KARPAGAM ACADEMY OF HIGHER EDUCATION
DEPARTMENT OF BIOTECHNOLOGY
M.Sc. Biotechnology Curriculum (2015 – 2016 Batch)

Code	Course	Objectives and Outcomes		Ins*			Marks			Exam Hrs	Credit
		PEO´s	PO´s & PSO´s	L	T	P	CIA	ESE	Total		
SEMESTER – I											
15BTP101	Biochemistry	I	a, b	4	0	0	40	60	100	3	4
15BTP102	Microbiology	I, II	a, b, c, d	4	0	0	40	60	100	3	4
15BTP103	Cell Biology and Molecular Genetics	I, II	a, d	4	0	0	40	60	100	3	4
15BTP104	Bioinstrumentation and Biostatistics	II, III	d, e, f	3	1	0	40	60	100	3	4
15BTP105	Food Biotechnology	I, II	a, d	4	0	0	40	60	100	3	4
15BTP111	Biochemistry, Cell Biology and Molecular Genetics – Practical I	I, II, III	a, b, d, f	0	0	4	40	60	100	6	2
15BTP112	Microbiology and Food Biotechnology Practical – II	I, II, III	a, b, c, d, f	0	0	4	40	60	100	6	2
	Seminar presentation			2	-	-	-	-	-	-	-
Semester total				**21**	**1**	**8**	**280**	**420**	**700**		**24**
SEMESTER – II											
15BTP201	Recombinant DNA Technology	II, III	d, e	5	0	0	40	60	100	3	5
15BTP202	Fermentation Technology	II, III	d, e	4	1	0	40	60	100	3	5
15BTP203	Environmental Biotechnology	II, III	d, e	4	0	0	40	60	100	3	4
15BTP204	Core Elective – I	IV	g	4	0	0	40	60	100	-	4
15OEP201	Open Elective – I	IV	g, i	-	-	-	-	-	100	-	3
15BTP211	Recombinant DNA Technology Practical – III	II, III	d, e, f	0	0	5	40	60	100	6	3
15BTP212	Fermentation Technology and Environmental Biotechnology Practical – IV	II, III	d, e, f	0	0	5	40	60	100	6	3
	Seminar presentation			2	-	-	-	-	-	-	-
Semester total				**19**	**1**	**10**	**240**	**460**	**700**		**27**

SEMESTER – III											
15BTP301	Plant Biotechnology	II, III, IV	d, g, h	4	0	0	40	60	100	3	4
15BTP302	Animal Biotechnology	II, III, IV	d, g, h	4	0	0	40	60	100	3	4
15BTP303	Immunotechnology	IV	g	3	1	0	40	60	100	3	4
15BTP304	Genomics and Proteomics	II, III, IV	d, e, f, g	4	0	0	40	60	100	3	4
15BTP305	Core Elective – II	IV	g	4	0	0	40	60	100	3	4
15BTP311	Plant Biotechnology Practical – V	IV	g	0	0	4	40	60	100	6	2
15BTP312	Animal Biotechnology and Immunotechnology Practical – VI	IV	g	0	0	4	40	60	100	6	2
	Seminar presentation			2	-	-	-	-	-	-	-
Semester Total				**21**	**1**	**8**	**280**	**420**	**700**		**24**
SEMESTER – IV											
15BTP491	Project and Viva Voce		d, g, i	-	-	-	80	120	200	-	15
Semester total				**-**	**-**	**-**	**80**	**120**	**200**	**-**	**15**
G. Total				**61**	**3**	**26**	**880**	**1420**	**2300**		**90**

Open Elective

15OEP201	Mushroom Technology

Core Electives

Core Elective – I		**Core Elective – II**	
15BTP204A	Nano Biotechnology	15BTP305A	Biosafety and IPR
15BTP204B	Pharmaceutical Biotechnology	15BTP305B	Bioinformatics
15BTP204C	Bioenergy Technology	15BTP305C	Industrial Toxicology
15BTP204D	Medicinal Plant Biotechnology	15BTP305D	Tissue Engineering
15BTP204E	Live Stock Management	15BTP305E	System Biology

Additional Courses

Code	Course(s)	Hrs / Week	Marks			Exam / Hrs	Credit
			CIA	ESE	Total		
15BTP306	Bioentrepreneurship	-	-	100	100	3	4
15BTP401	Research Methodology	-	-	100	100	3	4

Blue – Employability Green – Entrepreneurship Red- Skill Development

PROGRAMME OUTCOMES (POs)

a) Graduates will able to have knowledge on the basic and applied theories.

b) Providing a broad educational and analytical knowledge necessary to make the students for appearing in competitive examinations

c) Ability to design and conduct experiments as well as to interpret the results.

d) An expert to work on Biotechnological concepts and allied fields (immuno, medical, microbial, Food, agricultural, environmental, plant and animal) with modern tools and techniques towards
product and process development for academic, industrial and research application.

e) Generating the graduates with an ability to identify, formulate and solve to deliver process/product with professional, societal and ethical responsibilities.

f) Graduates will be able to visualize and work on multidisciplinary laboratory problems.

g) Graduates will be able to update the current knowledge of interdisciplinary subjects related to biotechnology

PROGRAMME SPECIFIC OUTCOMEs (PSOs)

To enable the student to emerge as:

h) Biotechnologist to recognize the societal need and lifelong learning.

i) Proficient to demonstrate entrepreneurial and leadership skills with life-long learning**.**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO I: The post-graduates of Biotechnology will able to acquire in-depth knowledge of the basic and applied subjects of Biotechnology and allied fields.

PEO II: The post-graduates of Biotechnology are equipped to design, analyze, conduct and interpret the experiments and data for the development of process/product within the realistic constraints.

PEO III: The post-graduates of Biotechnology will able to acquire the knowledge and ability to use the concept of theories, practical skills and recent technological tools in solving any technological and professional issues independently in a global and societal context.

PEO IV: The graduates of Biotechnology will continue learning to update and to become an entrepreneur in a competitive world of technology and also contribute to all forms of life.

MAPPING OF PEOs AND POs

PEOs			Programme Outcome (s)						
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
PEO I	×	×		`					
PEO II			×	×					
PEO III					×	×			
PEO IV							×	×	×

Semester - I

15BTP101 **BIOCHEMISTRY** **4H – 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The main objectives of the course are,

- To study the qualitative and quantitative determination of the biochemical substances
- To study the structure and functions of macromolecules
- To identify the molecular interactions between the atoms and molecules
- To derive the mathematical equations of enzyme kinetics
- To understand the metabolic pathways that occurs in the normal human life
- To elucidate the role of macromolecules for growth and development of organisms

Course Outcomes

On successful completion of the course, the learner will be able to

1. Demonstrate and understand the fundamental biochemistry principles including topics specific to chemistry and biochemistry
2. Acquire knowledge in understanding the enzyme structure/function
3. Understand the metabolic pathways and the regulation of biological/biochemical processes
4. Get insight into protein structures and folding mechanism
5. Applications of protein engineering in academia and industry
6. Acquire knowledge about the carbohydrates and its metabolisms

UNIT - I

Introduction: Chemical basis of life; Composition of living matter; Water – properties, pH, ionization and hydrophobicity; Emergent properties of biomolecules in water; Biomolecular hierarchy; Macromolecules; Molecular assemblies; Structure-function relationships.

UNIT - II

Biomolecules: Structure and properties of carbohydrates, fatty acids amino acids, proteins. Structure and properties of purines, pyrimidines, nucleosides, nucleotides, polynucleotides, Ribonucleic acids and deoxy ribonucleic acids, nucleoprotein complexes.

UNIT - III

Enzymology: Enzymes classification and nomenclature, Mechanism of action, regulation of enzymatic activity, enzyme kinetics – Michaelis Menton equation, Line Weaver Burk plot and Eadie Hoffstee and Haneswoll equation, enzyme inhibition.

UNIT - IV

Metabolism: Biosyntheses and degradation of fatty acids and cholesterol, Biosyntheses and degradation of amino acids, peptides and proteins; Biosyntheses and degradation of Purines, pyrimidines and nucleic acids.

UNIT - V

Bioenergetics: TCA Cycle, glycolysis, gluconeogenesis, Pentose phosphate shunt, Embden Meyerhof pathway, urea cycle, interconnection of pathways, Metabolic regulation, Bioenergetics: Respiratory chain, TP cycle, energy rich compounds.

TEXT BOOKS

1. Nelson, D. L. and M. M. Cox, 2006. Lehninger Principles of Biochemistry. III Edition, CBS Publishers, New Delhi.
2. Jain, J. L., 2002. Fundamentals of Biochemistry -V Edition, S. Chand & Co., New Delhi.

REFERENCES

1. Zubay,G.L., W. W. Parson, D. E. Vance, 1995. Principles of Biochemistry. MC Brown Publishers, Oxford.
2. Murray, R. K., D. K. Granner, P. A. Mayes and V. W. Rodwell, 2003. Biochemistry, Mc Graw Hill Companies Inc, Boston.
3. Voet, G. and A. Voet, 2004. Fundamentals of Biochemistry. III Edition, John Wiley and Sons, Inc. New York.
4. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell, 2006. Harper's Illustrated Biochemistry. XXVI Edition, McGraw-Hill Publishers, New York. Online version available.

Semester - I

15BTP102 **MICROBIOLOGY** **4H – 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The main objectives of the course are,

- To inculcate knowledge on fundamentals of microorganisms
- To learn the structural organization, morphology and reproduction of microbes.
- To know the principles of Microscopy and advancements in Microscopy
- To understand the classification of microorganisms
- To know about the microbiological scientists and their experimental proof
- To understand the application of microorganisms in different fields of life sciences

Course Outcomes

On successful completion of the course, the learner will be able to

1. Gain rigorous knowledge on historical perspective of Microbiology
2. Acquire basic knowledge on different structure of microbes
3. Get Ideas on different type of microscope.
4. Acquaint knowledge on the scientific proofs in microbiology
5. Understand the mechanisms of microorganisms in causing diseases
6. Get a brief idea about the host-pathogen interactions

UNIT - I

Microbial Diversity: Definition, history, scope, discovery and development of microorganisms. Diversity-Bacteria, fungi, algae - distribution, reproduction and characteristics divisions. Autotrophic and heterotrophic utilization.

UNIT - II

Microscopy Techniques: Principles, types and applications of light, phase contrast, fluorescence, scanning and transmission electron microscopy, cytophotometry and flow cytometry, fixation and staining. Types of media preparation, methods of sterilization, techniques of pure culture, maintenance and preservation. Staining – types of stains and dyes, staining methods. Microbial growth.

UNIT - III

Microbial metabolism: Common nutrient requirements, nutritional types, uptake of nutrients, culture media, isolation of pure cultures. Microbial growth, growth curve, measurement of microbial growth, continuous culture, influence of environmental factors on growth, control of microorganisms by physical and chemical agents.

UNIT - IV

Biomass production: Production of carbohydrates - higher alkanes and methanol; Edible mushrooms and its types. Oyster, paddy straw, button and medicinal mushroom production and its applications.

UNIT - V

Microbial Diseases: Causative agent, pathology, diagnosis, control and treatment of Bacterial - TB, Cholera and Typhoid. Protozoan – Amoebiasis and Malaria. Viral - AIDS. Control of microorganisms – drugs, chemotherapy, antimicrobial agents.

TEXTBOOKS

1. Black, J.G., 2002. Microbiology Principles and Explorations. John Wiley and Sons Publishing, NewYork.
2. Prescott, L.M., J.P Harley and D.A. Klien, 2005. Microbiology. McGraw - Hill Publishing Company, Boston, NewYork.
3. Talaro, K.P., 2009. Foundations in Microbiology. McGraw - Hill Publishing Company, New York.

REFERENCES

1. Prescott and Dunn's 1984 Industrial Microbiology, 4th Edition, Gerald Reed,AVI Publishing Company Inc. Conneticut
2. Atlas, R.M., 1997. Principles of Microbiology. WCB McGraw Hill, 1333 Burr Ridge Parkway, Burr Ridge, Illinois 60521 USA.
3. Pascale, C. 2005. Cellular Microbiology. American Society for Microbiology, New York.
4. Hui, Y.H., L. M. Goddik, A. S. Hansen, J. Josephsen, W. K. Nip, P.S. Stanfield and F. Toldra, 2004. Handbook of Food and Beverage Fermentation Technology. Taylor and Francis, London.
5. Pelczar,M.J., E.C.S. Chan and N. R. Krieg, 1993. Microbiology: Concepts and Applications. McGraw-Hill, USA.
6. Roland, V.G., 2005.Applied Food Microbiology. Star Publishing Co., London.

Semester - I

15BTP103 CELL BIOLOGY AND MOLECULAR GENETICS 4H – 4C

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The main objectives of the course are,

- To enable students to learn the basics of prokaryotic and eukaryotic cells
- To Understand how the cellular components are used to generate and utilize energy in cells
- To prepare students for subsequent biological courses that require an understanding of the physiology of organisms such as cell division, enzyme activity etc.
- To understand the genetic variability and traits of an individual
- To gain the information about the level of genome organization in various living organisms
- To obtain the knowledge about transmission of genetic information across generation at the individual and population level

Course Outcomes

On successful completion of the course, the learner will be able to

1. Understand the unique features of plant and animal cells
2. Illustrate how the cellular components are used for various cellular activities
3. Acquire knowledge about the central theories and methodologies in traditional, molecular and population genetics
4. Acquire information on sex- linked inheritance and associated diseases
5. Understand the principles of gene expression
6. Illustrate the effect of chromosomal abnormalities in human diseases

UNIT - I

Cell Organization: Structure of prokaryotic and eukaryotic cells, cellular organelles – Plasma membrane – Properties and functions, cell wall, mitochondria, chloroplast, peroxisomes, golgi complex, Endoplasmic reticulum and lysosome. Cell division.

UNIT - II

Nucleic Acid - Replication –Types of replication, Transcription and post transcriptional Modification, Translation and post translational modification, regulation of gene expression.

UNIT - III

Genetics: Mendelian and Non-Mendelian principles. Genetic recombination, Genetic mapping, linkage and crossing over. Mutations- Types of Mutation, Genetic analysis of Mutations, DNA repair Mechanisms.

UNIT - IV

Transposons: Types of bacterial transposons, Transposition, Detection of Transposition in Bacteria, Excision of Transposons, Types of Transposons in Eukaryotic cells.

UNIT - V

Bacterial genetics - Gene transfer in Bacteria, Transformation, Transduction and Conjugation. Bacteriophages - General properties, Structure, Lytic and Lysogenic phages, Role of phages as vectors.

TEXT BOOKS

1. Gardner,E.J., 2001. Principles of Genetics. VIII Edition. John Wiley and Sons, New York.
2. Karp, G., 2005. Cell and Molecular Biology: Concepts and Experiments. John Wiley and Sons, Inc.London.
3. Maloy SR, Cronan Jr. JE, Freifelder D 2006. Microbial Genetics. Jones and Bartlett Publishers, Sudbury, Massachusetts.

REFERENCES

1. Cooper, G. M., R. E. Hausman, 2004. Cell: A Molecular Approach. Sinauer Associates, Inc. Sunderland.
2. Glick,B.R and J.J. Pasternak. 2003. Molecular Biotechnology. III Edition, Panima Publishing Corporation, New Delhi.
3. Frifielder, D., 2001. Molecular Biology. II Edition, Narosa Publishing House, New Delhi.
4. Lodish B., 2004. Molecular and cell biology. V Edition, Freeman and company, New York.
5. Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P. 2002. Molecular Biology of the Cell. IV Edition. Garland Publishing. New York

Semester - I

15BTP104 BIOINSTRUMENTATION AND BIOSTATISTICS 4H - 4C

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The main objectives of the course are,

- To impart technical information on Instrumentation related to Biotechnology
- To know the working principle of instruments in biotechnology
- To understand the procedure for handling the instruments
- To understand the analytical experiments like GC-MS, LC-MS etc.
- To impart the knowledge of basic statistical methods to solve problems
- To attain strong knowledge on the applications of biostatistics and its relevant software

Course Outcomes

On successful completion of the course, the learner will be able to

1. Understand the working principles of instruments
2. Know the working principle, maintenance, and calibrations of bioanalytical tools and technique
3. Quantify the biomolecules using the bioanalytical tool
4. Implement the bioanalytical techniques to analyze the biomolecules
5. Have sufficient scientific understanding of the basic concepts in instrumentation used in biotechnology
6. To implement the statistical knowledge in analyzing the biological data used in modern biology and biotechnology research

UNIT - I

Colorimetry: Colour and absorption spectra, Beer's and Lambert's law. Principle of photoelectric colorimeter, Spectroscopy – Properties of electromagnetic radiations, Instrumentation and applications of – UV Visible light spectroscopy, Spectrofluorimeter, atomic spectroscopy, NMR spectroscopy and MALDI –TOF, Mass spectroscopy GC – MS, IR and FTIR.

UNIT - II

Centrifugation: Principle, types of centrifuges, Principles and applications of analytical and preparative centrifuge, density gradient and ultra centrifuge. **Chromatography:** Principles, Type – Paper, thin layer, ion exchange, affinity, gel filtration, HPLC and HPTLC

UNIT - III

Electrophoresis: Principle, instrumentation and applications of agarose gel electrophoresis, sodium dodecyl sulphate – polyacrylamide gel (SDS-PAGE), native PAGE, isoelectric focusing, immuno, pulse field, gel, capillary, 2D electrophoresis, gel documentation, PCR methods.

UNIT - IV

Biostatistics: Data collection, classification and presentation of tabulation. Measures of central tendency – mean, median and mode. Measures of dispersion – mean deviation, standard deviation, standard error and analysis of variance.

UNIT - V

Applications of biostatistics: Probability and probability distribution – theorems, binomial, poisson and normal distribution. Correlation and regression – simple correlation, correlation co-efficient, simple and linear regression analysis. Test of significance -F, t, DMRT and chi-square test. Statistical and graphical software.

TEXT BOOKS

1. Glover.T. and H.Mitchell, 2002. An Introduction to Biostatistics. Mc Graw- Hill Co. Inc., Boston.
2. Friedfelder,D., 2001. Physical Biochemistry. V Edition, Oxford Publishers. New York.

REFERENCES

1. Sharma, B.K., 2004. Instrumental Methods of Chemical Analysis. XXIV Edition, Goel Publishing House, Meerut.
2. Chatwal, G.R and S.K. Anand, 2003. Instrumental Methods of Chemical Analysis. V Edition, Himalaya Publishing House, Mumbai.
3. Boyer, R., 2000. Modern Experimental Biochemistry. III Edition, Addision Wesley Longman. New Delhi.
4. Wilson, K. and J. Walker, 2006. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, India.
5. Plummer, D.T., 1988. An Introduction to Practical Biochemistry. Tata McGraw-Hill, NewDelhi.
6. Sawhney, S.K. and R. Singh, 2000. Introductory practical Biochemistry. Narosa Publishing House, New Delhi.
7. www.pdfgeni.com/.../research-methodology--spss-pdf.html.

Semester - I

15BTP105 FOOD BIOTECHNOLOGY 4H - 4C

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The main objectives of the course are,

- To introduce the fundamental knowledge of food science and technology
- To integrate different aspects of technologies involved in food processing and product development
- To understand the methods and techniques involved in food production, processing, preservation, packaging, labelling, quality management, and distribution
- To emphasize on the importance of food safety, food quality, plant sanitation, packaging, marketing in food industry
- To transform raw materials into edible and nutritious food items
- To Acquire knowledge about the food preservation methods

Course Outcomes

On successful completion of the course, the learner will be able to

1. Understand the principles and current practices of processing techniques and the effects of processing parameters on product quality
2. Understand the principles that make a food product safe for consumption
3. Get experience on food processing and preservation
4. Develop new methods to improve their productivity and profitability
5. Able to seek Governments and non-governmental public advocates to offset global hunger
6. Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation

UNIT - I

Introduction: History and Scope of Food Biotechnology, Nutritive value of food, Role of microbes in food biotechnology – bacteria, fungi and yeast. Fermented foods – Types, Changes during Fermentation, Nutritive value of fermented foods.

UNIT - II

Food Microbiology: Primary Sources of Microorganisms in food. Food borne Bacteria, Molds and Yeasts. Intrinsic and Extrinsic Parameters of food affecting microbial count. Detection of Microorganisms in food - SPC, Membrane filters, Dry films. Bacterial Toxin - Botulism and Staphylococcal toxin. Fungal Toxins - Aflatoxin.

UNIT - III

Dairy Biotechnology: Milk - Definition, Composition and Types. Fermented Milk Products - Butter, Yoghurt and Cheese. Preservation of milk by heat treatment - Pasteurization and Ultra High Temperature. Physicochemical characterization of milk. Milk Tests - Dye Reduction (MBRT and Resazurin)

UNIT - IV

Food Production: Food safety - HACCP System to food protection, Responsibility for food safety. Food Additives - Definition, Types and Functional characteristics. Natural Colors -Types, Applications, Advantages of natural colours. Sweeteners - Types and Applications.

UNIT - V

Food Spoilage and Preservation: Causes of Food Spoilage, Spoilage of Fruits, Vegetables, Meat, Soft Drinks, Eggs, Dairy products. Food Preservation through chemicals - Acids, Salts, Sugars, Antibiotics, Ethylene oxide, Antioxidants. Other Methods of Food Preservation -Radiations, Low and High temperature and Drying.

TEXT BOOKS

1. Adam, M.R. and Moss, M.O., 2003. Food Microbiology, New Age International Pub.New Delhi, India.
2. Frazier, W.C. and Westhoff, D.C., 2005. Food Microbiology, IV Ed.,Tata Mc Graw Hill Pub. Company Ltd. New Delhi, India.

REFERENCES

1. Harrigan, W. F., 1998. Laboratory methods in Food Microbiology, III Ed. Academic Press, New York, USA.
2. Jay, J.M., 1992. Modern Food Microbiology, IV Ed. Chapman and Hall, New York, USA.

Semester - I

15BTP111 BIOCHEMISTRY, CELL BIOLOGY AND MOLECULAR GENETICS – PRACTICAL I

4H - 2C

Total hours/week: L:0 T:0 P:4 **Marks:** Internal**:40** External**:60** Total**: 100**

Course Objectives

The main objectives of the course are,

- To train the students on handling various experimental methods and techniques in biochemistry, cell biology and molecular genetics
- To analyze the given biological samples from biochemical stand points
- To handle the instruments with safety precautions
- To develop practical skills such as identification of cell types, cellular component and cell division, etc.
- To apply knowledge of modern techniques in cellular biology
- To grasp the structures of prokaryotic and eukaryotic cells, exclusively their membranes, and organelles

Course Outcomes

On completion of the course, students are able to

1. Acquire skills to quantitatively estimate various biomolecules and to carryout enzyme kinetics
2. Be efficient in handling the instruments
3. Acquaint knowledge on the working principle and the techniques
4. Understand the unique features of plant cells and animal cells
5. Gain knowledge on the fractionation of cellular components
6. Gain insight into the most significant molecular and cell-based methods to understand the biological concepts

List of Practicals

BIOCHEMISTRY

1. Quantification of proteins – Lowry *et al/* Bradford method
2. Quantification of sugars – Anthrone method
3. Total free amino acids
4. Quantification of lipids
5. Quantification of Ascorbic acid
6. Membrane based separation (e.g. Microfiltration/ Ultrafiltration)
7. Thin Layer Chromatography (Amino acids / fatty acids/ sugar/ nucleic acids)
8. Effect of pH, temperature, substrate concentration (any one enzyme - catalase / SOD by OD method))

CELL BIOLOGY

1. Identification of cell types- Microbe/plant /Human
2. Fractionation of cellular component – Nuclear Components, Mitochondria, Chloroplast.
3. Sucrose Fractionation of Castor Bean
4. Lipid Solubility of Membranes
5. Cell permeability – RBC/plant cells.

MOLECULAR GENETICS

1. Drosophila Giant Chromosome preparation
2. Nuclear staining (Giemsa / acridine orange / feulgen)
3. Metaphase preparation and karyotyping (Human leucocytes/ onion root tip)
4. Conjugation
5. Transduction

REFERENCES

1. Boyer, R., 2000. Experimental Biochemistry. Benjamin Cummings, Redwood City, California, USA.
2. Palanivelu, P., 2001. Analytical Biochemistry and Separation Techniques. Kalaimani Printers, Madurai.
3. Sadasivam. S. and A. Manickam, 2002. Biochemical methods. New Age International Private Limited Publishers, New Delhi.
4. Wilson, K. and K.H. Goulding, 1986. Biologists Guide to Principles and Techniques of Practical Biochemistry. ELBS Edition, London**.**

Semester - I

15BTP112 **4H - 2C**

MICROBIOLOGY AND FOOD BIOTECHNOLOGY - PRACTICAL II

Total hours/week: **L:0 T:0 P:4** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The main objectives of the course are,

- To understand the concept of microbial diversity and characterization of microbes
- To get familiarity with products obtained from microorganisms
- To understand methods of preservation of pharmaceutical products
- To impart knowledge on detection of microbes in food, risk assessment in food and food safety
- To gain experience in microbiological laboratory practices and skills in the design and execution of microbiology related research
- To provide foundation in various methods to cultivate the microbes and maintenance of the microorganism

Course Outcomes

On completion of the course, students are able to,

1. Comprise out line knowledge on isolation, sub culture and maintenance of microbes
2. Work well on their own as well as a part of a team, effective communication skills and a discerning approach to food items
3. Express genuine interest in science and to know the importance of high standards of cleanliness, commitment, enthusiasm and motivation
4. Understand nutritional requirements of bacteria
5. Able to understand basic and advanced techniques of various instrumentation like pH meter, spectroscopy, colorimetric, and microscopy
6. Develop adequate skills in microbial product synthesis and purification

List of Practicals

Microbiology

1. Pure culture technique - pour spread, loop out technique and streaking, preservation
2. Staining technique - Simple, grams, negative, endospore and fungal
3. Motility - Flagellar staining, hanging drop and soft agar analysis
4. Isolation of Mutants - physical and chemical
5. Growth curve
6. Biomass estimation

Food Biotechnology

1. Isolation and identification of microbes from food samples
2. Wine production
3. Citric acid production
4. Production of Industrially important enzymes – protease, amylase
5. Immobilization of enzymes
6. Working of fermentors

REFERENCES

1. Cappuccino, P. and D. Sherman, 2004. Microbiology-A Lab Manual. Pearson Education, Singapore.
2. Dubey, R. and E. Maheswari, 2004. Practical Microbiology. S. Chand and Co, New Delhi.
3. Goldman, E. and Green, L.H. 2008. Practical Handbook of Microbiology. II
4. Edition, CRC press, London
5. Kannan, P., 2002. Laboratory Manual in General Microbiology. Palani Paramount Publishers, Palani, Tamilnadu.
6. Murray, R., W.A Wood. and N.B. Krieg, 1984. Methods for General and Molecular Bacteriology. American Society for Microbiology, Washington D.C.
7. Heidcamp, W.H. 1995.Cell Biology Laboratory Manual. Saint Peter, Minnesota.
8. USA.http://homepages.gac.edu/~cellab/index-1.html.

Semester - II

15BTP201 **RECOMBINANT DNA TECHNOLOGY** **5H - 5C**

Total hours/week: **L:5 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The main objectives of the course are,

- To familiarize the students with the basic concepts in genetic engineering
- To acquaint the students with versatile tools and techniques employed in genetic engineering and recombinant DNA technology
- To enlighten the applications of genetic engineering
- To gain knowledge on methods of gene cloning
- To understand the mechanisms of hybridization techniques
- To learn different aspects of recombinant gene expression systems

Course Outcomes

On completion of the course, students are able to

1. Express adequate knowledge in principles and methods of genetic engineering and their applications
2. Discuss various types of cloning vectors and their application
3. Have good knowledge of application of recombinant DNA techniques in life sciences research
4. Explain the significance of model organisms in recombinant DNA technology
5. Describe recombinant gene expression systems
6. Gain knowledge on the principles of analytical techniques such as PCR and RAPD

UNIT - I

Tools in Genetic Engineering: Nucleic acid manipulating enzymes- restriction- nucleases, ligases, polymerases, modification enzymes - kinases, phosphatases, adapters and linkers. Polynucleotide tailing.

UNIT - II

Cloning Vectors: Plasmid - conjugative and non conjugative plasmid, Types of Plasmid- Natural plasmids, Artificial plasmid- pBR322 and PUC series. Phage vectors. Plant Vector – Ti plasmid. Animal viral vectors - Retroviral viral vectors, Shuttle vectors, cosmid, phagemid, phasmid. Artificial chromosomes –BACs, YACs.

UNIT - III

Gene transfer methods: Physical, chemical and biological methods of gene transfer- prokaryotes - eukaryotes. Screening and analysis of recombinants, DNA and RNA probes – construction. Analysis of cloned foreign genes. Hybridization techniques – Southern Blotting, Northern Blotting and Western Blotting.

UNIT - IV

Analytical Techniques: PCR, RAPD, RFLP, AFLP, SSCP, protein engineering- site directed mutagenesis, PCR mediated. Alteration of restriction sites, Molecular diagnosis and therapy of cancer, DNA based detection of microbial infection/ contamination.

UNIT - V

Application: Antisense technology, RNAi technology, terminator gene technology, gene therapy- *in vivo* and *ex vivo*. Gene delivery systems - viral and non viral; DNA marker technology in plants, DNA fingerprinting, genetically engineered biotherapeutics and vaccines.

TEXT BOOKS

1. Glick, B.R. and J.J. Pasternack, 2009. Molecular Biotechnology. Panima Publication, NewDelhi.

2. Primrose, S.B., R. M. Twyman and R. W. Old, 2006. Principles of Gene Manipulation, VII Edition, Blackwell Science Publishing Company, Germany.

REFERENCES

1. Brown, T.A., 1999. Genome. II Edition. Wiley-Liss, New York
2. Brown, T.A., 2006. Gene cloning - An introduction. III Edition, Stanley thrones Publishers Ltd, New York.
3. Winnacker, E.L., 2003. From Genes to Clones. Panima Educational Book Agency, New Delhi.
4. Watson, J.D., M. Gilman and J. Witkowski, 2000. Recombinant DNA. II Edition, Freeman Publication, New York.

Semester - II

15BTP202 FERMENTATION TECHNOLOGY 5H - 5C

Total hours/week: **L:5 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The main objectives of the course are,

- To understand the fermentation process for food manufacturing
- To learn about the microbial metabolism, the use of starter cultures, the process of food transformation
- To know the technological and nutritional impact of fermentation in different foods
- To make the students to understand various techniques involved in the characterization of the microorganism in fermentation and downstream processing
- To understand the technologies which have been adopted for downstream processing
- To Acquire knowledge about the fermented products

Course Outcomes

On completion of the course, students are able to

1. Acquaint knowledge on the designing of fermenter
2. Process the kinetics that will enable them to manipulate it for improvement
3. Discuss the impact of kinetics during fermentation process
4. Understand the nutritional impact of fermentation in different foods
5. Impart knowledge on the various process involved in the fermentation technology
6. Acquaint knowledge on the use of microbes and their role in fermentation process

UNIT - I

Introduction: Isolation and screening of industrially important strains- primary and secondary screening. Strain improvement, mutation, selection of mutants, recombination – bacteria, fungi and actinomycetes, assay and fermented products. Fermentations- submerged, solid state.

UNIT - II

Media: Media formulation – sterilization – batch and continuous sterilization, sterilization of air, fibrous filters. Microbial kinetics: batch, fed-batch and continuous cultures, phases of batch growth. kinetics of cell growth, product formation, substrate utilization, product inhibition kinetics, yield concept and productivity.

UNIT - III

Design of fermenter: Types – CSTR, Tower, Jet loop, Air lift fermenter, Fluidized bed reactor, bubble column, packed bed. Fundamentals of process control and monitoring – on line and off line analysis, feed back control, PID controller, computer aided control.

UNIT - IV

Kinetics: Transport phenomena – Rheological properties, determination of O_2 mass transfer, heat transfer, role of aeration and agitation, factors affecting O_2 transfer. Production of chemicals – alcohol, antibiotics – Penicillin and Streptomycin, Single cell proteins.

UNIT - V

Downstream processing: Cell distribution methods for intracellular products; foam separation, precipitation. filtration – micro and ultra-filtration; Solvent extraction, Liquid extraction, chromatographic separation, dialysis, centrifugation, distillation, drying, crystallization, turbidity analysis and cell yield determination. Fermentation products- available in market.

TEXT BOOKS

1. Stanbury P F., A Whitaker and S J Hall, (1997) "Principles of Fermentation Technology", Adithya Book Pvt Ltd, Chennai.
2. James E Bailey and David Follis, (1999) "Biochemical Engineering Fundamentals", 2nd Edition, Mc Graw Hill Book Company. Boston.

REFERENCES

1. Wulf Crueger and Anneliese Crueger, (2004) Textbook of Industrial Biotechnology, 2nd Edition, Panima Publishing Corporation, New Delhi.
2. Pauline M Doran, (1995) Bioprocess Engineering, Academic press, New York.
3. Doran P.M. (1995) Bioprocess Engineering Principles, 2nd Edition, Academic Press, London.
4. Shuler ML and Kargi F (2008) Bioprocess Engineering Basic concepts, 2nd Edition, Prentice Hall, Upper Saddle River, NJ.

Semester - II

15BTP203 ENVIRONMENTAL BIOTECHNOLOGY 4H - 4C

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The main objectives of the course are,

- To understand the basic concepts of ecosystem and waste management
- To realize the importance of microbes as a source of food biomass, fuel and to understand the methodologies available for treatment of solid wastes
- To integrate the appropriate aspects of pollution, its control measures and various treatment strategies
- To study the physic-chemical parameters with regards to environmental pollution
- To impart knowledge on the conservation strategy of numerous organisms
- To understand the environmental stress related factors

Course Outcomes

On completion of the course, students are able to

1. Comprehend the various biotechnological approaches to environmental management
2. Learn the strategies for obtaining energy from various natural sources and for energy conservation
3. Understand the concept of bioremediation to handle environmental toxins
4. Analyze the harmful effects of waste water disposal to the environment and the biotechnological solutions
5. Able to develop strategies for the conservation of existing organisms
6. Acquaint knowledge on the environmental impact assessment

UNIT - I

Introduction: Introduction to Biotechnology. Role of Environmental Biotechnology. Market for Environmental Biotechnology. Microbes and metabolism. Fundamentals of biological intervention.

UNIT - II

Pollution and pollution control: Classifying pollution - toxicity; persistence; mobility; ease of control; bioaccumulation; chemistry. Pollution control strategies – dilution and dispersal, concentration and containment. Practical applications to pollution control – biofilters, biotrickling filters, bioscrubbers. 'Clean' Technology - process changes, biological control, bio-substitutions.

UNIT - III

Contaminated land and bioremediation: Remediation Methods - generalised categories, biological, chemical, physical, solidification/vitrification, thermal, Intensive and Extensive technologies. *In situ* techniques – Biosparging, Bioventing, Injection recovery. *Ex situ* techniques - Land farming, Soil banking, Soil slurry reactor. Use of bioremediation, Factors affecting the use of bioremediation.

UNIT - IV

Aerobes and effluents: Biological decomposition of organic carbon, Nitrogen and Phosphate removal. Biological removal, biotransformation, and biosorption of metal ions. Aerobic and

Anaerobic Degradation of Xenobiotics. Bioaugmentation for degradation of Xenobiotics. Industrial sources of waste water. Treatment strategies.

UNIT - V

Phytotechnology and Photosynthesis: Terrestrial phyto-systems (TPS), phytoremediation of metals and pollutants. Organic phytoremediation. Hydraulic containment. Aquatic phyto-systems (APS), Macrophyte treatment systems (MaTS), Nutrient film techniques (NFT), Algal treatment systems (ATS).

TEXT BOOKS

1. Evans, G.M. and J. C. Furlong, 2003. Environmental Biotechnology: Theory and Applications. John Wiley & Sons Ltd, West Sussex, England.
2. Jördening, H.J. and J. Winter, 2005. Environmental Biotechnology. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.

REFERENCES

1. Agarwal, S.K., 2002. Environmental Biotechnology. APH Publishing Corporation, New Delhi, India.
2. Mara, D., 2003. The Handbook of Water and Wastewater Microbiology. Academic Press, London, England.

Semester - II

15BTP204A NANO BIOTECHNOLOGY 4H – 4C

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Obtain fundamental concepts of nanobiotechnology
- Offer a strong knowledge in the interface between chemistry, physics and biology on the nano structural level with a focus on biotechnological usage
- Provide advanced training in the area of nanobiotechnology
- Understand the interaction of nanomaterials with biological molecules and cells
- Learn nanomaterials and their use with biocomponents to synthesize and address larger systems
- Produce highly skilled individuals suited for the fast-changing requirements of today's advanced workforce

Course Outcomes

On successful completion of the course, students will be able to:

1. Recognize the role of bionanotechnology as an interdisciplinary tool and to understand how to use these new tools in to solve problems in biological systems
2. Demonstrate knowledge and understanding of biomolecules and biomolecular interactions, and the relationship between molecular dynamics, nanoscale physics and macroscopic system behaviour
3. Explain biophysical mechanisms in the context of nanobiotechnology application areas
4. Analyze and discuss the engineering requirements of multidisciplinary technology based on biology
5. Explain the challenges of commercializing new technologies
6. Demonstrate technical and cognitive skills associated with nanobiotechnology

UNIT - I

Nanotechnology: Definition, The fundamental Science behind nanotechnology- electrons, atoms and ions, molecules, metals, biosystems Nanoanalysis

UNIT - II

Microfluidics and Lab-on-a-chip: Materials of Microfluidic Components. Silicon, Glass, polymers, fluid structure, fabrication methods. Surface modifications, Spotting, Detection mechanics.

UNIT - III

Natural Nano scale sensors. Biosensors. Biomedical applications: drugs, drug delivery, molecular motors. Neuro electronic interfaces, Nanoluminescent tags, imaging and mapping. Defined networks of Neuronal cells *in vitro,* physiology of information processing within Neuronal Networks, Topographical patterning, Photolithographic patterning, Photochemical patterning.

UNIT - IV

Microcontact printing of proteins: Strategies for printing proteins on surfaces, Contact processing with hydrogel stramps, Affinity contact printing, Micro contact printing polypeptides and proteins, Printing one type of biomolecules, substrates, resolution and contrast of patterns, Activity of printed molecules, Printing multiple types of proteins, Molds and stamps, Surface chemistry, Characterization of printed patterns.

UNIT - V

Applications of Nanotechnology: Nanoparticles in bio- degradation, nanomaterial-based adsorbents for water treatment, possible mutagenic properties of nanoparticles, nanoparticle bioaccumulation. Nanoparticles in biomedical and clinical applications.

TEXT BOOKS

1. Niemeyer, C.M. and C. A. Mirkin, 2004. Nanobiotechnology Concepts,Application and Properties. Wiley – Vch Publishers, New york.

REFERENCES

1. Rao,C.N.R., 2006. The Chemistry of Nanomaterial: Synthesis, Properties and Applications. Vol I and III,Springer on line book.

2. Muralidharan, V.S. and A.Subramanian, 2009. Nanoscience and technology. CRC Press, New Delhi.

3. Ratner, M. and Ratner, D. 2005. Nanotechnology- a Gentle Introduction to the Next Big idea. Pearson Education, Inc. London.

4. Dinh, T.V. 2007. Nanotechnology in Biology and Medicine: Methods, Devices and Applications.CRC Press. NewDelhi.

Semester - II

15BTP204B PHARMACEUTICAL BIOTECHNOLOGY 4H – 4C

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Obtain basic skills necessary for employing biotechnology principles in together with various pharmaceutical parameters
- Understand novel formulation approaches for better delivery of biotechnology derived drugs, such as reverse micelles, liposomes, microemulsions and microencapsulation
- Attain knowledge on the delivery of peptides and proteins by the parenteral, oral, transdermal and nasal routes of administration
- Recognize novel biotechnology products and their use in therapeutics and diagnostics.
- Comprehend the physical and chemical properties of the solution/colloidal/dispersion that influence physical stability of the bioactive macromolecule with emphasis on aggregation behavior, its identification and its impact on bioactivity
- Learn about special storage, handling, reconstitution and administration conditions and techniques for drug delivery systems containing bioactive macromolecules

Course Outcomes

On successful completion of the course, students will be able to

1. Evaluate different pharmaceutical parameters of current biotechnology products
2. Determine parameters related to stability and formulation of biotechnology products
3. Discuss the quality control procedures related to biotechnology products
4. Demonstrate novel formulation methods for better delivery of biotechnology derived drugs
5. Evaluate different techniques related to separation and purification of cell types; conduct techniques for measuring cell turnover and growth, conduct cytotoxicity assays
6. Join pharmaceutical biotechnology lab and industries as a research assistant

UNIT - I

Introduction: Classification of Pharmaceuticals - Solutions, suspensions, tablets, capsules. Drugs and its sources, Routes of Drug Administration, Absorption and Bioavailability, Distribution, Drug metabolism, Drug theories, Drug Receptor interactions, Pro-drug concept.

UNIT - II

Biotechnology and health: Drug design; drug development; random screen up, target identification and validation, drug discovery, drug delivery. Drug abuse, self-poisoning. pharmacogenomics, biochip.

UNIT - III

Biotechnology and Pharmacy: Genetically engineered protein and peptide agents, novel drug delivery systems – non convectional routes of administration, Anti-AIDS drug development,

oncogenes as targets for drugs, Multi-drug resistance, vaccine development and role of genetic engineering in controlling infectious diseases, gene therapy, and stem cell therapy.

UNIT - IV

Enzyme Technology: Sources of enzymes, extraction and purification: Applications pharmaceutical, therapeutic and clinical. Production of amyloglucosidase, glucose isomerase, amylase and trypsin, Techniques of immobilisation of enzymes and their applications in the industry. Reactors for immobilised systems and perspective of enzyme engineering.

UNIT - V

Novel Drug Delivery Systems: Introduction to the drug carrier, liposomes as a drug carrier, biodegradable polymers as a drug carrier. Modified Drug Release: The sustained release, first order release approximation, multiple dosing.

TEXT BOOK

1. Jay P Rho, Stan G Louie 2003. Hand book of Pharmaceutical Biotechnology, Pharmaceutical products press, New york.
2. http://munatih-alsahab.blogspot.com/2009/03/fundamentals-of-medicinal chemistry.html. (E- book)
3. Ajay K. Banga, (2004).Therapeutic Peptides and Proteins: Formulation, Processing, and Delivery Systems, 2nd Ed. Mercer University, Macon, Georgia, USA.

REFERENCES

1. Satoskar, R. S., S. D. Bhandhakan and S. S. Alinaoure, 2000. Pharmacology and Pharmacotheraoeutics. 17th Edition, Popular Prakashan Publishers, Mumbai.
2. Bhagvan, N.V., 2002. Medical Biochemistry. Academic Press, New York.
3. Harvey,R.E., Lipin and W. C. Walters, 2002. Pharmocology.4th ED. Kluwer Company, New York.
4. Daan, J. A., Crommelin and R. D. Sindelar, 2002. Pharmaceutical Biotechnology. III Edition, Routledge Taylor and Francis Inc, New York
5. Sethi, P.D., 2005. Quantitative Analysis of Drugs in Pharmaceutical Formulations. III Edition, CBS Publishers and Distributers. New Delhi.
6. Manfred E. Wolff. 2000. Burger's Medicinal Chemistry and Drug Discovery. 5th Ed. Wiley and Sons, USA.
7. Daan Crommelin, Robert D Sindelar, 2002. Pharmaceutical Biotechnology, Taylor and Francis Publications, New York.

Semester - II

15BTP204C **BIO ENERGY TECHNOLOGY** **4H – 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Provide an overview of the basic process of bioenergy
- Understand different strategies to convert biomass to biofuels
- Obtain knowledge on the available technologies and how these could meet the growing demand for energy in the future
- Understand biomass biodegradability and bioconversion rate in relation to energy yields
- Describe biochemical processes of biomass conversion to bioenergy production with focus on fermentation and anaerobic digestion
- Understand technological potentials of biogas, bioethanol, biofuel and biohydrogen

Course Outcomes

On successful completion of the course, students will be able to

1. Demonstrate bioenergy production processes adequate to diverse biomass characteristics
2. Discuss state-of-the-art technologies of generating biofuels from sustainable bioresources
3. Discuss and propose feasible biofuel technologies and biofuel products from selected biomasses
4. To illustrate a bio-energy thermo-chemical conversion process
5. Design biogas reactor capacity and propose optimal and economically viable technical operational condition
6. Demonstrate sequential bioethanol and biogas production and compare bioethanol and biogas scenarios with respect to energy recovery

UNIT - I

Biofuel: Introduction, features, undesirable features, Energy crops – wood, sugar and starch crops, hydrocarbon producing crops. Modes of utilization of biomass.

UNIT - II

Biogas: Substrate, digester, microorganisms, process of biogas production, factors affecting biogas yield, precautions, advantages and disadvantages.

UNIT - III

Bioethanol: Introduction, bioethanol vs. petrol, production of bioethanol – yeast, sugar and starch crops, ethanol recovery.

UNIT - IV

Biodiesel: Introduction, lipids as a source of biodiesel – algae, sunflower, rapeseed, linseed, soybean, jatropha, peanut, biodiesel from hydrocarbons. Biobutanol – *Clostridium,* molases.

UNIT - V

Biohydrogen: Single cell microbial oil, Hydrogen as fuel – production - methods - electrolysis of water, gasification, biological agents. Biohydrogen production – anaerobic fermentation, photolyses and photosynthetic methods.

TEXT BOOKS

1. Mazumdar, B. 2003 A Textbook of Energy Technology. McGraw-Hill, Inc., New York.
2. Shepard, Marion L., 2000 Introduction to Energy Technology. McGraw-Hill, Inc, Newyork

REFERENCES

1. Grant, W.D. and P.E.Long, 2001. Environmental Microbiology. Blakie publications, Glasgow.

2. Reddy, G. M., M.N. Reddy, D.V.R. Saigopal and K.V. Mallaiah, 2007. Laboratory Experiments in Microbiology, II Edition. Himalaya Publishing House, Mumbai.

Semester - II

15BTP204D MEDICINAL PLANT BIOTECHNOLOGY 4H – 4C

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Learn about the biochemical parameters used in the in the identification and utilization of medical plants
- Understand the extraction procedures of phytochemicals
- Exploit and explore the medicinal values of plants
- Gain knowledge about various drugs, its effects, drug metabolism, drug receptors, drug tolerance, dependence and resistance with therapeutic monitoring of drugs
- Understand comprehensive information and insights in pharmaceutical biotechnology and the development of biopharmaceuticals in pharmaceutical industry
- Obtain scientific knowledge of designing and mechanism of action of drugs

Course Outcomes

On successful completion of the course, students will be able to

1. Know the biosynthesis of primary and secondary metabolites involved in plants
2. Understand the concept of phyto-chemical extraction and principles involved in DNA and chemical fingerprinting techniques
3. Know about applications of phyto-constituents in development of drug
4. Validate the results obtained using the techniques involved in photochemical analysis
5. Imparting a comprehension of basic skills necessary for employing biotechnology principles
6. Understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related products on the market

UNIT - I

Phytochemistry: Biosynthesis of primary and secondary metabolites - alkaloids, terpenoids, Phenolic compounds and coumarins. Classification of alkaloids and phenolic compounds.

UNIT - II

General extraction and isolation techniques: Alkaloids and phenolic compounds from plants. Techniques involved in extraction of phytochemicals – Perculation, Soxhlet extraction, reflux and other methods.

UNIT - III

Biotechnology of medicinal plants: Production of secondary metabolites from cultured plant cells, elicitation, immobilization and biotransformation. DNA bar coding. DNA fingerprinting of medicinal plants – DNA isolation and fingerprinting techniques.

UNIT - IV

Bioactive studies: Anticancer, antidiabetic, anti-inflammatory, hepatoprotectives, antimicrobials from medicinal plants. Antioxidants of plant origin – Reactive Oxygen Species (ROS). Toxicity studies on medicinal plant products and herbal formulations.

UNIT - V

Pharmacognosy: Authentication of medicinal plants – Organoleptic and other pharmacognostic studies. Anatomical studies. Organic cultivation of medicinal plants

REFERENCES

1. Harborne, J.B. 1998. *Phytochemical methods to modern techniques of plant analysis* Chapman and Hall, London.

2. Trease GE, Evans, M.C. 1979. *Textbook of Pharmacognosy* 12th ed. Balliere-Tindal, London.

3. Irfan A. Khan and Atitya Khanum. 2004. *Role of Biotechnology in medicinal and Aromatic plants,* Vols. I-X. Ukaaz Publications, Hyderabad.

Semester - II

15BTP204E **LIVE STOCK MANAGEMENT** **4H – 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- To familiarize with aspects of animal farming, problems and prospectus, principles of housing, breeding, feeding and health care of animals
- The student should be able to apply principles and concepts to make management decisions
- The course will present and explore options available to livestock producers in techniques
- The students will gain experience with different livestock management practices
- To explain the methodology of selection and breeding systems for genetic improvement of livestock
- To educate about basic principles of animal physiology and their applications in improving farm animals

Course Outcomes

On successful completion of the course, students will be able to

1. This course is designed to provide an overview and understanding of common and routine livestock management techniques, facilities and decision making
2. Students will know how to palpate cattle, to administer vaccinations, minor surgical techniques, freeze branding, hoof care, proper restraint, and safety in working with animals
3. Students are expected to show proficiency in all topics presented on the course outline.
4. This course will provide adequate knowledge about the animal breading techniques to students
5. Gain knowledge about various drugs to treat animal diseases
6. Gain knowledge commercial production of livestock and its maintenance

Unit - I

Introduction to livestock: Importance of livestock management; characteristics of a good farm manager; livestock population and its trends; role of farm animals in the national economy; types and breeds of livestock; principles of farm animal management; importance and objectives of housing; farm sanitation and waste disposal; transportation of farm animals; quarantine measures; behaviour and welfare of farm animals.

Unit - II

Animal physiology and behaviour: Functional histomorphology male and female reproductive system; Endocrine glands- Concepts in hormone function. Blood and its components constituents' properties and functions of blood. Importance of animal behaviour studies - Patterns of behaviour - Daily and seasonal cycles of behaviour. Environmental modification of behaviour - Developmental changes in behaviour - Genetic differences in behaviour.

Unit - III

System of housing and hygiene: Housing - General principles, planning, layouts for livestock farm of different sizes indifferent climatic zones, Farm structures. Hygiene: air hygiene, Composition of air, Air pollution – Factors, Assessment, control measures; water hygiene, Importance of water - Impurities – Sterilization - Hygienic requirements and standards for drinking water- Quantity of water - Methods of watering.

Unit - IV

Nutrients and Feedings: Fundamental concepts of Digestion and metabolism of Carbohydrate, Fat and Protein in different species of animals. Gluconeogenesis, Recent advances in glucogenic precursors on acetate utilization. NPN metabolism, measures of feed energy, feeding standards, commercially available feeds.

Unit - V

Breeding Management and disease control: Breeding seasons - fitness of purchase for first breeding - methods of detection of heat - Natural Service and artificial insemination - Care of the pregnant Animals - Breeding stock - Use of teaser- Culling. Common diseases and their control measure. Management of specific pathogen free and gnotobiotic animals, concepts to related to welfare of laboratory animals; Transportation of Laboratory animals – marketing of meat and fur. Importance and applications of laboratory animals.

REFERENCES

1. Applied Nutrition: (Livestock, Poultry, Human, Pet, Rabbit and Laboratory Animal Nutrition). IBH & Oxford. Ronald N & Penman S. 1991.
2. A Manual for Small Scale Rabbit Production. South Asia Publ.
3. McDowell LR. 2003. Minerals in Animal and Human Nutrition. Reed Elsevier India.
4. Peter RC. 2005. Applied Animal Nutrition Feeds and Feeding. Pearson Prentice Hall.
5. Bouenger EG. 1994. Animal Behaviour. WB London.
6. Sastry NSR & Thomas CK. 2006. Livestock Production and Management. Kalyani.
7. Wathes CM & Charles DR. 1994. Livestock Housing. CABI.

Semester - II

15OEP201 **MUSHROOM TECHNOLOGY** **0H – 3C**

Total hours/week: **L:0 T:0 P:0** **Marks:** Internal:0**0** External:100 Total: **100**

Course Objectives

The objectives of the course are to make the students to

- This paper will help in develop entrepreneurship among the students
- To identify the edible and nonedible mushrooms
- Enable the students to identify edible and poisonous mushrooms
- Provide hands on training for the preparation of bed for mushroom cultivation and spawn production
- Give the students exposure to the experiences of experts and functioning mushroom farms
- Help the students to learn a means of self-employment and income generation

Course Outcomes

On successful completion of the course, students will be able to

1. Appreciate the importance of embarking on self-employment and has developed the confidence and personal skills for the same.
2. Identify business opportunities in chosen sector / sub-sector and plan and market and sell products / services
3. Start a small business enterprise by liaising with different stake holders
4. Effectively manage small business enterprise
5. Take up Mushroom Cultivation and run it profitably
6. Selection of important types of Mushroom and their cultivation

UNIT - I

Introduction: Historical Development, Fungal Habitat, Mushroom Taxonomy, Types of Mushrooms, Cultivation Modalities - Parasitic, Mycorrhizal, Saprobic and Opportunistic.

UNIT - II

Mushroom Cultivation: Methods in mushroom cultivation- Paper Sack Capture, Raised Bed Mushroom Culture, Compost Making, Log Mushoom Culture, Mycorrhizal Mushrooms, Straw Bale Culture, Making, Mycelial Mats and Mycoremediation.

UNIT - III

Substrate Preparation: Phase-I Composting - Windrow formation – Temperature – Oxygen Requirement – Bed preparation for Spawn production. Phase-II Composting - Elimination of ammonia – Pasteurization of composting – Spawn production – Spawning.

UNIT - IV

Mushroom Fermentation: Substrate Fermentation – Carbon to Nitrogen ratio (C/N) – water - Acidity requirement. Applying and Stacking Mushroom Culture in Developing and Established Farms and Gardens. Choosing Mushroom species.

UNIT - V

Fruit bodies - Mushroom formation - Fruiting body formation – Picking and packaging -Processing problems - Pest Management - Marketing Mushrooms - Market Demand - Market Research- Adding Value to Fresh Mushrooms and value-added products.

TEXT BOOKS

1. James, M.J., 2000. Modern Food Microbiology. IV Edition, CBS Publishers and distributors, New Delhi.

2. Frazier, W.C. and Dennis C.W., 2002. Food microbiology. IV Edition, TATA McGraw-Hill Publishing Company Limited, New Delhi.

REFERENCES

1. Aneja, K.R., 2005. Experiments in microbiology, plant pathology, tissue culture and mushroom production technology. Iii edition, new age international publishers, new delhi.

2. Beausrjour and Marie, T., 1999. Mushrooms in the garden. Mushroom the journal. Fall. P. 17–19.

3. Franklin, G., 1996. Truffle cultivation in North America. Garland gourmet mushrooms and truffles, Inc., Hills Borough, NC. 41 p.

Semester - II

15BTP211 RECOMBINANT DNA TECHNOLOGY-PRACTICAL III 5H - 3C

Total hours/week: **L:0 T:0 P:5** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Be familiarize with practical knowledge in the emerging field of biotechnology: Recombinant DNA technology
- Perform basic molecular biology techniques including DNA and RNA isolation from microbes, plants and animals
- Acquaint versatile tools and techniques employed in recombinant DNA technology such as restriction and digestion, ligation, transformation and PCR
- Obtain practical knowledge on blotting techniques
- Acquire knowledge on quality and quantity checking of nucleic acids
- Comprehend the applications of recombinant DNA technology in human health care

Course Outcomes

On successful completion of the course, students will be able to

1. Carry out DNA and RNA isolation from microbes, plants and animals
2. Perform recombinant DNA techniques including restriction-digestion, ligation, transformation and PCR
3. Carry out versatile recombinant DNA techniques
4. Perform quality and quantity checking of nucleic acids
5. Demonstrate various blotting techniques
6. Join in research and clinical labs as a project/ research assistant

List of Practicals

1. Isolation of total DNA from Microbes (*E. coli*)
2. Isolation of total DNA from plant
3. Isolation of total DNA from animal cells
4. Isolation of plasmid DNA
5. Isolation of total RNA from Yeast
6. Quality and quantity checking of Nucleic acids
7. Restriction digestion of DNA
8. Ligation of DNA
9. Transformation of plasmid DNA using calcium chloride
10. Amplification by PCR
11. SDS-Polyacrylamide gel electrophoresis method
12. Southern blotting
13. Northern blotting
14. Western blotting

REFERENCES

1. Glover, D.M. and B.D. Hames, 2000. DNA Cloning a Practical Approach. IRL Press, Oxford.
2. James, J.G. and V.B. Rao, 2001. Recombinant DNA Principles and Methodologies. Marcel Dekker Publications, NewYork.
3. Maliga, P., 2000. Methods in Plant Molecular Biology. A Laboratory Course Manual, Cold Spring Harbour Laboratory Press, NewYork.
4. Brook, J.S., E.F. Fritsch and T. Maniatis, 2000. Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.

Semester - II

15BTP212 FERMENTATION TECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY PRACTICAL IV **5H - 3C**

Total hours/week: **L:0 T:0 P:5** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Be familiarize with practical knowledge in fermentation and environmental biotechnology fields
- Perform isolation and secondary screening of industrially important microorganisms
- Acquaint versatile tools and techniques employed in fermentation biotechnology such as enzyme immobilization, wine production and downstream processing
- Obtain practical knowledge on basic environmental techniques such as water quality test
- Gain hands on experience in quantifying chemical and biological oxygen demand
- Comprehend the protocol to analyze heavy metals

Course Outcomes

On successful completion of the course, students will be able to

1. Carry out isolation and screening of industrially important microorganisms
2. Perform analytical techniques including thermal death point and thermal death time
3. Explain the principles of enzyme immobilization, wine production and downstream processing
4. Describe the basic knowledge about testing the water quality via pH analysis
5. Perform various techniques to quantify total solids, chemical oxygen demand and biological oxygen demand
6. Join as a technician in quality control section in fermentation-based industries and environmental analysis labs

List of Practicals

Fermentation Technology

1. Isolation and secondary screening of industrially important microorganisms.
2. Auxotrophic mutants
3. Thermal death point and Thermal death time.
4. Production of amylase and protease.
5. Enzyme immobilization
6. Wine Production and alcohol determination by chromic acid method
7. Down stream processing by Solvent extraction,
8. Partial purification by Ammonium sulphate precipitation,
9. Partial purification by Dialysis
10. Quality checking by SDS PAGE

Environmental Biotechnology

1. Water quality tests for pH
2. Determination of total solids
3. Determination of Chemical Oxygen Demand
4. Determination of Biological Oxygen Demand
5. Analysis of heavy metals (Iron/Chromium)

REFERENCES

1. Aneja, K.R., 2004. Experiments in Microbiology Plant Pathology and Biotechnology. New Age International, New Delhi.

2. Metcalf, L. and R. Eddy, 2005. Waste Water Engineering. Tata McGraw Hill, New Delhi.

3. Palvannan,T., S. Shanmugam and T. Sathishkumar, 2005. Laboratory Manual on Biochemistry, Bioprocess and Microbiology. SciTech Publications India Pvt. Ltd, Chennai.

Semester - III

15BTP301 **PLANT BIOTECHNOLOGY** **4H - 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students

- To provide various techniques and aspects regarding Plant biotechnology
- To equip students with theoretical knowledge regarding the techniques and applications of Plant Biotechnology and Genetic Engineering
- To provide comprehensive training in the plant biotechnology and its application for increasing agricultural production, environment improvement, human, nutrition and health
- To get a career in Industry/R&D/Academic
- To learn about genome organization in plants, basic techniques in tissue culture and its applications
- To acquire knowledge about the genetic transformation in plants, metabolic engineering, production of pharmaceuticals and industrial products and plant molecular farming

Course Outcomes

On successful completion of the course, students will be able to

1. Describe the genome organizations in plants
2. Elaborate on the plant cell and tissue culture systems
3. Explain the genetic transformation techniques in plants
4. Demonstrate the application of genetic transformation techniques in plants
5. Evaluate the importance of metabolic engineering and molecular farming in plants
6. Join as a project assistant in Phyto pharma Industries

UNIT - I

Introduction: Principles of Plant Breeding: Important conventional methods of breeding – self, cross pollinated and vegetatively propagated crops. Non-conventional methods. Polyploidy, Genetic variability. Genome organization in plants – mitochondria and chloroplast. Cytoplasmic male sterility.

UNIT - II

Micropropagation: Tissue culture media – composition and preparation, Callus and suspension culture, somoclonal variation, micropropagation, organogenesis, somatic embryogenesis, Embryo culture and embryo rescue. Haploidy; protoplast fusion and somatic hybridization; cybrids; anther, pollen and ovary culture for production of haploid plants and homozygous lines. Plant hardening transfer to soil, green house technology.

UNIT - III

Plant Genome Organization – Chloroplast, Mitochondria, and Nucleus Strategies in bioconversion. Production of pharmaceutical compounds. Mass cultivation of plant cells. Secondary metabolite Production from Suspension Culture, Bioreactors – Photo bioreactor. Production of secondary metabolite in plants, stages of secondary metabolite production, uses of tissue culture techniques in secondary metabolites.

UNIT - IV

Plant genetic Engineering: Methodology; Plant transformation with Ti plasmid of *Agrobacterium tumifacians*; Ti plasmid derived vector systems, Ri plasmids; Physical methods of transferring genes to plants - Microprojectile bombardment, Electroporation; Manipulation of gene expression in plants; Production of marker free transgenic plants.

UNIT - V

Application of Genetic transformation: Productivity and performance: herbicide resistance, insect resistance, virus resistance, fungal resistance, nematode resistance, Induction of abiotic stress and cold stress. Delay in fruit ripening, terminator seed technology, plantibodies, edible vaccines - primary and secondary metabolite modification, biopolymers, plant-based enzyme engineering.

TEXT BOOKS

1. Slater,A., N.W. Scott and M. R. Fowler, 2008. Plant Biotechnology. Oxford University Press, Oxford.

2. Ignacimuthu, S., 2004. Plant Biotechnology. Oxford and IBH Publishing House, New Delhi.

REFERENCES

1. Chawla H.S 2002. Introduction to Plant Biotechnology Oxford and IBHP Publishing Co.Pvt. Ltd. New Delhi.

2. Kumar,U., 2008. Plant Biotehnology and biodiversity conservation. Agrobios, Jodhpur.

3. Stewart, N.C., 2008. Plant Biotechnology and Genetics. John Wiley & Sons, Inc., New Jersey.

4. Halford, N. and N. G. Halford, 2006. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops. John Wiley & Sons, New Jersey.

5. Nirmala, C.B., G. Rajalakshmi and C. Karthik, 2009. Plant Biotechnology. MJP Publication, Chennai.

Semester - III

15BTP302 **ANIMAL BIOTECHNOLOGY** **4H - 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Provide an experience for the students in an interdisciplinary research program connecting animal genomics with animal reproduction and biotechnology
- Introduce biotechnological methods for production of transgenic animals
- Give knowledge about various methods of gene transfer in animals
- Cognize and get the knowledge on techniques to protect endangered animals
- Explain the basics of the physiological and molecular processes for animals facing environmental adaptations
- Use basic biotechnological techniques to explore molecular biology of animals
- Understand the processes involved in the planning, conduct and execution of animal biotechnology experiments

Course Outcomes

On successful completion of the course, students will be able to

1. Understand the growth conditions required to culture the animals in *in vitro* conditions.
2. Inculcate the deep understanding of Gene expression system of animals
3. Acquire knowledge on producing Transgenic animals
4. Inculcate the deep knowledge on the processes involved in planning, conduct and execution of animal biotechnology experiments
5. Discuss the structure and organization of animal genome
6. Work as a research assistant in animal biotechnology industries

UNIT - I

Animal cells: culture media, types of media, balances salt solutions. Physical, chemical and metabolic functions of different constituents of culture medium; role of carbon dioxide, serum, growth factors, glutamine in cell culture; serum and protein free defined media and their applications.

UNIT - II

Cell culture: Types, disaggregation of tissue, primary culture, established culture; suspension culture, organ culture, three-dimensional culture and tissue engineering, feeder layers; cell synchronization; cryopreservation. Biology and characterization of cultured cells, tissue typing; cell – cell interaction; measuring parameters of growth; measurement of cell death – apoptosis and its determination.

UNIT - III

Molecular cell techniques: cell transformation- physical, chemical and biological methods; manipulation of genes; cell and organism cloning; green fluorescent protein and its application. Gene therapy.

UNIT - IV

Embryology: Collection and preservation of embryos; culturing of embryos; gametogenesis and fertilization in animals; types of cleavage pattern; role of maternal contributions in early embryonic development; *In vitro* fertilization and stem cell research.

UNIT - V

Transgenics: Transgenic animals; production and application; transgenic animals as models for human diseases; transgenic animals in live- stock improvement; expression of the bovine growth hormone; transgenics in industry. Ethical issues in animal biotechnology.

TEXT BOOKS

1. Ranga, M. M., 2003. Animal Biotechnology, II Edition, Agrobios India, Jodhpur.India.

2. Freshney, R.I., 2000. Animal Cell Culture: A Practical Approach. IV Edition, John Wiley Publications, New York.

REFERENCES

1. Glick, B.R. and J.J.Pasternack,2003. Molecular Biotechnology. 3rd ED. Blackwell Science, U.K **.**

2. Gordon, I., 2003. Laboratory Production of Cattle Embryos. II Edition, CAB International. New Delhi.

3. Houdebine, L.M., 1997. Transgenic Animals: Generation and Use. V Edition, CRC Press, New york.

4. Jenkins, N., 1999. Animal Cell Biotechnology Methods and Protocol. Humana Press, Totowa, New Jersey and Panima Publishing Corporation, New Delhi.

5. Yagasaki, K., Y. Miura, M. Hatori and Y. Nomura, 2008 .Animal Cell Technology: Basic and Applied Aspects. Vol. 13 .Springer-Verlag, New York.

6. Primrose, S. B., R. M. Twyman and R. W. Old, 2001. Principles of Gene Manipulation. VI Edition, Blackwell Science Publishing Company, Germany.

7. Portner,R., 2007. Animal Cell Biotechnology: Methods and Protocols. Vol. 24 Springer-Verlag, New York, LLC

Semester - III

15BTP303 **IMMUNOTECHNOLOGY** **4H - 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Expose the students with the immune system of human body
- Understand about our immune system and the immune response of cells and organs
- Obtain key concepts on gene-re-arrangement of immunoglobulin and T-cell receptor genes, and antigen processing and presentation.
- Comprehend the principles of immunological techniques like hybridoma technology and catalytic antibodies synthesis
- Understand strong fundamental knowledge in tumor immunology
- Attain the principles involved in vaccine technology including recombinant vaccines
- Recognize the basic concepts in bone marrow and other organs transplantation

Course Outcomes

On successful completion of the course, students will be able to

1. Demonstrate various immunological process including innate and adaptive immunity, cells and organs of immune system, antigen and antibody interaction, immunogenicity and antigenicity, epitopes and antibody structure
2. Describe the organization of Ig genes, class switching in constant regions of genes and expression and regulation of Ig genes
3. Recognize how antigens are processed, presented and immune activation occurs via B- and T- cells activation
4. Appreciate the underlying mechanisms of auto-immune diseases and allergic reactions
5. Illustrate the role of immune system in tumor formation
6. Apply the knowledge of this course in research and pharmacological industries

UNIT - I

Introduction: History and scope, Immunity – types, Antigen and Antibody - biology, structure and functions, super antigens, antigen- antibody interactions, primary and secondary immune response. Humoral and cell mediated immunity**.**

UNIT - II

Immune system: Hematopoiesis and differentiation, Lymphocytes, Lymphoid organs**:** Primary and secondary lymphoid organs. Antigen recognition and presentation, activation of B and T lymphocytes, cytokines and their role in immune regulation. **Complement system** - Classical and alternate pathway.

UNIT - III

Transplantation: MLR, MHC and HLA typing, bone marrow transplantation, organ transplants, immunosuppressive therapy. Hybridoma technology and monoclonal antibodies, immuno-diagnosis and application of monoclonal antibodies in biomedical research, human monoclonal antibodies and catalytic antibodies, Xeno transplantation from various species

UNIT - IV

Hyper sensitivity reactions, auto immune disorders. Tumour immunology: Tumour antigens, immune response to tumours, cancer immunotherapy. Immunodeficiencies – primary and secondary.

UNIT - V

Vaccines: Vaccine technology including DNA vaccines, identification of B and T epitopes for vaccine development. Immuno diagnosis of infectious diseases, immuno screening of recombinant library.

TEXT BOOKS

1. Goldsby, R.A., T. J. Kindt, B. A. Osborne and W.H. J. Kuby, 2004. Immunology. V Edition, Freeman and Company; USA.

2. Tizard, I.R.,2004. Immunology, V Edition, Saunders College Publishing, New York.

REFERENCES

1. Abbas,A.K., A. H. Lichtman and S. Pillai, 2007. Cellular and Molecular Immunology: With student consult Online Access. Elsevier Science, Australia

2. Abbas,A.K., A. H. Lichtman, D.L. Baker, 2008. Basic Immunology: Functions and Disorders of the Immune System.Elsevier Health Sciences, Australia

3. Roitt, I., J. Brstoff and D. Male, 2002. Immunology. III Edition, Mosby Yearbook Europe Ltd, London.

4. Goldsby, R. A., T.J. Kind and B.A. Osborne, 2004. Immunology. V Edition, Freeman and Company, New York.

5. Turgeon, M. L. 2008. Immunology and Serology in Laboratory Medicine. Elsevier Health Sciences, Australia

6. Surendranath, A. and R. Narain, 2004. Immunobiotechnology. Dominant Publishers and Distributors, New York.

Semester - III

15BTP304 GENOMICS AND PROTEOMICS 4H – 4C

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Teach the students a thorough knowledge on genome and proteome identification, analysis and applications.
- Educate students on stand-alone and online software for genetic studies.
- Import the basic and recent developments in the field of genome sequencing, genome mapping, proteomic data analysis
- Develop the knowledge on gene sequencing methods.
- Know the structure and interactions of proteins.
- Describe advanced genomics and proteomics technologies and the ways in which their data are stored
- Use bioinformatics techniques to query examples of genomic and proteomic databases to analyse cell biology
- Describe the different types of genome variation and their relationship to human diseases

Course Outcomes

On successful completion of the course, students will be able to

1. Have a clear understanding on the application of genetic markers in genome mapping.
2. Application of 2D technique to analyze the structure of protein.
3. Analyze the genomic and proteomic data.
4. Acquire knowledge and understanding of fundamentals of genomics and proteomics, transcriptomics and metabolomics and their applications in various applied areas of biology.
5. Discuss how biological systems information relating to genes, proteins and cellular structures can be used to model living cells, and even to create new synthetic cells.
6. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.

UNIT - I

Genome Sequencing: Gene and pseudogenes, Gene structure, Genomes, Sequencing Genomes- methodology, chain termination method, chemical degradation method, automated DNA sequencing, shotgun sequencing and assembly of contiguous DNA sequence. cDNA and Genomic library construction.

UNIT - II

Genomic Mapping: Different types of genome maps and their practical uses, Genetic and Physical mapping techniques. Map resources. Practical uses of genome maps. Genetic Markers - Mini and Micro satellite, STS and EST, SNPs.

UNIT - III

Gene Expressions and Microarrays: Expression systems - Bacteria, Yeast and Viral. Concepts of microarrays, spotter analysis, Normalization –total intensity, using regression techniques, ratio statistics. Clustering Gene expression profiles-hierarchical, single-linkage, complete linkage, and average linkage. Tools for microarray analysis- MADAM, spot finder, SAGE Applications of Microarrays- Bioinformatics challenges in micro array design and analysis.

UNIT - IV

Experimental Proteomics: Proteome analysis- 2D gel electrophoresis: general strategy, immobilized pH gradients, sample preparation, isoelectric focusing, staining, transfer of proteins from gels, image acquisition and analysis of gels. 2DE databases.

UNIT - V

Analytical Proteomics: RP-HPLC, Mass Spectrometry – ESI MS and MALDI techniques and applications. Characterization of protein complexes – Protein - DNA, Protein-protein interactions, yeast two-hybrid system and protein micro arrays – biomarkers.

TEXT BOOKS

1. Brown, T.A., 2002. Genomes. John Wiley & Sons, Singapore.

2. Cantor, C.R. and C. L. Smith, 1999. Genomics: The Science and Technology behind the Human Genome Project, John Wiley and Sons, Singapore.

3. Primrose, S.B. and R. M. Twyman, 2003. Principles of Genome Analysis. Blackwell Publishing, Oxford.

4. Reiner, W. and T. Naven, 2002. Proteomics in Practice. Wiley – VCH, Weinheim.

REFERENCES

1. Gibson, W. and V. Muse, 2003. A Primer of Genome Science. Sinauer Associates Inc. Publishers, Sunderlands, New York.

2. Stekal, D., 2003. Microarray Bioinformatics. Cambridge University Press, Cambridge.

3. Liebler, L.H., 2001. Introduction to Proteomics, Tools for the New Biology. Humana Press, New Jersey.

4. Richard, P. S., 2004. Proteins and Proteomics. A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.

5. Pennington, S. and M.J. Dunn, 2001. Proteomics: From Sequence to Function. Bios Scientific Pub.Ltd. Oxford.

6. Bourne, P.E. and H. Weissig, 2003. Structural Bioinformatics. John Wiley & Sons, Singapore.

Semester - III

15BTP305A **BIOSAFETY AND IPR** **4H – 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Introduce basic concepts of safety that is essential for different disciplines of science and procedures involved and protection of intellectual property and related rights
- Discuss about various aspects of biosafety regulations and IPR concerns arising from the commercialization of biotech products
- Understand balanced integration of scientific and social knowledge in sustainable development
- Attain the benefits of GM technology and related issues
- Identify and discuss the issues and concepts salient to the research process
- Recognize and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project

Course Outcomes

On successful completion of the course, students will be able to

1. Interpret basics of biosafety and its impact on all the biological sciences and the quality of human life
2. Recognize importance of biosafety practices and guidelines in research
3. Apply intellectual property law principles including copyright, patents, designs and trademarks to real problems and analyze the social impact of intellectual property law and policy
4. Comprehend the importance of protection of new knowledge and innovations and its role in business
5. Gain more insights into the regulatory affairs
6. Demonstrate knowledge of research processes such as reading, evaluating, and developing, and to identify, explain, compare, and prepare the key elements of a research proposal and report

UNIT - I

Biosafety: Introduction; Historical Background; Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents. Cartagena protocol on biosafety.

UNIT - II

Biological risk assessment: Biosafety guidelines for Genetically Modified Micro organisms (GMM) and Plants (GMP)-Risk assessment and contained use of GMM and GMPs-guidelines for research activities-import and shipment quality control of biologicals produced by rDNA technology. Guidelines for environmental release of GMM, GMPand GLP.

UNIT - III

Intellectual Property Rights: Types of IP: Patents, Trademarks, Copyright and Related Rights. **Agreements and Treaties:** History of GATT and TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 and recent amendments

UNIT - IV

Research methodology: Scope and significance – Types of Research – Research Process – Characteristics of good research – Problems in Research – Identifying research problems. Research Designs – Features of good designs, Report writing – Introduction, review of Literature, Result interpretation, bibliography.

UNIT - V

Sampling Design: Meaning – Concepts – Steps in sampling – Criteria for good sample design. Scaling measurements – Techniques – Types of scale.

TEXT BOOKS

1. Martin. M.W. and Schinzinger.R. 2003. Ehics in engineering, 3rd Edition, Tata McGraw-Hill, New Delhi.

REFERENCES

1. Bareact, 2007. Indian Patent Act 1970. Acts and Rules, Universal Law Publishing Co. Pvt. Ltd.
2. Kankanala, C., 2007. Genetic Patent Law and Strategy. I Edition, Manupatra Information Solution Pvt. Ltd., India.
3. Biosafety issues related to transgenic crops,DBT guidelines, Biotech Consortium India Limited, New Delhi
4. http://www.actahort.org/members/showpdf?booknrarnr=447_125
5. http://www.biomedcentral.com/content/pdf/1472-6939-2-2.pdf
6. http://www.wipo.int/portal/index.html.en
7. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html

Semester - III

15BTP305B **BIOINFORMATICS** **4H – 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Give knowledge on Bioinformatics and its applications
- Offer knowledge to assess biological databases
- Understand and to analyze protein/nucleotide sequences and to predict its 3D structure
- Understand the various online databases for submitting and retrieving data
- Attain how the phylogeny plays a vital role in finding ambiguities
- Get practiced with the tools and techniques for analyzing the data

Course Outcomes

On successful completion of the course, students will be able to

1. Understand The relationship between sequence - structure - function of genes
2. Familiarize with the algorithms required to compare sequences and require to know the phylogenetic relationship between the gene sequences
3. Inculcate knowledge on building 3D structures of genes
4. Locate and use the main databases at the NCBI and EBI resources
5. Know the difference between databases, tools, repositories and be able to use each one to extract specific information
6. Use selected tools at NCBI and EBI to run simple analyses on genomic sequences

UNIT - I

Introduction: Definitions, Objectives, Scope, Applications of Bioinformatics, History and milestones of bioinformatics, Genome sequencing projects – Steps, Human Genome Project and other genome projects.

UNIT - II

Basic concepts of biomolecules and computers: Basic concepts of biomolecules – Protein and amino acid, DNA and RNA - Sequence, Structure and function.

Basic computer components - Hardware, software, operating systems, computer networks, programming, internet, browsers, search engines, email, databases.

UNIT - III

Biological databases: Types of databases, Sequence databases, Nucleic acid sequence databases - Primary (GenBank, EMBL, DDBJ), Secondary (UniGene, SGD, EMI Genomes, Genome Biology), Protein sequence database – Primary (PIR, SWISS-PROT), Secondary (PROSITE, Pfam), Structural databases (PDB, SCOP, CATH), Bibliographic databases and Organism specific databases.

UNIT - IV

Database searching and Sequence Alignment: Similarity searching programs-BLAST, Sequence alignment - Pair-wise and Multiple-sequence alignment (Methods and Algorithms), CLUSTAL-W, Protein structure alignment (Methods, algorithms- DALI) Phylogenetic analysis (Methods, algorithms).

UNIT - V

Gene prediction: Gene prediction in prokaryote and eukaryotes. Extrinsic approaches and Ab initio approaches. Predicting the protein secondary structure (Domain, blocks, motifs), Predicting protein tertiary structure (Homology, Ab-initio, threading and fold recognition) and visualization of predicted structure.

TEXT BOOKS

1. Jin Xiong, 2006. Essential Bioinformatics, Cambridge University Press.
2. Attwood, K. and J. P. Smith, 2003. Introduction to Bioinformatics. Pearson Education, Singapore.

REFERENCES

1. Rajaraman. V., 2003. Introduction to information technology. Prentice Hall of India Pvt. Ltd, New Delhi.
2. Lesk, A. M., 2002. Introduction to Bioinformatics. Oxford University Press, London.
3. Web resources: http://www.ncbi.nlm.nih.gov/ ; http://www.ebi.ac.uk/2can/databases

Semester - III

15BTP305C **INDUSTRIAL TOXICOLOGY** **4H – 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Acquire knowledge and learn the terminology of the field of Industrial toxicology, understand and be able to describe in detail the toxicological effects of certain dangerous substances
- Describe the relationship of dose - response, and the principle of determining the theoretical expertise on the mutagenic, teratogenic and carcinogenic effects of toxic substances
- Obtain knowledge of current legislation on health protection while working with chemical agents, carcinogenic and mutagenic factors, and biological factors
- Learn about toxic effects of elements and their compounds
- Understand the classification of substances under the new legislation
- Gather and critically interpret toxicological information from diverse resources for human health hazard and risk assessment

Course Outcomes

On successful completion of the course, students will be able to

1. Describe toxicology as a discipline in the overall health sciences framework
2. Explain the basic concepts of chemical hazard and exposure as determinants of chemical toxicity
3. Describe key pathways and mechanisms of chemical absorption, distribution, metabolism, storage and excretion in the human body
4. Explain dose-response relationships as the basis of toxicity
5. Outline the derivation of reference dose and other related measures of occupational exposure
6. Describe the scientific basis of occupational exposure assessments and practical methods for their determination

UNIT - I

Introduction: Scope, Divisions of Toxicology, General principles of toxicology, - Classification of Toxic Agents. Mechanism of action of toxicants, Routes of exposure-absorption and translocation.

UNIT - II

Toxicokinetics: Absorption, Distribution, Metabolism and Excretion, Factors influencing Toxicity, Dose-effect and Dose response relationship- LD50, LC50.

UNIT - III

Human Toxicology: Pollution induced biochemical, hematological and pathological changes, Immunotoxicity, genotoxicity and carcinogenic effects

UNIT - IV

Ecotoxicology: Influence of ecological factors on the effects of toxicity; Pollution of the Ecosphere by industries; degradable and non-degradable toxic substances; food chain. Eco-system influence on the fate and transport of toxicants.

UNIT - V

Regulatory issues and testing: Bacterial mutation assays, Mammalian cell mutation assays, in vitro chromosome aberration assays, In vivo carcinogenicity assays and comet assay.

REFERENCES

1. Finkol, A.J. 1983. Hemitton and Hardy's Industrial toxicology. John Wright, PSG Inc. Boston. London.
2. Rand and Petrocelli, 1985. Fundamentals of aquatic toxicology. Hemisphere publishing corporation, Washngton.
3. Murthy A.S., 1999. Toxicity of pesticides to fish. CRC Press Inc. Florida.
4. Omkar, 1988. Concepts of toxicology. Shoban lal Nagir, Chand & Co, Delhi.

Semester - III

15BTP305D **TISSUE ENGINEERING** **4H – 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Give an overview of fundamental concepts in tissue engineering and regenerative medicine
- Understand tissue growth and development as well as the tools and theoretical information necessary to design tissues and organs
- Recognize the need of controlling all factors related to biomaterials architecture such as cell biology, biochemistry pathways, and surface characterization and modification
- Comprehend various physical and chemical stimuli that control the structure of biomaterials
- Get knowledge in which cell types are available to be used in tissue engineering applications
- Understand the relevance of the extracellular matrix and its interaction with materials

Course Outcomes:

On successful completion of the course, students will be able to

1. Describe and use the fundamental tools and techniques used in tissue engineering
2. Compare and contrast various strategies for repairing tissues
3. Show mastery of fundamental topics in tissue engineering including stem cells, plasticity, trans differentiation, and cloning
4. Describe and the developments of biomaterials for regenerative therapies and tissue engineering
5. Discuss and give an example of how biomaterials are used to fabricate devices for clinical use
6. Illustrate the basic concepts of cell culture and critical components of bioreactor/tissue design

UNIT - I

Tissue engineering: Introduction to tissue engineering; Basic definition; Cell sources and stem cells; Cell isolation and selection; Tissue preservation; Tissue types; Structure and organization of tissues; Epithelial, connective; vascularity and angiogenesis; Extracellular matrices; Cell-matrix interactions; development and use in therapeutic and *in-vitro* testing.

UNIT - II

Cell culture types and morphology: cell biology, Isolation, cell growth, Different cell types, progenitor cells and differentiations, different kind of matrix, cell-cell interaction. sterile techniques, plastics, enzymes, reactors and cryopreservation and migration; cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

UNIT - III

Cell analysis: Different cell types, staining, hormones, growth factors (receptor- ligand binding) and chemokines in signaling (eg. G-proteins). Growth factor delivery and applications (angiogenesis) in tissue engineering. Cell junctions in tissues, Growth factor delivery in tissue engineering and Cell surface markers.

UNIT - IV

Scaffold and transplant: Engineering biomaterials, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver.

UNIT - V

Bioreactors in Tissue engineering: Importance of tissue engineering, applications in pharmaceuticals industry. Case study and regulatory issues: Case study of multiple approaches: cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

TEXT BOOK

1. Palsson, B.O.,Sangeeta N. Bhatia. 2003. Tissue Engineering. Prentice Hall.

REFERENCES

1. Lanza, R., R. Langer & J. Vacanti. 2007. Principles of Tissue Engineering (3rd edn.), Academic Press.
2. Ravi, B. 2014. Introduction to Tissue Engineering: Applications & challenges. Wiley Publishing.
3. Robert. P.Lanza,,Principles of tissue engineering, Robert Langer & William L. Chick, Academic press.
4. Fisher, J.P., A.G. Mikos, J.D. Bronzino & D.R. Peterson. 2012. Tissue Engineering: Principles and practices. CRC Press.
5. Wong, J.Y., J.D. Bronzino & D.R. Peterson. 2012. Biomaterials: Principles and practices. CRC Press.
6. http://web.mit.edu/langerlab/
7. http://faculty.virginia.edu/laurencin/index.htm

Semester - III

15BTP305D **SYSTEMS BIOLOGY** **4H – 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Understand the new concept of system biology applied to the area of biotechnology
- Build the knowledge in computational methods in biotechnology
- Acquire requisite skills for the design and development of high throughput screening and to retrieve and submit the data, genome database and other databases and analysis
- Learn the computational tools for applying biotechnology in research
- Study the techniques involved in structural and functional proteomics
- Utilize the bioinformatics tools to design and development of novel drugs

Course Outcomes

On successful completion of the course, students will be able to

1. Understand the basic concepts of System Biology
2. Differentiate various Metabolic Networks and Models in System Biology
3. Understand the various databases available for data collection and interpretation
4. Understand the scope and applications of tools
5. Utilize the computational tools for applying biotechnology in research
6. Study and deduce the molecular characterization of human genome

UNIT - I

Introduction to Systems Biology: Introduction to Systems Biology. Need for System Analysis in Biology. Basic Concepts in System Biology: Component vs System, Links and Functional States, Links to Networks, Hierarchical Organization in Biology.

systems, scales, static/dynamic, approaches, limitations, reductionism; central dogma; mathematical models; computational analysis; statistics of prokaryotes and eukaryotes.

UNIT - II

Metabolic Networks and Models in System Biology: Basic Features of Metabolic Networks. Reconstruction Methods of Metabolic Networks. Models as Dynamical Systems. Parameter Problem. Meanings of Robustness.

UNIT - III

Systems Biology Databases KEGG (Kyoto Encyclopedia of Genes and Genomes). BRENDA (BRaunschweig ENzyme DAtabase). BioSilico. EMP (Embden-Meyerhof-Parnas). MetaCyc and AraCyc. SABIO-RK (System for the Analysis of Biochemical Pathways - Reaction Kinetics). BioModels.

UNIT - IV

Tools for System Biology: Cell Designer. Ali Baba. Cell Profiler. JDesigner. Bio-SPICE (Biological Simulation Program for Intra and Inter Cellular Evaluation). SBML (Systems Biology Markup Language). SBGN (Systems Biology Graphical Notation). SBML-SAT (SBML based Sensitivity Analysis Tool).

UNIT - V

Premises & Promises of Systems Biology: Premise of Systems Biology. Promise of Systems Biology. Challenges of Systems Biology. Applications of Systems Biology.

TEXT BOOK

1. Bernhard O. Palsson (2006). Systems Biology: Properties of Reconstructed Networks. Cambridge University Press, New York.

REFERENCES

1. Björn H. Junker, Falk Schreiber (2008). Analysis of Biological Networks. John Wiley & Sons, Inc., Hoboken, New Jersey.
2. Huma M. Lodhi, Stephen H. Muggleton. Elements of Computational Systems Biology. John Wiley & Sons, Inc., Hoboken, New Jersey.
3. Cánovas M., J.L. Iborra and A. Manjón (2006). Understanding and Exploiting Systems Biology in Biomedicine and Bioprocesses. CajaMurcia Foundation, Spain.
4. Brown T. A., Genomes, 2nd Edition, BIOS Scientific Publishers, Ltd., Oxford, UK, 2002.
5. Sensen, C.W Essentials of Genomics and Bioinformatics, Wiley-VCH, 2002 5. S.R.Pennington and M.J.Dunn, Proteomics, Viva Books Pvt. Ltd., New Delhi, 2002.
6. http://www.systemsbiology.org
7. http://www.systems-biology.org

Semester - III

15BTP306 BIOENTREPRENEURSHIP 0H – 4C

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:0**0** External:10**0** Total: **100**

Course Objectives

The objectives of the course are to make the students

- To learn various bio-entrepreneurship and marketing approaches
- To know about the entrepreneurship including identifying a business opportunity in the area of biotechnology through resource generation and launching a biotech business, growing and nurturing the organization as well as harvesting the rewards.
- To familiarize students with the scope of issues and decisions that managers in biotechnology face as their company progresses from its earliest stages to self-sustainability
- To give students the vocabulary to participate and contribute to the business side of scientific enterprises
- To provide a general procedural road map for bioscience students who are interested in starting their own companies

Course Outcomes

On successful completion of the course, students will be able to

1. Differentiate between Wage employment, Self-employment and Entrepreneurship
2. Understand, appreciate and develop the self-confidence for embarking on self-employment
3. Understand and internalize entrepreneurial competencies and know their importance for becoming a successful entrepreneur.
4. Candidate will be able to mobilize resources required for starting the enterprise
5. Trainee is able to appreciate need for continuous growth and expansion of an enterprise

UNIT - I

Accounting and Finance: Starting a venture; Bank loan; Sources of financial assistance; Business proposal; Statutory and legal requirements for starting a company. Budget planning and cash flow management; accounting practices: balance sheet, P&L account, and double entry bookkeeping; Estimation of income, expenditure, profit, income tax.

UNIT - II

Marketing: Assessment of market demand for potential product(s) of interest; Market conditions, segments; Prediction of market changes; Identifying needs of customers including gaps in the market, packaging the product; Market linkages, Advertising.

UNIT - III

Information Technology: IT for business administration; IT in improving business performance; Available software for better financial management; E-business setup and management.

UNIT - IV

Human Resource Development: Leadership skills; Managerial skills; Organization structure, pros & cons of different structures; Team building, teamwork; Appraisal; Rewards in small scale set up.

UNIT - V

Entrepreneurship and R&D

Support mechanism for entrepreneurship in India. Knowledge centers like universities and research institutions; Role of technology and upgradation; Assessment of scale of development of Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies.

TEXT BOOKS

1. Kotler, P. and G. Armstrong, 2001. Principles of Marketing. Prentice Hall. USA.

2. Dogramatzis, 2001. Pharmaceutical Marketing: A Practical Guide by. IHS Health Group, USA

REFERENCES

1. Armstrong, G., M. Harker, P. Kotler and R. Brennan, 2009. Marketing: An Introduction Financial Times Prentice Hall, USA.

2. Kotler, P. 2010. Principles of Marketing Management.13th Ed. Prentice-Hall India Pvt. Ltd., New Delhi.

3. Kotler, P. and K.L. Keller, 2006. Marketing Management. Prentice Hall, USA

4. Ramasamy, V.S. and S. Namakumari, 2005 Marketing Management. IV Edition Macmillan, New Delhi.

5. O'Brian, J. and A. Montazemia, 2004. Management Information Systems. McGraw-Hill Ryerson, Cannada.

6. http://www.sba.gov/smallbusinessplanner/start/financestartup/index.html

7. http://www.azhttp.com/2007/08/23/small-business-internet-marketing-services

8. http://www.marketingteacher.com/Lessons/lesson_emarketing.htm

Semester - III

15BTP311 PLANT BIOTECHNOLOGY - PRACTICAL V 4H - 2C

Total hours/week: **L:0 T:0 P:4** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Understand the new concept of plant biotechnological techniques applied to the area of biotechnology
- Gain hands-on experience and to learn the principles behind plant biotechnology
- Know the process involved in isolation, separation, manipulation of plant tissues
- Apply the technology in research and development and pharmaceutical industries
- Execute the recent technology involved in plant tissue culture
- Describe the principles of gene manipulation.

Course Outcomes:

On successful completion of the course, students will be able to

1. Acquaint with principles, technical requirement, scientific and commercial applications in plant biotechnology
2. Support methodologies in plant tissue culture
3. Be able to describe basic principles and techniques in genetic manipulation and genetic engineering
4. Be able to describe gene transfer technologies in plants
5. Be able to describe techniques and problems in plant cloning
6. Become motivated to set goals towards pursuing higher-level positions, such as lab manager and key scientist in plant biotechnological research institutes and industries

List of Practicals

Plant Tissue Culture Techniques

1. Sterilization Techniques in tissue culture
2. Laboratory organization in plant tissue culture.
3. Media Preparation
4. *In-Vitro* Germination of Seeds
5. Micropropagation
6. Callus induction, differentiation and regeneration
7. Suspension culture
8. Embryo Culture
9. Synthetic seed production.
10. Protoplast Isolation
11. Agrobacterium mediated gene transformation

REFERENCES

1. Aneja, K R., 2004. Experiments in Microbiology Plant Pathology and Biotechnology. IV Edition, New age international Pvt. Ltd. Publishers, New Delhi.

Semester - III

15BTP312 ANIMAL BIOTECHNOLOGY AND IMMUNOTECHNOLOGY - PRACTICAL - VI **4H - 2C**

Total hours/week: **L:0 T:0 P:4** **Marks:** Internal:**40** External:**60** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- Gain hands-on experience and to learn the principles behind animal biotechnology
- Know the process involved in isolation, separation, manipulation of animal cells
- Apply the technology in research and development and pharmaceutical industries
- Obtain practical knowledge on basic immunological techniques such as serum/plasma preparation and ABO blood grouping
- Gain hands on experience in immunological tools used in diagnosis, such as immunoelectrophoresis, ELISA and WIDAL test
- Comprehend the applications of recombinant DNA technology and Immunological techniques in human health care

Course Outcomes

On successful completion of the course, students will be able to

1. Support methodologies in animal cell culture
2. Describe basic principles and techniques in genetic manipulation and genetic engineering in animals
3. Explain the preparation of antigens and antibody in the blood sample
4. Describe the basic knowledge about antigen and antibody interaction
5. Perform various techniques like Immunoelectrophoresis, and ELISA etc.
6. Join in research and clinical labs as a project/ research assistant.

List of Practicals

Immunology

1. ABO blood grouping
2. Preparation of serum from blood
3. Methods of immunization
4. Methods of bleeding
5. Hemolysis
6. Single radial immunodiffusion
7. Double immunodiffusion
8. Immunoelectrophoresis
9. Rocket Immunoelectrophoresis
10. Counter Current Immunoelectrophoresis
11. WIDAL test
12. DOT-ELISA

Animal Biotechnology

13. Preparation of Animal Tissue Culture Medium
14. Preparation of Primary culture
15. Quantification of cells by trypan blue dye exclusion method.
16. Identification of leukocyte subsets and total count.
17. Cryopreservation of cell lines
18. MTT assay

REFERENCES

1. Freshney, R.I., 2000. Animal Cell Culture: A Practical Approach. John Wiley and Sons, New York.
2. Hay, F.C. and M.R. Westwood, 2004. Practical Immunology. Blackwell Science Publishers, London.
3. Weir, D.M., 1992. Immunological Techniques. Blackwell Scientific Publications, London.

Semester - IV

15BTP401 **RESEARCH METHODOLOGY** **0H – 4C**

Total hours/week: **L:4 T:0 P:0** **Marks:** Internal:0**0** External:10**0** Total: **100**

Course Objectives

The objectives of the course are to make the students to

- To understand the importance of the methodological approach to research.
- To acquire the required skills to approach a research project in a scientifically sound manner, from forming the hypothesis to publication of the research findings.
- To understand the importance of research methodology concepts and to put them in practice while working on dissertation projects.
- To acquire the technical writing skills and presentation skills apart from practically utilizing all aspects of research methodology that they had learnt earlier.
- To be able to integrate all aspects of the research project into a dissertation of print form as can be evaluated by internal and external experts

Course Outcome

Upon completing this course, each student will be able to

1. Demonstrate knowledge of research processes (reading, evaluating, and developing);
2. Perform literature reviews using print and online databases;
3. Identify, explain, compare, and prepare the key elements of a research proposal/report;
4. Define and develop a possible biotechnology research interest area using specific research designs;
5. Compare and contrast quantitative and qualitative research paradigms, and explain the use of each in biotechnology research;
6. Describe, compare, and contrast descriptive and inferential statistics, and provide examples of their use in biotechnology research;
7. Describe sampling methods, measurement scales and instruments, and appropriate uses of each;

UNIT- I

Analysis and Identification of research requirements: Prioritization of research area. Review of work done in identified area, choice of research topic – Methodology experiment design**.**

UNIT - II

Dissertation writing: Guidelines for review of literature - Materials and methods, results and discussion. Interpretation of results, summary, presentation of references and appendix.

UNIT - III

Experiment design: Regarding observation, Types of observation, Data collection – Presentation and analysis of collected data. Preparation of result reports and Publication of research findings in peer reviewed journals, impact factor, citation and its calculation.

UNIT - IV

Methods of data collection and analysis: Frequency distribution. Measures of central tendency – Mean, median and mode; Measures of dispersion – Standard deviation, standard error, and variance. Correlation and regression – simple correlation, correlation co-efficient, simple and linear regression analysis. Test of significance.

UNIT - V

Objective and roll of higher education - Important characteristics of an effective Lecture - Quality teaching and learning, Project, Brain storming, case Discussion, and assignment, Self evaluation, Question banking – Electronic media in education.

REFERENCES

1. Sandhu,T. 1990. *Research Techniques in Biological Sciences*. Anmol Publishers, New Delhi.
2. Palanivelu, P.1999. *Analytical Biochemistry and Separation Technique*. 3rd Ed, 21st Century Publications, Madurai.
3. Sundar Rao, P.S.S and Richard, J. 2006. *Introduction to Biostatistics and Research Methods*. PHI Publications, New Delhi.
4. Kothari, C. R. 2004. Research *Methodology – Methods and Techniques*. 2nd Ed. New Age International Pvt. Ltd, New Delhi.
5. Attwood, T. K. and Parry Smith, D. J. 2002. *Introduction to Bioinformatics*. Pearson Education Ltd, Singapore.

Semester - IV

15BTP491 **PROJECT – *VIVA VOCE*** **15C**

Total hours/week: **L:0 T:0 P:0** **Marks:** Internal:**80** External:**120** Total: **200**

Course Objectives

The main objectives of the course is

- The hands-on training through one full semester project with thesis gives special expertise within one of the research areas represented at The Department of Biotechnology.

Course Outcomes

On completion of the course, students are able to apply their knowledge on

1. This dissertation programme provides the candidate with knowledge, general competence, and analytical skills on an advanced level, needed in industry, consultancy, education and research