KARPAGAM ACADEMY OF HIGHER EDUCATION
DEPARTMENT OF BIOTECHNOLOGY
M.Sc., Biotechnology Curriculum (CBCS)
(2016 – 2017 Batch)

Course code	Name of the course	Objectives and Outcomes		Hrs / Week	Marks			Exam Hrs	Credit (s)
		PEO´s	PO´s & PSO´s		CIA	ESE	Total		
SEMESTER – I									
16BTP101	Biochemistry	I	a, b	4	40	60	100	3	4
16BTP102	Microbiology	I, II	a, b, c, d	4	40	60	100	3	4
16BTP103	Cell Biology and Molecular Genetics	I, II	a, d	4	40	60	100	3	4
16BTP104	Food Biotechnology	I, II	a, d	4	40	60	100	3	4
16BTP105A	Bioinstrumentation and Biostatistics	II, III	d, e, f	4	40	60	100	3	4
16BTP105B	Nano-Biotechnology	II	d						
16BTP105C	Bio-energy Technology	II	d						
16BTP111	Biochemistry, Cell Biology and Molecular Genetics - Practical – I	I, II, III	a, b, d, f	4	40	60	100	3	2
16BTP112	Microbiology, Food Biotechnology - Practical – II	I, II, III	a, b, c, d, f	4	40	60	100	3	2
Journal Paper Analysis & Presentation				2	-	-	-	-	-
Semester total				**30**	**280**	**420**	**700**	**-**	**24**
SEMESTER – II									
16BTP201	Recombinant DNA technology	II, III	d, e	4	40	60	100	3	4
16BTP202	Fermentation Technology	II, III	d, e	4	40	60	100	3	4
16BTP203	Environmental Biotechnology	II, III	d, e	4	40	60	100	3	4
16BTP204	Immunotechnology	II, III	d, e	4	40	60	100	3	4
16BTP205A	Pharmaceutical Biotechnology	II, III	d, e, f	4	40	60	100	3	4
16BTP205B	Biosafety and IPR	IV	g, h						
16BTP205C	Tissue Engineering	IV	g						
16BTP211	Recombinant DNA technology, Immunology -Practical – III	II, III	d, e, f	4	40	60	100	3	2
16BTP212	Fermentation Technology, Environmental Biotechnology - Practical – IV	II, III	d, e, f	4	40	60	100	3	2
Journal Paper Analysis & Presentation				2	-	-	-	-	-
Semester total				**30**	**280**	**420**	**700**	**-**	**24**
SEMESTER – III									
16BTP301	Plant Biotechnology	II, III, IV	d, g, h	4	40	60	100	3	4
16BTP302	Animal Biotechnology	II, III, IV	d, g, h	4	40	60	100	3	4
16BTP303	Bioinformatics	IV	g	4	40	60	100	3	4
16BTP304	Genomics and Proteomics	II, III, IV	d, e, f, g	4	40	60	100	3	4
16BTP305A	Medicinal Plant Biotechnology	IV	g	4	40	60	100	3	4
16BTP305B	Industrial Toxicology	IV	g						
16BTP305C	System Biology	IV	g						
16BTP311	Plant and Animal Biotechnology- Practical – V	II, III, IV	d, g, h, f	4	40	60	100	3	2
16BTP312	Bioinformatics -Practical – VI	II, III, IV	d, g, h, f	4	40	60	100	3	2
Journal Paper Analysis & Presentation				2	-	-	-	-	-
Semester total				**30**	**280**	**420**	**700**	**-**	**24**

Course code	Name of the course	Objectives and Outcomes		Hrs / Week	Marks			Exam Hrs	Credit (s)
		PEO´s	PO´s & PSO´s		CIA	ESE	Total		
SEMESTER – IV									
16BTP491	Project and *Viva Voce*	III, IV	f, g, h, i	-	80	120	200	-	15
Semester total				**-**	**80**	**120**	**200**	**-**	**15**
				90	**640**	**1380**	**2300**		**87**

Elective courses*

Elective – 1		Elective - 2		Elective - 3	
Course code	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**
16BTP105A	Bioinstrumentation and Biostatistics	16BTP205A	Pharmaceutical Biotechnology	16BTP305A	Medicinal plant Biotechnology
16BTP105B	Nano-Biotechnology	16BTP205B	Bio-safety and IPR	16BTP305B	Industrial Toxicology
16BTP105C	Bio-energy Technology	16BTP205C	Tissue Engineering	16BTP305C	System Biology

*Electives are Transborder /cross disciplinary/ Discipline centric elective nature.

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

16BTP101 **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 understand the key concepts of cellular structure and organization of various biomolecules
- To attain strong theoretical knowledge on three-dimensional construction of biological macromolecules and the principles of molecular recognition
- To understand the functions and importance of various biomolecules
- To describe the various metabolic pathways involved in cells for its normal functioning
- To obtain strong background on how the DNA is selectively expressed as functional proteins
- To obtain necessary knowledge on disorders associated with metabolism of biomolecules

Course Outcomes

On completion of the course, students are able to

1. Understand Biochemistry as discipline and milestone discoveries in life sciences that led to establishment of Biochemistry as separate discipline
2. Understand fundamental properties of elements, their role in formation of biomolecules and in chemical reactions within living organisms
3. Draw or describe the structure of amino acids, proteins, enzymes, chemical messengers, carbohydrates, lipids, and nucleic acid
4. Describe the metabolism of carbohydrates, lipids, proteins and amino acids, and write chemical reactions for the individual steps in each pathway
5. Write the chemical reactions involved in biochemical pathways that produce ATP, such as citric acid cycle and electron transport
6. Be familiar with the enzymes (biocatalysts), and their salient attributes including unique conformation and amazing catalytic properties

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; Biosynthesis 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, ATP cycle, energy-rich compounds.

REFERENCES

1. Jain, J. L.(2002). *Fundamentals of Biochemistry* (5th ed.).New Delhi: S. Chand & Co.
2. Zubay,G.L., Parson,W.W., &VanceD.E.(1995). *Principles of Biochemistry*. Oxford:MC Brown Publishers.
3. Nelson, D.L., & Cox, M.M. (2013). Lehninger: *Principles of Biochemistry* (6th ed.). New York: W.H. Freeman and Company.
4. Murray, R.K., Bender, D.A., Botham, K.M.,& Kennelly, P.J., (2012). *Harper's illustrated Biochemistry* (29th ed.). London : McGraw-Hill Medical.
5. Voet, G., &Voet,A.(2004). *Fundamentals of Biochemistry* (3 rd ed.).New York: John Wiley and Sons, Inc.

16BTP102 **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 understand landmark discoveries in Microbiology and different domains classification of living organisms
- To be familiar with general characters of prokaryotes for conventional and molecular characterization using modern methods
- To understand the conceptual knowledge on metabolism of microorganisms
- To attain essential knowledge of cellular organization and life cycle of microorganisms
- To understand the economic importance of microorganisms
- To obtain information regarding diseases caused by microorganisms

Course Outcomes

On completion of the course, students are able to

1. Demonstrate the principles and applications of microscopic techniques
2. Demonstrate microbial structure and similarities and differences among various groups of microorganisms such as bacteria and fungi
3. Illustrate microbial diversity using different methods and systematics of bacteria
4. Discuss the various methods for identification of isolated and unculturable microorganisms
5. Comprehend the various methods for identification of unknown microorganisms
6. Discuss the industrial applications of microorganisms

UNIT -I

Microbial Diversity: Definition, history, scope, discovery and development of microorganisms. Diversity-Bacteria, fungi, algae - distribution, reproduction and characteristics divisions. Autotropic and heterotopic 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 study.

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 mushroom and its types. Oyster, paddy straw, button and medicinal mushroom production and their 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.

REFERENCES

1. Black, J.G. (2002). *Microbiology Principles and Explorations*. NewYork: John Wiley and Sons Publishing.
2. Prescott, L.M., Harley, J.P.&Klien,D.A. (2005). *Microbiology*. Boston:NY,McGraw - Hill Publishing Company.
3. Talaro, K.P., (2009). *Foundations in Microbiology*. McGraw - Hill Publishing Company, NewYork.
4. Prescott, & Dunn's. (1984). *Industrial Microbiology*(4th ed.). Conneticut: Gerald Reed&AVI Publishing Company Inc.
5. Atlas, R.M.(1997). *Principles of Microbiology Illinois*: USA, WCB McGraw Hill publishers.
6. Pascale, C. (2005). *Cellular Microbiology*. New York:American Society for Microbiology.
7. Hui, Y.H., Goddik,L.M., Hansen,A.S., Josephsen,J., Nip,W.K., Stanfield,P.S., &Toldra, F.(2004). *Handbook of Food and Beverage Fermentation Technology*. London:Taylor and Francis publishers.
8. Pelczar, M.J., Chan, E.C.S., & Krieg, N.R. (1993). *Microbiology*(5thed.). McGraw Hill Book Company.
9. Roland, V.G.(2005).*Applied Food Microbiology*. London:Star Publishing Co.

16BTP103 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 objectives of the course are to make the students to

- Understand the structures and functions of basic components of eukaryotic cells especially macromolecules, membranes, and organelles
- Understand how the cellular components are used to generate and utilize energy in cells
- Understand the cellular components underlying cell division
- To impart knowledge in genetics and genome organizations in organisms
- To understand the principles of extensions to Mendelian inheritance, including multiple allelism, lethal alleles, and gene interactions
- To obtain knowledge on normal chromosome number, structure, and behaviour in human cells, and understand the cause and effect of alterations in chromosome number and structure

Course Outcomes

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

1. Describe the structures and basic components of eukaryotic cells
2. Illustrate how the cellular components are used for various cellular activities
3. Demonstrate the pathways involved in various cellular events including cell cycle
4. Understand the inheritance of genes among plants and animals and the genetic makeover as well as the physical appearance of organisms
5. Describe Mendelian inheritance, the interaction of genes among organism and to determine the inheritance of gene in human beings
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, 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.

REFERENCES

1. Gardner, E.J. (2001). *Principles of Genetics* (8th ed.). New York: John Wiley and Sons.
2. Karp, G. (2005). *Cell and Molecular Biology: Concepts and Experiments*. London: John Wiley and Sons, Inc.
3. Maloy, S.R., Cronan, J.E., & Freifelder, D.(2006). *Microbial Genetics*.Sudbury:Massachusetts, Jones and Bartlett Publishers.
4. Cooper, G.M. &Hausman,R.E., (2004). *Cell : A Molecular Approach*. Sunderland:Sinauer Associates, Inc.
5. Glick, B.R., &Pasternak,J.J. (2003).*Molecular Biotechnology* (3rd ed.).New Delhi: Panima Publishing Corporation,.
6. Frifielder, D.(2001). *Molecular Biology* (2nd ed.). New Delhi: Narosa Publishing House.
7. Lodish, B. (2004). *Molecular and cell biology* (5th ed.).New York: Freeman and company.
8. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P.(2002). *Molecular Biology of the Cell* (4th ed.). New York: Garland Publishing.

16BTP104 **FOOD 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

- Understand the concepts of food biotechnology along with principles of genetics in food industry
- Attain strong knowledge on primary sources of microorganisms in food
- Explore the methods for development and preservation of fermented foods
- Recognize the nutritive values of fermented foods
- Understand the concepts of food adulteration and food safety
- Obtain strong knowledge on food spoilage

Course Outcomes

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

1. Understand the beneficial role of microorganisms in fermented foods and in food processing and the microbiology of different types of fermented food products
2. Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods
3. Know the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage
4. Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods
5. Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries
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 Toxins - Botulism and Staphylococcal toxin. Fungal Toxins - Aflatoxins.

Unit - III

Fermented Foods: Origin, scope and development and preservation- Cheese, Yoghurt, Butter, miso, tempeh, kefir, koumiss, acidophilus milk, sourkraut, pickles and vinegar. Fresh juice production –Mango, orange, and pineapple. Technological aspects of industrial production of beer, wine and baker's yeast.

Unit - IV

Food Adulteration and 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 colors. Sweeteners - Types and Applications. Food packaging materials, and their properties.

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.

REFERENCES

1. Adam, M.R., & Moss, M.O. (2003). *Food Microbiology*. New Delhi: New Age International Pub.
2. Frazier, W.C., & Westhoff, D.C. (2005). *Food Microbiology* (6th ed.). New Delhi: Tata Mc Graw Hill Pub. Company Ltd.
3. Harrigan, W. F., (1998). *Laboratory methods in Food Microbiology* (3rd ed.). NY: USA, Academic Press.
4. Bell, C., Neaves, P., & Williams, A.P. (2005). *Food Microbiology and Laboratory Practice*. Oxford: Blackwell Science.
5. Jay, J.M., Loessner, J.M., & Golden, A.D. (2005). *Modern Food Microbiology* (7th ed.). USA: Springer Science and Business Media. Inc.

16BTP105A BIOINSTRUMENTATION AND BIOSTATISTICS 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 fundamental principles of bioinstrumentation commonly used in biomedical engineering research labs and hospitals
- Comprehend the colorimetric principles
- Recognize the concepts on centrifugation and chromatography
- Obtain key knowledge on electrophoresis
- Understand key concepts on biostatistics and its various parameters
- Attain strong knowledge on the applications of biostatistics and its relevant softwares

Course Outcomes

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

1. Demonstrate an understanding the bioinstrumentation principles with respect to device design and applications
2. Identify, explain and judge safety issues related to biomedical instrumentation
3. Apply the principles in the context of bioinstrumentation interactions with tissues, organs and human body to explain the measurement results and to develop the instrumentations
4. Define the principal concepts about biostatistics
5. Recognize the definition of statistics, its subject and its relation with the other sciences.
6. Collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data

UNIT - I

Colorimetry: Color 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.

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.

REFERENCES

1. Glover., & Mitchell, H. (2002). *An Introduction to Biostatistics*. Boston: Mc Graw- Hill Co. Inc.
2. Friedfelder, D. (2001). *Physical Biochemistry* (5th ed.). New York: Oxford Publishers.
3. Sharma, B.K. (2004). *Instrumental Methods of Chemical Analysis* (24th ed.). Meerut: Goel Publishing House.
4. Chatwal, G.R., & Anand, S.K. (2003). *Instrumental Methods of Chemical Analysis* (5th ed.). Mumbai: Himalaya Publishing House.
5. Boyer, R. (2000). *Modern Experimental Biochemistry* (3rd ed.). New Delhi: Addision Wesley Longman.
6. Sawhney, S.K., & Singh, R. (2000). *Introductory practical Biochemistry*. New Delhi: Narosa Publishing House.
7. Wilson, K., & Walker. (2006). *Principles and Techniques of Biochemistry and Molecular Biology*. India: Cambridge University Press.
8. Sawhney, S.K., & Singh, R. (Eds.). (2005). *Introductory Practical Biochemistry*. Alpha Science International Ltd.

16BTP105B **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 nanostructural 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, nano-material-based adsorbents for water treatment, possible mutagenic properties of nanoparticles, nanoparticle bioaccumulation. Nanoparticles in biomedical and clinical applications

REFERENCE

1. Niemeyer, C.M. & Mirkin, C. A. (2004). *Nanobiotechnology Concepts, Application and Properties*. New York: Wiley – VCH Publishers.
2. Rao, C.N.R. (2006). *The Chemistry of Nanomaterial: Synthesis, Properties and Applications* (Vols 1 &3). Springer.
3. Muralidharan, V.S., & Subramanian, A.(2009). *Nanoscience and technology*. New Delhi: CRC Press.
4. Ratner, M., & Ratner, D. (2005). *Nanotechnology- a Gentle Introduction to the Next Big idea*. London: Pearson Education, Inc.
5. Dinh, T.V. (2007). *Nanotechnology in Biology and Medicine: Methods, Devices and Applications*. New Delhi: CRC Press.

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,* molasses.

UNIT – V

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

REFERENCES

1. Mazumdar, B.(2003).*A Textbook of Energy Technology*.New York, NY: McGraw-Hill, Inc.
2. Shepard, & Marion L.(2000). *Introduction to Energy Technology*. NewYork, NY:McGraw-Hill, Inc.
3. Grant, W.D., & Long,P.E. (2001). *Environmental Microbiology*. Glasgow: Blakie publications.
4. Reddy, G. M., Reddy,M.N., Saigopal,D.V.R., &Mallaiah, K.V. (2007). *Laboratory Experiments in Microbiology* (2nd ed.).Mumbai:Himalaya Publishing House.

Semester – I

16BTP111 **4H - 2C**

BIOCHEMISTRY, CELL BIOLOGY AND MOLECULAR GENETICS –PRACTICAL I

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

- Give knowledge on Biochemistry, Cell Biology and Molecular Genetics and its application.
- Offer knowledge to execute the experiments flawlessly
- Understand quantification of sugars, aminoacids and lipids
- Understand various cell types and its components
- Understand how to perform fractionation of cellular components
- Get practiced with the tools and techniques for analyzing conjugation and transduction

Course Outcomes

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

1. Describe the quantification of sugars, aminoacids and lipids
2. Interpret the outcome of experiments that involve the use of cell biology and molecular genetics techniques
3. Discuss the various macromolecular components of cells and their functions
4. Describe cell permeability in plants and animal cells
5. Explain the basic steps involved in Drosophila giant chromosome preparation and nuclear staining
6. Perform conjugation and transduction experiments

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 séparation (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, Rodney. (2010). *Biochemistry Laboratory: Modern Theory and Techniques.* New Jersey: Pearson Education, Inc.
2. Palanivelu, P. (2001). *Analytical Biochemistry and Separation Techniques.* Madurai: Kalaimani Printers.
3. Sadasivam. S., & Manickam, A. (2002). *Biochemical Methods.* New Delhi: New Age International Private Limited Publishers.
4. Keith Wilson, & John Walker (Eds.). (2010). *Principles and Techniques of Biochemistry and Molecular Biology.* New York, NY: Cambridge University Press.

Semester- I

16BTP112 **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 objectives of the course are to make the students to

- Give knowledge Microbiology and Food Biotechnology techniques
- Offer knowledge to execute the experiments flawlessly
- Understand pure culture technique and microbiological staining techniques
- Gain practical knowledge on Isolation and identification of microbes from food samples
- Attain hands on experience on the production of industrially important enzymes
- Learn how to run fermentor

Course Outcomes

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

1. Know microbial techniques for isolation of pure cultures of microbes from different food, agricultural and environmental sources
2. Have hands on experience in microbial staining techniques
3. Illustrate motility analyses for bacteria
4. Perform Isolation and identification of microbes from food samples
5. Carry out the production of Industrially important enzymes such as protease and amylase
6. Have practical knowledge on fermentor operation

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

- Isolation and identification of microbes from food samples
- Wine production
- Citric acid production
- Production of Industrially important enzymes – protease, amylase
- Immobilization of enzymes
- Working of fermenters

REFERENCES

1. Cappuccino, P., & Sherman. (2004). *Microbiology-A Lab Manual*. Singapore: Pearson Education.
2. Dubey, R., & Maheshwari, E. (2004). *Practical Microbiology*. New Delhi: S. Chand & Co.
3. Goldman, E., & Green, L.H. (2008). *Practical Handbook of Microbiology*. (2nd ed.). London: CRC press.
4. Kannan, P. (2002). *Laboratory Manual in General Microbiology*. Tamilnadu: Palani Paramount Publishers.

JOURNAL PAPER ANALYSIS AND PRESENTATION **2H-0C**

16BTP201 RECOMBINANT DNA 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

- Be familiarize with emerging field of biotechnology: Recombinant DNA Technology
- Understand the basic concepts of recombinant DNA Technology and genetic engineering
- Acquaint versatile tools and techniques employed in recombinant DNA technology
- Obtain the principles of versatile DNA modifying enzymes, cloning strategies and vector types for selection and screening of recombinant clones
- Understand the concepts of nucleic acid labeling techniques
- Illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences and to use recombinant DNA technology in biotechnological research

Course Outcomes

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

1. Outline the fundamental steps in recombinant DNA technology
2. Demonstrate the mechanism of action and the use of restriction enzymes in biotechnology research and recombinant protein production
3. Explain the value of plasmid preparations and how the concentration and purity of plasmid samples can be determined
4. Confer cloning strategies and techniques used in DNA probing for specific genes of interest.
5. Conceptualize PCR technique in clinical research
6. Recapitulate various applications of recombinant DNA technology in human health care and safety regulations

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, sequence analysis, SNP, NGS, gene editing tool CRISPR.

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.

REFERENCES

1. Glick, B.R., & Pasternack, J.J. (2009). *Molecular Biotechnology*. New Delhi: Panima Publication.
2. Primrose, S.B., Twyman, R. M., & Old, R. W. (2006). *Principles of Gene Manipulation* (7th ed.). Germany: Blackwell Science Publishing Company.
3. Brown, T.A., (2006). *Gene Cloning and DNA Analysis* (5th ed.). Oxford: UK, Blackwell Publishing.
4. Brown, T.A., (2006). *Gene cloning - An introduction* (3rd ed.). New York, NY: Stanley thrones Publishers Ltd.
5. Winnacker, E.L., (2003). *From Genes to Clones*. New Delhi: Panima Educational Book Agency.
6. Watson, J.D., Gilman, M., & Witkowski, J. (2000). *Recombinant DNA*. (2nd ed.). New York: Freeman Publication.

16BTP202 FERMENTATION 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

- Be familiarize with knowledge about biological and biochemical technology, with a focus on biological products, the design and operation of industrial practices
- Describe power requirements in bioreactors, modeling of bioprocesses, and traditional and new concepts in bioprocess monitoring, and the biological basis for industrial fermentations
- Understand biological and engineering principles for cultivating microorganisms in fermentors
- Obtain knowledge on assessing biological and engineering principles for cultivating microorganisms in fermentors
- Understand the importance of monitoring foam control, nutrient dosing, sterile sampling and filter sterilization
- Attain key concepts in calibration and maintenance of process critical for fermentation such as aeration, agitation and pH

Course Outcomes

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

1. Evaluate factors that contribute in enhancement of cell and product formation during fermentation process
2. Analyze kinetics of cell and product formation in batch, continuous and fed-batch cultures
3. Differentiate the rheological changes during fermentation process
4. Develop protocol for scale-up and harvesting from shake flask to bench top fermentor
5. Analyze the bioprocess paradigms including scale-down, bioprocess simulation and economics in biological manufacturing
6. Examine considerations in bioprocess simulation and economics, sterilization in biological manufacturing, and clinical implications of bioprocesses

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, 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-, chromatographic separation- FPLC, HPLC, dialysis, centrifugation, distillation, drying, crystallization, turbidity analysis and cell yield determination. Fermentation products- available in market.

REFERENCES

1. Stanbury PF, Whitaker A and Hall SJ. (2006). *Principles of Fermentation Technology* (2nd ed.). Elsevier Science Ltd.
2. James Bailey,E., & David Follis. (1999). *Biochemical Engineering Fundamentals* (2nd ed.). Boston: Mc Graw Hill Book Company.
3. Wulf Crueger, & Anneliese Crueger. (2004). *Textbook of Industrial Biotechnology* (2nd ed.). New Delhi: Panima Publishing Corporation.
4. Pauline Doran,M., (1995).*Bioprocess Engineering*. New York: Academic press.
5. Rajiv Dutta, (2008). *Fundamentals of Biochemical Engineering*. India: Ane Books.
6. Shuler, M.L., &Kargi, F. (2008). *Bioprocess Engineering Basic concepts* (2nded.) NJ: Prentice Hall International Series in the Physical and Chemical Engineering Sciences.

16BTP203 ENVIRONMENTAL 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

- Understand the various components of the environmental biotechnology including ecosystems, biodiversity, threats and policy
- Obtain knowledge on the sources for environmental pollution and its remedial measures
- Understand toxic chemicals and their impact on environment and human health
- Attain key concepts on the role of microbes in remediation of environmental pollutants
- Learn various technologies, tools and techniques in the field of environmental biotechnology
- Understand the importance of biological techniques in controlling air pollution

Course Outcomes

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

1. Demonstrate various types of ecosystems, biodiversity components, environmental threats and Policy
2. Discuss the impact of environmental pollution and its remediation measures
3. Recognize various global and regional environmental concerns due to natural causes and/or human activities
4. Illustrate the role of Toxic chemicals in the environment and their associated health issues in humans
5. Investigate some examples of different types of environmental pollution and their impacts
6. Appreciate the scientific, ethical and/or social issues associated with certain applications of biotechnology for alleviating the environmental concerns

Unit - I

Limiting factors, energy transfer and biogeochemical cycling in ecological systems; Response of microbes, plant and animals to environmental stresses; Concept of ecosystems and ecosystem management, Environmental problems- ozone depletion, greenhouse effect, water, air and soil pollution, land degradation.

Unit - II

GEMs in environment; Role of environmental biotechnology in management of environmental problems, Bioremediation, advantages and disadvantages; In situ and ex-situ bioremediation; slurry bioremediation; Bioremediation of contaminated ground water and phytoremediation of soil metals; microbiology of degradation of xenobiotics.

Unit - III

Sewage and waste water treatment and solid waste management, chemical measure of water pollution, conventional biological treatment, role of microphyte and macrophytes in water treatment; Recent approaches to biological waste water treatment, composting process and techniques, use of composted materials.

Unit – IV

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

Biofuels and biological control of air pollution, plant derived fuels, biogas, landfill gas, bioethanol, biohydrogen; use of biological techniques in controlling air pollution; Removal of chlorinated hydrocarbons from air.

REFERENCES

1. Evans, G.M., & Furlong., (2003). *Environmental Biotechnology: Theory and Applications*. England: John Wiley & Sons Ltd.
2. Jördening, H.J., & Winter, J. (2005). *Environmental Biotechnology.* Germany: Wiley-VCH Verlag GmbH & Co. KGaA.
3. Agarwal, S.K. (2002). *Environmental Biotechnology*. New Delhi: APH Publishing Corporation.
4. Mara, D. (2003). *The Handbook of Water and Wastewater Microbiology.* London: Academic Press.

16BTP204 **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

- 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. Tumor immunology: Tumor 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. Immunodiagnosis of infectious diseases, immuno screening of recombinant library.

REFERENCES

1. Goldsby, R.A., Kindt, T. J., Osborne,B. A., &Kuby, W.H.J. (2004). *Immunology* (5th ed.).USA: Freeman and Company.
2. Tizard, I.R. (2004). *Immunology* (5th ed.). New York: Saunders College Publishing.
3. Abbas,A.K., Lichtman,A. H., &Pillai,S. (2007). *Cellular and Molecular Immunology: With student consult*. Australia: Online Access. Elsevier Science.
4. Abbas,A.K., Lichtman,A. H., &Baker, D.L. (2008). *Basic Immunology: Functions and Disorders of the Immune System*.Australia: Elsevier Health Sciences.
5. Roitt, I., Brstoff,J., &Male, D. (2002). *Immunology* (3rd ed.).London: Mosby Yearbook Europe Ltd,.
6. Goldsby, R. A., Kind,T.J., &. Osborne, B.A.(2004). *Immunology* (5th ed.). New York: Freeman and Company.
7. Turgeon, M. L. (2008). *Immunology and Serology in Laboratory Medicine*. Australia: Elsevier Health Sciences.
8. Surendranath, A., & Narain, R. (2004). *Immunobiotechnology*. New York: Dominant Publishers and Distributors.

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 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 immobilization of enzymes and their applications in the industry. Reactors for immobilized systems and perspective of enzyme engineering.

UNIT -V

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

REFERENCES

1. Jay Rho,P., Stan Louie,G.,(2003). *Hand book of Pharmaceutical Biotechnology*. New York: Pharmaceutical products press.
2. http://munatih-alsahab.blogspot.com/2009/03/fundamentals-of-medicinalchemistry.html. (E-book)
3. Ajay Banga, K. (2004).*Therapeutic Peptides and Proteins: Formulation, Processing, and Delivery Systems.* (2nd ed.).USA: Mercer University.
4. Satoskar, R. S., Bhandhakan, S. D., & Alinaoure, S.S. (2000). *Pharmacology and Pharmacotherapeutics* (17th ed.). Mumbai: Popular Prakashan Publishers.
5. Bhagvan, N.V.(2002). *Medical Biochemistry*. New York: Academic Press.
6. Harvey, R. E., Lipin, & Walters, W. C. (2002). *Pharmacology* (4th ed.). New York: Kluwer Company.
7. Daan, J. A., Crommelin, & Sindelar, R. D. (2002). *Pharmaceutical Biotechnology* (3 rd ed.). New York: Routledge Taylor and Francis Inc.
8. Sethi, P.D. (2005). *Quantitative Analysis of Drugs in Pharmaceutical Formulations* (3 rd ed.). New Delhi: CBS Publishers and Distributers.
9. Manfred Wolff, E. (2000). *Burger's Medicinal Chemistry and Drug Discovery* (5th ed.). USA: Wiley and Sons.
10. Daan Crommelin & Robert Sindelar, D. (2002). *Pharmaceutical Biotechnology*. New York: Taylor and Francis Publications.

16BTP205B **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 Microorganisms (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, GMP and 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.

REFERENCES

1. Martin. M.W., & Schinzinger, R. (2003). *Ehics in engineering* (3rd ed.). NewDelhi: Tata McGraw-Hill,.
2. BAREACT, (2007). *Indian Patent Act 1970*. Acts and Rules, Universal Law Publishing Co. Pvt. Ltd.
3. Kankanala, C. (2007). *Genetic Patent Law and Strategy* (1st ed.).India: Manupatra Information Solution Pvt. Ltd.
4. *Biosafety issues related to transgenic crops*.DBT guidelines, New Delhi: Biotech Consortium Ltd,
5. http://www.actahort.org/members/showpdf?booknrarnr=447_125
6. http://www.biomedcentral.com/content/pdf/1472-6939-2-2.pdf
7. http://www.wipo.int/portal/index.html.en
8. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html

16BTP205C **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

- 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
- Obtain knowledge on bioreactors used in tissue engineering

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.

REFERENCES

1. Palsson, B.O., & Sangeeta Bhatia, N. 2003. *Tissue Engineering*. Prentice Hall.
2. Lanza, R., Langer,R.& Vacanti,J. (2007). *Principles of Tissue Engineering* (3rd ed.), Academic Press.
3. Ravi, B. (2014). *Introduction to Tissue Engineering: Applications & challenges*. Wiley Publishing.
4. Lanza, R., Langer, R., &William, L. *Principles of tissue engineering*. Academic press.
5. Fisher, J.P., Mikos, A.G.,Bronzino,J.D.,& Peterson,D.R.(2012). *Tissue Engineering: Principles and practices.* CRC Press.
6. Wong, J.Y., Bronzino, J.D.,& Peterson, D.R.(2012). *Biomaterials: Principles and practices.* CRC Press.
7. http://web.mit.edu/langerlab/
8. http://faculty.virginia.edu/laurencin/index.htm

RECOMBINANT DNA TECHNOLOGY, IMMUNOLOGY -PRACTICAL III

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

- 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 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. Carry out DNA and RNA isolation from microbes, plants and animals
2. Perform recombinant DNA techniques including restriction and digestion, ligation, transformation and PCR
3. Explain the preparation of antigens and antibody in the blood sample
4. Describe the basic knowledge about antigen and antibody interaction using Rocket immune electrophoresis
5. Perform various techniques like Immunoelectrophoresis, and ELISA etc.
6. Join in research and clinical labs as a project/ research assistant

List of Practicals

Recombinant DNA Technology

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

11. Northern blotting
12. Western blotting

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

REFERENCES

1. Glover, D.M., & Hames, B.D. (2000). *DNA Cloning- a Practical Approach.*Oxford:IRL Press.
2. James, J.G., &Rao, V.B. (2001). *Recombinant DNA Principles and Methodologies*.NewYork: Marcel Dekker Publications.
3. Maliga, P.(2000). *Methods in Plant Molecular Biology. A Laboratory Course Manual.*NewYork: Cold Spring Harbour Laboratory Press.
4. Brook, J.S., Fritsch,E.F., &Maniatis, T. (2000). *Molecular Cloning: A Laboratory Manual*. New York: Cold Spring Harbor Laboratory Press.
5. Hay, F.C., &Westwood, M.R. (2004). *Practical Immunology*.London: Blackwell Science Publishers.

Semester – II

16BTP212 **4H-2C**

FERMENTATION TECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY – PRACTICAL IV

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

- 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 oxygen demand 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 an alcohol determination by chromic acid method
7. Downstream 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 Delhi: New Age International.
2. Metcalf, L., &Eddy, R. (2005). *Waste Water Engineering.* New Delhi: Tata McGraw Hill.
3. Palvannan,T., Shanmugam,S., & Sathish Kumar, T. (2005). *Laboratory Manual on Biochemistry, Bioprocess and Microbiology.*Chennai: SciTech Publications India Pvt. Ltd.

16BTP301 **PLANT BIOTECHNOLOGY** **Semester- III 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 biotechnological methods for production of transgenic plants
- Give knowledge about various methods of gene transfer in plants
- Cognize and get the knowledge on micro propagation to protect endangered plants
- Explain the basics of the physiological and molecular processes that occur during plant growth and development and during environmental adaptations
- Use basic biotechnological techniques to explore molecular biology of plants
- Understand the processes involved in the planning, conduct and execution of plant biotechnology experiments

Course Outcomes

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

1. Understand the growth conditions required to culture the plants in *in vitro* conditions
2. Inculcate the deep understanding of Gene expression system of plants
3. Acquire knowledge on producing Transgenic plants
4. Inculcate the deep knowledge the processes involved in the planning, conduct and execution of plant biotechnology experiments
5. Learn the structure and organization of plant genome
6. Learn the basic techniques for hybridization in producing transgenic plants

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, somaclonal 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, LEA protein, plantibodies, edible vaccines - primary and secondary metabolite modification, biopolymers, plant-based enzyme engineering.

REFERENCES

1. Slater, A., Scott, N. W., & Fowler, M. R. (2008). *Plant Biotechnology.* Oxford: Oxford University Press.
2. Ignacimuthu, S.(2004).*Plant Biotechnology.*New Delhi:Oxford and IBH Publishing House.
3. Chawla, H.S.(2002). *Introduction to Plant Biotechnology*. New Delhi: Oxford and IBHP Publishing Co. Pvt. Ltd.
4. Kumar,U.(2008). *Plant Biotehnology and biodiversity conservation.* Jodhpur: Agrobios.
5. Stewart, N.C. (2008). *Plant Biotechnology and Genetics* .New Jersey: John Wiley & Sons, Inc.
6. Halford, N., & Halford, N. G.(2006). *Plant Biotechnology: Current and Future Applications of Genetically Modified Crops*. New Jersey: John Wiley & Sons.
7. Nirmala, C.B., Rajalakshmi,G., & Karthik, C.(2009). *Plant Biotechnology.* Chennai: MJP Publication.

Semester - III

16BTP302 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

- 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 invitro* conditions
2. Inculcate the deep understanding of Gene expression system of animals
3. Acquire knowledge on producing Transgenic animals
4. Inculcate the deep knowledge the processes involved in the planning, conduct and execution of animal biotechnology experiments
5. Discuss the structure and organization of animal genome
6. Demonstrate the basic techniques for hybridization in producing transgenic animals

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.

REFERENCES

1. Ranga, M. M. (2003). *Animal Biotechnology*. (2nd ed.). Jodhpur: Agrobios.
2. Freshney, R.I. (2000). *Animal Cell Culture: A Practical Approach* (4th ed.). New York: John Wiley Publications.
3. Glick, B.R., & Pasternack, J.J. (2003). *Molecular Biotechnology*(3rded.). UK: Blackwell Science.
4. Gordon, I. (2003). *Laboratory Production of Cattle Embryos* (2nd ed.). New Delhi: CAB International.
5. Yagasaki, K., Miura, Y., Hatori, M.& Nomura, Y. (2008). *Animal Cell Technology: Basic and Applied Aspects* (Vols 13). New York: Springer-Verlag.
6. Primrose, S.B., Twyman, R.M., & Old, R.W. (2001). *Principles of Gene Manipulation* (6th ed.). Germany: Blackwell Science Publishing Company.
7. Portner, R. (2007). *Animal Cell Biotechnology: Methods and Protocols* (Vols 24). New York: Springer-Verlag.

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.

REFERENCES

1. Jinxing, (2006). *Essential Bioinformatics*, Cambridge University Press.
2. Attwood, K., & Smith, J. P. (2003). *Introduction to Bioinformatics*. Singapore: Pearson Education.
3. Rajaraman, V. (2003). *Introduction to information technology*. New Delhi: Prentice Hall of India Pvt. Ltd.
4. Lesk, A. M. (2002). *Introduction to Bioinformatics*. London: Oxford University Press.
5. Ghosh, Z., & Bibek Anand, M. (2008). *Bioinformatics: Principles and Applications*. Oxford University Press.
6. http://www.ncbi.nlm.nih.gov/ .
7. http://www.ebi.ac.uk/2can/databases.

Course Objectives

The objectives of the course are to make the students to

- 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, Association mapping, Haplotypes. 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 focussing, 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.

REFERENCES

1. Brown, T.A. (2002). *Genomes.* Singapore: John Wiley & Sons,.
2. Cantor, C.R., & Smith, C. L. (1999). *Genomics: The Science and Technology behind the Human Genome Project*. Singapore: John Wiley and Sons.
3. Primrose, S.B., &Twyman, R.M. (2003). *Principles of Genome Analysis*. Oxford: Blackwell Publishing,
4. Reiner, W., &Naven, T. (2002). *Proteomics in Practice.*Weinheim: Wiley – VCH.
5. Gibson, W., & Muse, V. (2003). *A Primer of Genome Science.* New York: Sinauer Associates Inc. Publishers.
6. Stekal, D. (2003). *Microarray Bioinformatics.* Cambridge: Cambridge University Press.
7. Liebler, L.H. (2001). *Introduction to Proteomics, Tools for the New Biology.* New Jersey: Humana Press.
8. Richard, P.S. (2004). *Proteins and Proteomics. A Laboratory Manual.* New York: Cold Spring Harbor Laboratory Press.
9. Pennington, S., & Dunn, M.J. (2001). *Proteomics: From Sequence to Function.* Oxford: Bios Scientific Pub.Ltd.
10. Bourne, P.E., & Weissig, H. (2003). *Structural Bioinformatics.* Singapore: John Wiley & Sons,.

16BTP305 A 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 about the extraction of phytochemicals and to procedures
- 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. Recall 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 finger-printing 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.* London: Chapman and Hall.
2. Irfan Khan, A., & Aditya Khanum. (2004). *Role of Biotechnology in medicinal and Aromatic plant* (Vols. 1-10). Hyderabad: Ukaaz Publications.
3. Slater, A., Scott, N.W., & Fowler, M.R. (2008). *Plant Biotechnology: The Genetic Manipulation of plants*. Oxford University press.

16BTP305 B **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

- Students will 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. Toxic effects of heavy metals.
- 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.* London: John Wright, PSG Inc.
2. Mohammad Khan, (2013). *Pesticides in Aquatic Environments*. Springer Science & Business Media
3. Murthy, A.S. (1999). *Toxicity of pesticides to fish.* Florida: CRC Press Inc.
4. Jim Riviere, E. (2006). *Biological Concepts and Techniques in Toxicology: An Integrated Approach.* CRC Press.

16BTP305 C **SYSTEM 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. SYN1, SYN3 and molecular simulation, Parameter Problem. Meanings of Robustness.

Unit -III

Systems Biology Databases KEGG (Kyoto Encyclopedia of Genes and Genomes). BRENDA (BRaunschweigENzymeDAtabase). 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.

REFERENCES

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

16BTP311 PLANT AND ANIMAL 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 system biology applied to the area of biotechnology
- Gain hands-on experience and to learn the principles behind plant and animal biotechnology
- Know the process involved in isolation, separation, manipulation of plant and animal tissues
- Apply the technology in research and development and pharmaceutical industries
- Execute the recent technology involved in plant and animal cell 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 and animal biotechnology
2. Support methodologies in plant and animal tissue/cell 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 and animals
5. Be able to describe techniques and problems in plant and animal cloning
6. Become motivated to set goals towards pursuing higher-level positions, such as lab manager and key scientist in plant and animal biotechnological research institutes and industries

Plant Tissue Culture Techniques

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

11. Preparation and Filter-sterilization of Animal Tissue Culture Medium
12. Chicken embryo fibroblast Culture
13. Quantification of cells by haemocytometer
14. Quantification of viable and non-viable cells by trypan blue dye exclusion method
15. Identification of leukocyte subsets and total count.
16. Blood leukocyte culture
17. Soft agar assay
18. Cryopreservation and revival of cell lines
19. Transfection

REFERENCES

1. Bhojwani, S.S., & Razdan,(2004).*Plant Tissue Culture and Practice.*
2. Brown, T. A. (2006). *Gene cloning and DNA analysis: An Introduction.* Blackwell Publication.
3. Gardner, E.J., Simmons, M.J., & Snustad, D.P. (2008). *Principles of Genetics.* (8th ed.). India: Wiley.
4. Raven, P.H., Johnson, GB., Losos, J.B., &Singer, S.R. (2005). *Biology.* Tata MC Graw Hill.
5. Russell, P.J. (2009). *Genetics – A Molecular Approach* (3rded.). Benjamin Co.
6. Slater, A., Scott, N.W. & Fowler, M.R. (2008). *Plant Biotechnology: The Genetic Manipulation of plants*. Oxford University press.
7. Butler, M. (2004). *Animal cell culture and technology: The basics* (2nd ed.). Bios scientific publishers.
8. Glick, B.R., & Pasternak, J.J. (2009). *Molecular biotechnology- Principles and applications of recombinant DNA* (4th ed.). USA: ASM press.
9. Griffiths, A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C., & Gelbart, W.M. (2009). *An introduction to genetic analysis* (9th ed.).NY: USA, Freeman & Co.
10. Watson, J.D., Myers, R.M., Caudy, A., & Witkowski, J.K. (2007). *Recombinant DNA genes and genomes- A short course* (3rd ed.).NY: USA, Freeman & Co.

16BTP312 BIOINFORMATICS -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

- Give knowledge on Bioinformatics and its application
- 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
- Understand 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

List of Practicals

Bioinformatics

1. Using RasMol through command line
2. Quaternary structural analysis
3. Investigation of molecular interactions using the program KineMage
4. Similarity search using the Blast and interpretation of the results
5. Pair-wise and multiple sequence sequence alignment by using ClustalW
6. Introduction of BioEdit
7. Phylogenetic analysis using web tools
8. Protein Structure Prediction (Homology Modeling) using SPDBV
9. Molecular modeling using SPARTAN
10. Model Building and Energy minimization
11. Quantum chemical and molecular mechanics practicals
12. Basic UNIX commands, pine, telnet, ftp
13. Molecular dynamics simulation using GROMACS etc.
14. Molecular Docking and Drug designing by using Chimera

REFERENCES

1. Bunin Barry, A.,Siesel Brian, Morales Guillermo & Bajorath Jurgen.(2006). *Chemoinformatics*.New York: Theory, Practice, & Products Publisher & Springer.ISBN: 1402050003.
2. Gasteiger Johann, &Engel Thomas. (2003).*Chemoinformatics: A Textbook*.WileyVCH. ISBN: 3527306811.
3. Leach Andrew R., Valerie J. Gillet. (2003).*An introduction to chemoinformatics*. Kluwer academic. ISBN: 1402013477.

4. Gasteiger Johann, (2003). *Handbook of Chemoinformatics: From Data to Knowledge (Vols 4)*.Wiley-VCH. ISBN: 3527306803.

16BTP491 **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