VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

Syllabus: Semester -VI

IBT – 601: Animal Biotechnology

SECTION-1

UNIT-1:

1.1 Introduction: History and concept of Animal Biotechnology.

1.2 Applications of Animal Biotechnology:

- 1.2.1 Advantages and application of Medicine.
- 1.2.2 Vaccine production.
- 1.2.3 Diagnosis of diseases.
- 1.2.4 Detection of genetic disorders.
- 1.2.5 Treatment.
- 1.2.6 Forensic medicine.
- 1.2.7 Metabolite production.
- 1.2.8 Bio-control agents.
- 1.2.9 Cell culture substrates and products.
- 1.2.10 Stem cell research.

1.3 Problems related to Animal Biotechnology:

- 1.3.1 Social, cultural, economic and legal problems.
- 1.3.2 Safety in Animal Biotechnology.

UNIT-2:

2.1 Animal tissue culture techniques:

- 2.1.1 Instruments and laboratory designing, sterilization methods, natural and artificial culture media.
- 2.1.2 Tissue culture techniques: Plasma clot, cover slip method, hanging drop method, carel flask method and raft methods, agar gel, grid method.
- 2.1.3 Monolayer and suspension cultures, immobilized cultures, organ culture, histotypic cultures and organ engineering.
- 2.1.4 Initiation and maintenance of cell cultures: cell lines generation and maintenance, Hayflick's limit, cell viability, cytotoxixity and cell growth.

2.2 Hybridoma technology:

- 2.2.1 Somatic cell fusion.
- 2.2.2 HAT selection and hybridoma technology.

2.3 Gene cloning:

- 2.3.1 Clonig techniques in animals.
- 2.3.2 Gene cloning and gene transfer technology.
- 2.3.3 Expression of induced genes.

[P. T. O.]

SECTION-2

UNIT-3:

3.1 Animal Maintenance:
- 3.1.1 Designing of animal house.
- 3.1.2 Animal care in animal house.
- 3.1.3 Animal health.

3.2 Animal Breeding:
- 3.2.1 Natural Breeding: Selective animal breeding and their potential.
- 3.2.2 Artifical Breeding: Gynogenesis, Androgenesis, ploidy induction, artificial insemination, *in utero* insemination, *in vitro* fertilization and embryo transfer.

3.3 Cryopreservation techniques:
- 3.3.1 Preservation of cell lines.
- 3.3.2 Preservation of eggs and sperms.
- 3.3.3 Preservation embryos.

UNIT-4:

4.1 Transgenic Animal Technology: Need and advantages of animal cell manipulation.

4.2 Transplantation Techniques: Selection and isolation of desired genes, nuclear transplantation, gene injection, gene testing and gene therapy.

4.3 Use of transgenic animals:
- 4.3.1 Production of transgenic animals (Fish, Pig, Mice, Sheep and Cattle).
- 4.3.2 Ethics of transgenic animals.

Reference Books:

1. Animal Cell Culture: A Practical Approach, J. R. W. Masters, Oxford.
2. Animal Cell Culture Techniques, M. Clynes, Springer Verlag.
3. Cell Culture LabFAx, M. Butler and M. Dawson, Bios scientific Publications Ltd.
4. Cell Growth and Division- A Practical Approach, R. Basega, IRL Press.
5. Culture of Animal Cells, R. I. Freshney, Wiley-Leiss.
6. Animal cell culture techniques, Ian Freshney, Wiley-Leiss.
7. Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication.
8. Cell and Tissue Culture: Laboratory Procedures in Biotechnology, A. Doyle and B Griffith, Wiley publications.
9. Basic Cell Culture Protocols, C. D. Helgason and C. L. Miller. Humana press.
10. Human Cell Culture Protocols, Joanna Picot, Humana press.

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Syllabus: Semester -VI

IBT – 602: Plant Biotechnology

SECTION-1

UNIT-1: Plant Molecular Biology:

1.1 History & Development of plant molecular biology events.
1.2 Nuclear genome & expression of nuclear genes.
1.3 Transcription and Translation, processing of RNA & post translation modification.
1.4 Levels of gene expression in plants.
1.5 Salient features of Chloroplast and Mitochondrial genome.

UNIT-2 Plant Tissue Culture- Introduction:

2.1 Significance & scope of plant tissue culture.
2.2 Differentiation & Totipotency in plants.
2.3 Nutritional Media- tissue nutrition. Conventional & liquid media.
2.4 Preparatory steps for tissue culture- selection of explants and sterilization. Problems & possible remedies.
2.5 Aseptic tissue transfer & maintenance of plants.

SECTION-2

UNIT-3 Types of Culture- Tools and Techniques:

3.1 Tissue culture of specialized plant materials (Anthers, Pollens, Protoplast, Ovary, Ovule, Embryo and Endosperm) culture.
3.2 Indirect organogenesis- Callus culture, types and morphological nature of callus. Advantages & limitations.
3.3 Micro propagation- types & methods. Direct organogenesis.
3.4 Advantages, limitations and application of micro propagation.
3.5 Factors affecting morphogenesis & clonal propagation.

UNIT-4 Commercial Applications & Plant Products:

4.1 Use of plants as energy- Bioethanol, Biohydrogen & Methane production. Potential sources of plants for energy & fuels.
4.2 Secondary metabolites & Phytopharmaceuticals from plant tissue culture.
4.3 Application of plant tissue culture techniques in agriculture, breeding and crop improvement viz. Horticulture and Floriculture.
4.4 Cryopreservation and germ plasm storage.
4.5 Production of synthetic and artificial seeds.

[P. T. O.]

Reference Books:

1. Plant Biotechnology – The Genetic manipulation of Plants by Adrain Slater, Nigel Scott and Mark Flower. Oxford University Press.
2. Medicinal Plant Biotechnology by Ciddi Veerasham. CBS Publishers.
3. Handbook of Plant Tissue Culture by A. F. Mascarenhas, ICAR, New Delhi.
4. Plant Cell & Tissue Culture by S. Narayanaswamy. Tata McGraw Hill Publishing Company Pvt. Ltd. New Delhi.
5. Methods in Plant Tissue Culture by U. Kumar. Agrobios.
6. Plant Tissue Culture – Concepts & Laboratory Ecexcises. Eidted by Trigiano & Gray. CRC Press. USA.
7. An Introduction to Plant Tissue Culture. 2nd Edition, by M. K. Razdan. Oxford & IBH Publishing Co. Pvt. Ltd.
8. Plant Cell, tissue & Organ Culture. Fundamental Methods by O. L. Gamborg and G. C. Philips. Narosa Publishing House, New Delhi.
9. Plant Tissue Culture- basic and Applied by Timir Baran Jha & Biswajit Ghosh. Universities Press Pvt. Ltd. Hyderabad.
10. Introduction to Plant Biotechnology. 2nd edition. By H. S. Chawla. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi.

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Syllabus: Semester -VI

IBT – 603: Microbial Biotechnology

SECTION-1

UNIT – 1 Introduction to Microbial Fermentation Processes:

***(Ref. Principles of fermentation technology, 2nd edition, Whitaker,* Butterworth-Heinemann, ISBN: 978-81-8147-808-5)**

***(Ref. Text book of Industrial Microbiology*, 2nd edition, Wulf Crueger and Anneliese Crueger, Panima Publishing corporation, ISBN: 81-86535-27-6)**

1.1 The Chronological Development of the Fermentation Industry.

1.2 The Range of Fermentation Processes:

- 1.2.1 Microbial biomass.
- 1.2.2 Microbial enzymes.
- 1.2.3 Microbial metabolites.
- 1.2.4 Recombinant products.
- 1.2.5 Transformation processes.

1.3 The Component parts of a Fermentation process.

1.4 Substrates for Industrial Fermentations:

- 1.4.1 Carbon sources.
- 1.4.2 Nitrogen sources.

1.5 Medium formulation and optimization.

UNIT – 2 Fermentor Design:

***(Ref. Industrial Microbiology by A. H. Patel, Macmillan India Ltd.* ISBN: 0333-90842-2)**

***(Ref. Principles of fermentation technology, 2nd edition, Whitaker,* Butterworth-Heinemann, ISBN: 978-81-8147-808-5)**

2.1 Basic functions of a fermentor.
2.2 Aseptic operation and Containment.
2.3 Factors involved in fermentor design.
2.4 Fermentor configurations:

- 2.4.1 Batch fermentor.
- 2.4.2 Continuous stirred-tank fermentor.
- 2.4.3 Tubular fermentor.
- 2.4.4 Fluidised Bed fermentor.

2.5 Principal operating characteristics of fermentors.

[P. T. O.]

SECTION-2

UNIT – 3 Isolation, Improvement and Preservation of Industrially Important Microorganisms:

***(Ref. .Principles of fermentation technology, 2nd edition, Whitaker,* Butterworth-Heinemann, ISBN: 978-81-8147-808-5)**

3.1 Isolation: Introduction
- 3.1.1 Methods utilizing selection of the desired characteristics.
  - 3.1.1.1 Enrichment liquid culture.
  - 3.1.1.2 Enrichment cultures using solidified media.
- 3.1.2 Methods not utilizing selection of the desired characteristics.
- 3.1.3 Screening Methods.

3.2 Improvement of Industrial Microorganisms:
- 3.2.1 Methods for synthesizing improved levels of primary metabolites
- 3.2.2 Methods for synthesizing improved levels of secondary metabolites.
- 3.2.3 Improvement of industrial strains by modifying properties other than the yield of product.

3.3 Preservation of Industrially Important Microorganisms:
- 3.3.1 Storage at reduced temperature.
- 3.3.2 Storage in a dehydrated form.
- 3.3.3 Quality control of preserved stock cultures.

UNIT – 4 Fermentation Processes (Overview):

***(Ref. Industrial Microbiology by A. H. Patel, Macmillan India Ltd.* ISBN: 0333-90842-2)**

4.1 Antibiotics: Penicillin and Streptomycin.
4.2 Organic acids: Citric acid and Gluconic acid.
4.3 Enzymes: Amylases and Proteases.
4.4 Solvents: Ethanol and Acetone-butanol.
4.5 Amino-acids: L-Glutamic acid and L-lysine.
4.6 Vitamins: Vitamin B12 and Vitamin C.

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IBT – 604: Environmental Biotechnology

SECTION-1

UNIT: 1. Wastewater and Biosolid Treatments:

1.1 Characteristics of sewage.
1.2 Modern waste water treatments.
1.3 Septic tank.
1.4 Land application of waste water.
1.5 Sludge processing.
1.6 Land application of biosolid.

UNIT: 2. Bioremediation:

2.1 General perspectives of bioremediation.
2.2 Microbes for bioremediation.
2.3 Bioremediation techniques.
2.4 Genetics of microbial bioremediation.
2.5 Phytoremediation of metal and organic compounds.
2.6 Biodegradation of Xenobiotic compounds.

SECTION-2

UNIT: 3. Applications of Environmental Biotechnology:

3.1 Bioleaching of metal.

3.2 Biopolymer.

3.3 Biopesticides.

3.4 Biofertilizers.

3.5 Biofuels and Biogas.

[P. T. O.]

UNIT: 4. Biodiversity and Biodiversity Conservation:

4.1 Introduction to biodiversity (National and Global):

4.1.1 Alfa and beta biodiversity

4.2 Loss of Biodiversity:

4.2.1 Global crisis.

4.2.2 Listing of threatened species.

4.2.3 Reasons for loss of biodiversity.

4.3 Biotechnology for bioconservation:

4.3.1 Methods of conservation (*in situ* and *ex situ*).

4.3.2 IPR.

4.4 Reforestation through micropropagation.

4.5 Transgenic crops, eco-social impact and environment.

Reference Books:

1. Biotechnology fundamentals and applications, S. S. Purohit, (4th Ed.), 2008, Agrobios (India), Jodhapur, India.(ISBN: 81-7754-139-0).
2. Elements of biotechnology, P. K. Gupta (1st Ed.), 2008, Rastogi Publications,Meerut, India.
3. Environmental biotechnology -Basic concepts and applications, Indu Shekhar Thakur, 2006, IK International Pvt. Ltd. New Delhi, India. (ISBN: 81-88237-52-3).
4. Environmental biotechnology- Theory and application, Gareth M. Evans and Judith C. Furlong, 2003, John Wiley & Sons Ltd, West Sussex, England. (ISBN: 0-470-84373-X).
5. Environmental Microbiology, Raina M. Maier, Ian L Pepper and Charles P. Gerba, (2nd Ed.), Academic press-Elsevier imprint. (ISBN: 987-0-12-370519-8).
6. Environmental microbiology, P. D. Sharma, 2006, Narosa Publishing House Pvt.Ltd.Delhi, India. (ISBN: 81-7319-683-4).
7. Microbial bioremediation, P Rajendran and P Gunasekaran, (2006) MJP publisher, Chennai, India.
8. Microbiology by Michael J. Pelczar, E.C.S. Chan and Noel R. Krieg (5th Ed.), 2001, Tata McGraw-Hill publishing company Limited, New Delhi, India. (ISBN: 0-07-462320-6).
9. Microbial ecology- Fundamental and application, Ronal M. Atlas and Richard Bartha, (4th Ed.), 2007, Pearson education, Delhi, India. (ISBN: 81-317-1384-9).

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Syllabus: Semester -VI

IBT – 605: Medical Biotechnology

SECTION-1

UNIT-1 Biology of Diseases:

1.1 History, Epidemiology, Pathogenesis, Life cycle, Diagnosis & Treatment of: HIV, Hepatitis, Polio, Tuberculosis, Malaria, Leishmaniasis and Reproductive tract infections.

UNIT-2 Molecular Biology of Genetic Disorders:

2.1 History, Diagnosis and Treatment of:
Huntington's Disease, Rheumatoid Disease, Alzheimer's Disease, Parkinson's Disease and Duschine Muscular Dystrophy.

2.2 Cancer and Oncogenetics.

SECTION-2

UNIT-3 Molecular Characterizations and Diagnosis:

3.1 New targets and novel drug delivery systems related to viral, bacterial and parasitic infections.

3.2 Products from non-recombinant organisms and recombinant organisms

3.2.1 Interferons.
3.2.2 Growth factors.
3.2.3 Monoclonal antibodies.
3.2.4 Antisense nucleotides as therapeutic agents.

UNIT-4 Molecular biological techniques for rapid diagnosis of genetic diseases and gene therapy:

4.1 Gene Therapy:

4.1.2 Types of Gene therapy.
4.1.3 Augmentation therapy.
4.1.4 Targeted gene transfer.

4.2 Gene Fishing.

4.3 FISH cytogenetics.

4.4 PCR in Genetic disease diagnosis.

[P. T. O]

Reference Books:

1. Medical Biotechnology; Albert Sasson (2006), United Nations Publications.
2. Medical Biotechnology; S. N. Jogdand (2000), Himalaya publication.
3. Medical Devices and Systems in Biomedical Engineering Handbook, Vol 2; Joseph Bronzino.
4. The Proteus effect, Ann B. Parson (2006); National Academic Press.
5. Biotechnology and Biopharmaceuticals (2003). Rondey J. Y. Ho and Milo Gilbaldi, John Wiley & Sons.
6. Stem Cell Now: Christropher Thomas Scott (2005) penguin group (USA).
7. Biotechnology, Sharon Walker (2006) McGrow Hill Publication.
8. Surgical anatomy and physiology for the surgical technologist, Kevin B Frey & Paul Price (2006).

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

Syllabus: Semester -V

PRACTICALS
IBT – 606

Plant and Animal Biotechnology

Plant Biotechnology:

1. Media preparation: MS and Gamborg B5 media
    a. Stock solution preparation.
    b. Media for callus induction.
    c. Shoot induction.
    d. Root induction.
2. Sterilization of explants and demonstration of axenic condition.
3. Induction of callus from different explants (Shoot tip, Leaf, Axillary bud and Internodes).
4. Identification of morphological nature of callus cells.
5. Sub-culturing of Callus and explants on the ready made media for shooting and adventitious shoots.
6. Isolation of Mesophyll cells by mechanical and enzymatic method.
7. Isolation of genomic DNA by CTAB method.
8. Single cell culture- vital staining and viability counting.
9. Demonstration of encapsulation of somatic embryos.

Animal Biotechnology:

1. To isolate liver parenchyma cells and perform viability count.
2. To detect estrus cycles in mice or rat.
3. To study SCE assay and calculate RI.
4. To study COMET assay.
5. To study G2 assay.
6. To study Cytokinesis Blocked Micronucleus (CBMN) assay.
7. To study micronuclei from exfoliated epithelial cells.
8. To prepare karyotypes from *in vitro* induced aberrant human metaphases.

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Syllabus: Semester -V

PRACTICALS
IBT – 607

Microbial Biotechnology

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1. Isolation and screening of antibiotic producing microorganisms:
   (a) Crowded Plate Technique.
   (b) Wilkin's Technique.

2. Isolation and screening of organic acid producing microorganisms.

3. Isolation and screening of Extracellular enzyme producing microorganisms:
   (a) Amylase producer.
   (b) Protease producer.
   (c) Cellulase producer.
   (d) Lipase producer.

4. Estimation of Ethanol.

5. Estimation of Citric acid.

6. Estimation of antibiotic Penicillin and Streptomycin.

7. Fermentation of Ethanol using ***Saccharomyces cerevisiae***.

8. Fermentation of Amylase using ***Bacillus subtilis***.

9. Fermentation of Citric acid by ***Aspergillus niger***.

10. Laboratory scale Bioreactor operation (Demonstration).

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