

COURSE PROFILE
M.Sc., BIOTECHNOLOGY

From 2018 batch onwards

Se m.	Course Code	Course Title	Cour se Type	Hrs/Wk		Credits	Passed in	Offered to	Offered by
				Theory	Lab				
I	PBT1531M	CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY	T	6		5		BIOTECH	BIOTECH
	PBT1532M	MICROBIOLOGY	T	6		5		BIOTECH	BIOTECH
	PBT1533M	SYSTEM PHYSIOLOGY	T	6		5		BIOTECH	BIOTECH
	PBT1431P	LAB IN BIOLOGICAL METHODS	L		4	4		BIOTECH	BIOTECH
	PBT1432P	LAB IN MICROBIOLOGY	L		4	4		BIOTECH	BIOTECH
		VALUE BASED COURSES /CEC	T	2		1			
		LIBRARY		2					
	TOTAL			30		24			
II	PBT2531M	BIOCHEMISTRY	T	5		5		BIOTECH	BIOTECH
	PBT2532M	MOLECULAR BIOLOGY	T	5		5		BIOTECH	BIOTECH
	PBT2431P	LAB IN BIOCHEMISTRY	L		4	4		BIOTECH	BIOTECH
	PBT2432P	LAB IN MOLECULAR BIOLOGY	L		4	4		BIOTECH	BIOTECH
	PBT2531O	BIODINFORMATICS	L/T	3	2	5		BIOTECH	BIOTECH
	PBT2425E/ PBT 2426E	REPRODUCTIVE HEALTH FOR WOMEN	T		4	4			
		FOOD SCIENCE AND TECHNOLOGY	T						
		VALUE BASED COURSES / CEC	T		2	1			
		LIBRARY			1				
	Total			30		28			
III	PBT3531M	IMMUNOLOGY AND IMMUNOTECHNOLOGY	L/T	4	2	5		BIOTECH	BIOTECH
	PBT3532M	PLANT AND ANIMAL BIOTECHNOLOGY	T	5		5		BIOTECH	BIOTECH
	PBT3431P	LAB IN PLANT AND ANIMAL BIOTECHNOLOGY	L		4	4		BIOTECH	BIOTECH
	PBT3531O	BIOSTATISTICS	T	5		5		BIOTECH	BIOTECH
PBT 3425E / PBT 3427E	EMERGING INFECTIOUS DISEASE	T	4		4			BIOTECH	BIOTECH
	STEM CELL TECHNOLOGY	T						BIOTECH	BIOTECH
	PROJECT				4				
	VALUE BASED COURSES /CEC				1	1			
	LIBRARY				1				
	TOTAL				30		24		

IV	PBT4531M	INHERITANCE BIOLOGY AND EVOLUTION	T	5		5		BIOTECH	BIOTECH
	PBT4532M	rDNA TECHNOLOGY	T	6		5		BIOTECH	BIOTECH
	PBT4533M	MICROBIAL BIOTECHNOLOGY, BIOSAFETY AND IPR	T	5		5		BIOTECH	BIOTECH
	PBT4431P	LAB IN rDNA TECHNOLOGY	L		4	4		BIOTECH	BIOTECH
	PBT4631M	PROJECT			7	6			
		VALUE BASED COURSES / CEC				1	1		
		LIBRARY				2			
		TOTAL			30	26			

Sem.	Course Code	Course Title	Course Type	Hrs./Wk.		Credits	Passed in Academic Council	Offered to	Offered by
				Theory	Lab				
II	PBT2425E/	REPRODUCTIVE HEALTH FOR WOMEN	TH	4		4	AT 2012	SPLLM (EXCEPT BIOTECH)	BIOTECH
	PBT2426E	FOOD SCIENCE AND TECHNOLOGY	TH	4		4	AT 2012	SPLLM (EXCEPT BIOTECH)	BIOTECH
III	PBT3425E/	EMERGING INFECTIOUS DISEASE	TH	4		4	AT 2012	SPALLM	BIOTECH
	PBT3427E	STEM CELL TECHNOLOGY	TH	4		4		SPALLM	BIOTECH

COURSES OFFERED TO STUDENTS OF OTHER DEPARTMENTS

ELECTIVES

SELF LEARNING COURSES

Sem.	Course Code	Course Title	Course Type	Credits	Passed in	Offered to	Offered by
II / III	PBT0421D	ENVIRONMENTAL MANAGEMENT	T	4	AT 2012	ALLM	BIOTECH
	PBT0422D	SERI BIOTECHNOLOGY	T	4	AT 2012	ALLM	BIOTECH
EXTRA CREDIT COURSES							
II / III	PBT0324MT	TERM PAPER		3		BIOTECH	BIOTECH
	PBT0324MP	MINI PROJECT		3		BIOTECH	BIOTECH

BTE2202CP BIOCHEMISTRY LAB

(LAB)

LEARNING OUTCOME

4 hrs. /

wk.

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

- develop skills in the detection and estimation of various biochemical components
- experience hands on skills on working principles of certain basic instruments
- apply vital testing procedures that can be carried out in clinical laboratories

COURSE CONTENT:**EXPERIMENTS / LAB:****60 hrs.**

1. Preparation of solutions–Reading Exercise.
2. Measurement of pH – titration curve of Acetic acid,
3. Qualitative analysis of amino acids
4. Estimation of Protein–Bradford's method
5. Qualitative analysis of Carbohydrates
6. Estimation of blood glucose level – O –Toluidine method
7. Separation of amino acids – Paper chromatography/TLC.
8. Qualitative analysis of lipids
9. Assay of enzyme activity – Amylase.
10. Estimation of nucleic acids–Diphenylamine method

REFERENCE BOOK(S):

Jayaraman J, (2011). *Laboratory Manual in Biochemistry*, (2nd ed.). New Delhi: New: Age International Publishers, Print.

Palanivelu P, (2001) *Analytical Biochemistry and Separation Techniques – A Laboratory Manual for B.Sc. and M.Sc. Students*, (3rd ed.). Madurai: Kalaimani Printers, Print.

Palanivelu, (2004). *Analytical Biochemistry and Separation Techniques – A Laboratory Manual for B.Sc. and M.Sc., Students*, (4thed.). Madurai: Kalaimani Printers,Print.

Plummer T. D, (1990). *An Introduction to Practical Biochemistry*, Europe: McGraw Hill Book Company. Print.

Ranjna Chawla, (2014), *Practical Clinical Biochemistry Methods and Interpretations* (4th ed.). Jaypee Brothers Medical Publishers. Print.

Sadasivam .S, (1996).*Biochemical Methods*, New Age International, Print.

BTMA3201EI DEMOGRAPHY AND VITAL STATISTICS**(THEORY)****LEARNING OUTCOME****2hrs. /****wk.**

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

- identify appropriate methods of finding the fertility rate, reproduction rate and death rate
- analyze typical demographic patterns and their comparability across populations
- interpret the concept of demographic transition and its related effects on population expansion

COURSE CONTENT:**UNIT I: POPULATION, DEVELOPMENT AND ENVIRONMENT****7 hrs.**

Introduction – Concepts – definitions – relevance and measurement of population – Population trends in the twentieth century– Concepts of stable population– Population explosion – Threatened or real – distant or imminent – international aspects of population growth and distribution– Pattern – determinants and demographic effects of sex and age structure – Age pyramids and projections – Individual aging and population aging.

UNIT II: EFFECT OF POPULATION GROWTH AND HEALTH**8 hrs.**

Concepts – impact and measures of components of population – Nuptiality – Fertility – mortality and morbidity. Life expectancy– Women empowerment and its demographic consequences – Reproductive Health – physiology of human reproduction – reproductive – importance of the study fertility in population dynamics – prevalence of RTI (reproductive tract infection) – STDs and HIV / AIDS; estimated levels and interventions. Family Planning Methods–Advantages / disadvantages – effectiveness- Survey on health status of College (critical analysis of data, correlation of factors and report preparation.

UNITIII: VITAL STATISTICS – FERTILITY RATE

8 hrs.

Introduction to vital statistics – importance of vital statistics – methods of obtaining vital statistics – Population census method – Registration method – Analytic method – measurement of fertility – crude birth rate – general fertility rate – specific fertility rate – total fertility rate.

UNIT IV: VITAL STATISTICS – REPRODUCTION RATE AND DEATH RATE

7 hrs.

Reproduction rate – gross reproduction rate – net reproduction rate – measurement of mortality – crude death rate – specific death rate – standardized death rate – life tables.

TEXT BOOK(S):

Odum, E. P., and Barrett, G. W. (1971). *Fundamentals of ecology* (Vol. 3). Philadelphia: Saunders Chicago

Park, J. E., and Park, K. (1997). *Textbook of social and preventive medicine*. Jabalpur: Publ. Mis. Banarasides Bharol .Print.

REFERENCE BOOK(S):

Ehrlich, P. R., and Ehrlich, A. H. (1972). *Population, resources, environment: issues in human ecology* (No. 301.3 E47 1972). San Francisco: WH Freeman.

Hannan, M. T., and Freeman, J. (1977). *The population ecology of organizations*. *American journal of sociology*, 82(5), 929–964.

Jhingan, M. L. Bhatt, B.K. and Desai, J.N, (2003). *Demography*. New Delhi: Vrinda Publications.

Jones, M. L., and Swartz, S. L. (1984). *Demography and phenology of gray whales and evaluation of whale–watching activities in Laguna San Ignacio, Baja California Sur, Mexico*.

Lee, Ronald D. (1994). "The formal demography of population aging, transfers, and the economic life cycle. *Demography of aging*: 8–49.

Sharma, R. K. (2004). *Demography and population problems*. Atlantic Publishers and Dist.

BTFD4201EI SILK REARING AND PROCESSING TECHNOLOGY

(THEORY)

LEARNING OUTCOME

2 hrs. / wk.

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

- acquire knowledge on the types of silk
- understand the biology and process of rearing silkworm
- apply the technology and make fabric from silk
- appreciate the role of silk in fashion industry

COURSE CONTENT:

UNIT I: INTRODUCTION TO SERICULTURE

7 hrs.

History– types of silk : Tussar – Muga – Eri – recombinant silk – uses of silk. *Bombyx mori* – morphology – life cycle – silk gland – Mulberry – cultivation – pruning and harvesting – optimum conditions – diseases of mulberry.

UNIT II: SILK REARING TECHNOLOGY

8 hrs.

Rearing house – rearing appliances, rearing operations – optimum conditions for rearing – rearing methods – Filature operations – sorting cocoons – softening the sericins – cocoon marketing – byproducts of defective cocoon waste – classification of silk thread waste – filature – charka waste – spun silk – recombinant silk protein genes.

UNIT III: MANUFACTURING AND WET PROCESSING OF SILK

8 hrs.

Reeling the filaments – Manufacturing of silk yarn – throwing of silk – degumming of thrown silk – spun silk. Physical and chemical properties of silk yarn – Preparatory process of silk – degumming – bleaching – Dyeing – Yarn dyeing – fabric dyeing – tie and dye – dyes used for silk – Printing – Block printing and screen printing – Finishes of silk.

UNIT IV: SILK IN FASHION INDUSTRY

7 hrs.

Identification and Analysis of Silk Quality – Silk Mark – Silk clusters in India – Uniqueness of silk clusters – Accessories and silk products – Care and maintenance of silk– marketing strategies for silk products.

TEXT BOOK:

Ganga, G. and Sulochana Chetty, J.,(2012). *An Introduction to Sericulture*. (2nd ed.), New Delhi: Oxford & IBH publishing Co. (P) Ltd. Print.

REFERENCE BOOK(S):

Krishna swami, S., Narasimhanna Suryanarayan, S.K., Kumararaj, S, (1998). *Silkworm Rearing*, New Delhi: Oxford & IBH publishing Co.(P) Ltd. Print.

Sonwalkar, T.N, (1992) *Handbook of silk technology*, New Delhi: Wiley eastern Ltd. Print.

Rangaswami, G., Narasimhanna, M.N.m Kasiviswanathan, K., Sastry, C.R, (1991). *Mulberry cultivation Sericulture manual 1*, New Delhi: Oxford & IBH publishing Co.(P) Ltd. Print.

Bernard, P. Corbman, (1983). *Textiles: Fiber to Fabric*. (6th ed.), International edition, Singapore: Print.

Koshy, T.D. (1993). *Silk exports and Development*. New Delhi: Ashish publishing house Print.

Roland Kilgus. (2008). *Clothing Technology from Fibre to Fashion*.(5thed.), Neckartenzlingen:Print.

Staff and Students of SSMITT, (1991). *Fibre Science*. (5th ed.), Komarapalayam, Tamil Nadu: Print.

BTIT6401DT CLINICAL INFORMATICS

(LAB CUM THEORY)

LEARNING OUTCOME

3T + 1L hrs. / wk.

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

- acquire knowledge on basic programming skills in drug designing

- implement docking skills through open source software
- gain hands on skills in informatics and implement them in analyzing biological data

COURSE CONTENT:

UNIT I: CLINICAL INFORMATICS

9 hrs.

Data – data generation – generation of large scale molecular biology data – genome sequencing. Protein sequencing - NMR spectroscopy – x – ray diffraction and microarray(Review). Introduction – associated disciplines and recent advances – system biology – interactomics (PPI) – fluxomics – biomics – metagenomics – immunoinformatics – stemformatics – Scope – applications – limitations – Pathway database – KEGG – reactome – PANTHER – concept of pharmacogenomics.

UNIT II: BASIC PRINCIPLES IN DRUG DESIGNING

9 hrs.

Tools for drug discovery – chemical structure representation (SMILE and SMART) – Chemical databases – CSD – ACD – WDI – ChemBank – Drug Bank - hazardous chemical database and PUBCHEM – Molecular modeling of small molecules – introduction – molecular modeling functions – structure generation – structure visualization – conformation generation – molecular superposition – Pharmacology and toxicology – Pharmacodynamics and kinetics.

UNIT III: COMPUTER AIDED DRUG DESIGNING

9 hrs.

Introduction to CADD – rational drug design – factors contributing to drug design – drug design process – software for drug design– computers in drug design – computer simulation for drug design – drug design theory – success and failure of using computers in drug design – RACHEL software package.

UNIT IV: PHARMACOPHORE MODELLING AND DOCKING

9 hrs.

Introduction – pharmacophore modeling in Schrodinger – docking using open source software – Autodock suite overview – features – Installation – AutoDock tools – applications – macromolecule preparation – ligand preparation – AutoDock Steps – docking using AutoDock Vina – other docking algorithms – protein –protein docking.

UNIT V: APPLICATIONS OF PyRx

9 hrs.

Installation – environment – tools – configure PyRx to AutoDock – load a molecule and perform the following operations – hide a molecule – hide a particular chain – label a particular protein residue – add module in Isosurface – bounding Box – docking log files – creating clustering histogram – AutoDock ligand – dock only few molecules.

EXPERIMENTS / LAB:

15 hrs.

1. Nucleic acid sequence analysis – promoter, terminator, ORF identification and detection of SNP
2. Protein sequence analysis: Hydrophobicity, amphipathicity, Transmembrane and secondary structure prediction – ExPASy tools
3. Homology modeling – SWISSMODEL
4. Target identification and active site prediction – CASTp
5. Small molecule building – ChemSketch
6. Molecular Visualization – RasMol 2.7.5.2, SwissPDB viewer 4.10
7. Molecular docking using AutoDock 4
8. Molecular docking using PyRx

TEXT BOOK(S):

Andrew, R. L, (2001). *Molecular Modeling Principles and Applications (2nded.)*. Pearson Education Limited. Print.

Cohen, N. C, (1996). *Guidebook On Molecular Modeling in Drug Design*. Academic Press. Print.

Karthikeyan, M. and Vyas, R, (2014). *Practical chemoinformatics*. Springer. Print.

Nag, A. and Dey, B, (2011). *Computer-aided drug design and delivery systems*. McGraw-Hill. Print.

REFERENCE WEBSITE(S):

<http://www.acdlabs.com/resources/freeware/index.php>

<https://www.ncbi.nlm.nih.gov/orffinder/>

<https://molbiol-tools.ca/Promoters.htm>

<https://swissmodel.expasy.org/>

http://www.acdlabs.com/products/draw_nom/draw/chemsketch/

<http://sts.bioe.uic.edu/castp/>

<https://www.expasy.org/spdbv/>

<http://autodock.scripps.edu/faqs-help/tutorial>

https://faculty.missouri.edu/~gatesk/Docking_Assignment.pdf

PBT4528M GENOMICS, PROTEOMICS & BIOINFORMATICS

(THEORY)

5 hrs. / wk.

LEARNING OUTCOME

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

- understand the concepts of gene, protein and their function
- integrate the various approaches of analyzing the genome and proteome data
- explore the *in silico* tools used for genomic and proteomic analysis

COURSE CONTENT:

UNIT I: THE ORGANIZATION AND STRUCTURE OF GENOME

15 hrs.

Concept of genome – genomes of various cellular organisms – viruses and prokaryotes – genome complexity – introduction to databases – nucleotide sequence databases – NCBI – DDBJ – EMBL – genome databases – TIGR – SGD – organization of nuclear DNA in eukaryotes – animal models – microsatellites dispersed repeated sequences – *in silico* gene prediction methods and tools for promoter – terminator and ORF identification.

UNIT II: MAPPING STRATEGIES

15 hrs.

Physical mapping – FISH, optical mapping; genetic mapping – radiation hybrid mapping, QTL mapping; linkage mapping disequilibrium studies – cytological mapping – alignment of randomly isolated clones based on shared RFLP profiling – chromosome walking – hybridization mapping – marker sequences – EST – STS – SNP – databases & discovery tools molecular markers – SNP database – dbSNP – PolyPhen – PolyDoms.

UNIT III: COMPARATIVE GENOMICS

15 hrs.

Genome comparison of prokaryotes and eukaryotes – comparison of gene order – *insilico* approach of gene comparison and phylogeny analysis – BLAST, FASTA and ClustalW – transcriptomics – analysis and quantifying mRNA levels – single gene expression analysis –

expression profiling – SAGE – microarray technology – microbead technology – applications – profiling of microbial gene expression – RNA Fold analysis – RNA fold server – introduction to *in silico* microarray data analysis.

UNITIV: PROTEOMICS

15 hrs.

Protein separation – 2D analysis, Mass spectroscopy – expression analysis – protein microarray – protein chips – structural analysis – X-ray crystallography, NMR – protein sequence (Uniprot knowledgebase) and structure database (PDB) – proteome analysis – structure prediction methods and tools – ExPASy server – ProtParam, Compute pI / MW – CFSSP – SWISS 2D-PAGE – protein interaction analysis – biochemical methods – yeast two hybrid system – matrix method – random library approach metabolomics – metabolomic studies.

UNIT V: APPLICATIONS OF GENOMICS

15 hrs.

Vaccine development – combating bacterial pathogenicity – agriculture (expression profiling in *Arabidopsis* – drug discovery) – proteomics – forward and reverse genetics – knock -in – RNA screens – plant breeding. Pharmacogenomics – individual response to drug – ADMET properties – *insilico* tools to predict ADMET properties – pharmacodynamics & Pharmacokinetics.

TEXT BOOK(S):

Attwood, T.K. Smith, P.D.J. Phukan S, (2007). *Introduction to Bioinformatics* (1st ed.). New Delhi: Pearson Education Pvt. Ltd. Print.

Baxevanis, D. and Francis, B.F, (2004). *Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins* (3rd ed.). New York: John Wiley & Sons Inc. Print.

Primrose, S.B. and Twyman, R.M, (2003). *Principles of genome analysis and genomics* (3rd ed.).UK: Blackwell publishing, Oxford. Print.

REFERENCE BOOK(S):

Bergeron, B.M.D, (2003). *Bioinformatics Computing – The Complete Practical Guide to Bioinformatics for Life Scientists*, New Delhi: Pearson Education (Singapore) Pvt. Ltd. Print.

Birren, B. Green, E.D. Hicter, P. Klapholz, S. Myers, R.M. Reithman, H. and Roskams, J, (2006) *Genome Analysis – A Laboratory Manual, Mapping Genomes*, Volume IV, New Delhi: Panima Publishing Corporation. Print.

Bosu, O. and Thukral, S K, (2007). *Bioinformatics Databases, Tools, Algorithms*, New Delhi: Oxford University Press. Print.

Campbell, M.A. and Heyer, J.L,(2007). *Discovering Genomics, Proteomics and Bioinformatics* (2nd ed.). USA: Pearson Education Inc., Publishing as Benjamin Cummings.Print.

Kothekar, V. and Nandi, T, (2007). *An Introduction to Bioinformatics* (2nd ed.). New Delhi: Panima Publishing Corp. Print.

Lesk, M, (2004). *Introduction to Bioinformatics*, New Delhi: Oxford University Press. Print.

Primrose,S.B. and Twyman, R.M, (2003). *Principles of Genome Analysis and Genomics* (3rd ed.). UK: Blackwell Publishing, Oxford.Print.

Rastogi, P.S.C. Namita, M. Rastogi, P, (2004). *Bioinformatics Concepts, Skills and Applications*, New Delhi: CBS Publishers. Print.

PBT4529M DEVELOPMENTAL BIOLOGY, GENETICS & EVOLUTION

(THEORY)

LEARNING OUTCOME

5 hrs. / wk.

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

- understand the basic concepts and principles of evolution
- appreciate the genetic processes, role of genes and their application
- recognize the interplay between development and evolution

COURSE CONTENT:

UNIT I: EMBRYOLOGY - GAMETOGENESIS & FERTILIZATION 15 hrs.

Introduction: historical perspectives – concepts (Classical and Modern Embryology), Gametogenesis: Oogenesis – types of ova – Spermatogenesis - types of spermatozoa (Review) – gene expression during spermatogenesis and oogenesis. Fertilization: Cortical reaction – fertilization membrane – changes in organization of egg – Cleavage: Patterns of cleavage – Amphibia – Chick – Mammals – Fate maps; Organizer – experimental evidences.

UNIT II: ORGANOGENESIS, MAMMALIAN EMBRYOLOGY & DEVELOPMENTAL DISORDER 15 hrs.

Organogenesis: (Central Nervous System – Eye – Heart – Limb) - Axis formation in Vertebrate - Metamorphosis in Amphibia – hormonal regulation – Regeneration (Amphibia); Placentation – types of placenta – human developmental stages – Twins study – parturition – Contraceptives – Pre-natal diagnosis – amniocentesis – teratology – congenital and neonatal diseases and abnormalities

UNIT III: MECHANISM OF GENETIC EXCHANGE IN PROKARYOTE 15 hrs.

Prokaryotic genome (Review) – Bacterial genetics – Plasmid – Mutant phenotypes – Horizontal gene transfer Transformation – mapping and Conjugation – F-plasmid, Cointegrate formation and Hfr – Time – of – Entry mapping. Transduction – types – mapping.

UNIT IV: HUMAN & POPULATION GENETICS 15 hrs.

Simple Mendelian traits – Mendelian laws – Karyotyping – Banding techniques – Gene mutation – associated syndromes – Chromosomal aberrations – ploidy (Review). Sex determination – Sex linked diseases. Genetic equilibrium – Hardy – Weinberg law – its applications – Gene pool – Genetic drift – genetic polymorphism.

UNIT V: EMERGENCE OF EVOLUTIONARY THOUGHTS & PALEONTOLOGY 15 hrs.

Origin of life – Miller and Urey experiment – Oparin – Lamarckism – Darwinism – Weismann's germ plasm theory – Adaptive radiation – Palaeontological evidences – fossils & rocks – formation – fossilization – types & significance. Geological time scale – Evolution of mammals – horse – primate evolution & human origins – Selection – natural – directional – artificial selection – mutation – migration – random genetic drift – founder principle.

TEXT BOOK(S):

Anthony, J.F. Griffiths, Susan, R. Wessler, Richard C. Lewontin, Sean B. Carroll, (2000). *Introduction to Genetic Analysis* (9th ed.). New Delhi: W.H. Freeman & Company. Print.

Gilbert, S.F., (1994). *Developmental Biology* (4th ed.). Sunderland, Massachusetts: Sinauer Associates Inc. Print.

Strickberger, W.M., (2005). *Evolution*, Boston: Jones & Bartlett Publishers. Print.

REFERENCE BOOK(S):

Banerjee, S., (2005). *A Textbook of Developmental Biology*, New Delhi: Dominant Publishers and Distributors. Print.

- Browder, L.W., Erickson, C. A and Jeffery, W. R, (1991). *Developmental Biology* (3rd ed.). London:Saunders College Pub.Print.
- Futuyma, J.D,(2005). *Evolution* (2nd ed.). Sunderland, USA: Sinauer Associates, Inc.Print.
- Klug,W.S and Cummings, M.R,(2003).*Concepts of Genetics*(2nd ed.). Singapore: Pearson Education.Print.
- Lewis, R,(1997) *Human Genetics- Concepts and Applications* (2nd ed.). New York: WCB/ Mc Graw-Hill Company.Print.
- Ridley, M,(1996) *Evolution* (2nd ed.).New York: Oxford University Press.Print.
- Strickberger, W.M, (1985). *Genetics* (3rd ed.). New Delhi: PHI Learning Pvt Ltd.Print.
- Verma P.S., Agarwal V.K, (2005) *Cell Biology, Genetics, Molecular Biology, Evolution & Ecology*, New Delhi:S. Chand & Company Ltd.Print.
- Sudbery,P, (2002).*Human Molecular Genetics*(2nd ed.). India:Pearson Education.Print.
- Tamarin, H.R,(1998).*Principles of Genetics* (7th ed.). New Delhi:Tata McGraw Hill Education Pvt. Ltd.Print.
- Strachan,T., Read, P.A,(1999). *Human Molecular Genetics*(3rd ed.). New York : Oxford University Press Print.
- Wolpert, L.,(2002).*Principles of Development* (2nd ed.). New York: Oxford University Press.Print.

PBT4530M BIOPROCESSING TECHNOLOGY

(THEORY)

LEARNING OUTCOME

5 hrs. / wk.

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

- acquire knowledge about bioreactor and their industrial applications
- apply the theoretical knowledge into practice
- understand the enzyme catalytic reactions and their industrial applications

COURSE CONTENT:

UNIT I: FERMENTATION PROCESSES - BATCH, FED BATCH AND CONTINUOUS BIOREACTIONS

15 hrs.

Fundamentals of fermentation process - design – media, microbial strains, fermenter design, scope of the product, process design analysis, objectives of design project; Bioreactors – Introduction, Types – Tower, jet loop, Airlift, Bubble column, Stirred & Packed bed; Specialized bioreactors – Pulsed, Fluidized bed reactors, Enzyme bioreactors, Photobioreactors; Stability of microbial reactors.

UNIT II: BIOPROCESS CONTROL

15 hrs.

Concepts of process control - biosensors in monitoring – current trends and future prospects - applications of artificial intelligence, - case studies on bioreactor control problems. Quality assurance & quality control.

UNIT III: ENZYME ENGINEERING

15 hrs.

Introduction - types of industrial enzymes, methods, modification of enzyme - in vivo biosynthetic process. Immobilization of enzymes and whole cell – covalent bonding, encapsulation, cross linking, physical attachment, occlusion and entrapment, merits and demerits of immobilization.

UNIT IV: DOWNSTREAM PROCESSING**15 hrs.**

Introduction, removal of microbial cells and solid matter foam separation, flocculation, floatation, filtration, centrifugation, cell disruption, chromatography, drying & crystallization & precipitation.

UNIT V: INDUSTRIAL PRODUCTION OF: ORGANIC ACID**15 hrs.**

Citric, acetic, gluconic & lactic acid, Amino acids – L-glutamic acid, Lysine, L-tryptophan, Enzymes- amylases, glucose isomerase, L-asparaginase, proteases, lipases, Vitamins-vitamin B12, riboflavin,β-carotene, Biotransformation of steroids, non-steroid compounds & antibiotics; Antibiotics – penicillin, streptomycin, tetracycline.

TEXT BOOK(S):

Demain, L.A., And Davies. E.J,(1999).*Manual of Industrial Microbiology and Biotechnology*(2nd ed.). New Delhi :Panima Educational Book Agency.Print.

Young, M.M., Bull, A.T and Dalton, H,(2004). *Comprehensive Biotechnology – The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine*, Volumes I, II & III, Oxford, UK: Pergamon Press Ltd.Print.

REFERENCE BOOK(S):

Asenjo,J.A,(1990).*Separation Processes in Biotechnology*, Noida:Brijbasi Art Press Ltd.Print.

Berg,J.M., Tymoczko, L.J and Stryer, L,(2003). *Biochemistry*(5th ed.). New York:W.H. Freeman & Company.Print.

Crueger W and Crueger A,(1990). *A Textbook of Industrial Microbiology*(2nd ed.). New Delhi:Panima Publishing Corporation.Print.

Demain,A.L and Davis, J.E,(2004).*Manual of Industrial Microbiology and Biotechnology*(2nd ed.). Kundli: Replika Press Pvt. Ltd.Print.

El-Mansi E.M.T., Bryce C.F.A. Demain A.L., Allman A.R,(2006). *Fermentation Microbiology And Biotechnology*(2nd ed.). New York :Taylor& Francis Group. Print.

Joshi, V.K and Pandey,(1999). *A.Biotechnology: Food Fermentation*, Vol. I & II, New Delhi :Educational Publishers & Distributors.Print.

Mukhopadhyay, S.N.(2005).*Process Biotechnology Fundamentals*(2nd ed.). New Delhi:Viva Books Pvt. Ltd.Print.

Nelson, L.D and Cox, M.M.(2005). *Lehninger – Principles of Biochemistry*(4th ed.). New York:W.H. Freeman & Company.Print.

Palmer, T.(2004).*Enzymes: Biochemistry, Biotechnology & Clinical Chemistry*, New Delhi:East West Press Pvt. Ltd.Print.

Pandey, A., Larroche, C., Soccol ,C.R and Dussap ,C.G.(2008).*Advances in Fermentation Technology*, New Delhi :Asiatech Publishers Inc.Print.

Pandey, A., Soccol,C.R and Larroche, C.(2007).*Current Developments in Solid-State Fermentation*, New Delhi:Springer (USA) & Asiatech Publishers Inc.Print.

PBT4223P LAB IN BIOINFORMATICS**(LAB)****LEARNING OUTCOME****3 hrs. / wk.**

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

- acquire knowledge on biological databases
- relate the significance of computational approach in understanding concepts of biology
- implement the skills in bioinformatics in analyzing the biological data

COURSE CONTENT:

EXPERIMENT / LAB:

45 hrs.

1. Access to Biological database in the web sources
2. Sequence submission tools (BankIt, Webin & SPIN)
3. Pairwise Sequence alignment -BLAST, FASTA
4. Multiple sequence alignment - Clustal W
5. Phylogenetic analysis - MEGA 5
6. Nucleic acid sequence analysis - promoter, terminator and ORF identification
7. Protein sequence analysis: Hydrophobicity, amphipathicity, Transmembrane and secondary structure prediction - ExPasy tools
8. Small molecule building – ChemSketch
9. Molecular Visualization – RasMol, SwissPDB viewer
10. Homology modeling –.SWISSMODEL

REFERENCE BOOK(S):

- Baxevanis, A.D. & Ouellete, F,(2006) *Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins* (3rd ed.). B.F., John Wiley and Sons (Asia) Pvt. Ltd., Print.
- Mount, D.W,(2001) *Bioinformatics- Sequence, Genome analysis* New Delhi: CBS Publishers and Distributors, Print.
- Xiong, J,(2006) *Essential Bioinformatics* (1st ed.). United Kingdom: Cambridge University Press. Print.
- Gautham N, (2007) *Bioinformatics- Databases and Algorithms* New Delhi: Narosa Publishing House.Print.
- Attwood, T.K., & Parry Smith, D.J, (2005) *Introduction to Bioinformatics* New Delhi: Pearson Education.Print.
- Han, J., Pei, J., & Kamber, M, (2011). *Data mining: concepts and techniques*. Elsevier. Print.
- Larose, D. *Discovering Knowledge in data; An introduction to data mining* (2004) New Jersey: John Wiley science.Print.
- Mani, K., & Vijayaraj, N, (2004) *Bioinformatics - A Practical Approach* Coimbatore: Aparna Publication.Print.
- Selzer, P.M., Marhofer, R., & Rohwer, A, (2008) *Applied Bioinformatics-An Introduction*. Springer Science &Business Media.Print.

REFERENCE WEBSITES:

- <http://www.ncbi.nlm.nih.gov/>
- <http://www.expasy.ch/sprot/sprot-top.html>
- <http://pbil.univ-lyon1.fr/bookmarks.html>
- <http://bmbpcu36.leeds.ac.uk/~david/bioinf.html>
- <http://rna.tbi.univie.ac.at/cgi-bin/RNAWebSuite/RNAfold.cgi>
- <http://www.megasoftware.net/>

PBT4224P LAB IN BIOPROCESSING TECHNOLOGY (LAB)

LEARNING OUTCOME

3 hrs. / wk.

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

- acquire knowledge about Fermentation process
- understand the enzyme catalytic reactions and their industrial applications
- apply the theoretical knowledge into practice

COURSE CONTENT:

EXPERIMENTS/LAB:

45 hrs.

Demonstration of Batch fermenter.

1. Analysis of microbial consortia from fermented food (rice dough)
2. Isolation of amylase / protease producing microbes from the consortia.
3. Assaying of microbial proteases/amylases
4. Solid state fermentation of *Aspergillus sp.* for production of hydrolytic enzymes
5. Purification of enzymes by centrifugation, precipitation
6. Determine the specific activity of a hydrolytic enzyme.
7. Immobilization of microbial enzymes – Entrapment method.
8. Mass production of *Trichoderma sp.*
9. Assay for antimicrobial activity of *Trichoderma sp.*

REFERENCE BOOK(S):

- Pandey, A., Larroche C., Socol,C.R and Dussap,C.G,(2008). *Advances in Fermentation Technology*. New Delhi: Asiatech Publishers Inc.Print.
- Pandey, A., Socol, C.R and Larroche, C,(2007).*Current Developments in Solid-State Fermentation*New Delhi :Springer (USA) & Asiatech Publishers Inc.Print.
- Pandey, A., Webb, C., Socol ,C.R and Larroche, C,(2006) *Enzyme Technology*. New Delhi : Asiatech Publishers Inc.Print.
- Peppler, H.J and Perlman, D,(2006).*Microbial Technology – Microbial Processes*, Volume I(2nd ed.). New York: Academic Press.Print.
- Mukhopadhyaya, S.N,(2005). *Process Biotechnology Fundamentals*(2nd ed.). New Delhi: Viva Books Pvt. Ltd.Print.
- Nelson, L.D and Cox, M.M, (2005).*Lehninger – Principles of Biochemistry*(4th ed.). New York: W.H. Freeman & Company.Print.
- Singh, R and Ghosh,S.K,(2004). *Industrial Biotechnology*, New Delhi: Global Vision Publishing House.Print.
- Palmer, T,(2004). *Enzymes: Biochemistry, Biotechnology & Clinical Chemistry*, New Delhi: East West Press Pvt. Ltd.Print.
- Demain, A.L and Davis, J.E,(2004).*Manual of Industrial Microbiology and Biotechnology*, (2nd ed.). Kundli: Replika Press Pvt. Ltd.Print.
- Crueger, W and Crueger,A,(1990). *A Textbook of Industrial Microbiology*,(2nd ed.). New Delhi:Panima Publishing Corporation.Print.

Price, N.C and Lewis S,(1998). *Fundamentals of Enzymology*,(2nd ed.). New York:Oxford University Press.Print.

PBT1531M CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY

(THEORY)

LEARNING OUTCOME

6 hrs. / wk.

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

- appreciate the dynamic nature of the cell and its organelles
- comprehend the important cellular mechanisms in normal and abnormal cell
- relate the molecular mechanisms that underlie plant and animal development

COURSE CONTENT:

UNIT I: STRUCTURE AND FUNCTION OF PLASMA MEMBRANE AND INTRACELLULAR ORGANELLES

18 hrs.

Cell as the basic unit of living organism – origin of cells, cell theory, molecules of cell, Cell membrane – models – mechanism of transport – passive and active transport (Reading exercise). Biogenesis and functions of organelles – nucleus – nucleolus – ribosomes – endoplasmic reticulum – Golgi complex – lysosomes – mitochondria and chloroplast.

UNIT II: CELL DIVISION, CELL CYCLE AND CANCER BIOLOGY

18 hrs.

Stages and regulation of mitosis, meiosis and fertilization – process – regulation and gene expression of oocytes (egg and sperm) during meiosis. Cell cycle and cancer – checkpoints; biology of cancer – genetic role of oncogenes and tumor suppressor genes – interaction of cancer cells with normal cells.

UNIT III: CELL SIGNALING AND COMMUNICATION

18 hrs.

Hormones and their receptors– secondary messengers and signaling through G–protein coupled receptors and MAP kinase, regulation of signaling pathways in induction and competence – TGF– β and Wnt family – General principles of cell communication, cell adhesion molecules and their roles in development.

UNIT IV: EARLY EMBRYONIC DEVELOPMENT

18 hrs.

Gametogenesis and fertilization (Review); comparative study of cleavage, gastrulation, fate maps and differential gene expression– invertebrates (*Caenorhabditis elegans*, *Drosophila melanogaster*), mammals (human– developmental stages, types of placenta)–Organizer concept with experimental evidences.

UNIT V: DIFFERENTIATION AND PATTERN FORMATION IN PLANTS AND ANIMALS

18 hrs.

Organogenesis and development in Plants: shoot, root, apical meristem, leaf and flower, phyllotaxy–*Arabidopsis thaliana*. Organogenesis in animals– vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development, myogenesis and regeneration in vertebrates– metamorphosis and regeneration in fruit fly and tadpole – genetic, hormonal regulation.

TEXT BOOK(S):

Becker, W. M., Kleinsmith, L. J., and Hardin, J (2005). *The world of the cell*,San Francisco: Benjamin–Cummings Publishing Company. Print.

Scott. F., Gilbert, (2010). *Developmental Biology*(9th ed.).Sunderland: Sinauer Associates, Inc.Print.

REFERENCE BOOK(S):

Alberts, B, Johnson, A, Lewis, J,(2002). *Molecular Biology of the Cell*. (4th ed.).New York: Garland Science. Print.

Balinsky,B.I,(2012).*An Introduction to Embryology*.(4thed.).Philadelphia: Holt–Saunders International. Print.

Berril,N.J,(1980).*Developmental Biology*.(6thed.).New Delhi: Tata McGraw Hill Company Ltd.Print.

Bradley,P.M,(1925). *The Early Embryology of the Chick*(3rded.).Toronto: The Blakiston Company. Print.

Browder, L.W., Erickson, C.A and Jeffery,W.R,(1991).*Developmental Biology*.(3rd ed.).London: Saunder College.Print.

Cooper, G. M and Hausman,(2007).*The Cell – A Molecular Approach*.(4th ed.).Washington D.C:ASM Press.Print.

De Robertis, E.D.P. and De Robertis,E.M.F,(2001).*Cell and Molecular Biology*(8th ed.).Philadelphia, USA: Williams and Wilkins.Print.

Karp, G,(2005).*Cell and Molecular Biology – Concepts and Experiments*.(4thed.).New Jersey, USA: John Wiley and Sons Inc. Print.

Karp, G,(2006). *Cell and Molecular Biology: Concepts and Experiments*.(4thed.).New Jersey, USA: John Wiley and Son. Inc. Print.

Lodish, H., Berk,A., Zipursky,S.L., Matsudaira, P., Baltimore, D and Darnell, J,(2000).*Molecular Cell Biology*.(4thed.).New York, USA:W.H. Freeman and Company.Print.

Prescott, M.D,(1998).*Cells*.Boston, London:Jones and Bartlett Publishers.Print.

Swanson, C.P,(1990).*The Cell*. New Delhi: Prentice Hall of India Pvt. Ltd.Print.

Wolpert,L,(2002).*Principles of Development*.(2nd ed.). New York: Oxford University Press. Print.

PBT1532M MICROBIOLOGY

(THEORY)

LEARNING OUTCOME

6 hrs. / wk.

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

- appraise the diversity of microbial world
- understand the structure, growth, nutrition and metabolism of microbes
- acquire knowledge about the causes, symptoms and control of microbial diseases

COURSE CONTENT:

UNIT I: FUNDAMENTALS OF MICROORGANISMS

16 hrs.

History and scope of microbiology – controversy over spontaneous generation – golden age of microbiology. Microscopy – types – bright field – dark field – fluorescence – phase–contrast and electron microscopy. Prokaryotic cell structure and functions–structure of peptidoglycan – flagella – pili – capsule – inclusion bodies – endospore (Reading exercise) – Microbial classification and taxonomy – numerical taxonomy – Bergey’s manual of systematic bacteriology– molecular genetic methods (16S /18S rRNA, ITS) – Host microbe interactions – Metagenomics studies.

UNIT II: VIRUSES**20 hrs.**

General characteristics–morphology–classifications–cultivation–detection and enumeration methods – structure – virus attachment to host cells – interaction with cell receptors – entry into cells – genome replication – Multiplication of lambda phage – M13 phage – T4 phage – TMV – Herpes virus – adeno virus – AAV – retro virus – SV40 and baculovirus –viral pathogenesis – virulence and host susceptibility – prion based diseases.

UNIT III: MICROBIAL NUTRITION AND GROWTH**18 hrs.**

Common nutritional requirements – Nutritional types of microbes – control of microbial growth – physical methods – dry heat – moist heat – radiation – filtration – Chemical methods and their application (Review) – Microbial Growth – growth curve – measurement of growth. Synchronous culture and continuous culture – factors affecting microbial growth – enrichment culture technique – preservation and maintenance of microbial cultures– glycerol cultures – deep freezing – freeze drying – liquid nitrogen preservation.

UNIT IV: MICROBIAL METABOLISM**18 hrs.**

Entner Doudroff pathway – fermentation– anaerobic respiration – photosynthesis – light and dark reaction in cyanobacteria – green and purple bacteria – Assimilation of inorganic phosphorous – sulphur and nitrogen – photosynthetic fixation of CO₂.

UNIT V: MICROBIAL DISEASES AND CONTROL MEASURES**18 hrs.**

Normal microflora, opportunistic and facultative microbes– causative agent, pathogenesis and control measures of bacterial and fungal diseases (air – water – food and vector borne – tuberculosis – typhoid – botulism – malaria – mycoses)– antimicrobial agents and their mode of action – antibacterial, antifungal, antiviral – mechanism of action– resistance to antibiotics – quorum sensing – quorum quenching.

TEXT BOOK(S):

Flint, S.J., Enquist, L.W., Racaniello, V.R., and Skalka, A.M., (2004). *Principles of Virology* (2nd ed.). Washington: ASM Press. Print.

Prescott, L.M., Harley, K.P., and Klein, D.A., (2011). *Microbiology* (9th ed.). Boston: McGraw Hill Inc. Print.

REFERENCE BOOK(S):

Ananthanarayanan, R and Panikar, C.K.J., (2002). *Text Book of Microbiology*. (6th ed.). Hyderabad: Orient Longman Pvt. Ltd. Print.

Garrity, G.M., (2001). *Bergeys Manual of Systemic Bacteriology*. (2nd ed.). New York: Springer Verlag. Print.

Holt, J.G., Krig, N.R., Peter, H.A., Stanley, S.J.T and Williams, S.T., (1994). *Bergeys Manual of Determinative Bacteriology* (9th ed.). Baltimore, U.S.A: Williams and Wilkins, A Maverly Company. Print.

Ingraham, J.L., and Ingraham, (2004). *Introduction to Microbiology* (3rd ed.). Australia: Thomson Brooks/ Cole. Print.

Pelczar, M.J., Schan, E.C., and Krieg, (2004). *Microbiology Concepts and Applications* (5th ed.). Boston: McGraw Hill Inc. Print.

Persing, D.H., (2003) *Molecular Microbiology – Diagnostic Principles and Practice*. (2nded.). Washington: ASM Press. Print.

Tortora, G. J., Funke, B. R., Case, C. L., and Johnson, T. R., (2004) *Microbiology: an introduction* (5thed.). San Francisco, CA: Benjamin Cummings. Print.

PBT1533M SYSTEM PHYSIOLOGY

(THEORY)

LEARNING OUTCOME

6 hrs. / wk.

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

- understand the basic concepts and functions of organs and organelles
- compare and relate the regulation of various organ systems
- appreciate the homeostasis between the organs and the system

COURSE CONTENT:

UNIT I: WATER RELATIONS AND METABOLIC PROCESSES

22 hrs.

Plant cell organs– structure and organization (Review) – Water balance in plant cells– pathway of water uptake and movement–concepts of symplast and apoplast– ascent of sap; transpiration– mechanism of stomatal movement; long–distance transport mechanisms – solute movement through xylem and phloem; photosynthesis – CO₂ fixation– C₃ – C₄ and CAM pathways – photorespiration – Nitrogen and Sulphur metabolism– Nitrogen and Sulphur uptake and assimilation – mineral nutrition – mechanism of uptake and translocation of minerals – biosynthesis of hormones and its role in growth and development – Secondary metabolites and their significance in plant defense mechanism.

UNIT II: PLANT MOLECULAR BIOLOGY

23 hrs.

Skotomorphogenesis and photomorphogenesis– molecular mechanisms of light perception– signal transduction and gene regulation; biological clocks and their genetic and molecular determinants; Molecular genetics of floral development and floral organ differentiation– photoperiodism– gene expression in flowering –vernalization–signal perception, transduction and regulation during plant growth and development – phospholipids and Ca²⁺– calmodulin cascade– MAP kinase cascade– two component sensor–regulator system; hormonal control of seed development– seed maturation and dormancy–senescence and its regulation– hormonal and environmental control of senescence; PCD in the life cycle of plants.

UNIT III: RESPIRATORY, CIRCULATORY AND NERVOUS SYSTEM

15 hrs.

Respiratory system: transport of gases, exchange of gases – waste elimination (Review) – neural and chemical regulation of respiration – molecular mechanism of COPD. Circulatory system – blood corpuscle – haemopoiesis – plasma function – blood volume regulation – haemostasis – Cardiovascular System – (Review–comparative anatomy of heart structure, myogenic heart, cardiac cycle) heart– structure and function – blood pressure – molecular mechanism of myocardial infarction. Nervous system– central and peripheral nervous system – neuron – structure and function – action potential – receptors – hormonal regulations and neuromuscular

junction – Sense organs – vision – hearing and tactile response- molecular mechanism of Alzheimer's disease.

UNIT IV: DIGESTIVE AND EXCRETORY SYSTEM

15 hrs.

Digestion – absorption – energy balance – BMR (Review). Excretory system – comparative physiology of excretion – kidney – structure and function – mechanism of urine formation – normal and abnormal constituents of urine – regulation of water and electrolyte balance – acid base balance molecular mechanism of diabetes–Thermoregulation – temperature balance – heat production – shivering and non –shivering thermogenesis, brown fat – thermogenic tissues in mammals and heat loss –acclimation and acclimatization – adaptive response to temperature – hibernation, aestivation.

UNIT V: ENDOCRINE AND REPRODUCTIVE SYSTEM

15 hrs.

Endocrine glands – types and their functions. Hormones – classification – basic concept of regulation of hormone actions – Positive and negative feedback mechanism – hormonal imbalance and diseases – testis: testicular hormones and their functions – Ovary – ovarian hormones and their functions – neuroendocrine regulation- molecular mechanism of Thyroid disorders

TEXT BOOK(S):

Buchanan. B, Gruissem W and Jones R.L, (2007) *Biochemistry and Molecular Biology of Plants*.(2nd ed.).Maryland, USA: The American Society of Plant Physiologists. Print.

Knut Schmidt-Nielsen, (2002). *Animal Physiology: Adaptation and Environment*(5thed.).USA: Cambridge University Press. Print.

Lauralee S,(2001).*Human Physiology from Cells to Systems*.(4th ed.). USA: Brooks. Print

REFERENCE BOOK(S):

Buchanan. B, Gruissem W and Jones R.L, (2007) *Biochemistry and Molecular Biology of Plants*.(2nd ed.). The American Society of Plant Physiologists.Print.

Hopkins, W.G and Huner N.P.A, (2004). *Introduction to Plant Physiology*. John Wiley and Sons.

Kabita Datta,(2007). *Plant Physiology*. Mittal Publ.Print.

Prescott M.D ,(1988). *Cells*.Boston: Jones and Bartlett Publishers. Print.

Salisbury, F.B. and Ross, C.W ,(1991). *Plant Physiology*, USA: Wadsworth Publishing Co. Ltd. Print.

Swanson C.P ,(1990). *The Cell* (5th ed.). New Delhi: Prentice Hall of India Pvt. Ltd. Print.

Swart I.F ,(1984). *Human Physiology* USA: WMC brown Communications. Print.

Sylvia S.M,(1985) *Biology* (4thed.) USA: WMC brown Communications. Print.

Sylvia S.M, (2007) *Biology* (9th ed.) New York: Mc Graw Hill Companies. Print.

Taiz, L. and Zeiger, E (2006). *Plant Physiology*, (4th ed.).USA: Sinauer Associates Inc .Print.

Taiz, L., E. Zeiger, Mollerl.M., and A. Murphy, (2015) *Plant Physiology and Development*. (56th ed.).USA: Sinauer Associates, Sunderland, MA.Print.

Verma, S.K. and Verma Mohit ,(2007). *A.Text Book of Plant Physiology, Biochemistry and Biotechnology*. S.Chand Publications.Print.

(LAB)

LEARNING OUTCOME

4 hrs. / wk.

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

- understand the concepts of biology
- execute the skills in the field of cell biology, physiology and developmental biology
- apply the appropriate skills for the significance of biological field

COURSE CONTENT:

60 hrs.

EXPERIMENTS/LAB:

1. Cell fractionation– Isolation of mitochondria from the given plant material
2. Histological analysis of normal and diseased spleen/head / kidney cells of fish
3. Estimation of chlorophyll
4. Osmoregulation in fish
5. Measurement of Respiration rate of various plants and Lung capacity test in human
6. Measurement of blood pressure, bleeding and clotting time and ESR
7. APPT (Activated partial thromboplastin time) assay
8. Determination of haemin crystals and renal calculi
9. Estimation of T3, T4 and TSH
10. Developmental stages in Zebra fish embryo and chick
11. Tadpole tail/earthworm regeneration

REFERENCE BOOK(S):

- Balinsky B.I ,(2012). *An Introduction to Embryology*(5th ed.). Philadelphia, Holt–Saunders International.Print.
- Bradley, P.M,(1925).*The Early Embryology of the Chick* (3rded.).Toronto:The Blakiston Company Print.
- Carlson, B.M,(1998).*Patten’s Foundation of Embryology*(5th ed.). New Delhi: McGraw Hill Inc.Print.
- Celis, J. E., Carter, N., Simons, K., Small, J. V., Hunter, T., and Shotton, D,(2005). *Cell biology*, four–volume set: a laboratory handbook. Academic Press.Print.
- Cruz Y.P,(1993).*Laboratory exercises in developmental biology*, USA: Academic press, Inc.Print.
- Keibel, F., Mall, F. P,(1912). *Manual of Human Embryology*. Philadelphia:J. B. Lippincott Company.Print.
- Laura, R. Keller, and John H,(1998). *Experimental Developmental Biology: A Laboratory Manual*, Academic Press. Print.
- Mukherjee, K. L,(1998).*Medical Laboratory Technology – a procedure manual for routine diagnostic*
- Pappas, G.S,(1994) *Laboratory Manual of Histology* (2nd ed). England:Wm. C.Brown Publishers. Print.
- Sumner,A.T and Sumner B.E.H,(1969). *A Laboratory Manual of Microtechnique and Histochemistry*, Oxford: Blackwell Scientific Publications. Print.
- Westerfield, M and Detrich III, H. W, (2009). *Essential zebrafish methods: cell and developmental biology*, Academic Press.Print.

Wolpert, L., Tickle, C., and Arias, A. M, (2015). Principles of development. Oxford University Press, USA.Print.

PBT1432P LAB IN MICROBIOLOGY

(LAB)

LEARNING OUTCOME

4 hrs. / wk.

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

- understand the principles and procedures of basic microbiological techniques
- develop the skills of identification and characterization
- compare the significance of microbes in relation to their environment

COURSE CONTENT:

60 hrs.

EXPERIMENTS/LAB:

1. Nutritional types of microbes – culture media and their types. (Reading exercise)
2. Isolation and enumeration of microbes from different sources – soil, air, water and food
3. Pure culture techniques, preparation and maintenance of stock culture
4. Measurement of microbial growth by growth curve (turbidity method)
5. Effect of temperature on bacterial growth
6. Staining techniques – simple, Gram's, endospore, negative, staining
7. Biochemical characterization of unknown isolates – carbohydrate fermentation, IMViC test, oxidase test
8. Biochemical characterization of unknown isolates – TSI test, H₂S test, catalase test
9. Extracellular enzymatic activity (protease, amylase)
10. Titration of bacteriophage–lambda phage
11. Antibiotic sensitivity testing:
 - a. Kirby–Bauer disc diffusion method
 - b. MIC

REFERENCE BOOK(S):

- Cappucino, J.G.,and Sherman N,(1999).*Microbiology – A Laboratory Manual*.(4thed.). Boston:Addison Weisely Longman Inc.Print.
- Cappucino, J.G.,and Sherman N,(2008).*Microbiology – A Laboratory Manual*.(7th ed.). Boston:Addison Weisely Longman Inc.Print.
- Dhawale, S., and Lamatre A, (2003). *Microbiology – Lab Manual*.(2nd ed.). New York:Mc Graw Hill Company.Print.
- Garrity G.M, (2001) *Bergey's Manual of Systematic Bacteriology*.(2nded.).New York:Springer Verlag.Print.
- Gunasekaran, P, (2002). *Laboratory Manual in Microbiology*, **New** Delhi:New Age International (P) Ltd Publishers.Print.
- Holt, J.G., Kreig, N.R., Peter, H.A., Stanley, S.J.T., and Williams, S. T,(1994).*Bergey's Manual of Determinative Bacteriology*,Baltimore, U.S.A: Williams and Wilkins, A Maverly Company.Print.
- Pelczar, M.J., Schan, E.C., and Krieg, N.R, (1993).*Microbiology Concepts and Applications*, Boston:McGraw Hill Publishers.Print.
- Prescott,L.M., Harley,K.P., and Klein,D.A ,(2011) *Microbiology*.(9thed.).Boston:McGraw Hill .Print.

PBT2531M BIOCHEMISTRY

(THEORY)

LEARNING OUTCOME

5 hrs. / wk.

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

- appreciate the molecular dimension of life
- understand the structure, classification and properties of biomolecules
- analyse the structure/ function relationships in biocatalyzed reactions

COURSE CONTENT:

UNIT I: FUNDAMENTALS OF BIOCHEMISTRY

15 hrs.

Diversity of biomolecules in living organisms – evolution of biomolecules – atoms – molecular interactions – Bronsted – Lowry concept of acids and bases – pH and buffers – biological buffer systems – phosphate – bicarbonate – protein – aminoacids and haemoglobin.

UNIT II: CARBOHYDRATES AND LIPIDS

15 hrs.

Carbohydrates – types (mono, di, oligo and polysaccharides) – structure and properties (review) – isomerism – asymmetry – mutarotation – glycoconjugates – proteoglycans – glycoproteins and glycolipids – biological importance of carbohydrates – metabolic disorders and their clinical correlations. Lipids – types – properties – structure and function; fatty acids –biosynthesis – storage – oxidation of fatty acids ($\alpha, \beta, \gamma, \omega$) – cholesterol – regulation of lipid metabolism – metabolic disorders and their clinical correlations.

UNIT III: PROTEIN AND NUCLEIC ACIDS

15 hrs.

Amino acids – classification – structure and properties – biosynthesis and degradation of amino acids – level of structural organisation of proteins – primary – secondary (Ramachandran plot) – tertiary and quaternary structures – fibrous and globular proteins – protein denaturation and folding – metabolic disorders and their clinical correlations. Nucleic acids – components – properties – denaturation and renaturation –*cot* kinetics – structure of DNA (A – B – Z) and RNA and their functions – biosynthesis and degradation of purine and pyrimidine – metabolic disorders and their clinical correlations.

UNIT IV: BIOENERGETICS

15 hrs.

Laws of thermodynamics – energy – enthalpy –free energy – activation energy – entropy – measurement of entropy – standard free energy changes – coupled reaction – group transfer – biological energy transducer – glycolysis – gluconeogenesis – TCA cycle – oxidative phosphorylation – electron transport chain (ATP synthase).

UNIT V: ENZYMES AND ENZYME TECHNOLOGY

15 hrs.

Nomenclature – classification, properties of enzymes – vitamins as coenzymes –minerals as cofactors –catalytic mechanisms (lock and key and induced fit models) – reaction kinetics (MM and LB plots) – enzyme inhibition – types, regulation of enzyme activity – covalent modifications – allosteric control – clinical and industrial application of enzymes – abzymes – ribozyme and Isozymes – immobilized enzymes – methods of immobilization.

TEXT BOOK(S):

Conn, E.E. Stumpf, P.K. Bruening, G. Doi, R.H. (2004) *Outlines of Biochemistry* (5thed.). Singapore: John Wiley and Sons, 2004. Print

Jeremy, Berg, M, John L. Tymoczko, Stryer L, (2006). *Biochemistry* (6th ed.). New York: W.H. Freeman Publishers. Print.

REFERENCE BOOK(S):

Bhatt S.M, (2014). *Enzymology and Enzyme technology for UG and PG courses in Biotechnology and also useful for competitive Examinations like ICMR, NET, GATE, TIFR etc*, New Delhi : S. Chand and company Ltd. Print

Champe, P.C. and Harvey, R.A, (1994). *Lippincott's illustrated reviews: Biochemistry*, Philadelphia: Lippincott–Raven Publishers. Print.

Devlin, M.T, (1997). *Textbook of Biochemistry with Clinical Correlations*, New York: Wiley–Liss

McKee, T. and McKee J.R, (2001). *Biochemistry – An Introduction*. (3rded.). U.S.A: Wm.C. Brown

Montgomery, R. Conway, T.W. Spector, A.A. Chapell, D, (1996). *Biochemistry – A case oriented approach*. (6th ed. London: Mosby Inc publishers, 1996. Print.

Murray, K.R. Granner, D.K. Mayer, A.P. Rodwell, V.W, (2000) *Harper's Biochemistry* (25thed.). Philippines: Appleton and Lange. Print.

Nelson, D.L. and Cox, M.M, (2008). *Lehninger– Principles of Biochemistry* (5thed.). New York: W.H. Freeman and Company. Print.

Rawn, J.D, (2009). *Biochemistry*. (4thed.). Burlington: Neil Patterson Publisher. Print.

Stryer, L, (2003) *Biochemistry* (5th ed.). New York: W.H. Freeman Publishers. Print.

Voet, D. and Voet, J.G, (2011) *Biochemistry*, Asia: International student version, John Wiley and sons

Voet, D. Voet, J.G. Pratt, C.W, (2013) *Principles of Biochemistry*, Asia: International student version, John Wiley and Sons Pvt. Ltd. Print.

PBT2532M MOLECULAR BIOLOGY

(THEORY)

LEARNING OUTCOME

5 hrs. / wk.

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

- understand the mechanism of genetic information
- comprehend the complex interaction of biomolecules at the cellular level
- evaluate the regulatory mechanism underlying the expression of genes

COURSE CONTENT:

UNITI: INTRODUCTION AND DNA REPLICATION

15 hrs.

Central dogma – genome organisation in prokaryotes and eukaryotes (review) – features of DNA replication – replication origin – replication fork – fidelity of replication – models (semiconservative – semidiscontinuous – unidirectional – bidirectional and rolling circle replication) – enzymology of DNA replication – helicase – single strand binding protein – topoisomerases I and II – DNA polymerase in *E. coli*, eukaryotic DNA polymerase – mechanism of replication in *E. coli* and eukaryotes.

UNIT II: DNA REPAIR AND RECOMBINATION**15 hrs.**

Cell cycle (Review) - DNA repair – replication error – transition, transversion and point mutation – DNA damage – radiation (UV, gamma, X-rays) – alkylation – oxidation – base analogs – hypermutation – repair mechanism – photoreactivation – excision repair– mismatch repair – SOS repair – Recombination – homologous recombination (The Holliday model – The Meselson – Radding model – The Rec BCD pathway) – Cre LoxP recombination – site specific recombination – lambda phage integration and excision; Transposition – bacterial transposon (replicative and conservative transposition), eukaryotic transposon (retroelement transposition)

UNIT III: RNA SYNTHESIS, PROCESSING AND REGULATION**15 hrs.**

Transcription in prokaryotes – RNA polymerase structure – promoters – transcription factors and mechanism – control of gene expression – *lac* operon– *ara* operon–*trp* operon and *mal* regulon. Transcription in eukaryotes – multiple forms of RNA polymerase– promoters (class I, II and III) – enhancers – silencers– transcription activators and repressor – mechanism of transcription – post-transcriptional events – capping – trans-splicing – polyadenylation – RNA editing – regulation of transcription – chromatin structure and gene activity – gene silencing – gene on and off by histone acetylation.

UNIT IV: PROTEIN SYNTHESIS, PROCESSING AND REGULATION**15 hrs.**

Genetic code, ribosome – structure – 30S and 70S initiation complex – initiation factors and their regulation in prokaryotes and eukaryotes – elongation – three site model of ribosome – aminoacylation of tRNA – tRNA identity –aminoacyl tRNA synthetase – codon – anticodon interaction – termination – release of ribosome – recycling factors – post translational modification – protein folding (Heat shock protein) – proteolytic cleavage – chemical modification – intein splicing –protein degradation and protein turnover.

UNIT V: REGULATION OF GENOME ACTIVITY**15 hrs.**

Transient changes in gene activity – signal transmission via extracellular signal and cell surface receptor – permanent and semipermeable changes – genome rearrangement – changes in chromatin structure – feedback loops –regulation of gene activity during development – sporulation in *Bacillus subtilis* – development in *Drosophila melanogaster*– homeotic genes.

TEXT BOOK (S):

Brown T.A, (2006). *Genomes 3*, (3rded.). New York: Wiley – Liss, Print

Clark D. P, (2010). *Molecular biology*, New York: Elsevier Inc. Print

Weaver R. F, (1999). *Molecular Biology*, (5thed.). London: WCB / Mc Graw–Hill,. Print

REFERENCE BOOK(S):

Brown, T.A, (2002) *Genomes* (2nded.). New York: Wiley – Liss. Print.

Cooper, G. M and Hausman, R.E, (2007). *The Cell – A Molecular Approach* (4thed.). Washington D.C.: ASM Press. Print.

Cooper, G.M, (1997) *The Cell – A Molecular Approach* (2nd ed.). Washington D.C.: ASM Press. Print.

Friefelder, D, (2004) *Molecular Biology* (3rded.). New Delhi: Narosa Publishing House. Print.

Karp, G, (2005) *Cell and Molecular Biology – Concepts and Experiments* (4thed.). USA: New Jersey, John Wiley and Sons Inc. Print.

Lewin, B, (2004) *Genes VIII*, UK: Oxford University Press. Print.

Lodish, D.J. and Baltimore, D, (2004) *Molecular Cell Biology* (5thed.). New York: Science American Books, W.H. Freeman and Company. Print.

Watson, J.D. Baker, T.A. Stephen, B.P. Gann, A. Levine, M. Losick, R, (2004) *Molecular Biology of the Gene* (5thed.). USA: New Jersey, Pearson Education. Print.

Wolfe S.L, (1995) *An Introduction to Cell and Molecular Biology*, New York: Wadsworth Publishing Company. Print

PBT2431P LAB IN BIOCHEMISTRY**(LAB)****LEARNING OUTCOME****4hrs. / wk.**

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

- understand the properties and function of the biomolecules and enzymes
- relate the activity of biomolecules under *in-vitro* conditions
- apply the techniques for clinical diagnostics

COURSE CONTENT:**60 hrs.****EXPERIMENT / LAB:**

1. Buffer preparation and pH calculation (review)
2. Titration curve of glycine
3. Qualitative analysis of carbohydrates (monosaccharide, disaccharides and polysaccharides)
4. Estimation of carbohydrate by Anthrone method
5. Qualitative analysis of amino acids
6. Estimation of serum protein by Bradford's method
7. Separation of serum protein by gel filtration chromatography

8. Estimation of creatinine by Jaffe's method (serum / urine)
9. Estimation of uric acid in urine by Caraway method
10. Determination of K_m and v_{max} of serum alkaline phosphatase/salivary amylase (effect of substrate, pH, temperature)

REFERENCE BOOK(S):

- David T. Plummer, (2004) *An Introduction to Practical Biochemistry*. (3rd ed.). New Delhi: Tata McGraw–Hill Education Pvt. Ltd. Print.
- Harold Varley, Alan H. Gowenlock, (1998). *Varley's practical clinical biochemistry* (6th ed.). Oxford: Heinemann Medical Books. Print.
- Jeyaraman, J, (2011) *Laboratory Manual in Biochemistry*. (2nd ed.). New Delhi: New Age Publication. Print.
- Malhotra V.K, (2004). *Practical biochemistry for students*. (4th ed.). Jaypee Brothers Medical Publishers. Print.
- Praful B Godkar, (2014) *Textbook of Medical Laboratory Technology*, Bombay: Bhalani Publishers. Print.
- Ranjna Chawla, (2014). *Practical Clinical Biochemistry Methods and Interpretations*. (4th ed.). New Delhi: Jaypee Brothers Medical Publishers. Print.
- Sadasivam .S, (1996). *Biochemical Methods*. New Delhi: New Age International. Print.

PBT2432P LAB IN MOLECULAR BIOLOGY

(LAB)

LEARNING OUTCOME

4 hrs. /

wk.

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

- understand the principles of various isolation techniques
- acquire hands on training in basic molecular techniques
- employ the molecular techniques in the field of research and clinical laboratories

COURSE CONTENT:

60 hrs.

EXPERIMENT / LAB:

1. Isolation of genomic DNA from prokaryotic cell
2. Isolation of genomic DNA from plant system
3. Isolation of genomic DNA from liver/ spleen
4. Isolation of total RNA from mammalian tissue
5. Estimation of DNA and RNA by spectrophotometric method
6. Electrophoretic separation of nucleic acid – Agarose and MOPS acetate
7. T_m analysis of DNA
8. Different techniques for protein lysate preparation from *E.coli* / liver (Tween 20 / SDS)
9. Estimation of protein – ONPG assay
10. Electrophoretic separation of protein – SDS–PAGE

REFERENCE BOOK(S):

- Boyer, R, (2000). *Modern Experimental Biochemistry* (3rd ed.). Pearson Education Inc. Print.

- Gardner, E.H. Simmons, M.J. Snustad, D.P. (2007). *Principles of Genetics* (8th ed.). Singapore: John Wiley and Sons. Print.
- Palanivelu, P. (2004). *Analytical Biochemistry and Separation Techniques – A laboratory manual for B.Sc. and M.Sc. students* (3rd ed.). Madurai: Kalaimani Printers. Print.
- Plummer, T.D. (1990). *An Introduction to Practical Biochemistry* (4th ed.). Europe: Mc Graw Hill Book Company. Print.
- Roe, S. (2001). *Protein Purification Techniques – A Practical Approach* (2nd ed.). USA: Oxford University Press. Print.
- Sambrook, J. Fritsch, E.F. Maniatis, T. (2005). *Molecular Cloning – A Laboratory Manual* (2nd ed.). New York: CSH Publishers. Print.
- Srb, A.M., Owen, R.D., Edgar, R.S. (1970). *Facets of Genetics*, San Francisco: W.H. Freeman and Company. Print.
- Strickberger, M.W. (1962). *Experiments in Genetics with Drosophila*, Singapore: John Wiley and Sons, Print.
- Wilson, K. and Walker, J. (2004). *Practical Biochemistry* (5th ed.). New York: Cambridge University Press. Print.
- Wilson, K., Kenneth, H.G.A. (1992). *Biologists Guide to Principles and Techniques of Practical Biochemistry* (3rd ed.). UK: Cambridge, Cambridge University Press. Print.

PBT25310 BIOINFORMATICS

(LAB CUM THEORY)

LEARNING OUTCOME

3T + 2L hrs. / wk.

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

- acquire knowledge on biological databases
- relate the significance of computational approach in learning biology
- gain hands on skills in bioinformatics and implement them in analyzing biological data

COURSE CONTENT:

UNIT I: DATA AND BIOLOGICAL DATABASES

9 hrs.

Data – generation of large scale data – genome sequencing–protein sequencing, NMR Spectroscopy – x – ray diffraction and microarray (Review) – Biological databases and bioinformatics: history – definition – scope – bioinformatics – applications and limitations – Recent advances – system biology – immunoinformatics and stemformatics – Databases – relational and object – oriented – biological databases – primary and secondary – Nucleotide sequence databases – Genbank – EMBL – DDBJ – Protein sequence databases – UniProt (UniprotKB / SWISS–PROT and UniprotKB / TrEMBL) – PIR–PSD – Protein structure databases – PDB – Specialized databases – TIGR – Flybase Metabolic (HMDB) and pathology databases (OMIM). Secondary databases – Prosite – PRODOM – Pfam – PRINTS – BLOCKS – CATH – SCOP – Small molecular databases – CSD – PubChem – ZINC.

UNIT II: SEQUENCE ALIGNMENT

9 hrs.

Components of gene – homologs – analogs – orthologs – paralogs – xenologs (Review). Pairwise sequence alignment – Sequence Homology Vs Similarity – Similarity Vs Identity – Methods–

(global and local) – Alignment algorithm (Dot matrix – Dynamic Programming) – Scoring matrices – (PAM and BLOSUM) – Database similarity searching – Requirements – Heuristic searching – BLAST and FASTA – Database searching with Smith Waterman algorithm – Multiple sequence alignment (MSA) – Scoring functions – Exhaustive and Heuristic algorithms (Progressive–CLUSTAL W – Iterative – block–based) – PSSM – Profiles – Markov Model and Hidden Markov Model. Identification of motifs and domain in MSA – Protein family database.

UNIT III: MOLECULAR PHYLOGENETICS

9 hrs.

Molecular evolution and Molecular phylogenetics (molecular identification of prokaryotes and eukaryotes) – Gene phylogeny Vs species phylogeny – Form of tree representation – Phylogenetic trees – types and construction – Distance matrix methods – UPGMA – Neighbour joining – Character based methods – Maximum parsimony and maximum likelihood methods.

UNIT IV: STRUCTURAL BIOINFORMATICS

9 hrs.

Structure and characteristics of macromolecules (proteins, DNA, RNA) – Relation between sequence – structure and function (Review) – Protein structure visualization – Rasmol and Swiss–pdb viewer – Protein secondary structure prediction (globular protein and transmembrane protein) – coiled coil prediction – Protein tertiary structure prediction – methods – homology modelling – threading and fold recognition – *Ab initio* –CASP – Levinthal paradox and protein folding.

UNIT V: DRUG DESIGNING

9 hrs.

Pharmacogenomics – molecular recognition – structure – based ligand design – molecular docking – virtual screening – structure – based pharmacophore generation – pharmacophore representation – *de novo* design of ligands – basic concepts of QSAR – 2D–QSAR in drug design – pharmacodynamics and kinetics – ADMET calculation.

EXPERIMENTS / LAB :

30 hrs.

1. Database searching, sequence retrieval, understanding file formats (fasta, Genbank)
2. Sequence submission tools (BankIt, Webin and SPIN)
3. Nucleotide sequence analysis: Detection of ORF's (ORF Finder); Identification of translational and transcriptional signals, codon usage; RNA fold analysis (RNA fold web server)
4. Protein sequence analysis: hydrophobicity, amphipathicity, transmembrane and secondary structure prediction – ExPasy tools
5. Phylogenetic tree construction – MEGA 5
6. Homology modelling of three–dimensional structures based on sequence data – SWISS MODEL
7. Small molecular docking – Autodock 4

TEXT BOOK(S):

Baxevanis, A.D. and Ouellete, F, (2006) *Bioinformatics– A Practical Guide to the Analysis of Genes and Proteins* (3rd ed.). B.F., John Wiley and Sons (Asia) Pvt. Ltd., Print.

Mount, D.W,(2001) *Bioinformatics– Sequence, Genome analysis* New Delhi: CBS Publishers and Distributors, Print.

Xiong, J, (2006). *Essential Bioinformatics* (1st ed.). United Kingdom: Cambridge University Press. Print.

Gautham N, (2007) *Bioinformatics– Databases and Algorithms* New Delhi: Narosa Publishing House. Print.

REFERENCE BOOK(S):

Attwood, T.K., and Parry Smith, D.J, (2005). *Introduction to Bioinformatics* New Delhi: Pearson Education. Print.

Han, J., Pei, J., and Kamber, M, (2011). *Data mining: concepts and techniques*. Elsevier. Print.

Larose, D,(2004) *Discovering Knowledge in data; An introduction to data mining* New Jersey: John Wiley science. Print.

Mani, K., and Vijayaraj, N, (2004) *Bioinformatics – A Practical Approach* Coimbatore: Aparna Publication. Print.

Selzer, P.M., Marhofer, R., and Rohwer, A, (2008) *Applied Bioinformatics–An Introduction*. Springer Science and Business Media. Print.

REFERENCE WEBSITES:

<http://bmbpcu36.leeds.ac.uk/~david/bioinf.html>

<http://pbil.univ-lyon1.fr/bookmarks.html>

<http://rna.tbi.univie.ac.at/cgi-bin/RNAWebSuite/RNAfold.cgi>

<http://www.expasy.ch/sprot/sprot-top.html>

<http://www.megasoftware.net/>

<http://www.ncbi.nlm.nih.gov/>

<https://www.ncbi.nlm.nih.gov/orffinder>

PBT3531M IMMUNOLOGY AND IMMUNOTECHNOLOGY

(LAB CUM THEORY)

LEARNING OUTCOME

4T + 2L hrs. / wk.

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

- acquire knowledge on the basic principles of Immunology
- comprehend T and B - lymphocytes interaction and their effector mechanisms
- develop skills in basic immunological techniques

COURSE CONTENT:

UNIT I: BASICS OF IMMUNOLOGY

10 hrs.

Innate and adaptive immunity – anatomy of lymphoid organs – cells of the immune system – phagocytes – activation and maturation – antigen–nature – types – factors influencing antigenicity – haptens – adjuvants – superantigen – antigen processing and presentation – cytosolic and endosomal pathway – generation – maturation – activation and differentiation of T and B cells – Immunoglobulins: structure – function and biological properties of Ig classes – antigen antibody interaction assays – precipitation – agglutination (reading assignments) – organization and expression of immunoglobulin genes – generation of antibody diversity.

UNIT II: IMMUNE EFFECTOR MECHANISMS

15 hrs.

Properties of cytokines – cytokine receptors – cytokine secretion by T_H subsets – cytokine related diseases leucocyte activation and migration – Hypersensitivity reactions: Type I – anaphylactic reactions – Type II – cytotoxic reactions – Type III – immune complex reactions – Type IV – delayed – type hypersensitivity reactions – complement: functions – components.

UNIT III: THE IMMUNE SYSTEM IN HEALTH AND DISEASE**15 hrs.**

MHC – types – structure – function – distribution – self-restriction – Immunity to infectious diseases – viral – bacterial – fungal and protozoan – Autoimmunity – basis and therapy– transplantation – tissue transplantation and grafting – mechanism of graft acceptance and rejection – HLA typing–tumor immunology – tumor antigen – classification – tumor diagnosis – immune response to tumors – immunotherapy for cancer.

UNIT IV: IMMUNOTECHNIQUES I**10 hrs.**

Principles and applications of immuno–electrophoresis – radio immuno assay (RIA) – immunofluorescence – ELISA – flow cytometry – Effector cell assays – PFC– lymphocyte stimulation test – C–M lympholysis – ELISPOT – Hybridoma Technology – monoclonal antibody production – Antibody engineering.

UNIT V: IMMUNOTECHNIQUES II**10 hrs.**

Whole organism vaccine – attenuated and killed vaccines – Purified macromolecule vaccine – recombinant vector vaccine – anti–idiotypic vaccine – synthetic peptide vaccine – DNA vaccine – subunit vaccine – immune screening of recombinant proteins.

EXPERIMENTS / LAB:**30 hrs.**

1. Raising antibodies in fish
2. Antibody titration by Haemagglutination and ELISA
3. Immunodiffusion assays
4. Measurement of ROS and RNS
5. Preparation of primary and secondary antibodies

TEXT BOOK(S):

Goldsby, R.A Kindt, T.J Osborne, B.A and Kuby, J,(2013).*Immunology* (7thed.).New York: W.H. Freeman and Company.Print.

REFERENCE BOOK(S):

Abbas,A.K, and Lichtman, A.H,(2003).*Cellular and Molecular Immunology*(5th ed.). Philadelphia:Saunders's Publishers.Print.

Benjamini, E Sunshine, G and Leskowitz, S,(1996).*Immunology: A Short Course*(3rded.).New York:Wiley–Liss Inc. Print.

Benny, K.C.L,(2004). *Antibody Engineering – Methods and Protocols*, Vol. 248, New Jersey:Humana Press Inc.Print.

Coleman, R.M. Lombard, M.F., Sicard R.E and Rencricca N.J,(1994).*Fundamental Immunology*.(3rd ed.).Lowa: Wm.C.Brown.Print.

Goldsby, R.A Kindt, T.J and Osborne,B.A,(2003). *Kuby Immunology* (5thed.). New York:W.H. Freeman and Co. Print..

Male, D., Brostoff, J. Roth,D.B and Roitt I,(2006).*Immunology*,Canada:Mosby Elsevier Ltd. Print.

Rao,C.V,(2006)*Immunology – A Text Book*.New Delhi:Narosa Publishing House. Print.

Roitt,I.M and Delver. P.J,(2005).*Essential Immunology*(10th ed.).London:Blackwell Pub.Print.

Roitt, I.M., Brostoff, J, and Male, D,(2005).*Immunology*.(4thed.).UK:Times Mirror International Pub. Ltd.Print.

PBT3532M PLANT AND ANIMAL BIOTECHNOLOGY

(THEORY)

LEARNING OUTCOME

5hrs. / wk.

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

- acquire the basic concepts in plant and animal molecular biology
- understand the fundamental aspects of tissue culture
- apply the knowledge of culturing methods in tissue engineering

COURSE CONTENT:

UNIT I: CELL AND TISSUE CULTURE IN PLANTS

16 hrs.

Plant nutrition and role of hormones in plant growth and development – review) – Callus cultures – *in vitro* morphogenesis – organogenesis and embryogenesis – artificial seeds – micro propagation – virus elimination – pathogen indexing – haploidy – anther and ovule cultures– embryo cultures – protoplast isolation and fusion and its application – somatic hybrids – cybrids – somaclonal variation; suspension culture for secondary metabolite production–cryopreservation.

UNIT II: APPLICATION OF PLANT GENETIC ENGINEERING

19 hrs.

Gene transfer methods – mechanism of transformation using *Agrobacterium* vectors and viral vectors review)–herbicide resistance (glyphosate and triazine) – insect resistance – *Bt* gene, non-*Bt* (protease inhibitors) – disease resistance (RIP, PR proteins)–virus resistance coat protein and nucleocapsid mediated) – mechanism of abiotic stress (drought – cold and salt) – post – harvest losses (ACC synthase – polygalacturonase – ACC oxidase) – male sterile lines barstar and barnase systems) – heterologous protein expression in chloroplast; reverse genetics – gene targeting – tagging – silencing – trapping and editing (transposons – RNAi – small RNA and CRISPR/Cas9).

UNITIII: INTRODUCTION TO ANIMAL BIOTECHNOLOGY

12 hrs.

Introduction – cell culture, tissue culture, primary culture, passaging, cell lines, cell strain, adherent and suspension culture methods (review) – Cell culture of specialized cells – epithelial cells – mesenchymal cells – neuroectodermal cells – hematopoietic cells – mouse embryonic stem cells – pluripotent stem cells from fish and its applications– initiation of cell culture – primary culture – mechanical and enzymatic (warm and cold trypsinization) – cell selection methods – identification and characterization of cell lines – need – authentication – parameters for characterization – principles of cryopreservation – cell banks. contamination – sources – types and monitoring.

UNITIV: HETEROLOGOUS EXPRESSION IN ANIMAL CELLS

16 hrs.

Transfection methods– (calcium phosphate co–precipitation, cationic polymers, lipofection and electroporation) – elements required for gene expression (transcriptional and translational) – viral vectors – SV 40 – AV – AAV – HSV – EBV – BPV – vaccinia virus and baculovirus, transgene amplification – selectable markers (HAT selection – *alu* marker – dihydrofolate reductase – neomycin resistance – CAT) and reporter genes (GFP – luciferase) – screening strategies (direct–spi – CI and indirect methods – hybrid arrested and selected translation). Artificial insemination techniques – ART – IVF and ICSI – embryo transfer and embryo sexing – cloning of animals– principle – types–reproductive and therapeutic cloning – transgenic animals and gene pharming –

gene knockout and knock-in – recombinant protein production (rt-PA and neupogen) – gene therapy – principle and methods – gene insertion – replacement – bioethical issues.

UNITV: TISSUE ENGINEERING and ITS APPLICATIONS

12 hrs.

Introduction to tissue engineering – basic concepts and future perspectives – 3D cell culture–organ – organotypic and histotypic cultures –Scaffolds–types (natural and synthetic). Applications–cell based therapies for the treatment of articular cartilage injury – myoblast transplantation – vision enhancement systems – CNS grafts for treatment of neurological disorders – cryopreserved dermal implants.

TEXT BOOK(S):

Chawla H.S, (2009) *Introduction to Plant Biotechnology*, 3rd Ed, New Delhi: Oxford and IBH Publishing, Print.

Freshney, R.I, (2010). *Culture of Animal Cells –A Manual of Basic Techniques* (6th ed.). New Jersey: John Wiley and Sons. Print.

Ranga, M.M, (2002). *Animal Biotechnology* New Delhi: Agrobios Publishers (3rd ed.). Print.

Slater A., Nigel W., Scott and Fowler R.M,(2008) *Plant Biotechnology – The Genetic Manipulation of Plants*,(2nded.). UK: Oxford University Press. Print.

REFERENCE BOOK(S):

Atala. A and Lanza R.P,(2002).*Methods of Tissue Engineering*(2nd ed.). New Delhi:Elsevier India Private Limited.Print.

Bhojwani, S.S., and Razdan, M.K,(2008).*Plant tissue culture Theory and Practice –Studies in Plant science* (5thed.). New York: Elsevier. Print.

Dodds, J.H., and Roberts, L.K,(1985) *Experiments in Plant Tissue Culture* New York: Cambridge University Press.Print.

Gilmartin, M.P.,and Bowler, C, (2002) *Plant Molecular Biology– Vol.I and II* USA: Oxford University Press.Print.

Keshavachandran, R. and Peter K.V, (2008).*Plant Biotechnology – Methods in Tissue Culture and Gene Transfer* Hyderabad: Universities Press India Private Limited. Print.

Leach, C.K,(1994).*In vitro cultivation of Animal cells*(5th ed.). New York: Butterworth and Heinmamm Ltd. Print.

Mantal, S.H., Mathew, J.A., and Mickee, R.A,(1985) *Principles of Plant biotechnology– An introduction to genetic engineering in plants*United Kingdom: Blackwell Scientific publication. .Print.

Narayanaswamy, S,(1999).*Plant Cell and Tissue Culture* New Delhi:Tata McGraw– Hill Publishing Company. Print.

Pareek,L.K,(2002)*Trends in Plant Tissue Culture and Biotechnology* Jodhpur: Agrobios. Print.

Portner, R,(2007).*Animal Cell Biotechnology: Methods and Protocol*,(2nd ed.). New York: Humana Press. Print.

Razdan, M.K,(2003) *An Introduction to Plant Tissue Culture*New Delhi: Oxford and IBH Publishing.

Seidman, L.A., and Moore,C.J,(2009).*Basic Laboratory Methods for Biotechnology* (2nded.). San Francisco: Benjamin Cummings. Print.

PBT3431P LAB IN PLANT AND ANIMAL BIOTECHNOLOGY

(LAB)

LEARNING OUTCOME

4 hrs./ wk.

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

- acquire the skills in handling plant and animal cell cultures
- comprehend the basics of animal and plant tissue culture
- apply tissue culture techniques in problem solving experiments in transgenic biology

COURSE CONTENT:

60 hrs.

PLANT BIOTECHNOLOGY

1. Preparation of MS medium, sterilization and storage
2. Micropropagation of potato / rose
3. Haploid production and synthetic seeds
4. Isolation of protoplasts
5. Agrobacterium mediated gene transfer by leaf disc method
6. Regulation of seed dormancy and germination using ABA and gibberellins
7. Estimation of total phenols and antioxidants from plants (normal and stressed)

ANIMAL BIOTECHNOLOGY

1. Establishment of Primary culture from chick embryo
2. Maintenance of cell lines (monolayer and suspension cells)
3. Cytotoxicity assay using MTT
4. Nuclei counting using Hemocytometer
5. Cytogenetic analysis of cell lines (G–banding)

REFERENCE BOOK(S):

- Bhojwani, S.S. and Razdan, (2004). *Plant tissue culture: Theory and Practice*. Netherlands. Print.
- Buchanan, B.B. Gruissem, W and Jones R.L., (2000). *Biochemistry and Molecular Biology of Plants*, USA :ASPP Press. Print.
- Davis, J., (2011). *Animal Cell Culture – Essential Methods*. John Wiley and Sons. Print.
- Dodds, J.H. and Roberts L.K., (1985). *Experiments in Plant Tissue Culture* New York: Cambridge University Press. Print.
- Freshney, R.I., (2010). *Culture of Animal Cells – A Manual of Basic Techniques* (6th ed.). New Jersey: John Wiley and Sons. Print.
- Gimartin, and Bowler, (2002). *Plant Molecular Biology–vol.I and II*. USA: Oxford University Press. Print.
- Keshavachandran, R and Peter, K.V. (2008). *Plant Biotechnology – Methods in Tissue Culture and Gene Transfer*, Hyderabad: India, Universities Press (India) Private Limited. Print.
- Mantal, S.H, Mathew, J.A., Mickee, R.A, (1985). *Principles of Plant biotechnology. An introduction to genetic engineering in plants*. United kingdom :Blackwell Scientific publication. Print.
- Razdan, M.K., (2003). *An Introduction to Plant Tissue Culture*. New Delhi: Oxford and IBH Publishing. Print.
- Seidman, L.A and Moore, C.J, (2009). *Basic Laboratory Methods for Biotechnology*. (2nd ed.). Benjamin Cummings, San Francisco. Print.

PBT35310 BIOSTATISTICS

(THEORY)

LEARNING OUTCOME

5 hrs. / wk.

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

- explain the basic concepts in statistics for biological data
- analyze data pertaining to attributes and to interpret the results
- apply statistical tools to solve the biological problems

COURSE CONTENT:

UNIT I: BASICS OF BIOSTATISTICS

15 hrs.

Types of biological data– quantitative and qualitative data –nominal – ordinal and time series data – discrete and continuous data. Measure of central tendency and dispersion – mean – median – mode – range – variance – standard deviation – coefficient of variation and standard error using height and weight of population–measures of skewness and kurtosis– coding data and effects of coding.

Unit II: CORRELATION and REGRESSION

15 hrs.

Correlation coefficient (Pearson's Correlation coefficient) – significance tests in correlation and applications; regression – introduction, models, types– linear, multiple and logistic.

UNIT III: PROBABILITY DISTRIBUTION

15 hrs.

Introduction –theorems of probability – Probability distribution – binomial, poisson and normal distribution – symmetry and kurtosis, proportions of a normal curve – Z scores, assessing Normality, confidence limits.

Unit IV: TESTING FOR GOODNESS OF FIT (NON-PARAMETRIC TESTS)

15 hrs.

Chi-square test – definition–assumption and conditions for the use of χ^2 test–applications of Chi-square test. Application based on Hardy–Weinberg equilibrium – linkage and recombination of genes– gene frequency calculation.

Unit V: TESTING OF HYPOTHESIS (PARAMETRIC TESTS) AND DATA ANALYSIS

15 hrs.

Hypothesis testing: Comparison of two large samples– student's t –test (paired and unpaired) – multiple sample comparison by analysis of variance (ANOVA) – one (single factor) and two way (more than two factor) classification. Multiple comparison –Tukey test – Statistical data analysis and plotting of graphs using MS–spread sheets and sigmaplot.

TEXT BOOK(S):

Khan, I.A and Khanum, A,(2004).*Fundamentals of Biostatistics*(2nd ed.). Hyderabad:Ukaaz Publications. Print.

Wardlaw, A.C,(1989).*Practical Statistics for Experimental Biologists*(reprint), New York:John Wiley and Sons. Print.

REFERENCE BOOK(S):

Bailey, N.T.J,(1994).*Statistical Methods in Biology*(3rd ed.).UK: Cambridge University Press.Print.

Banerjee, P.K,(2006).*Introduction to Biostatistics*(3rd ed.). New Delhi:S.Chand Publication.Print.

Instruction Manual: State level workshop on Biological Data Handling, Instructor Dr. Reginald Victor, Prof., Centre for Environmental Studies and Research, Sultanate of Oman: Sultan Qaboos University, Print

Mackenzie, A,(2005).*Mathematics and Statistics for life scientists*(1st ed.). Noida:S.P.Printers: Print.

Misra, B.N and Misra, M.K,(1983). *Introduction to Practical Biostatistics*.Calcutta: Naya Prokash: Print.

Research Methodology.(2006) Lady Doak College, Madurai:Print

PBT4531M INHERITANCE BIOLOGY AND EVOLUTION

(THEORY)

LEARNING OUTCOME

5 hrs. / wk.

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

- acquire knowledge about the basic principles of heredity
- relate the concept of origin of life through the fossil records
- analyze the genetic processes and their application in human population and evolution

COURSE CONTENT:

UNIT I: MENDELIAN AND NON- MENDELIAN INHERITANCE

15 hrs.

Mendelian Principles–dominance, segregation, independent assortment – gene concept–allele – multiple alleles – pseudoallele – complementation tests (Review) Non–mendelian inheritance–codominance – incomplete dominance – gene interactions – pleiotropy – genomic imprinting – penetrance and expressivity – phenocopy – linkage and crossing over – sex linkage – sex limited and sex influenced characters – gene map –linkage maps– tetrad analysis – mapping with molecular markers – mapping using somatic cell hybrids.

UNIT II: MICROBIAL GENETICS

15 hrs.

Methods of gene transfers – transformation, conjugation, transduction and sex–duction –genetic analysis of bacteria– mutagenesis– isolation of mutants – selection of mutants (auxotrophs, conditional lethal and resistant) – genetic mapping of mutations (mapping by Hfr – transformation and other types of markers and complementation tests.)

Unit III: HUMAN GENETICS

14 hrs.

Pedigree analysis – lod score for linkage testing – karyotypes – genetic disorders – structural and numerical alterations of chromosomes – deletion – duplication – inversion – translocation – ploidy and their genetic implications–quantitative genetics – polygenic inheritance – heritability and its measurements – QTL mapping.

UNIT IV: ORIGIN AND EVOLUTION OF LIFE

14 hrs.

Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, concept of Oparin - Haldane, Miller-Urey Experiments – The first cell; Evolution of prokaryotes and eukaryotes –Concepts in evolution–Lamarckism – Neo – Lamarckism – Darwinism – Neo – Darwinism and theories– Adaptive radiation – Isolating mechanisms – Speciation – allopatric – sympatric and parapatric – Convergent evolution – Co–evolution.

UNIT V: MOLECULAR EVOLUTION

17 hrs.

Concepts of neutral evolution – contributions of Margulis (endosymbiotic theory), molecular divergence and molecular clocks – molecular tools in phylogeny, classification and identification – Protein and nucleotide sequence analysis – origin of new genes and proteins – gene duplication and divergence – Brain, behavior and evolution – approaches and methods in study of behavior – proximate and ultimate causation – altruism and evolution – group selection – Kin selection – reciprocal altruism – neural basis of learning – memory – cognition – sleep and arousal – biological clocks – palaeontology: evolutionary time scale – eras – periods and epoch– fossil records of plants and animals – stages in primate evolution – homo.

TEXT BOOK(S):

Chattopadhyay, S. *LIFE: (2012). Evolution Adaptation and Ethology. (3rd ed.)*. Kolkata: Books and Allied Pvt. Ltd. Print.

Hall, B.K. and Hallgrímsson, B. Strickberger's (2014). *Evolution. (5th ed.)*. New Delhi: Jones and Barlett India. Print.

REFERENCE BOOK(S):

Alice Marcus,(2010).*Human Genetics– An Overview*, New Delhi: Narosa publishing house Pvt Ltd, Print.

Futuyma,J.D,(2005)*Evolution (2nd ed.)*. Sunderland, USA :–Sinauer Associates, Inc.Print.

Gardner, E,(1975).*Principles of Genetics (5th ed.)*.Canada: John Wiley and Sons Inc.Print.

Gardner, E.H., Simmons,M.J and Snustad, D.P(2007).*Principles of Genetics(8th ed.)*.Singapore:John Wiley and Sons.Print.

Hancock, J.T,(2008).*Molecular Genetics(1st ed.)*. UK:Scion Publishing Limited.Print.

Hartl, D and Jones, E.W,(1998)*Genetics – Principles and Analysis(4th ed.)*.London: Jones and Barlett Publishers.Print.

Jorde, L.B., Carey, J.C., Bamshad,M.J and White, R.L,(2007).*Medical Genetics.(3rd ed.)*. Missouri:Elsevier Publications.Print.

Lewis, R, (1997).*Human Genetics– Concepts and Applications(2nd ed.)*.New York:Mc Graw– Hill Company.Print.

Maloy, S.R., Cronan, J.E and Freifelder,D,(1994).*Microbial Genetics (2nd ed.)*. London: Jones and Barlett Publishers.Print.

Sinnot ,E. W., Dunn L.C and Dobzhansky,T,(1973) .*Principles of Genetics(4th ed)*. New Delhi: Tata Mc Graw Hill Pub. Co. Ltd.Print.

Sudbery,P,(2002) .*Human Molecular Genetics(2nd ed.)*.New Delhi :Pearson Education.Print.

Tamarin, H.R, (1998).*Principles of Genetics(7th ed.)*.New Delhi: Tata McGraw Hill Education Pvt. Ltd.Print..

Verma,P.S.and Agarwal V.K,(2005) *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*.New Delhi:S. Chand and Company Ltd.Print.

Verma,P.S., Agarwal V.K,(2005) *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*.New Delhi:S. Chand and Company Ltd.Print.

PBT4532M rDNA TECHNOLOGY

(THEORY)

LEARNING OUTCOME

6 hrs. / wk.

On successful completion of the course the student will be able to

- acquire knowledge on gene manipulation techniques
- understand the principles of cloning
- appreciate its application in biotechnology

COURSE CONTENT:

UNIT I: INTRODUCTION TO GENE MANIPULATION

15 hrs.

Fundamental techniques for gene manipulation – enzymes for DNA manipulation – DNA polymerases – RNA polymerases, nucleases – restriction endonuclease – types – nomenclature and mechanism of action – exonucleases – modifying enzymes – ligases – adaptors and linkers – homopolymer tailing.

UNIT II: VECTORS

18 hrs.

Cloning vectors - Plasmids derived vectors (pBR322 and PUC series) – selectable markers and lambda vectors – Cre – LoxP vector, λ DASH and λ ZAP – EMBL vectors – M13 derived vectors – cosmids – high capacity cloning vectors – BACs, YACs, PACs, MACs and HACs – other advanced vectors – expression vectors (pTarget™, pH6HTN His₆HaloTag®, pALTER®-MAX vector etc.,) – special purpose vectors (pAT153, pBR325, pSGS series etc.)

UNIT III: PCR AND ITS APPLICATIONS

18 hrs.

Basic principle of PCR – technique of PCR – key factors for optimal PCR – sources of DNA polymerase involved in PCR – synthesis of oligonucleotide primers – primer mismatches – types of PCR – nested – inverse – anchored – reverse transcription – asymmetric – real time PCR and RAPD – applications of PCR – creating mutation – primer extension mutagenesis – strand selection method (phosphorothioate strand selection, kunkel strand selection) – cassette mutagenesis – PCR based mutagenesis – QuickChange® mutagenesis – applications of PCR in clinical diagnosis.

UNIT IV: CLONING STRATEGIES

21 hrs.

Genomic library – cDNA library – full length cDNA cloning (Gubler–Hoffman, oligo capping, RACE) – directional cDNA cloning – PCR based libraries – subtraction libraries – library construction in post–genomic era – different strategies for library screening – nucleic acid hybridization – immunoscreening – screening by function – screening by interaction – phage display – two hybrid screening – other interaction screening – one hybrid, three hybrid and reverse two hybrid. Nucleic acid probes – radioactive methods – non–radioactive methods – functional and positional cloning – PCR based subtractive cloning.

UNIT V: APPLICATION OF GENE CLONING AND EXPRESSION

18 hrs.

Sequencing methods – Maxam-Gilbert method – dideoxynucleotide method – automated DNA sequencing and high through put sequence – PCR based sequencing – alternative methods of DNA sequencing – pyrosequencing – NGS – sequence assembly of contiguous sequences (reading exercise) – expression analysis at mRNA level – transcriptome analysis, assembly and differential expression – SAGE – microbead technology – expression analysis at protein level – *E. coli* as a host – factors influencing the expression of recombinant proteins – purification of recombinant proteins – His-tag – GST-tag – MBP-tag – examples of alternate expression systems

– yeast *Saccharomyces cerevisiae* – *Pichia pastoris* – baculovirus – mammalian expression systems.

TEXT BOOK(S):

Primrose S.B. and Twyman R.M,(2006). *Principles of Gene Manipulation and Genomics*(7th ed.). New York :Blackwell Scientific Publications. Print.

REFERENCE BOOK(S):

Brown T.A,(2006).*Gene Cloning and DNA Analysis*(5th ed.).,UK: Blackwell Scientific Publications. Print.

Channaraayappa,(2006)*Molecular Biotechnology – Principles and Practices*, Universities Press (India) Private Limited.Print.

Mickloss, D.A. and Frever, G.A,(2003).*DNA Science – A First Course*, New Yorkr: Cold Spring Harbor Laboratory Press.Print.

Rateledge, C. and Kristiansen B, (2006).*Basic Biotechnology*, New Delhi: Cambridge University Press.Print.

Recombinant DNA Safety Guidelines, Department of Biotechnology, Ministry of Science and Technology, Government of India, New Delhi, 1990. Print

Sambrook, J. and Russell D.W, (2001).*A Laboratory Manual*, New York: Cold Spring Harbor Laboratory Press. .Print.

Walker, J.M. and Gingold, E.B,(2008)*Molecular Biology and Biotechnology*(3rd ed.). New Delhi: Panama Publishing Corporation.Print.

Young,M. and Howell ,R,(2004).*Comprehensive Biotechnology*, Volumes I, II, III and IV, Netherlands: Elsevier Publications. Print.

PBT4533M MICROBIAL BIOTECHNOLOGY, BIOSAFETY AND IPR

(THEORY)

LEARNING OUTCOME

5 hrs. / wk.

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

- appreciate the role of microbes in industries
- acquire knowledge on environmental protection through microbial products
- relate the industrial application in scaling up of the fermentation process

COURSE CONTENT:

UNIT I: FERMENTATION

18 hrs.

Fermentation processes – Batch – fed batch and continuous bioreactions – Fermenters – Introduction – Types – Tower – jet loop – Airlift – Bubble column – Stirred and Packed bed; Specialized bioreactors (Pulsed – Fluidized bed reactors and Photobioreactors) – stability of microbial reactors– Upstream processing – scale up of fermentation process (parameters used in scale up, problems associated) – downstream processing – removal of microbial cells and solid matter foam separation – flocculation – floatation – filtration – centrifugation – cell disruption – chromatography – drying and crystallization – precipitation.

UNIT II: MICROBIAL PRODUCTS

18 hrs.

Microbial Biomass – gene cloning in microorganisms other than *E. coli* (*Salmonella*, *Bacillus subtilis*)– microbial metabolites: amino acids (glutamic acid, L-lysine) – Vitamins and hormones (vitamin B12, vitamin A, riboflavin, gibberellins). Organic acids and other industrial chemicals (lactic acid, citric acid, alcohol). Antibiotics (penicillin, streptomycin, tetracycline) – peptide antibiotics (lantibiotics).-Concept of entrepreneurs- product formulation- Market research and assessment tools- developing a market strategy- Institutional support- DIC, SISI,SIDCO, startups and SME in Biotech-Sources of finance-Government support- BIRAC- case studies.

UNIT III: MICROBIAL ENZYMES

15 hrs.

Microbial production– purification of enzymes – immobilization of enzymes – applications in industries (protease, amylase, invertase, pectinase, xylanase) – microbial exopolysaccharides (EPS) – classification and applications (chitin, chitosan, alginate, cellulose, hyaluronic acid, xanthan, gellan, pullulan, polysaccharides of lactic acid bacteria).

UNITIV: MICROBES AND ENVIRONMENT

12 hrs.

Bioremediation– process and organisms involved –bioaugmentation, biotransformation of heavy metals and xenobiotics, petroleum biodegradation– reductive and aerobic dechlorination. Polyaromatic hydrocarbon pollution – organic pollutant degradation– biosorption, bioleaching – wastewater treatment – primary, secondary, tertiary – biofilms in treatment of waste water, use of membrane bioreactor for industrial sewage treatment – biosensors – types – applications – biofertilizers – *Pseudomonas fluorescens*, *Rhizobium* sp., *Azospirillum*, VAM-

UNITV: BIOSAFETY AND IPR

12 hrs.

Good Laboratory Practices– biological safety cabinets– primary containment for biohazards– Biosafety Levels– GMOs and LMOs and their environmental impact– roles of Institutional Biosafety Committee – RCGM – GEAC – environmental release of GMO – risk analysis – assessment and management – Intellectual property rights (IPR) – patents – copyright – trademarks – International framework for the protection of IP – GATT – WTO – WIPO and TRIPS – patent system in India – plant breeder's right and farmer's right.

TEXT BOOK(S):

Young M.M., Bull A.T and Dalton H,(2004)*Comprehensive Biotechnology – The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine*, Volumes I, II and III, ,Oxford, UK: Pergamon Press Ltd.Print.

Ganguli.P, (2001). *Intellectual property right* New Delhi: Tata McGraw – Hill Publishing Company Limited.Print.

REFERENCE BOOK(S):

Belter, P.A, Cussler, E.L. and Wei–Houhu H.U,(1998). *Bio separations – Downstream Processing for Biotechnology*(1st ed.).New York: Wiley Interscience Pub. Print.

Chatterji, A.K,(2011).*Introduction to Environmental Biotechnology*(3rd ed.). Prentice Hall.Print.

Crueger W and Crueger,(1990)*A Textbook of Industrial Microbiology*,(2nd ed.).New Delhi :Panima Publishing Corporation.Print.

Mukhopadhyay, S.N,(2005) *Process Biotechnology Fundamentals*(2nd ed.).New Delhi: Viva Books Pvt. Ltd.Print.

Pandey, A., Larroche, C., Soccol, C.R and Dussap, C.G,(2008)*Advances in Fermentation Technology*, New Delhi :Asiatech Publishers Inc.Print.

Peter, F.S, Hall, S.J. and Whitaker,(1995). A.*Principles of Fermentation Technology* (2nd ed.). London: Butterworth–Heinemann publishers. Print.

Price, N.C and Lewis, S,(1998)*Fundamentals of Enzymology*.(2nd ed.).New York:Oxford University Press.Print.

Vallero, D,(2014)*Environmental biotechnology*.(2nd ed.).Baltimore, U.S.A: Academic press.Print.

PBT4431P LAB IN rDNA TECHNOLOGY

(LAB)

LEARNING OUTCOME

4 hrs. / wk.

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

- acquire knowledge on basic technical skills in genetic engineering
- understand the methodology of construction of recombinant plasmid and clones
- apply the knowledge of rDNA techniques in research

COURSE CONTENT:

60 hrs.

EXPERIMENT/LAB:

1. Isolation of plasmid DNA (mini preparation)
2. Primer designing (*in silico*) and PCR amplification of gene of interest
3. Restriction digestion of interest and vector
4. Effect of DNA methylation on restriction digestion
5. Preparation of competent cell, cloning (transformation / TA cloning)
6. Southern hybridization
7. Strain improvement by physical mutagen – UV
8. Strain improvement by chemical mutagen – MNNG
9. Expression of recombinant protein from wild and mutant strains
10. Western blotting of expressed protein

REFERENCE BOOK(S):

Brown, T.A,(2006).*Gene Cloning and DNA Analysis*.(5th ed.). UK: Blackwell Scientific Publications.Print.

Demain,A.L,(2004).*Manual of Industrial Microbiology and Biotechnology*, Washington: ASM Press. Print.

Gardner,E.H. Simmons, M.J. Snustad, D.P,(2007). *Principles of Genetics*(8th ed.). Singapore: John Wiley andSons.Print.

Glover, D.M. and Hames, B.D,(1995).*DNA Cloning*, Volumes I, II and amp; III(2nd ed.).New York: IRL Press at Oxford University Press. Print.

Hudock,G.A,(1967).*Experiments in Modern Genetics*.USA: John Wiley and Sons Inc. Print. Laboratory Press. Print.

Miller, J.H,(1992).*A Short Course in Bacterial Genetics – Laboratory Manual*. USA: Cold Spring Harbor

Naik ,G.R. (2004).*Introduction to Basic Molecular Biology Techniques*, India: Himalaya Publications. Print

Sambrook and Russel,(2001).*Molecular Cloning– Laboratory Manual*(3rd ed.).New York: Cold Spring Harbor Laboratory Press.Print.

Sambrook J. Fritsch E.F. Maniatis T,(1999).*Molecular Cloning – A Laboratory Manual*(2nd ed.).New York:CSH publishers. Print.

Stephenson F.H,(2006).*Calculations for Molecular Biology and Biotechnology, A guide to Mathematics in the Laboratory*, California: Academic Press.Print.

PBT2425E REPRODUCTIVE HEALTH FOR WOMEN

(THEORY)

LEARNING OUTCOME

4 hrs./ wk.

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

- understand the reproductive physiology of women
- recognize the importance of health related issues
- select the various healthcare services available for women and children

COURSE CONTENT:

UNIT I: FEMALE REPRODUCTIVE PHYSIOLOGY

12 hrs.

Anatomy – ovarian function – follicle growth – ovarian and other hormones associated with female reproductive physiology – uterine changes in the menstrual cycle. puberty and menopause –common gynaecological problems in women sexually transmitted diseases.

UNIT II: PREGNANCY AND PARTURITION

12 hrs.

Fertilization –implantation – formation of placenta – hormones in pregnancy – pregnancy test – normal physiological changes – nutrition before and during pregnancy – common problems during pregnancy and remedies –parturition.

UNIT III: LACTATION AND POST NATAL CARE

12 hrs.

Hormonal control of breast development and lactation nutrition in lactation– breast feeding for maternal and child health – Immunization schedule – under five mortality – contraception and assisted reproductive technology– MTP genetic counselling.

UNIT IV: HEALTH CARE STATUS AND PROBLEMS

12 hrs.

Level of health care – primary health care, elements and principles of primary health care – health status and health problems: communicable diseases – nutritional – environmental sanitation – medical care and population problems.

UNIT V: HEALTH CARE SERVICES

12 hrs.

Public and private sector – indigenous systems of medicine – voluntary health agencies and national health programs.

REFERENCE BOOK(S):

Chaudhuri,(1988). *Concise medical physiology* (6th ed.). Calcutta: New Central book agency. Print.
Fenwick, E,(2001) *The complete book of mother and baby care*. London: Dorling Kindersley limited. Print.

Moore and Persaud,(1999).*The developing human – Clinically oriented embryology*(6th ed.).Noida: Thomson press (I) Ltd.Print.

Outcalt, D.C,(2000).*Twenty common problems in preventive health care* New York :The Mc Graw Hill Company.Print.

Park, J.E., Park.,K,(2001)*Park's Text book of preventive and social medicine*(13th ed.). Jabalpur:M/S Banasidas Bhanot Publishers.Print.

Vander, A.J., Sherman ,J.H and Luciano, D.S.(1990).*Human Physiology – the mechanisms of body function*(5th ed.). New York :The Mc Graw – Hill Publishing Company.Print.

PBT2426E FOOD SCIENCE AND TECHNOLOGY

(THEORY)

LEARNING OUTCOME

4 hrs. / wk.

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

- explain the basic concepts of food and nutrition
- relate the knowledge on food spoilage and preservation techniques
- apply the technology in food industries

COURSE CONTENT:

UNIT I: INTRODUCTION TO FOOD

12hrs.

Basic food groups and nutritive values of food – balanced diet – planning of balanced diet – food preparation techniques – medium of cooking, boiling, simmering, pressure cooking, baking, deep fat frying – fast food culture.

UNIT II: FOOD ADULTERANTS

12 hrs.

Food standards – common adulterants in different foods, methods to detect adulterants in food – contamination of food with toxic chemicals pesticides and insecticides, food additives and fortifiers – Definition, types and functional characteristics, natural colors: types and applications, advantages of natural colour over artificial sweeteners.

UNIT III: FOOD SPOILAGE

12 hrs.

Causes of food spoilage – spoilage of fruits and vegetables – meat, soft drinks, cereals, sugar products, dairy products, fish and other sea foods, eggs, poultry, canned foods.

UNIT IV: FOOD PRESERVATION

12 hrs.

Methods of food preservation – chemical preservation – chemical preservatives – bacteriostatic methods – dehydration, mechanical drying, uses of salt and sugar, oil and spices, acid, temperature – low and high temperature.

UNIT V: APPLICATIONS OF BIOTECHNOLOGICAL STRATEGIES IN FOOD INDUSTRY

12 hrs.

Technological aspects of industrial production of beer, wine, SCP, fermented food – yoghurt, cheese bread, idly, meat and dairy products. Probiotics –food safety – FDA legislation – Indian and international perspectives – Food process wastes – whey, molasses, starch substrates and other food wastes for bioconversion to useful products.

SUGGESTED ACTIVITIES:

1. Detection of common food adulterants.
2. Observation of food spoilage.

REFERENCE BOOK(S):

- Adam, M.R., Moss, M.O,(1998).*Food Microbiology*(2nded.).**New Delhi: New age International (p) limited, book house.Print.**
- Banwart, G.J,(1998).*Basic food Microbiology*(2nd ed.).**New Delhi: CBS publishers.Print.**
- Frazier, C.W., Westhoff, C.D,(1995).*Food microbiology*.(4th ed.).New Delhi:Tata McGraw – HillLtd Print.** Mudambi, R.S., Ras, M.S,(1997).*Food Science*.**New Delhi: New ASE International (P) limited.Print.**
- Swaminathan, M,(2008).*Food and Nutrition*, Vol.II,**New Delhi:Bangalore Printers and Publishing Co.Print.**

PBT3425E EMERGING INFECTIOUS DISEASES

(THEORY)

LEARNING OUTCOME

4 hrs. / wk.

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

- analyze the general concepts of existing and emerging infectious diseases
- describe the reasons of infectious diseases
- outline the means and limits of controlling and managing the diseases

COURSE CONTENT:

UNIT I: INTRODUCTION

12 hrs.

Definition of emerging infectious diseases; infectious and non-infectious diseases: toxic, occupational diseases – qualification and quantification of emerging diseases – differentiation of emerging and resurging (re-emerging) diseases.

UNIT II: FACTORS CONTRIBUTING TO EMERGENCE OF INFECTIOUS DISEASES

12 hrs.

World population, urbanization trends, demographic social changes, technological procedures – immune suppression and use changes – climatological changes – international travel and commerce.

UNIT III: PATHOLOGY

12 hrs.

Characteristics of emerging diseases similar to and different from 'stable' diseases;dengue, chikungunya, SARS, swine flu, avian flu, plague, anthrax, leptospirosis – causes, zoonosis, signs and symptoms, control measures.

UNIT IV: ADDRESSING EMERGING DISEASE THREATS AND OUTBREAKS

12 hrs.

Enhance surveillance, conducting epidemiologic and laboratory research –direct work with the organisms –implementing effective prevention and control programmes.

UNIT V: DIAGNOSTIC TECHNIQUES AND THERAPY

12 hrs.

Principle – types of techniques –screening for infectious diseases and their treatment.

SUGGESTED ACTIVITIES:

1. Hospital visit
2. Case study

REFERENCE BOOK(S):

Ewald, P.W. (1994). *Evolution of Infectious Disease*. New York: Oxford University Press. Print.

Garrity, G.M. (2001). *Bergey's Manual of Systematic Bacteriology* (2nd ed.). New York: Springer Verlag. Print.

Holt, J.G., Kreig, N.R., Peter, H.A., Stanley S.J.T and Williams S, (1994). *Bergey's Manual of Determinative Bacteriology*, New York: Williams and Wilkins, A Maverville Company. Print.

Pelczar, M.J., Schan, E.C and Krieg, (2004). *Microbiology Concepts and Applications* (5th ed.). Boston: Mc Graw Hill Inc. Print.

Persing, D.H. (2003) *Molecular Microbiology – Diagnostic Principles and Practice*. Washington: ASM Press. Print.

Scheld, W.M, Armstrong, D and Hughes, J.M, (1998). *Emerging Infections*. Washington, DC: ASM Press. Print.

PBT3427E STEM CELL TECHNOLOGY

(THEORY)

LEARNING OUTCOME

4 hrs. / wk.

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

- comprehend the biology of stem cells
- relate the stem cell potential in therapies and regenerative medicine
- assess the social and ethical issues related to stem cells technology

COURSE CONTENT:

UNIT I: INTRODUCTION TO STEM CELLS

12 hrs.

Biology of cells – organization of tissue, organ system – stem cells; definitions, properties, potency (totipotent, pluripotent, multipotent and unipotent), stem cell niche, identification of stem cells – flow cytometry and immunofluorescent assay.

UNIT II: STEM CELL TYPES AND CULTURING

12 hrs.

Embryonic stem cells, adult stem cells – epithelial (epidermis and mammary), hematopoietic (bone marrow and umbilical cord), mesenchymal (osteoblast and adipocytes), neural (neuron) and side population stem cells, mammary stem cells, and their derivation and culture; induced pluripotency – reprogramming of mouse and human stem cells, storage of stem cells (cryopreservation), stem cell bank.

UNIT III: STEM CELL APPLICATION I

12 hrs.

Stem cell therapy – cancer, spinal cord injury, cardiovascular disease and Parkinson's disease.

UNIT IV: STEM CELL APPLICATION II

12 hrs.

Stem cells in regenerative medicine – stem cells for organ and tissue transplant, nerve repair, bone marrow transplantation.

UNIT V: SAFETY AND ETHICS OF STEM CELL TECHNOLOGY

12 hrs.

Guidelines for stem cell research, NAC-SCRT (National Apex Committee for Stem Cell Research and Therapy), institutional stem cell research oversight committee (SCRO), ethics behind the use of embryonic stem cells (animals and human) – ownership of cells, tissues and organs – controversies in stem cell research.

REFERENCE BOOK(S):

Lanza, R., Gearhart, J., Hogan, B., Melton, D., Pedersen, R., Thomas, E. D., and West, M,(2005). (Eds.), *Essentials of stem cell biology*. Academic Press.. Print

Kapoor,S.(2008).*Stem cell technology*. New Delhi, India: Arise Publishers and Distributor. Print.

Sarkar, A,(2009).*Encyclopedia of stem cells – 3 Human stem cells*, New Delhi, India: Discovery Publishing house Pvt, Ltd.Print.

Sarkar, A,(2009).*Encyclopedia of stem cells – 4 Animal stem cells*, New Delhi, India: Discovery Publishing house Pvt, Ltd.Print.

Sarkar, A,(2009).*Encyclopedia of stem cells – 5 Specific stem cells*, New Delhi, India: Discovery Publishing house Pvt, Ltd.Print.

Sarkar, A,(2009).*Encyclopedia of stem cells – 6 Stem cell cultures*, New Delhi, India: Discovery Publishing house Pvt, Ltd.Print.

