV (Practical/Project)**

#### **Gen Pr 406 – Project**

Students have to start the research project during III Semester and submit and present during the practical examination of IV semester.

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