VIVEKANANDHA

COLLEGE OF ARTS AND SCIENCES FOR WOMEN [AUTONOMOUS]

An ISO 9001:2008 Certified Institution,
Affiliated to Periyar University, Salem,
(Approved by AICTE and Re-Accredited with 'A' Grade by NAAC,
Recognized Under 2(f) and 12(b) of UGC Act, 1956).
Elayampalayam, Tiruchengode - 637 205, Namakkal Dt., Tamilnadu, INDIA.

DEPARTMENT OF BIOTECHNOLOGY
MASTER IN SCIENCE (M.Sc.)

M. Sc., BIOTECHNOLOGY
REGULATIONS AND SYLLABUS

[FOR CANDIDATES ADMITTED FROM 2017-18 ONWARDS UNDER AUTONOMOUS & CBCS PATTERN]

SPONSORED BY
ANGAMMAL EDUCATIONAL TRUST
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VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN
(AUTONOMOUS)
SYLLABUS FRAME WORK (M.Sc.)

Paper Code	Papers	Paper Title	Inst. Hour/Week	Credit	Exam Hours	Internal	External	Total Marks
YEAR I		**Semester I**						
17P1BT01	Core I	Cell and Molecular Biology	5	5	3	25	75	100
17P1BT02	Core II	Biochemistry and Biophysics	5	5	3	25	75	100
17P1BTE01	Elective I	Microbiology	4	4	3	25	75	100
17P1BTP01	Core I Practical	Lab in Cell and Molecular Biology	5	4	6	40	60	100
17P1BTP02	Core II Practical	Lab in Biochemistry and Biophysics	5	4	6	40	60	100
17P1BTEP01	Elective I Practical	Lab in Microbiology	5	3	6	40	60	100
	Library		1	0	0	0	0	0
Total			**30**	**25**	27	**195**	**405**	**600**
YEAR I		**Semester II**						
17P2BT03	Core III	Immunology and Immunotechnology	5	5	3	25	75	100
17P2BT04	Core IV	Genetic Engineering	5	4	6	40	60	100
17P2BTE02	Elective II	Bioprocess and Microbial Technology	4	4	3	25	75	100
17P2BTP03	Core III Practical	Lab in Immunology and Immunotechnology	5	5	3	25	75	100
17P2BTP04	Core IV Practical	Lab in Genetic Engineering	5	4	6	40	60	100
17P2BTEP02	Elective II Practical	Lab in Bioprocess and Microbial Technology	5	3	6	40	60	100
	Library		1	0	3	25	60	100
		Total	**30**	**25**	27	**195**	**405**	**600**
I YEAR TOTAL				**50**	**54**	**390**	**810**	**1200**

Paper Code	Papers		Inst. Hour/Week	Credit	Exam Hours	Internal	External	Total Marks
YEAR II		**Semester III**						
17P3BT05	Core V	Plant and Animal Biotechnology	5	5	3	25	75	100
17P3BT06	Core VI	Environmental Biotechnology	5	5	3	25	75	100
17P3BTP03	Elective IV	Genomics and proteomics	4	4	3	25	75	100
17P3BTP05	Core V Practical	Lab in Plant and Animal Biotechnology	5	4	6	40	60	100
17P3BTP06	Core VI Practical	Lab in Environmental Biotechnology	5	4	6	40	60	100
17P3BTEP03	Elective IV Practical	Lab in Genomics and proteomics	5	3	6	40	60	100
17P3BTV01	Value Education (HR)	Human Rights	1	1	3	25	60	100
Total			**30**	**25**	27	**195**	**405**	**600**
YEAR II		**Semester IV**						
17P4MBED1	EDC	Plant and Animal Cell Culture Techniques	2	2	3	25	75	100
17P4BTE04	Elective III	Research Methodology and Bioinformatics	4	4	3	25	75	100
17P4BTEP04	Elective III Practical	Lab in Research Methodology and Bioinformatics	5	3	6	40	60	100
17P4BTPR01	Project work	Project &Viva voce	19	5	6	40	60	100
Total			**30**	**14**	18	**130**	**270**	**400**
II YEAR TOTAL				**90**	**102**	**740**	**1545**	**2300**

YEAR I – SEMESTER I
CELL & MOLECULAR BIOLOGY

Paper	: Core I	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 17P1BT01	External	: 75

Subject description

This paper provides a thorough knowledge about structure and function of cells at molecular level like, cellular energetic, protein trafficking, bio molecules and cellular development.

Goal

Goal of the present paper is to impart students with knowledge pursue careers in cellular and sub cellular biological research, biomedical research, medicine, allied health fields, et.

Objective

- To teach students on cell structure and its general function
- To teach nucleic acids and their function
- To teach transcription and translation
- To teach process of mutation
- To teach cell signaling and oncobiology

UNIT	CONTENT	HOURS
I	**Cell:** Cell theory - Ultra structure of prokaryotic and eukaryotic cells. cellular organelles – structure and functions of cell wall, Plasma membrane, Mitochondria, Chloroplast, Endoplasmic reticulum, Ribosomes, Golgi complex, Vacuoles, Peroxysomes, Lysosome, Nucleus, Chromosomes and their organization.	**15**
II	**Introduction to Nucleic acid:** Types and their structure – DNA and RNA as genetic material – Evidences. DNA Replication in Prokaryotes and Eukaryotes: Mechanism – Replication of RNA genome, Replicase and reverse transcriptase. DNA repair mechanisms- direct reversal; Excision repair (base excision, nucleotide excision and mismatch); re-combinational repair; SOS response and SOS bypass.	**15**
III	**Transcription and translation:** Transcription: initiation, elongation and termination (rho-	**15**

	dependent and independent) of RNA synthesis; eukaryotic promoters, enhancers, transcription factors, RNA polymerases; various protein motifs involved in DNA-protein interactions during transcription. Translation: Prokaryotes and eukaryotes translation and their regulation, processing of mRNA for translation (e.g. 5' capping and splicing) and involvement of different translational factors at different stages of the process. Regulation of gene expression (Lac and Trp operons)	
IV	**Mutation:** Gene Mutation and its mechanism ; Types of mutation: Forward; Reverse; Intragenic suppressor; Extragenic suppressor; point mutations; Missense; Nonsense; mutation. Mutagenesis- spontaneous and induced. **Cell cycle:** Cell division (Mitosis and Meiosis), Apoptosis and its significance, cell differentiation.	**15**
V	**Cell signaling:** Signal Transduction. Role of CAM, Calmodulin as the second messenger. **OncoBiology:** Induction of Cancer: characteristics & causes, oncogenes and tumour suppressor genes. Recombination - Models; Rec A, RecBCD, Ruv ABC, and molecular mechanism of recombination. Transposons - simple and complex in prokaryotic and eukaryotic systems.	**15**

REFERENCE

Text Books

1. Ajay, P. (2007). Text Book of Cell and Molecular Biology. 2nd edition. Books and Allied (P) Ltd.

Reference

2. Bruce, A. Alexander, J. Julian, L. Martin, R. Keith, R. and Peter, W. (2002). Molecular Biology of the Cell. 4th edition. New York: Garland Science.
3. Darnell, J. Lodish, H. and Baltimore, D. (1990). Molecular Cell Biology. 2nd edition, Scientific American Books Inc.
4. David, A. D. Harvey, A. M. and James, W. Plant Mitochondria.
5. Gardener, E.J. Simmons, M.J.and Snustad, D.P. (2006). Principles of Genetics. 8th edition, John Wiley and Sons Publications.
6. Hancock, J.T. (2008). Molecular Genetics. Viva Books Pvt. Ltd.
7. Karp, G. 2008.Cell and Molecular Biology. 5th edition, John Wiley and Sons Inc. Hardcover, ISBN:978-0-470-04217-5.

8. Lodhish, H. (1995). Molecular cell Biology. WH Freeman and Co., New York.
9. Malacinski, G.M. and Freifelder, D. (1998). Essentials of Molecular Biology. 3rd edition, Jones and B. Artlet Publisher Inc., London.
10. Peter, J. R. (2006). Fundamentals of Genetics.
11. Pragya, K. Cell and Molecular Biology.
12. Roberties, E.D.P. and Roberties, E.M.F. (1998). Cell Biology and Molecular Biology. K. M. Verghese and Company.
13. Tamarin, R.H. (2004). Genome to function - Principles of Genetics. Tata McGraw-Hill Publishing Comp. Ltd.
14. Verma, P.S. and Agarwal, V.S. (1986). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand and Company, New Delhi.
15. Watson, J.D.T.A. Baker, S.P. Bell, A. Gann, M. and Levine, R.L. (2004). Molecular Biology of the Gene. 5th edition. Pearson Education Inc.

Publications

1. Gupta, P.K. (2004). Biotechnology and Genomics. Rastogi Publications.
2. Malacinski, G.M. (2002). Essentials of Molecular Biology. Jones and Barlett Publishers.

YEAR I – SEMESTER I
LAB IN CELL & MOLECULAR BIOLOGY

Paper	: Core Practical I	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 4	Internal	: 40
Paper Code	: 17P1BTP01	External	: 60

Subject description

This lab provides hands on skill in handling cell and its molecules to study their function and also their aberrations. Further the lab work also provides skill in estimating their biochemical compounds in knowing their normal and abnormal function.

Goal

Goal of the present lab is to convert the knowledge acquired through core paper 1 cell and molecular biology into skill.

Objective

- Impart skill in isolating and differentiating cell and its components
- Impart skill isolating and analyzing their bio molecule
- Imparting skill in improving the bio molecules
- Impart skill in identifying normal and abnormal cell multiplication
- Impart skill in estimating the cell health in normal and abnormal conditions

Experiment	**CONTENT**	**HOURS**
1	Introduction to principles of sterile techniques and cell propagation.	**5**
2	Principles of microscopy Preparation of Buccal Smear squash. Observation of specialized cells	**5**
3	Identification of given plant, animal and bacterial cells and their components by Microscopy	**5**
4	Isolation of Quantification Genomic DNA (Bacteria, Plant and Animal) Seperation of RNA and DNA (Bacteria, Plant and Animal) through Gel Doc (Agarose gel electrophoresis)	**10**
5	Separation of Protein by SDS-PAGE	**5**
6	Competent cells preparation.	**10**

	Transformation and screening for recombinants. Blue and white selection for recombinants.	
7	Induced Mutagenesis (UV & NTG). Detection of mutants by replica plate technique	**10**
8	Demonstration of various stages of mitosis using onion root tip	**5**
9	Demonstration of various stages of meiosis using grasshopper testis squash	**5**
10	Investigation of viability of cells and mechanism of cell death	**5**
11	Determination of Free radical scavenging activity by DPPH assay.	**5**
12	Checking the cell viability by MTT assay	**5**

REFERENCE

1. Janarthanan, S and Vincent, S. (2007). Practical Biotechnology: Methods and Protocols.
2. Jayaraman, J. (2007). Practical Biochemistry.
3. Palanivelu, P. (2001). Analytical biochemistry and separation techniques- A Laboratory Manual, 2nd edition. Tulsi book centre publication, Madurai, Tamilnadu.
4. Sambrook, J. Fritsch, E.F. Maniatis, T. (1989). Molecular cloning: a laboratory manual.
5. Sadasivam., et al. (1991). Practical Biochemistry.
6. Wilson, K. and Walker, J. (2003). Practical Biochemistry- Principles and Techniques. 5th edition, Cambridge University Press.

YEAR I – SEMESTER I
BIOCHEMISTRY, BIOPHYSICS AND BIOINSTRUMENTATION

Paper	: Core II	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 17P1BT02	External	: 75

Subject Describtion

This paper provides information about structure and functions of cellular components such as proteins, carbohydrates, lipid, nucleic acids and other biomolecules along with techniques of physical science to study biological systems.

Goal

On successful completion of this paper a student will acquired knowledge in structure and function of living things at the molecular level and provides career opportunity in many jobs.

Objective

- Reviewing the structure and classification of Carbohydrates and proteins
- Highlighting biosynthesis and metabolism of lipids and vitamins
- Explaining enzyme kinetics and nucleic acid metabolism.
- Imparting the importance of electrophoresis and centrifugation
- providing the basic principles of various spectroscopy and chromatography

UNIT	CONTENT	HOURS
I	**Carbohydrates and Proteins:** Definition and classification of carbohydrates. Concepts of isomerism and epimers. Mono, Di and Polysaccharides. Clinical significance of carbohydrate deficiencies. Carbohydrate metabolism-Glycolysis, Gluconeogenesis, Glycogenesis, Glycogenolysis, HMP shunt, TCA cycle. Definition, classification, structure and functions of aminoacids and proteins. Protein architecture. Clinical significance of proteins deficiencies. Amino acid metabolism: Transamination and deamination reactions. Urea cycle and its clinical significance.	**15**
II	**Lipids and Vitamins:** Definition, structure, functions and reactions of lipids. Fatty acids (saturated and unsaturated - Essential and non-essential). Sterols and its significance. Clinical significance of lipid deficiencies. Lipid metabolism: Biosynthesis of saturated and unsaturated fatty	**15**

	acids, sterols and phospholipids. Beta-oxidation of fatty acids. Definition, structure, classification and functions of fat and water soluble vitamins. Clinical significance of vitamin deficiencies-Hypervitaminosis	
III	**Enzymes and Nucleic Acids:** Definition, classification, properties of enzymes. Mechanism of enzyme action (Lock & Key model, induced fit hypothesis). Enzyme kinetics: MM equation and LB plot) and enzyme inhibition (Reversible & Irreversible). Coenzymes (FAD & NAD) and Isoenzymes (LDH & ALP). Chemical structure, composition and functions of DNA and RNA. Biological types of nucleic acids. Nucleic acid metabolism: Biosynthesis of purines and pyrimidines - Denovo and salvage pathways. Degradation purines and pyrimidines.	**15**
IV	**Biophysics:** Introduction and scope of biophysics. Nucleic acid and protein structural studies: Transition angle of nucleic acids, sugar puckering model and pseudorotation cycle. Syn-anti orientation of glycosyl bond. Geometry of Watson – Crick and Hoogsteen base pairs. Amino acid confirmations (Phi & Psi angles), Ramachandran plot. **Electrophoresis and Centrifugation:** Principles and applications of Moving boundary, zone, Low and high voltage electrophoresis, gel electrophoresis, SDS-PAGE, isoelectric focusing and continuous flow electrophoresis. Principles and types of centrifugation (Differential, rate-zonal and isopycnic).	**15**
V	**Spectroscopy and Chromatography:** Basic principles of spectroscopy. Laws of absorption. Instrumentation, applications, advantages and disadvantages of UV-VIS, IR, Raman, FTIR, NMR and AAS, Fluorescence spectroscopy. Principle and applications of paper, thin layer, column, GC, HPLC and ion-exchange and size exclusion chromatographic techniques. Potentiometry	**15**

REFERENCES:

Text Books

1. Lehninger, A.L, Nelson,D.L and Cox, M.M. Principles of Biochemistry. (2002). CBS Publishers
2. Sathyanarayana U. Biochemistry. (2005). Books and Allied (P) Ltd.

3. Palanivelu P. (2001). Analytical Biochemistry and separation techniques. Tulsi Book Centre, Madurai, Tamil nadu.

Reference Books

1. Lehninger, A.L, Nelson,D.L and Cox, M.M. Principles of Biochemistry. (2002). CBS Publishers.
2. Voet D. and Voet J. G. Biochemistry. John Wiley and Sons.
3. Biochemical Calculations, Irwin H.Segal, John Wiley and Sons Inc.
4. RAo CNR. (1999). Understanding Chemistry, CNR Rao, Universities Press, Hyderabad.
5. Wilson K. and Goulding KH. (1986). A Biologist's Guide to principles and techniques of practical Biochemistry. ELBS Edition.
6. Stryer L. Biochemistry. (2002). 5th edition. W.H.Freeman and co.
7. Jain JL. (1999). Fundamentals of Biochemistry. S.Chand company pvt Ltd.
8. Cantor and Schinmel. (2002). Biophysical chemistry.
9. Upadyay Nath U. (1997). Biophysical chemistry-principles and techniques.
10. Arora. Biophysics. 1st edition, Himalaya Publications, New Delhi.
11. Vasantha Pattabhi and Gautham N. Biophysics. Narosha publishing house, Chennai. E-Book ISBN: 0-306-47520-0.
12. Roland Glazer. (2001). Biophysics 4th edition. Humboldt University of Berlin. Germany.
13. Oren M. Becker, Alexander D. MacKerell, Jr. Benoi t Roux. Masakatsu Watanabe. (2001). Computational Biochemistry and biophysics. 1st edition. Harvard University, Cambridge. UK.

YEAR I – SEMESTER I
LAB IN BIOCHEMISTRY AND BIOPHYSICS

Paper	: Core Practical II	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 4	Internal	: 40
Paper Code	: 17P1BTP02	External	: 60

Subject Description

This practical paper imparting the hands on experience in analysis of various biomolecules and handling of analytical techniques.

Goal

This paper will foster the real experience in analytical techniques.

Objective

- Imparting qualitative analysis of carbohydrates and amino acids.
- Reviewing estimation of DNA, RNA and protein
- Performing chromatography (TLC and Paper).
- Performing plant pigment separation by column chromatography.
- Imparting SDS-PAGE of protein separation.

Experiment No	Content	Hours
1.	Qualitative analysis of carbohydrates (glucose, fructose, lactose, maltose, sucrose & starch).	5
2.	Qualitative analysis of amino acids (histidine, tyrosine, tryptophan, methionine, arginine).	5
3.	Estimation of glucose by Anthrone method.	5
4.	Estimation of protein by Lowry's method.	5
5.	Estimation of DNA by diphenylamine method	5
6.	Estimation of RNA by Orcinol method	5
7.	Qualitative analysis saturated and unsaturated fattyacids	5
8.	Solid liquid separation – centrifugation	5
9.	Precision and validity in an experiment using absorption spectroscopy and Validating Lambert-Beer's law using KMn O_4	5
10.	Separation of amino-acids by paper and thin layer chromatography.	5
11.	Separation of plant pigments by column chromatography.	5
12.	Calibration of pH meter & conductivity meter	5

REFERENCE

1. Palanivelu P. (2001). Analytical Biochemistry and separation techniques. Tulsi Book Centre, Madurai, Tamil nadu.
2. Sadhasivam S and Manickam A. (2005). Biochemical methods. 2nd edition. New age International Publishers. New Delhi.
3. Jayaraman J. Laboratory manual in Biochemistry

YEAR I – SEMESTER I
MICROBIOLOGY

Paper	: Elective I	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 17P1BTE01	External	: 75

Subject description

This course deals with the basic Principles underlying Microbiology its scope, the tools and techniques for better understanding and its interdisciplinary nature

Goals

To enable the students to understand the basic concepts of Microbiology

Objectives

* To gain the Knowledge on
* Microscopic technique
* Classification of micro organism
* Culture Process
* Pathogenic organism & symptoms
* Resolution of biogeocycles

UNIT	CONTENT	HOURS
I	**Introduction to Microbiology:** Scope, history of microbiology, Applications. Microscopy: Light Microscope – Bright- field, Dark field, phase contrast, fluorescent. Electron Microscope: TEM and SEM. Staining – simple, Differential stain: Gram's, Acid fast. Special stain – capsule, spore. Fungal stain-KOH, LCB, Hanging drop technique.	**15**
II	**Classification of microorganisms:** Actinomycetes; Fungi, Protozoa & Virus. Bacterial Anatomy-Structure and functions of bacterial cell. Haeckels, Whittaker's, Bergey's system (Prokaryotes) Carl Weese classification, General features and classification of Rickettsiae, Mycoplasma, Archaebacteria, and Prochlorates	**15**
III	**Microbial culture Techniques:** Isolation & maintenance of purecultures. Cultivation of bacteria-aerobes & anaerobes, Culture media-Preparation & Types. Identification of Bacteria-culture characteristics. Microbial growth-Growth curve & Measurement of growth, Nutritional types of microorganism. sterilization & disinfection.	**15**
IV	**Microorganisms and Disease:** Normal microflora, Host Microbe interaction, Immunity-Types.	**15**

	Bacterial diseases (Tuberculosis, Cholera, Typhoid), Viral diseases HIV/ AIDS, Dengue fever, Hepatitis, Protozoan –*Entamoeba histolytica*, Malaria, Fungal-Dermatophytosis, Candidiasis, Collection and examination of Microbiological specimens.	
V	**Microbial Ecology:** Biogeochemical cycles – Carbon, Nitrogen, Phosphorous and Sulphur. Nitrogen fixation. Microflora of soil-Enumeration of bacteria from soil. Microbial decomposition of organic matter. Microbial interaction-Morphology of water-Microbial analysis of Water-Purification &disinfection of watt. Microbiology of Air-Enumeration of bacteria in Air-Air sampling methods-Air sanitation.	**15**

REFERENCE

Text Books

1. Ananthanarayan, R and Jayaram Paniker, C.K. (2000). Text book of Microbiology. 6th edition, Orient Longman Limited, Chennai.
2. Dubey, R.C and Maheswari, D.K. A Text book of Microbiology. S.Chand Publications, New Delhi.2010.
3. Larry, M. and Judy, K. (1996). Microbiology: Essential and Applications. 2nd edition, McGraw Hill Inc.
4. Prescott, Harley, Klein. (1999). Microbiology. 6th edition. McGraw Hill Inc.
5. Roger, Y. Stanier. J. Ingraham, Mark. I. Wheelis, I. and Page R. P. (1986). Microbiology. 5th edition, Macmillion Press Ltd, Hampshire.
6. Michael, J. Pelczar, J.R. Chan, E.C.S. and Noel, R.Krieg. Microbiology,5th edition TATA McGraw-Hill publication.1993
7. Environmental aspects of Microbiology-Joseph.C.Daniel,Brightsun publications

Publications

1. Jacquelyn, G.B. (2008). Microbiology- Principles and explorations. John Wiley and sons Ltd.

YEAR I – SEMESTER I
LAB IN MICROBIOLOGY

Paper	: Elective Practical I	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 4	Internal	: 40
Paper Code	: 17P1BTEP01	External	: 60

Subject Description

This course deals with the Basic laboratory techniques and skill in Microbiology, for isolation, identification and characterization of microorganisms.

Goal

To learn the various techniques in microbiology

Objectives

After the successful completion of the course the students will be aware of handling of microorganisms and production of enzymes antibiotics etc.

Experiment	CONTENT	HOURS
1	Introduction to Principle of Sterilization Techniques and cell preparation.Biosafety measures GLPs &SoPs	**5**
2	Media Preparation-Liquid media, Solid media, Agar slants, Agar tubes, Agar Plates. Basal, Enriched & selective media Preparation	**10**
3	Staining techniques-Smear Preparation Simple, Grams, Acid fast bacilli, Fungal staining-KOH & LCB	**10**
4	Hanging drop techniques-Determination of Motility	**5**
5	Pure culture techniques-Streak plate, Pour plate, Spread Plate &Serial dilution methods	**10**
6	Biochemical tests-IMViC, TSI, Catalase, Oxidase & Urease	**5**
7	Antibiotic Sensitivity test-Kirby Bauer Method	**5**
8	Enumeration of microbes from air by settle Plate Method	**5**
9	Enumeration of bacteria from Soil.	**10**
10	Examination of Water-MPN	**10**

REFERENCE

1. Aneja, K.R. (2009). Experiments in Microbiology.
2. Dubey, R.C. and Maheswari, D.K. (2005). A Text book of Microbiology. S.Chand and Company Ltd., New Delhi.
3. James, G. Cappuccino. and Natalie, S. (2004). Microbiology: A laboratory Manual.
4. Kannan, N. (2000). Microbiology manual. Palani Paramount Publ.

5. Pelczar, M.J. Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. MC Graw-Hill Inc., New York.
6. Prescott, L.M. Harley, J.P. and Klein, D.A. (1993). Microbiology. 2nd edition, WM, C Brown Publishers.

YEAR I – SEMESTER II

IMMUNOLOGY & IMMUNOTECHNOLOGY

Paper	: Core III	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 17P2BT03	External	: 75

Subject Description

This course presents the defense system of the higher vertebrates against invading pathogen.

Goal

To provide a fundamental knowledge on principle and concepts in immunology.

Objectives

To enable the students to understand the basic concepts of immunology and molecular mechanism behind immunological reactions that enables them to apply them to develop methods for diagnostic assays, treatment strategies, vaccine production, therapeutical drugs and Monoclonal antibody production.

UNIT	CONTENT	HOURS
I	**History and scope of immunology**; Infection &Immunity – types- Active and passive immunity, mechanisms, Haematopoiesis and cells of immune system. Organs of immune system – Primary and secondary lymphoid organs – structure and functions	10
II	**Antigen – Properties and classes**; Haptens, Mitogens, adjuvants, epitopes. Immunoglobulin – Basic structure, classes, function, molecular diversity of immunoglobulins. Immune responses – Humoral & Cell mediated immune responses.& antigen recognition. Generation of lymphocyte specificity and clonal selection of lymphocytes. MHC – General organization and its role in antigen processing and presentation	15
III	**Antigen- antibody interactions** – Principle and applications of Precipitation & Agglutination reactions; Complement – components, properties and activation of pathways (Classical, alternative	15

	and lectin); Cytokines- properties, structure and function.	
IV	**Hypersensitivity reactions** – Types and mechanisms; Transplantation immunology; Immunosuppresive therapy; Immunological tolerance and Autoimmune diseases; Immunodeficiency diseases.	**10**
V	**Isolation & Culture-** Isolation & Culture of macrophages and Immunoscreening of recombinant libraries. Detection of immune complex in tissues; FACs; Hybridoma technology and monoclonal antibody production; Immunization schedule and recent strategies in vaccine production; Molecular aspects of HLA typing.	**10**

Text books

- Kuby J (2000) Immunology 4 th Edition. WH Freeman & Co. New York.
- Tizard IR (1995). Immunology 4th Edition. Saunders College Publishing Harcourt. Brace College Publishers.

Reference books

- Goldsby RA, Kindt TJ. Osborne BA, Kuby J (2003) Immunology 6th Edition. WH Freeman & Co. New York.
- Kuby J (2000) Immunology 4 th Edition. WH Freeman & Co. New York.
- Benjamini E, Coico R and Sunshine G (2000). Immunology 4th Edition. A John Wiley & Sons, Inc. Publications.
- Roitt I, Brostoff J and Male D (1993). Immunology 3 rd Edition. Mosby
- J. Darnell, H. Lodish and D. Baltimore (1994). Molecular Biology 2nd Edition. Scientific American Book, USA

YEAR I – SEMESTER II
LAB IN IMMUNOLOGY AND IMMUNOTECHNOLOGY

Paper	: Core Practical III	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 4	Internal	: 40
Paper Code	: 17P2BTP03	External	: 60

Experiment No	Content	Hours
1	Study on blood cells	5
	a) Identification of blood cells	
	b) Identification of lymphocytes by rosette assay	
	c) Nitroblue tetrazolium (NBT) reduction by neutrophiles	
2	Preparation of specimen for immunology	5
	a) Preparation of serum	
	b) Preparation of plasma	
	c) Preparation of blood antigens	
3	Agglutination teast	5
	a) ABO blood grouping	
	b) Widal test for typhoid fever (qualitative and quantitative test)	
	c) Haemagglutination test	
4	Passive agglutination test	5
	a) Anti- streptolysin (ASO) test	
	b) C- reactive protein (CRP) test	
	c) Rhematoid arthritis (RA) test	
5	Agglutination inhibition test	5
	a) Pregnancy test – Detection on HCG	
6	Flocculation test	5
	a) Rapid PlasmaReagin test (RPR)	
7	Precipitation test	5
	a) Ouchterlony double immunodiffusion technique (ODD)	
	b) Counter current immunoelectrophoresis(CIE)	
	c) Immuno Electrophoresis (IE)	
	d) Radial Immuno diffusion (RID)	
	e) Rocket Immuno Electrophoresis (RIE)	
8	Animal handling in Immunology and immunotechnology (Demonstration)	10
	a) Inoculation routes in Laboratory animals	
	b) Raising of antiserum in laboratory animals	
9	Antibody purification by column	10

	chromatography (DEMO)	
10	ELISA	10
11	Western Blotting	10

Text Manual

1. G. P. Talwar and S. K. Gupta, 2006, Hand Book of Practical and Clinical Immunology. CBS Publishers

REFERENCE

1 Arti Nigam, 2007, Lab Manual in Biochemistry, Immunology and Biotechnology. Tata Mc Graw Hill.

YEAR I – SEMESTER II
GENETIC ENGINEERING

Paper	: Core IV	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 17P2BT04	External	: 75

AIM:

This paper enables the student to understand the recombinant DNA Teachnology and importance of Bioethics and IPR in Bioresearch

Objectives:

1. Impart knowledge of Genetic Engineering
2. To impart knowledge on different types of products produced by recombinant DNA Teachnology
3. To impart the importanceof research in genetic engineering

UNIT	CONTENT	HOURS
I	Role of genes within cells - genetic elements that control gene expression in prokaryotes and eukaryotes – Repressors and Promoters – Methods of creating recombinant molecules - Restriction and modifying enzymes - safety guidelines ofrecombinant DNA research.	15
II	Restriction mapping, design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryoticexpression vectors. Insect, Yeast and Mammalian vectors.	15
III	Cloning strategies and DNA libraries, cDNA libraries, cDNA cloning & Screening of libraries and recombinant clone selection, Gene transfer to Bacterial, animal and plant cells, Stability of transgene, inheritance, patterns of integration, Advances and applications of Transgenic and Recombinant DNA Technology.	15

IV	Principles of Blotting & Amplification techniques, Gene expression analysis & Polymerase Chain Reaction (PCR)-Types, Micro Array and Analysis, Gene Chip, Labeling & Hybridization, Basic DNA Sequencing, Whole genome sequencing, Shotgun sequencing	15
V	Applications of recombinant technology in agriculture, pharmaceutical industry and medicine – knockout animals, Productionof novel products, Antisense technology - Transgenic animals – embryo transfer.	15

References

1. Principles of Gene manipulation by R.N. Old and S.B. Primrose (2001)Blackwell Scientific publications.
2. Recombinant DNA by Watson et al., (1992) Scientific American books.
3. Lambda II by Hendrix et al., (1983) Cold spring Harbor Laboratory.
4. The Bacteriophages Vol. II by R. Calendar (1988) Plenum Press.
5. Escherichia Coli and Salmonella by Neidhardt et.al ASM Press 1996.
6. Genetic engineering Vol 1 – 4 by Williamson (Ed).
7. Genetic engineering Vol 1 – 7 by Setlow and Hollandor (Ed).
8. Recombinant DNA safety guidelines & regulation, Department of Biotechnology, Ministry of Sciences & Technology, Government of India.
9. IPR, Biosafety and Bioethics - By Deepa Goel, Shomini Parashar

STUDENT LEARNING OUTCOMES:

1. The students will be able to know the role of genes and its expression
2. The students will be able to know the genes and genome mapping and its importance
3. The students will be able to do modify the genome in living things
4. The students will be able to know the importance of bioethics and IPR

YEAR I – SEMESTER II			
LAB IN GENETIC ENGINEERING			
Paper	: Core Practical IV	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 4	Internal	: 40
Paper Code	: 17P2BTP04	External	: 60

Experiment No.	**Content**	**Hours**
1.	Isolation of DNA, RNA and Plasmids	
2.	Separation and Characterization of protein by SDS PAGE	
3.	Western Blotting	
4.	Designing cloning strategies	
5.	Cloning using restriction enzymes	
6.	Cloning of PCR products	
7.	Cloning in expression vector	
8.	Induction of expression of recombinant protein	
9.	Purification of recombinant proteins using His Tag	
10.	Automated DNA sequencing (demonstration)	

REFERENCES

1. Primrose.S.B and Twyman.R.M, "Principles of Gene Manipulation and Genomics", Blackwell Publishing Company, Oxford, UK Third Edition (2006).
2. Brown.T.A and Gene Cloning "DNA Analysis: An Introduction", Wiley-Blackwell, UK. Fifth Edition (2006).
3. Innis.M, White.T and Sninsky.J.J, PCR Protocols: A Guide to "Methods and Applications", Academic Press First Edition (1990).
4. Ying.S, Generation of cDNA Libraries: "Methods and Protocols", Humana Press First Edition (2003).

MANUALS

1. Sambrook, and Russel D.W, "Molecular Cloning. A Laboratory Manual", Cold Spring Harbor Laboratory Press, New York, USA. Volume 1-3. Third Edition(2001).
2. 2 Ausubel.F.M, Brent.R, Kingston.R.E and Moore.D.D, "Current Protocols in Molecular Biology", John Wiley & Sons, Inc., Brooklyn, New York., First Edition (1987).

YEAR I – SEMESTER II

BIOPROCESS & MICROBIAL TECHNOLOGY

Paper	: Elective II	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 17P2BTE02	External	: 75

Subject description

The Bioprocess Technology is designed to prepare individuals to work as Process Operators in biological products manufacturing facilities. Students will combine basic science and communication skills, manufacturing technologies, and good manufacturing practices in the course of study. The Microbial technology presents the principles and applications of microorganism for the production of useful biological materials.

Goal

Upon successful completion of the program, individuals should posses the necessary skills to qualify for employment in a variety of Bioprocessing industries. To learn various microbial Biotechnology applications

Objectives

- To teach the students about introduction to fermentation process
- Impart skill in formulating the nutrients for growth of microbes
- Impart skill about downstream processing
- Impart skill about production of industrially important microorganisms for beneficiary products
- Impart skill in the production of aminoacids, organic solvents and vitamins.

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UNIT	CONTENT	HOURS
I	**An introduction to fermentation process**. Isolation of industrial important micro organisms- direct isolation method, enrichment culture method-general and special enrichment system. Screening of industrial important microorganisms-primary screening, secondary screening, Strain improvement-physical, chemical, biological method. Immobilization techniques-cell and enzyme.	**15**
II	**Media formulation**- nutritional requirement of microorganisms, Types of fermentation – Batch, Fed batch and Continuous. Sterilization of fermentation media - Batch and Continuous. Inocula development-criteria, development of abiotic component for bacterial	**15**

	process. Types and Designing of fermentor and Scale-up, Instrumentation for Monitoring and Controlling Bioreactors-Computer aided control and Monitoring, Photo bioreactors.	
III	**Downstream Processing** – Disruption of Microbial Cells, Centrifugation, Filtration of Fermentation Broths, Cell Processing & Cell separations, Ultrafilteration, Liquid-Liquid Extraction, Chromatography - Ion Exchange, Molecular Sieve, Affinity, HPLC. Distillation, Fluid Extraction & Electrodialysis.	**15**
IV	**Production of industrially important products**: Enzymes – Amylase, Lipase and Cellulase. Beverages – Wine, Beer and Whisky. Dairy products – Cheese and yogurt. Production of SCP. Mushroom –types and cultivation. Spirullina- Production and cultivation. Biofertilizer- Rhizobium and Azolla.	**15**
V	**Industrial Biotechnology** – Microbial synthesis of commercial products – Amino acids – Lysine, Glutamic acid. Vitamins – B_2 and B_{12}. Antibiotics – Penicillin, Tetracycline and Streptomycin. Organic acids – Acidic acid and citric acid, Organic Solvents- Methanol and Ethanol.	**15**

REFERENCE

Text Books

1. Sathyanarayana, U. Biotechnology. Books and Allied (Pvt) Ltd.
2. Moo-Young, M. Comprehensive Biotechnology. 1-4 Volumes, Pergamon Press Ltd.
3. Glazer et al. (1995). Microbial Bitechnology. W.H. Freeman and Co., New York**.**
4. M.L.Srivastava,Fermentation technology, 2008 ,Narosa Publishing House Pvt Ltd.
5. Patel, A.H. Industrial Microbiology, MacMillan Publishers.
6. Casida. (2006). Industrial Microbiology, New age Publishers

Reference

1.P.F.Stanbury,A.Whitaker and S.J.Hall,2005 Principles of fermentation technology,Second Edition,NarosaPublishing House.

2.Crueger, W. and Cruger, A. Biotechnology: A Text Book of Industrial Microbiology. Science Tech Publishers,USA.

YEAR I – SEMESTER II			
LAB IN BIOPROCESS AND MICROBIAL TECHNOLOGY			
Paper	: Elective Practical II	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 40
Paper Code	: 17P2BTEP02	External	: 60

Subject description

This lab provides hands on skill in producing organic acids, wine, and about fermented food products. Further the lab work provides skill in the commercial production of beneficial products from microorganisms.

Goal

Goal of the present lab is to convert the knowledge acquired through bioprocess and microbial technology into skill.

Objectives

- To Impart skill in production and estimation of organic acids
- To Impart skill in fermented food products
- To Impart skill in the process of immobilization
- To Impart skill in production of antibiotics
- To Impart skill in the production and estimation of biomass

Experiment	CONTENT	HOURS
1	Fermentor –parts and its function	5
2	Media sterilization	**5**
3	Batch fermentation and Continuous fermentation	**5**
4	Wine production	10
5	Yoghurt Preparation	**5**
6	Production of Saurkraut	5
7	Immobilization of Yeast cell using by Sodium alginate method	5
8	Production of Azolla and its nutrient estimation	**5**
9	Production of Spirullina and its nutrient estimation.	**5**
10	Production and estimation of acetic acid	**10**
11	Penicillium production	**5**
12	Microbial production and estimation of Citric acid	**10**

YEAR II – SEMESTER III
PLANT AND ANIMAL BIOTECHNOLOGY

Paper	: Core V	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 17P3BT05	External	: 75

Subject description

This course introduces the principles and applications of plant tissue culture, animal tissue as well as the biology of cultured plant cells. Later through the course, Students will be exposed to the molecular techniques using plant systems. The designed experiments will illustrate the principles and ideas discussed in the plant biotechnology, animal biotechnology.

Goal

This paper will help students interested in careers as laboratory, plant and animal care technicians in the fields of agriculture, veterinary and human health or biotechnology.

Objective

- To impart basic knowledge about plant tissue culture.
- To promote knowledge on transformation methods in plants.
- To produce transgenic plants.
- To impart basic knowledge on Animal biotechnology.
- To impart practical knowledge on animal biotechnology.

UNIT	CONTENT	HOURS
I	**Tissues culture**: Media - Composition and preparation MS & B5; Cell and tissue culture techniques for plants - Micro propagation, Callus culture, somatic embryogenesis, suspension culture, embryo culture, haploid culture, protoplast culture, protoplast fusion; Somaclonal variation; Artificial seeds; hardening. Germ plasm and Cryopreservation.	**15**
II	**Plant transformation technology**: Ti and Ri plasmids, binary & co-integrated vector systems; viral vectors and their applications; 35S and other promoters; genetic markers; reporter genes; virulence genes; Cloning Strategies; Gene transfer methods in plants – Direct DNA transfer methods, Agrobacterium mediated nuclear transformation,	**15**

	Chloroplast transformation.	
III	**Genetic engineering**: Pest, herbicides, virus, fungal and bacterial resistance. Induction of stress tolerance in plants (Salt and drought). Edible vaccines, Plantibodies, therapeutic proteins, long shelf life of fruits and flowers.	**15**
IV	**Equipments and materials used in animal cell culture:** Media used for ATC, Primary culture Isolation of explants, Disaggregation of explants, Primary explant techniques - Slide or cover slip cultures, flask cultures, test tube cultures. Organ culture and whole embryo culture. Measurement of cell viability and cytotoxicity, maintenance of cell culture; cell separation.	15
V	**Transgenic plants and animals** : Animal viral vectors, Transgenic animals – Transgenic sheep, mice, cattle, bird and fish. Biotechnology of silkworm – Silkworm as bioreactor. Biotechnology in aquaculture (Ploidy induction, Gynogenesis, Androgenesis) Ethical issues in animal biotechnology.	**15**

Text books:

1. Bernad, R. G. and John, E.T. (1993). Methods in plant Molecular Biology and Biotechnology. CRC press.
2. Satyanarayana, U. (2008). Biotechnology. Allied (P) Ltd.
3. Chawla. Introduction toPlant Biotechnology. 2nd edition, Oxford Publishers.(2002)
4. Dubey, R. C. A text book of Biotechnology. S. Chand and Company Ltd,(1993)
5. Iorn, F. Culture of animal cells. 3rd edition, Wiley-liss.
6. Jenni, P. M. and David, B. Methods in cell biology, animal cell culture methods. Vol. 57, Academic Press.
7. Ranga, M. M. (2000). Animal Biotechnology. Agrobios, India.
8. Roberta, S. (2000). Plant tissue culture- Techniques and experiments. 2nd edition, Academic press.

YEAR II – SEMESTER III			
LAB IN PLANT AND ANIMAL BIOTECHNOLOGY			
Paper	: Core Practical V	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 4	Internal	: 40
Paper Code	: 17P3BTP05	External	: 60

Subject description

This lab provides the basic knowledge in plant tissue culture and about the transgenic plant production. Further the lab work provides the skill in micropropagation techniques and also it provides the basic knowledge in animal cell lines.

Goal

Goal of the present lab is to provide knowledge about the production of plants through tissue culture. This provides basic skill in the preparation of cell lines

Objective

- To impart skill in plant tissue culture, media formulation and sterilization
- To impart knowledge about different tissue culturing methods
- To impart skill in the production fodder by hydrophonics
- To impart skill in animal tissue culturing methods
- To promote knowledge about the cell viability checking by haemocytometer.

Experiment No.	Content	Hours
PLANT BIOTECHNOLOGY		
1	Media preparation and sterilization	5 Hrs
2	Micropropagation – Nodal and apical meristems.	5 Hrs
3	Callus induction	5 Hrs
4	Somatic embryogenesis and preparation of synthetic seeds.	5 Hrs
5	Embryo culture	5 Hrs
6	Protoplast isolation.	5 Hrs
7	Determination of protoplast viability by Evan's blue staining method.	5 Hrs
8	Pollen culture.	5 Hrs
9	Anther culture.	5 Hrs

10	Hydrophonics	5 Hrs
ANIMAL BIOTECHNOLOGY		
11	Sterilization techniques	5 Hrs
12	Preparation of culture media and sera	5 Hrs
13	Preparation of primary cell culture	5 Hrs
14	Trypsinization and subculturing cells from a monolayer	5 Hrs
15	Determining cell umber and viability with a haemocytometer and Trypan blue staining	5 Hrs

Manuals

- Ian Freshney,R., 2016, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 7th Edition, Wiley-Blackwell
- John H. Dodds, Lorin W. Roberts, 1985, Experiments in Plant Tissue Culture, Cambridge University Press,New York.
- Bhojwani , S.S., Razdan, M.K., 1996, Plant Tissue Culture: Theory and Practice, Elsevier Science

YEAR II – SEMESTER III

ENVIRONMENTAL BIOTECHNOLOGY

Paper	: Core VI	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 17P3BT06	External	: 75

Subject description:

This course presents the basic or research, research purpose, problem solving in research, statistical methods used in research, data description, waste water treatments and alternative source of energy.

Goal

Objectives:

- To equip the students with basic knowledge of how to do research, problem solving in research
- To know about the different waste water treatments and different energy sources and to familiarize with biofuel technology.

UNIT	CONTENT	HOURS
I	**Environmental issues:** Climate change, Conservation Energy, Environmental degradation, Environmental Health Genetic engineering Intensive farming Land degradation soil, Land use. Nanotechnology Nuclear issues Over population, Burial, Ozone depletion-CFCP pollution, Water pollution, Air pollution, Reservoirs Resources depletion Consumerism-Fishing, Logging, Mining Toxins, Waste.	**15**
II	**Bioremediation and Bio-leaching:** Environmental impact of pollution and measurement methods-Composting of organic wastes, microbial bioremediation of oil spills; Waste water treatment- sewage treatment and common industrial effluent treatment; Concepts of bioremediation (in-situ and ex-situ), Bioremediation of toxic metal ions-biosorption and bio accumulation principles. Concepts of phytoremediation; Microbial biotransformation of pesticides and xenobiotics: Microbial leaching of ores- direct and indirect mechanisms.	**10**

III	**Biofuel technology:** Classification of biofuel, First generation biofuels, Bioalcohols, Biodiesel, Green diesel, Vegetable oil, Bioethers, Biogas, Syngas, Solid biofuels, Second generation biofuels (advanced biofuels), Biofuels by region, Issues with biofuel production and use.	**15**
IV	**Waste Water treatment**: Definition, source, types and composition of waste water, domestic sewage and industrial waste water. Methods of analysis of waste water- Std. parameters for physical, chemical and biological analysis, microbiological analysis, rationales and methods, their significance and limitations. Primary treatment: (Chemical/Physical) sedimentation, screening, coagulation, flocculation, dilution, neutralization, equalization etc. Secondary treatment: (Biological/ biochemical) Activated sludge process, Trickling filters, anaerobic filters, sludge digestion, Aerated lagoons, Algal ponds, Evapo- transpiration system.	**10**
V	**Alternate Source of Energy**, Biomass as a source of energy. Biocomposting, Vermiculture, Biofertilizers, Organic farming, Biomass project, Biomass centre & Species used for Biomass production.s Biomineralization, Bioelectricity through microbial fuel cell. Energy management and safety.	**10**

REFERENCE

Text Books

1. Alan, S. (1999). Environmental Biotechnology. Pearson Education Limited, England.
2. Allsopp, D. and Seal, K.J. (1986). Introduction to Biodeterioration. ELBS/Edward Arnold, London.
3. Athie, D and Ceri, C.C. (1990). The use of Macrophytes in Water Pollution Control. Pergamon Press, Oxford.
4. Chin, K.K. and Kumarasivam, K. (1986). Industrial Water Technology Treatment- Reuse and Recycling. Pergamon Press, Oxford.
5. Dart, R.K. and Stretton, R.J. (1994). Microbiological aspects of pollution control. Elsevier Pub. Co., Amsterdam, New York.
6. Fry, F.C. and Gadd, G.M. Herbert, R.A. Jones, C.W. and Watson-Crick, J.A. (1982). Microbial Control of Pollution.

Cambridge University Press, New York.
7. Henze, M and Gujer, W. (1992). Interactions of waste water: Biomat and Reactor Configurations in Biological Treatment Plan. Pergamon Press, Oxford.
8. Jenkins, D. and Olson, B. H. (1989). Water and Waste water Microbiology. Pergamon Press, Oxford.
9. John, C. and Todd, V.C. (1990). Integrated environmetal Management. Lewis Publishers Inc., Chel.
10. Kaul, T.N. and Trrivedy, R.K. (1993). Pollution Control in Distilleries. Enviromedia, Karad, India.
11. McEldowney, Sharon, Hardman, David, J. and Waite, S. (1993). Pollution, Ecology Biotreatment. Longman Scientific and Technical, Harlow, England.
12. Technoglous, G. Burton, F.L. and Stensel, H.D. (2004). Wastewater Engineering-Treatment, Disposal and Reuse. Metcalf and Eddy Inc., TataMcGraw Hill, New Delhi.

Publications

1. De, A. K. (2004). Environmental Chemistry . Wiley Eastern Ltd., New Delhi.
2. Jogdand, S.N. (1995). Environmental Biotechnology. Himalaya Publishing House, Bombay.
3. Sastry, C.A. Hashim, M.A. and Angamuthu, P. (1995). Waste Treatment Plants. Narosa Publishing House, New Delhi, India.

LAB IN ENVIRONMENTAL BIOTECHNOLOGY

Experiment No.	Content	Hours
1	Isolation of Air Borne Bioparticles	5 Hrs
2	Effect of high salt concentration on microbial growth	5 Hrs
3	Oligodynamic action heavy metals on microbes	5 Hrs
4	Isolation of Coliforms from sewage	5 Hrs
5	Estimation of total solids in effluent sample	5 Hrs
6	Analysis of TDS of effluent	5 Hrs
7	Estimation of total suspended solids of effluent sample	5 Hrs
8	Determination of Biological demand	5 Hrs
9	Determination of chemical oxygen demand	5 Hrs
10	Microbial degradation of cellulose	5 Hrs

REFERENCE

1. Rajan S. and Selvi Christy R. (2015). Experimental Procedures in Life Sciences. 4th Edition. Anjana Book House, PSR Associates. Chennai.

YEAR II – SEMESTER III
GENOMICS AND PROTEOMICS

Paper	: Elective III	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 17P3BTE03	External	: 75

Subject Description

The students are able to understand the fundamental principle and techniques in genomics and proteomics which will enable them to sequence and analyze the gene and unlock potential candidate gene that may help to discovery new drugs and therapeutics, to establish evolutionary relationship, study and analyze gene and protein expressions.

Goal

The enable the students to understand the concepts and applications of genomics and proteomics

Objective

- To understand the basic concepts in genomics and various techniques applied to enumerate genome sequences and its functions
- To understand the fundamentals of proteomics and various techniques supporting the protein sequence and functional analysis

UNIT	CONTENTS	HOURS
I	Genomics- Prokaryotic &Eukaryotic Genomes Organization- Nuclear Genomes- - Organelle genomes-origin- Repetitive DNA contents- Tandem repeats – DNA transposons- Comparative genomics and application of genomics in understanding genetic disease of humans	15
II	Traditional approaches to expression profiling to study genes- SAGE for large scale gene expression and analysis- DNA sequencing- shot gun sequencing – Contig assembly-techniques for gene location – ORF- Next generation sequencing	15

	(NGS)- RT-PCR-RACE-S1nuclease mapping – exon trapping- transcriptome analysis-DNA chips and Microarrays, Real time PCR	
III	Genome Mapping – Human genome project Genetic Mapping –SNP-AFLP-Human pedigree analysis–FISH – STS mapping –Gene therapy for inherited disorders and infectious diseases.	**15**
IV	Proteomics: Definition, Characterization of proteins using 2-D gel electrophoresis, Multidimensional liquid chromatography and Mass spectrometry Tools of Proteomics- MALDI-TOF-ESI – tandem Mass analyzers-peptide Mass finger printing-protein identification with MS data.	**15**
V	Metabolomics & Global biochemical networks, different levels of metabolite analysis, basic mass spectrometery metabolomics analysis, sample selection and handling for analysis of metabolites, methodology to construct global biochemical network.Protein mining - SALSA algorithm for mining specific features- protein microarraysprotein expression profiling –	**15**

Text book

- Old and Primrose, 2006, Principles of Gene manipulation and genomics.

Reference book

1. Terence A Brown, 2002, Genomes, 2nd Edition, Bios Scientific Publishers.
2. Tom Strachan and Andrew P Read, 1999, Human Molecular Genetics, 2nd edition, Bios Scientific Publishers.
3. Daniel C. Liebler, 2002, Introduction to Proteomics, tools for the New biology- Humana press. Totowa,NJ.
4. Pennington.S, M. Dunn, 2001, Proteomics: From Protein Sequence to Function, 1st edition, Bios Scientific Publishers.

YEAR II – SEMESTER III			
LAB IN GENOMICS AND PROTEOMICS			
Paper	Elective III Practical	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 40
Paper Code	: 17P3BTEP03	External	: 60

Experiment No.	**Content**	**Hours**
1	Online and offline tools for analysis of genomics and proteomic information	
2	16 s rRNA sequence amplification	
3	Phylogenetic Analysis of gene sequence using MEGA4 software	
4	Random amplified polymorphic DNA analysis	
5	Single nucleotide polymorphism	
6	Chromatographic techniques for proteins separation	
7	Characterization of proteins & protein profiling	

References

1. R. Simpson (2003). Proteins and Proteomics: A Laboratory Manual. Cold Spring Harbor Laboratory Press, 2003
2. J.F. Sambrook and D.W. Russell, ed., (2001).Molecular Cloning: A Laboratory Manual, 3rd ed., Vols 1,2 and 3. Cold Spring Harbor Laboratory Press

YEAR II – SEMESTER IV			
DEPARTMENT OF BIOTECHNOLOGY **PLANT AND ANIMAL CELL CULTURE TECHNIQUES**			
Paper	: Extra Disciplinary Course I	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 06
Credit	: 4	Internal	: 40
Paper Code	: 17P4BTED1	External	: 60

Subject Description:

This course aims to introduce the principles and applications of plant tissue culture, animal tissue as well as the biology of cultured plant cells. Later through the course, Students will be exposed to some molecular techniques using plant systems. The designed experiments will illustrate the principles and ideas discussed in the plant biotechnology, animal biotechnology.

Goal

This paper helps the students to learn about the basics of plant and animal cell culture techniques.

Objectives

This course was designed to acquaint the students to:

- Work under aseptic conditions to cultivate different plant species and/or parts in vitro. Learn how to subculture and follow the growth pattern of the cultures.
- Practice scientific thinking in analyzing the experiments, keeping records, and presenting results.
- Practice and learn some techniques in plant biochemistry, molecular biology, animal biotechnology.

UNIT	CONTENT	HOURS
I	**Introduction to plant tissue culture:** Structure and organization of plant cell. Establishment of plant tissue culture laboratory. Preparation of explants. Sterilization techniques. Preparation and composition of Plant tissue culture media. Growth regulators - auxin, cytokinin and other hormones.	**15**
II	**Tissue culture techniques:** Callus culture - initiation and maintenance of callus. Suspension culture, Meristem tip culture, Anther culture, Embryo and ovule culture Principles of Micropropagation: Direct and indirect morphogenesis, somatic embryogenesis. Synthetic seed production. Protoplast isolation, culture & fusion, somaclonal variations.	**15**
III	**Gene transfer methods in plants**: Agrobacterium mediated transformation (Ti plasmid & Ri plasmid). Particle bombardment, Electrophoration. Selectable marker, promoter and reporter genes used in plant transgenesis- Genetic engineering for Pest, Herbicide	**15**

	Viral, fungal and Bacterial resistance.	
IV	**Introduction to animal cell culture:** ATC Laboratory design- Equipments and materials used in animal cell culture -Balanced salt solutions and Complete medium; Constituents of animal cell culture media and role of serum containing and serum free media and their applications. Primary and established cell line cultures. Applications of animal cell culture.	**15**
V	**Animal cell culture techniques:** Primary culture Isolation of explants, Disaggregation of explants, Primary explantation techniques - Slide or cover slip cultures, flask cultures, test tube cultures. Organ culture and whole embryo culture. Measurement of cell viability and cytotoxicity, maintenance of cell culture; cell separation. Cryopreservation. Large scale culture of cell lines.	**15**

REFERENCE

1. Bernad, R. G. and John, E.T. (1993). Methods in plant Molecular Biology and Biotechnology. CRC press.
2. Bhowjwani, S. S, (2004). Plant tissue culture- Theory and practice.
3. Chawla. Introduction toPlant Biotechnology. 2nd edition, Oxford Publishers.
4. Dubey, R. C. A text book of Biotechnology. S. Chand and Company Ltd.
5. Iorn, F. Culture of animal cells. 3rd edition, Wiley-liss.
6. Jenni, P. M. and David, B. Methods in cell biology, animal cell culture methods. Vol. 57, Academic Press.
7. John, R.W.M. Animal cell culture. Raifica approach, OXFORD.
8. Martin, C. Animal Cell culture techniques. Springer.
9. Ranga, M. M. (2000). Animal Biotechnology. Agrobios, India.
10. Roberta, S. (2000). Plant tissue culture- Techniques and experiments. 2nd edition, Academic press.
11. Satyanarayana, U. (2008). Biotechnology. Allied (P) Ltd.

YEAR II – SEMESTER IV

RESEARCH METHODOLOGY,BIOSTSTISTICS AND BIOINFORMATICS

Paper	: Elective IV	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 17P4BTE04	External	: 75

Aim: To enable the students to learn about the basics of research and application of Bioinformatics

Objectives:

To equip the students with basic knowledge of how to do research, problem solving in research and to know about the biological database and tools and its application

UNIT	CONTENT	HOURS
I	Research definition, Types of Research: Descriptive vs. Analytical Research, Applied vs. Fundamental Research, Quantitative vs. Qualitative Research, Conceptual vs. Empirical Research, Formulating the Research Problem, Research Methods vs. Research Methodology, Literature Review, Review Concepts and Theories, Current trends in Research, Mono,Trans, Inter- disciplinary Research, Computer & Internet: Its Role in Research, Threats and Challenges to Good Research	**15**
II	Hypothesis: Formulation, Sources, Characteristics, Role, Test, Research Design, Legal Research, Clinical Trials, Evolutive and Evaluative, Identificatory and Impact studies, Projective and Predictive, Writing an: Article, Essay, Research Paper, Research Project, Legislation Drafting, Judgment Writing, Thesis, Dissertation, Book, Reviews - Book Review; Case Review, Criteria of Good Research, Research Ethics, Citation Methods: Foot Note, Text Note, End Note, Bibliography, Citation Rules	**15**
III	Statistics in Research: Sampling Design, Data Collection- Primary and Secondary data, Processing and Analysis of Data, Limitation and uses of Statistics, Graphs, mean, Median, Mode, Standard deviation, Standard error	**15**
IV	Biological Data Acquisition: Access, Retrieval and Submission methods for DNA sequence, protein sequence and protein structure information; Databases –Annotated sequence databases, Organism specific databases; Sequence Similarity Searches: Local versus global. Distance metrics, Scoring matrices, Dynamic programming algorithms,	15

	Needleman-wunsch and Smith-waterman.	
V	Genome Analysis: Whole genome analysis, existing software tools; Genome Annotation and Gene Prediction; Structure Prediction, ORF finding, Primer Designing, Phylogenetic Analysis, Gene Disease Associations Database: DisGeNET, GWAS, Open-source Bioinformatics software : Bioconductor, BioPerl, Biopython, BioJava, BioJS, BioRuby, Bioclipse, EMBOSS, .NET Bio, Orange	**15**

TEXTBOOKS

1. Research Methodology: A Step-by-Step Guide for Beginners–by Ranjit Kumar
2. Practical Research: Planning and Design (10th Edition) 10th Edition by Paul D. Leedy, Jeanne Ellis Ormrod
3. Developing Research Proposals (Success in Research) by Pam Denicolo, Lucinda Becker
4. Research Methodology – C.R.Kothari
5. 1.B.K. Mahajan, (1997)Methods in Biostatistics, Sixth Edition, Jaypee Brothers Medical Publishers(p)Ltd
6. 2.S.P. Gupta, (2011)Statistical Methods (41th edition),Sultan Chand & sons, New Delhi
7. Bioinformatics: Databases and Systems, by Stanley I. Letovsky
8. Bioinformatics Databases: Design, Implementation, and Usage (Chapman & Hall/ CRC Mathematical Biology & Medicine), by SorinDraghici
9. Data base annotation in molecular biology, principles and practices, Arthur M.Lesk
10. Current topics in computational molecular biology, Tao, Jiang, Ying Xu, Michael Q.Zang

STUDENT LEARNING OUTCOMES:

This course gives an idea about the basics of research, research purpose, problem solving in research, writing research articles, essay, review the paper, statistical methods used in research, data description, Bioinformatics tools and its application

YEAR II – SEMESTER IV			
LAB IN RESEARCH METHODOLOGY AND BIOINFORMATICS			
Paper	Elective IV Practical	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 40
Paper Code	: 17P4BTEP04	External	: 60

Experiment No.	**Content**	**Hours**
1	Retrieving the data and Blast analysis of the sequence data from Entrez	5
2	Locating the chromosome of a Gene	10
3	Retrieve gene expression data from GEO	5
4	Finding ORF of a Given Sequence	10
5	Retrieving structural data of a protein using PDB database	10
6	Retrieving Motif Information of a Protein Using Prosite	10
7	Retrieving Gene Information from TAIR database	10
8	Designing a primer	5
9	Retrieving genes and variants associated with human diseases from DisGeNET	5
10	Research paper - Review ,Synapsis,summary	5