SRI DHARMASTHALA MANJUNATHESHWARA COLLEGE, UJIRE-574240

(Autonomous)

(Re-Accredited by NAAC at 'A' Grade with CGPA 3.61 out of 4)

DEPARTMENT OF
PG STUDIES AND RESEARCH IN BIOTECHNOLOGY

Syllabus of

Masters' Degree in

BIOTECHNOLOGY

(CHOICE BASED CREDIT SYSTEM)

2020-2021 onwards.

Approved by the BOS meeting held on 21st Aug. 2020

Approved by the Academic Council meeting held on 10-11-2020

Preamble

Revision of syllabus for the two years Master Degree programme in Biotechnology

Board of Studies in Biotechnology has revised and prepared the Syllabus (CBCS based) for the Biotechnology course in its meeting held on 30th July 2016 based on the UGC letter (Ref, No. MU/ACC/CR.38/CBCS (PG)/2015-16 dated 05-05-2016) to offer Hard Core, Soft Core and Open Elective course papers with credits amounting to 92 credits, for the entire programme

The BOS has prepared the syllabus by adopting the pattern of 14 hard core and 11 soft core along with one project. Total credits for hard coreis 52, soft core 30, project 4 and 6 credits are for open elective.

Detailed syllabus is prepared for all the four semesters

Course/Credit Pattern

Semester	Hard Core Theory	Soft Core Theory	Hard Core Practical	Soft Core Practical	Open Elective	Project	Total Credits
First	12	3	08	------	------	-----	23
Second	08	06	04	03	03*	-----	21+03*
Third	08	06	04	03	03*	-----	21+03*
Fourth	04	06	04	03	-----	04	21
Total	32	21	20	09	06*	04	86 + 06* = 92

Total credits from all the four semesters = 86+6*=92

Total hard core credits = 52 + 4 =56

ProjectCredits =

04 Total Soft core credits = 09+ 21

=30

*Open electivecredits = 6

Open electives are given grades and they are not included in the CGPA In the first semester two soft core papers are offered and the student has to opt for any one. In the second, third and fourth semesters three soft core papers are offered in each semester and the student has to opt for any two.

Faculty of PG Studies in Biotechnology: PGBTY051

Programme Specific Outcomes:

PSO1: Demonstrate bimolecular knowledge and analytical skills at an advanced level.

PSO2:Show an ability to qualify various range of positions in industry, consultancy, education and public administration.

PSO3: Undertake further Study on biotechnology and its related disciplines such as genetics, animal biotechnology, food technology, plant biotechnology, etc.

PSO4: Show an ability to work in the capacities such as Sr. Associate Scientist, Research Biochemist, Sr. Regulatory Affairs Associate, Biotechnology Researcher, Associate Engineer, Quality Controller and Regional Manager and in industries such as Pharmaceuticals, Manufacturing, Biotechnology, Research Organisations, and FMCG besides colleges and universities as teachers.

PSO5: Undertake research projects on the leading edge in a chosen Specialized area of biotechnology, based on own research experience from a master's project and international literature.

PSO6:Show skills to qualify for research/ for further education in a doctoral program.

SDM COLLEGE (AUTONOMOUS), UJIRE

M.Sc. BIOTECHNOLOGY,
CONTENT OF THE COURSE AND SCHEME OF EXAMINATION

FIRST SEMESTER

Course Code	Course Title	Teaching hours per week	Credits	Marks		Total
				IA*	Exam	
	HARD CORE COURSES - THEORY					
BTH401	Biochemistry	4	4	30	70	**100**
BTH402	Microbiology	4	4	30	70	**100**
BTH403	Cell biology	4	4	30	70	**100**
	SOFT CORE COURSES-THEORY (CHOOSE ANY ONE)					
BTS404	Molecular Genetics	3	3	30	70	**100**
BTS405	Bio analytical techniques					
	PRACTICALS					
BTP406	Biochemistry& Microbiology	6	4	30	70	100
BTP407	Cell biology & Molecular Genetics	5	4	30	70	100
	OR	5	4	30	70	100
BTP407	Cell biology & Bio analytical techniques					
	Total		**23**			**600**

IA consists of Seminars, Assignments, Internal Tests

SECOND SEMESTER

Course Code	Course Title	Teaching hours per week	Credits	Marks		Total
				IA*	Exam	
	HARD CORE COURSES - THEORY					
BTH451	Molecular biology	4	4	30	70	**100**
BTH452	Genetic Engineering	4	4	30	70	**100**
	SOFT CORE COURSES - THEORY (CHOOSE ANY TWO)					
BTS453	Metabolism	3	3	30	70	**100**
BTS454	Enzymology					
BTS455	Biostatistics & Bioinformatics	3	3	30	70	**100**
	PRACTICALS					
BTP456	Molecular biology & Genetic Engineering	6	4	30	70	100
BTP457	Metabolism &Ezymology	5	3	30	70	100
	OR		3	30	70	100
BTP457	Metabolism & Bioinformatics	5	3	30	70	100
	OPEN ELECTIVES					
BTE458	Fundamentals of Biotechnology	3	3	30	70	**100**
BTE459	Environmental Issues					
BTE460	Biodiversity & conservation					
	Total		**21**			**700**

IA consists of Seminars, Assignments, Internal Tests

THIRD SEMESTER

Course Code	Course Title	Teaching hours per week	Credits	Marks		Total
				IA*	Exam	
	HARD CORE COURSES - THEORY					
BTH501	Plant Biotechnology	4	4	30	70	**100**
BTH502	Animal Biotechnology	4	4	30	70	**100**
	SOFT CORE COURSES - THEORY (CHOOSE ANY TWO)					
BTS503	Bioprocess Technology	3	3	30	70	**100**
BTS504	Microbial Technology					
BTS505	Nano Biotechnology	3	3	30	70	**100**
	PRACTICALS					
BTP506	Plant Biotechnology& Animal Biotechnology	6	4	30	70	100
BTP507	Bioprocess & Microbial Technology	5	3	30	70	100
	OR					
BTP507	Bioprocess Technology& Nano Biotechnology	5	3	30	70	100
	OPEN ELECTIVES					
BTE508	Immune system & Human health	3	3	30	70	**100**
BTE509	Basics concepts in clinical Biochemistry					
BTE510	Applications of Biotechnology in Food science					
	Total		**21**			**700**

IA consists of Seminars, Assignments, Internal Tests

FOURTH SEMESTER

Course Code	Course Title	Teaching hours per week	Credits	Marks		Total
				IA*	Exam	
	HARD CORE PAPERS– THEORY					
BTH551	Immunology	4	4	30	70	**100**
	SOFT CORE COURSES-THEORY (CHOOSE TWO ONE)					
BTS552	Environmental Biotechnology	3	3	30	70	**100**
BTS553	Agricultural Biotechnology					
BTS554	Food Biotechnology	3	3	30	70	100
	PRACTICALS					
BTP555	Immunology	6	4	30	70	100
BTP556	Environmental Biotechnology					
	Agricultural/Food biotechnology	5	3	30	70	100
	PROJECT WORK					
BTH557	Project Work and Dissertation	4	4	30	70	**100**
	Total		**21**			**600**
	Grand Total		**92**			**2600**

Certificate Course/ Value added course
QC Microbiology
STRUCTURE AND SCHEME – QC MICROBIOLOGIST

Paper code	Title of the paper	Teaching hours per week	Duration of examination (hours)	Internal assessment marks	Exam. marks	Max. marks	Credits
Theory & Practical's split for 2 semesters							
Paper1	Quality control Microbiology	4	3	30	70	100	4
Paper2	Quality control Microbiology(Practical)	4	3	30	70	100	4
Total Marks and Credits						**200**	**08**

First semester-Internal Assessment -30 marks

Theory

Seminar 10 marks(2 seminars per paper)

Assignment 5 marks

Internal test 15 marks(2 internals)

Practical

Continuous assessment - 15 marks(Based on attendance, performance and record)

Internal test- 15 marks(2 internal)

First semester –End Semester Assesmnt-70marks

Theory

Part A:5*3=15(5 Questions to be answered out of 6)

Part B:5*5=25(5 Questions to be answered out of 6)

Part C:2*15=30(2 Questions to be answered out of 3)

Practical

Part A: Major Experiment:1*30=30

Part B :Minor Experiment:1*20=20

Part C:Viva/voce:20

FIRST SEMESTER SYLLABUS

HARD CORE PAPERS	SOFT CORE PAPERS	OPEN ELECTIVE
BTH401Biochemistry	BTS404 Molecular Genetics	Nil
BTH402 Microbiology	BTS405 Bio analytical techniques	
BTH403 Cell biology		
BTP406 Biochemistry& Microbiology		
BTP407 Cell biology & Molecular Genetics OR BTP407 Cell biology & Molecular Genetics & Bio analytical techniques		

BTH401 BIOCHEMISTRY

No of Credits: 4

No. of Hours: 52

Objectives

1. To study about chemical bond, types and its effect on reactivity
2. To understand the structure, function and interaction between biological macromolecules in living system

Course Outcomes:

CO1: Understand chemical reactions and structures of biological molecules essential to life on Earth

CO2: Demonstrate the theoretical knowledge and practical application of UV/VIS, IR, and NMR spectroscopy, Colorimetry, Turbidometry, Nebulometry,nucleic acid purification, electrophoresis, SDS-PAGE protein electrophoresis, Western blotting, protein purification, Centrifugation.

CO3: Apply skills with Circular Dichorism, X-ray Diffraction and Radio isotope techniques like GM counter, Liquid scintillation counter and Cerenekov counting and Autoradiography.

CO4: Be highly conversant about classification of Biomolecules

Unit-I **15Hrs**

Chemical basics of biology: The atom and chemical bonding, Ionization potential, nature and types of chemical bonding, electron affinity, bond length, bond energy and noncovalent bonds/interactions. Properties of water.

Carbohydrates: Classification, structure and Properties of mono, oligo and polysaccharides. Chirality and optical activity, stereoisomerism, cyclic structure of monosaccharide, (pyranoses and furanoses), structures of glucose. absolute and relative configuration (D & L and R & S nomenclature). Derived sugars- sugar acids (aldonic, aldaric and saccharic acids), Amino sugars. Disaccharides-structures of maltose, lactose, sucrose, trehalose, raffinose. Polysaccharidesstructure and properties of homo and hetero polysaccharides. Storage polysaccharides. (starch, glycogen, cellulose, chitin) glycosaminoglycans andglycoproteins

Unit–II **12Hrs**

Amino acids and proteins: Structure, specific rotation, electrochemical properties, Classification and characteristics of amino acids. Nonstandard amino acids, peptide bond and chemical bonds involved in protein structure. Conformational determination of peptide, Ramachandran plot, helix-coil transition, structural organization in proteins. Primary structure determination and synthesis of peptides. Secondary structure- Alpha helix, beta sheet and amorphous structures. Tertiary structure of myoglobin, QuaternaryStructure-Structural organization of haemoglobin. Proteins – Classification based on source, shape, composition and biological function. Structural organization in silk fibroin

α-keratin, collagen and elastin. Protein folding - Denaturation and renaturation of proteins (Work of Cristian Anfinsen on ribonuclease), folding pathways, the roles of folding accessory proteins and prediction of protein structures (Chou and Fasman scheme).Motifs of proteins: Alpha structure: coiled coil, four helix bundles, & globin motifs with examples, Beta structures : up & down beta barrel, Greek key motif ,jelly roll motifs,horse shoe motifs ,TIM barrel motifs, Rosmann fold , beta alpha beta motifs

Unit–III **15Hrs**

Lipids: General structure and functions of Fatty acids. Classification – Simple lipids, Compound lipids (phospholipids and glycolipids), Derived lipids (Steroids, Sphingolipids, Terpenes and Carotenoids). Properties of fats and oils – physical properties and chemical properties (Reactions involving COOH group, double bond and OH groups). Biological functions of lipids and eicosanoids (prostaglandins, leucotrienes and thromboxanes).

Vitamins: Biological functions of fat-soluble vitamin: A, D, E & K; Water soluble vitamins, Coenzymes.

Unit–IV **10Hrs**

Nucleic acids: Introduction, types and structural components (Phosphoric acid, Pentose sugar and Nitrogenous bases). Structure and functions of Nucleosides and Nucleotides. Deoxyribonucleic acid – internucleotide linkages, base composition, evolution of Watson - Crick Model (Chargaff's rule of base pairing in DNA). Denaturation and renaturation of DNA helix (hyperchromism, Tm,cot).Variants of double helical DNA. DNA's with

unusual structures. Interaction of DNA with other molecules (small molecules-ethidium bromide; large molecules-proteins) Ribonucleic acid – differences with DNA. structure and types of RNA (rRNA, tRNA and mRNA).

References:

1. Nelson, D.L., Cox, M.M. Lehninger. (2004). Principles of Biochemistry 4th edition Pub WH FreemanCo.
2. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3rdIndian edition,Pub. Oxford.
3. Mathews, Van Holde and Ahern, Biochemistry by 3rd edition, Pub Pearsoneducation
4. Stryer, L. Biochemistry 4th Edn. W.H. Freeman and Co.NY.
5. Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2nd edition Pub:Tata.
6. Voet, D., Voet J.G. (2004). Biochemistry 2ndEdn.
7. Devlin, T.M. (1997). Biochemistry with clinical correlations, Wiley-Liss Inc.NY
8. Zubey, G.L. Parson, W.W., Vance, D.E. (1994). Principles of Biochemistry WmC Brown publishers.Oxford.
9. Edwards and Hassall. Biochemistry and Physiology of the cell 2nd Edn. McGraw Hill Co. UK.Ltd.

BTH402 MICROBIOLOGY

No of Credits: 4

No. of Hours: 52

Objective:

1. Studies about emergence & evolution of micro-organism, streamlining microbial groups into prokaryotes, eukaryotes&archaea with morphologicaldetails.
2. Tells about nutritional requirement, metabolism & growth kinetics of micro organisms. Microbialcommunity.
3. Viral classification with few examples of bacterial, animal & plant viruses with its life cycle.
4. Microbialpathogenesis

Course Outcomes:

CO1: Explainthemicrobial world, its beginning with basics of evolution of micro organism on early earth life & its gradual transformation to most resistant forms.

CO2 : Demonstrate taxonomic grouping of micro organism through conventional & molecular approach and explain properly.

CO3 : Demonstrate the knowledge of microbialnourishment : respiration, factors affecting growth, measurement of growth, Co-existence of micro organisms as microbial association, structure & life cycle of virus on the basis of viral genomes as dsDNA, ssDNA, ssRNA, dsRNA with few predominant viral form carrying replication in different host such as bacteria, animal, plant.

CO5: Give analysis of the dark side of microbial world that is microbe & host interaction leading to disease is explained with respect to few plant pathogens, animal pathogens etc, Pathogenesis caused by invading bacteria and few secreted microbial products such as toxin resulting in food poisoning and also the role played by micro-organisms in food spoilage, prerequisites contributing to food spoilage.

CO6 : Suggest remedial measures of preservation of food through various methods

UnitI **13 Hrs**

Historical perspectives, Microscopy, origin and evolution of microorganisms, principles of

classifications, numerical and molecular taxonomy, Comparative morphology, structure and reproduction (Geneti recombination) in archaebacteria, eubacteria, cyanobacteria, Fungi.

Microbial nutrition, nutritional grouping of microorganism; Growth kinetics, Factors affecting growth and death; methods of isolation, enumeration cultivation and preservation of microorganisms

UnitII **13 Hrs**

Microbial metabolism, Microbial respiration, aerobic and anaerobic respiration(w.r.t chemorganotroph& chemolithotroph), fermentation, Bacterial photosynthesis. General account of symbiosis, mutualism, antagonism, parasitism, commensalism in microorganisms.

UnitIII **13 Hrs**

Classification, morphology, ultra-structure and life cycle of plant viruses, animal viruses and bacteriophages. DNA viruses: Herpes virus, Adenovirus. RNA viruses: Polio, Influenza, Retroviruses, (HIV); Bacteriophages: Lambda phage, Bacteriophage MU, M13, T4.

UnitIV **13 Hrs**

Animal microbe interactions: Tuberculosis, Dermatophytes, Rabies, Mycoplasma, Rickettsiae, Typhoid, Leprosy and Cholera. Antibiotics: Types, mode of action and drug resistance (Cholera, Salmonella and Staphylococcus), Antimicrobial therapy.

Principles of microbial spoilage of food, Methods of food preservation by physical (freezing, canning, pasteurization and irradiation) and chemical (preservatives, lactic antagonism), Methods of Microbial food poisoning (Botulinum, Mycotoxins, Algal toxins(relevance to fresh water & marine algae, Cholera and Salmonellosis).

eferences:

1. Brock Biologyof microorganisms**,** Michael T. Madigan , John M. Martinko , Kelly S. Bender 14th edition2012
2. Element of microbiology 5th edition– Pelczar J. and Chan ECS. MacGraw Hill NewYork,1998
3. General Microbiology .Schlegel HG 7th ed. Cambridge Univ. Press1993
4. Microbial biology. Rosenberg E and Cohen IR. .Saunders Coll.Pub.,1983
5. The microbial world. Stanier RY et al 5th ed. Prentice Hall NewDelhi.1990

Skill components Identified :

Various bio-safety issues including physical and biological containment, universal containment, personal protective equipment for biological agents

Various isolation precautions including standard and transmission based precautions

In-depth knowledge about various method of Sterilization, and disinfection

Nomenclature, classification and morphology of bacteria as well as other microorganisms

Requirements for growth and nutrition of bacteria along with bacterial metabolism 9. Microbiology of air, soil, water

Various types of host-parasite relationship and their significance

Various antimicrobial agents and mechanisms drug resistance

Bacterial genetics, bacteriophages and molecular genetics relevant for medical microbiology .

Applications of quality assurance, quality control in microbiology and accreditation of laboratories

BTH403 CELL BIOLOGY

No of Credits: 4

No. of Hours: 52

Objective:

1. To Understand the structure and function of prokaryotic and eukaryotic cells as whole and in terms of their sub-cellular processes.
2. To study structural organization of their membranes, transportation of solutes across membranes, cellular development, defence, division both in somatic and gametic cells, cell cycle regulation will bedealt.
3. Cell-cell integration, communication, cellular organization into tissue, signalling pathways and its regulation are also the key features which the students will be enlightened.

Course Outcomes:

CO1: Trace and relate the evolution of cells.

CO2: Show the conversant ability on different organelles present within the cell that has an evolutionary significance with respect to the changing environment, adaptations, improvisation of survival skills and the changing surroundings based on their activities.

CO3: participate in academic meets or workshops concerning cell signalling, cell interactions.

UnitI **13 Hrs**

Introduction: Prokaryotic and eukaryotic cells; Differences between plant and animalcells. Membrane structure: Different models of membrane; Structural Organization of Biomembranes - Lipid composition, protein components, membrane carbohydrates; Functions of Biomembranes; Ion channels, Electrical properties of membranes, Nerve impulse transmission; Transport across bio-membranes – active and passive; Endocytosis: Phagocytosis, receptor mediated endocytosis, protein trafficking in endocytosis; Chemical composition of cell walls in plants, bacteria and fungi; Tensile strength, turgor modifications.

UnitII **13 Hrs**

Subcellular Organization: Ultrastructural organization and functions of Golgi complex, endoplasmic reticulum, mitochondria, chloroplast, peroxisomes, lysosomes, ribosomes, nucleus and nucleolus.

UnitIII **13 Hrs**

Chromosomes – Structure, organization and types of eukaryotic chromosomes; Types of Chromatin - Heterochromatin, Euchromatin,. Types of chromosomes- Polytene and lamp brush chromosomes; Chromosomal Organization of Genes; Morphology and Functional Elements of Eukaryotic Chromosomes – Telomeres, Centromere, Kinetochore.

Chromosome dynamics during cell division: Mitosis, Meiosis; Centrosome, Microtubule dynamics and motor proteins. Metaphase and Anaphase movements.

Cell cycle and its regulations in yeasts and mammalian cells; extracellular signals, cell cycle check points, cyclins, MPF.

UnitIV **13 Hrs**

Cell signaling: Broad types - endocrine, paracrine, juxtacrine, and autocrine.

Primary and secondary messengers; Hormones and growth factors; cyclic AMP, cyclic GMP, Nitric oxide, Phospholipids and Calcium; G-protein coupled recetpors; Enzyme coupled receptors – receptor protein tyrosine kinases, tyrosine kinase associated receptors, receptor protein serine/theonine kinases, non-receptor protein tyrosine kinases, receptor protein tyrosine phosphatases.

Wnt signaling pathway, NF-KB signaling pathway.

Integrating cells into tissues: Cell adhesion molecules; Cell junctions – Anchoring junctions, Tight junctions, Gap junctions and Plasmodesmata; Extracellular matrix.

References:

1. Molecular Biology of the Cell 5E (2008). Bruce Alberts, Alexander Johnson, Julian Lewis and Martin Raff, Garland Publishing, Inc., NewYork.
2. Cell: A Molecular Approach, 6th Edition (English)Author:Robert E.Hausman,Geoffrey M. Cooper: Sinauer associates Inc.,2013
3. Cell and MolecularBiology 8th Edition (2010)byE. D. P. DeRobertis. CBS Publishers &Distributors
4. DevelopmentalBiology,10th Edition(2013)byScott F Gilbert: Ingram

International Inc

5. Molecular Cell Biology. – International Edition, (2012) by Harvey F. Lodish et al., WH Freeman and company, NewYork.
6. Cell and Molecular Biology: Concepts and Experiments, 7th Edition (2013) Gerald Karp. Wiley &sons, NewYork.

Skill component Identified:

We learn the how and why of biology by exploring the function of the molecular components of cells, and how these cellular components are organized in a complex hierarchy. Learners will have a deep intuition for the functional logic of a cell. Together we will ask how do things work within a cell, why do they work the way they do, and how are we impacted? In laboratory, they will master the most important instrumental techniques required for work in biotechnological and other chemical laboratories.

BTS404 MOLECULAR GENETICS

No of Credits: 3

No. of Hours: 36

Objective:

1. To Understand genetics ofinheritance
2. To understand types of mutation & repair mechanism
3. To understand genetics diseases through structural & numerical chromosomal abberations

CO1: Explain the inheritance patterns of characters from one generation to another.

CO2: Show the expertise in Chromosomal mapping or gene mapping.

CO3: Analyse how modifications of chromosomes aka genes causes diseases in humans and populations.

CO4: Relate to life the change in a gene could happen all of a sudden in an organisms.

Unit–I **9 Hrs**

Mendelian Genetics: Mendel's experiments, Principle of segregation, Symbols and terminology, Monohybrid Crosses (Dominance, Recessiveness, Codominance, Lethal), principle of Independent assortment (Dihybrid ratios, Trihybrid ratios, gene interaction, Epistasis),Genetic versus environmental effects (Penetrance and expressivity), multiple alleles, pleiotropy. Linkage, Crossing- over and Chromosome mapping. Sex determination, dosage compensation and extra-chromosomal inheritance.

Genetic material: DNA as genetic material: Experiments of Griffith, Avery MacLeod and McCarthy.

Unit–II **13Hrs**

Chromosome Structure: Histones, Nucleosomes, 300-A^{O}Filaments, Radial Loops and Polytene Chromosomes.

Human Cytogenetics: Variations in chromosome structure – Deficiencies, Duplications, Inversions, Translocations and position effects. Karyotyping human chromosomes – Classification and banding techniques. Chromosome aberrations in humans. Trisomy in humans – Down syndrome, trisomy 13 & 18, Turner syndrome, Klinefelter syndrome,

Aneuploidy of X chromosomes and mental deficiency.

Prenatal diagnosis: Concept, procedure and applications, (Amniocentesis and Chronic Villus Sampling)

Population and evolutionary genetics: Genetic variation, Random mating and Hardy–Weinberg method, Inbreeding, Out-breeding, Changes in allele frequencies and Evolutionary genetics.

Unit–III **14Hrs**

Mutation: Spontaneous versus induced mutation, Mutation: Random rather than directed by the environment (Replica Plating), Phenotypic effects of mutations, Somatic and Germinal Mutations, molecular basis of mutation, Radiation induced mutation, Chemically induced mutation, DNA Repair mechanisms, Correlation between mutagenicity and carcinogenicity (Ames test).

Transposable elements: Discovery, types and their characteristics. Transposable elements in prokaryotes and eukaryotes – IS elements, Composite transposans, Tn3 elements, Ac and Ds elements, P elements, Retrotransposons and theirsignificance.

References:

1. Hartl, D. L. and E. W. Jones, 2002 *Essential Genetics*. 3 ed. Jones & Bartlett, Sudbury, Massachusetts. 613pp.
2. Hartl, D. L. and E. W. Jones, 2004 *Genetics: Analysis of Genes and Genomes*. 6 ed. Jones & Bartlett, Sudbury, MA. 854pp.
3. Conner, J. K., and D. L. Hartl, 2000 *A Primer of Ecological Genetics*.Sinauer Associates, Sunderland, Massachusetts. 304pp.
4. pstein RJ (2002) *Human molecular biology*. Cambridge UniversityPress, Cambridge.
5. Gardner A, Howell RT, Davies T (2000) Biomedical sciences explained.*Human genetics*. Arnold,London.
6. Lewin B (2000) *Genes* vII. Oxford University Press, NewYork.
7. Strachan T, Read AP (2004) *Human molecular genetics 3*. Garland Science, New York.
8. Mobile genetic elements-Shapilo/NY Academic press,
9. Microbial genetics.Maloy SR. Friefelder /Jones and Bartlett pub.,1994.

BTS405 BIO ANALYTICAL TECHNIQUES

No of Credits: 3

No. of Hours: 36

Objectives:

1. Introduces about principle and application of Biophysical methods

Course Outcomes:

CO1: Demonstrate the knowledge ofthe working principle, instrumentation, and applications of an age old technique, chromatography and also show how this traditional method has been modernised into the present day HPLC, UPLC etc

CO2: Analyse the working principle, instrumentation and applications of technique, electrophoresis.

CO3: Apply the principles and methodology of different centrifugation techniques

CO4: Show the familiarity of the usage of radio isotopes that has marveled modern biology, environment, medicine as well as in routine biological assays.

CO5: Employ spectroscopy for the identification of unknown compounds in the biological samples.

Unit-I **9 Hrs**

Chromatographic techniques: General principles, Sample preparation, Selection of chromatographic system, Low pressure column chromatography, HPLC, Adsorption chromatography, Partition chromatography, Ion exchange chromatography, Exclusion chromatography, Affinity chromatography, GLC, TLC, Paper chromatography.

Unit-II **12 Hrs**

Electrophoretic Techniques: General principles, Support media, Native gels, SDS-PAGE, Isoelectric Focusing, 2D gel electrophoresis, Agarose gel electrophoresis, Pulse field gel electrophoresis, Capillary electrophoresis.

Centrifugation Techniques: Introduction, Basic principles of sedimentation, Types of centrifuges and their uses, Preparative and density gradient separation, Analytical ultracentrifuges and their applications.

Radioisotope techniques: Nature of radioactivity, detection and measurement, GM counter, scintillation counting, Safety aspects and applications of radioisotopes in biology.

Unit-III **15 Hrs**

Spectroscopic techniques: Introduction, UV and visible light spectroscopy, IR and Raman spectroscopy, Electron Spin Resonance (ESR), NMR, Spectrofluorimetry, Luminometry, Atomic absorption spectrophotometry, X-ray diffraction, Optical Rotatory Dispersion, Circular Dichroism.

Mass spectrometric techniques: Introduction, mass spectrometer and applications. Ionization techniques- Electron impact ionization (EI), Electrospray Ionization, Chemical ionization (CI), Field ionization (FI) and MALDI. Ion desorption and evaporation methods, Analyzers- Magnetic sector, time-of-flight, quadrapole, and ion trap. Detectors- electron multipliers. Tandem massspectrometry.

Reference:

1. Biophysical Chemistry –Principles and techniques-A, Upadhaya – Himalayapub.
2. Nuclear and Radio chemistry -3rd ed. Gerhan Fried Lander John Wiley andsons,
3. Basic concepts of analytical chemistry 2nd ed. S.N. Khopkar. New Age Pub. 4.Principles of instrumental analysis .Da Skooge Holt – Saunders,1985.
5. Text Book of Biochemistry with Clinical Correlations - Thomas M. Devlin (ed) (Wiley-Liss) - 4th Edition.

Skill component identified :

1) Analytical and PreparativeChromatography
2) Basic electrophoretic principles
3) Centrifuges used forseparation
4) UV/ VisibleSpectrophotometer
5) Chromatography – TLC , PaperChromatography
6) Buffers used in DownstreamLab.

Colour reactions for mono-, di- andpolysaccharides
Identification of unknowncarbohydrates
Estimations of blood glucose, free fatty acids, cholesterol andproteins
Estimation of aminoacids
Estimation of serumproteins

Estimation of bloodurea

Determination of urinecreatinine

Tests for nonprotein nitrogen (NPN)substances

Determination of plant phenolics and ascorbicacid

Chromatography (TLC and Column)

Colorimetry

Flamephotometry

Electrophoresis

Microscopic observations ofmicroorganisms

Microbial staining techniques (simple and differential staining, cell wall, endospores, intracellular lipids, acid-fast, flagella,viability)

Microbial motilitytests

Sterilization techniques

Microbial culture media and their preparation

Qualitative and quantitative assessment of microflora in soil, water,air, andfood

Milkmicrobiology

Studies on bacteria,fungi andactinomycetes

Studies on symbiotic association ofmicroorganisms

* Practical exercises to be conducted with back ground of respective theory papers.(BTH401,BTH402,BTH403,BTS404)

SECOND SEMESTER SYLLABUS

HARD CORE PAPERS	SOFT CORE PAPERS	OPEN ELECTIVE
BTH451 Molecular biology	BTS453 Metabolism	
BTH452 Genetic Engineering	BTS454 Enzymology	
BTP456 Molecular biology & Genetic Engineering	BTS455 Biostatistics & Bioinformatics	
	BTP457 Metabolism &Ezymology OR BTP457 Metabolism & Biostatistics & Bioinformatics	

BTH451 MOLECULAR BIOLOGY

No of Credits: 4
No. of Hours: 52

Objectives

1. Study of transfer of sequential information through central dogma oflife
2. Introduce about replication of Nucleic acid, Transformation andtranslation
3. Explains DNA damage and Repairmechanism
4. Molecular and cellular biology offertilization

Course Outcomes:

CO1: Show the understanding of the basic properties of Nucleic acid and its principle and mechanism of replication in prokaryotes and Eukaryotes.

CO2 : Explain the role of different type of enzymes and accessory proteins involved in DNA replication.

CO3 : Analyse the transcription process in prokaryotes and eukaryotes, RNA processing enzymes and modification in different types of RNA in view of translation, regulation of gene expression, DNA damage and types of repair mechanism.

CO4 : Describe developmental biology in terms of gene action, ribosomal RNA synthesis during oogenesis and molecular genetics of pattern formation.

Unit–I **15Hrs**

DNA Replication: Experimental evidence for semi conservative DNA replication, Replication Forks, Role of DNA Gyrase, Semi discontinuous Replication, RNA primers. Enzymes of replication – DNA polymerase I, DNA polymerase III, Helicases, Binding proteins, Nuclease and DNA Ligases. Prokaryotic replication mechanisms – Bacteriophage M13, Bacteriophage ØX174, *E. Coli*(DnaA protein) and Fidelity of replication. Eukaryotic DNA replication – Cell cycle, Eukaryotic DNA polymerases, Reverse transcriptase, Telomeres and Telomerases.

Repair of DNA: Direct reversal of damage, Nucleotide Excision repair, Recombination repair, The SOS response and identification of carcinogens.

UnitII **15 Hrs**

Transcription: Role of RNA in protein synthesis – Enzyme induction (Lactose Operon), Messenger RNA. RNA Polymerase – Enzyme structure, Template binding, Chain initiation, Chain Elongation, Chain termination and Eukaryotic RNA Polymerases.

Control of Transcription in Prokaryotes: Promoters, *lac* Repressor, Catabolite Repression (example of gene activation), Sequence-Specific Protein – DNA interactions, *araBAD*Operon (Positive & negative control by same protein), *trp*Operon (Attenuation) and Regulation of Ribosomal RNA synthesis (Stringent response).

Unit–III **12 Hrs**

Genetic Code: Chemical mutagenesis, Codons Assignment (Deciphering the genetic code) and characteristics of genetic code.

Translation: Transfer RNA and its Aminoacylation – Primary and Secondary structures of tRNA, Tertiary structure of tRNA, Aminoacyl-tRNA synthetases, Codon – Anticodon interactions (Wobble hypothesis) and nonsense suppression. Ribosomes – Structure, Polypeptide synthesis (An overview), Chain initiation, Chain Elongation, Chain Termination, Translational Accuracy and Protein synthesis inhibitors(Antibiotics).

Unit–IV **10 Hrs**

Control of Eukaryotic Translation: Translational control by Heme, Interferon, mRNA masking and Antisense RNA.

Posttranscriptional Processing: Messenger RNA Processing, Ribosomal RNA Processing and Transfer RNA Processing.

Posttranslational Modification: Proteolytic cleavage and Covalent modifications

Protein Degradation: Degradation specificity and degradation mechanisms

References:

1. Alberts, B., Bray D., Lewis J., Raff,M., Roberts K., Wtson ,J.D., (eds) 2002. Molecular biology of the Cell,4thedn., Garland Publishing ,Inc ., NewYork.
2. Cooper,GeoffreyM.Thecell–AMolecularApproach2nded.Sunderland(MA) :Sinauer Associates .,Inc;2000
3. De Robertis ,E.D.P and De Robertis ,E.M.F.1995 Cell and Molecular Biology .8thedn, B.I. Waverly Pvt Ltd., NewDelhi.
4. Griffiths ,AnthonyJ.F .; Gelbart, William M.;Miller, Jeffrey H., Lewontin,Richard C New York :W.H, Freeman &Co.,1999
5. Harvey Lodish, Arnold Berk,S.Lawence Zipursky ,Paul Matsudaira&david Baltimore Molecular cell Biology,4th edn.2000, wH.freeman&Company,New York.
6. Karp G.1999 .Cell and Molecular Biology-Concepts, and experiments. 2nded., JohnHarris ,D.(ed) Wiley &sons,New York.
7. Kleinsmith ,l.J.& Kish ,V.M 1995 Principles of cell and Molecular Biology.2ndedn, Mclaughlin ,S., Trost ,k., Mac Elree,E.(eds) ., Harper CollinsPublishers,NewYork.
8. Lewin ,B., 2000 ,Genes VII .Oxford University Press

BTH452 GENETIC ENGINEERING

No of Credits: 4

No. of Hours: 52

Objective:

1. Introduces basics of genetic engineering with its tools &techniques
2. Explains invitro &invivo gene cloning, use of vectors, construction of compatible ends, creating rDNA, and its transfer into host, construction of genomic & cDNA libraries .
3. Methods of selection ofrecombinants.
4. Applications of genetic engineering

Course Outcomes:

CO1 : Distinguish between invivo & invitro gene cloning through PCR, and discuss about various components used in PCR, types, & application

CO2: Show familialrity with the end processing of PCR products to be used for gene cloning experiments.

CO3: Be skilled in invivo gene cloning, importance of vehicles, availability of different types of vehicles for carrying gene of interest is dealt. Classification of vehicles on the basis of function as cloning vector, expression vector, shuttle vectors are discussed.

CO4 : Show the familiarity with the process of ligation of gene of interest with vector with a prior generation of compatible ends to create rDNA & its transfer to subsequent host followed by screening & selection of recombinant cells.

CO5 : Demonstrate the understanding of the Construction of genomic & cDNA libraries,wide application of genetic engineering in DNA sequencing, finding genetic variations through RFLP,RAPD,AFLP methods, analysis of gene expression methods, comparison of differential expressed transcript.

CO6 : Analyse the translational products and the manipulation of gene expression.

UnitI **13 Hrs**

General introduction to concepts of genetic engineering. Host controlled restriction and modification, restriction endonucleases, target sites sticky, cohesive ends and blunt ended fragments. Role of DNA ligase, linkers, adaptors, homopolymer tailing.

Other methods of joining DNA molecules: TA cloning of PCR products, Construction of genomic libraries, construction of cDNA library, methods of cDNA synthesis;

PCR: Optimization of PCR reaction, analysis of products, Nested PCR, Application of PCR in cloning, agriculture and medicine. RT-PCR – technique and applications.

UnitII **13 Hrs**

Vectors: Vectors in Gene Cloning**,** Basic properties of plasmids, desirable properties of plasmid cloning vehicles, natural plasmid. Artificial vectors: PBR 322, Improved vehicles derived from PBR 322, PUC. Vectors for transforming bacteria and yeast, animals and plants Special vectors: Shuttle vectors, expression vectors, Construction of Artificial chromosomes vectors BACs, YACs and MACs. Cosmids, phagemids, Viral vectors Techniques of introducing genes in Prokaryotes and eukaryotes: transformation, calcium phosphate method, DEAE – Dextran method, Liposome medicated transfer, microinjection, electroporation and gene gun.

UnitIII **13 Hrs**

Identifying the right clones; Direct screening: Insertional inactivation of marker gene, visual screening, plaque phenotype .indirect screening: Immunological techniques, Hybrid arrest translation, Hybrid select translation. Screening using probes: construction of gene probes, hybridization and labeling. Nucleic acid hybridization – Southern blotting, colony hybridization, dot blot; Chromosome walking and chromosome jumping.

DNA sequencing: Maxim & Gilbert's method, Sanger & Coulson's method, Messing's shot gun method, automated sequencers. Analysis of genetic variation: Single nucleotide polymorphism, conserved and variable domains, RFLP, AFLP, RAPD. Genome sequencing: overview, strategies (e.g. Human genome project.)

UnitIV **13 Hrs**

Mapping of DNA: Restriction mapping, DNase foot printing, Use of transposons in gene mapping.

Analysis of gene expression: Analysis of transcription by Northern blot, RNase protection assay, Primer extension assay, *in situ* hybridization. Comparing transcriptomes: Differential screening, subtractive hybridization, array based methods; implication of genetic engineering.

Translational analysis: Screening expression libraries with antibodies –Western Blot, two dimensional electrophoresis, Proteomics.

Manipulating gene expression: Transcriptional fusions, translational fusions, *In vitro*

mutagenesis, Oligonucleotide directed mutagenesis, deletions, Insertional mutagenesis, direct single base mutagenesis

References:

1. From genes to clones –Winnaker ,panima educational bookagencyGene IX- Lewin , OxfordUniversityPress,2007
2. Principles of gene manipulation- Old and primrose –Blackwell scientificpub.,6th Ed,2006
3. Recombinant DNA technology –Watson JD et al Scientific American books, 3rd Ed1992

Skill component Identified:

Techniques for isolation, handling and processing of nucleic acids

Principles of nucleic acid hybridization

Gel electrophoresis techniques

Enzymes used in gene manipulation, features of plasmid vectors and DNA cloning, transformation assay

BTS453 METABOLISM

No of Credits: 3

No. of Hours: 39

Objectives:

1. To learn how organisms acquire and use the energy and material resources needed to complete their life cycle, highlighting relationships between structure and function, and coordination of development, resource acquisition and environmental responses within and across cells, tissues andorgans.
2. To learn how biological systems use free energy based on empirical data that all organisms require constant energy input to maintain organization, to grow and to reproduce and how changes in free energy availability affect organisms, populations and ecosystems
3. To understand what mechanisms and structural features allow organisms to capture, store and use free energy will be dealt in details under the heading of nucleic acid, protein, lipid and carbohydrate metabolism.

Course Outcomes:

CO1 : Relate the living entities based on the principles of thermodynamics laws

CO2 : Explain the complex reaction whilecalculating the free energy of a particular reaction.

CO4 : Understand how the energy is stored inside the cell which is readily available whenever needed

UnitI **13 Hrs**

Thermodynamic principles, free energy, enthalpy and entropy, chemical equilibrium, reaction kinetics, redox processes. ATP as an energy currency in the cell and other high energy compounds. Standard free energy, coupled reaction.

Carbohydrate metabolism: Glycolysis, inter conversion of various monosaccharides citric acid cycle, Amphibolic pathway of citric acid cycle, Anaplerotic reaction, Gluconeogenesis, Glycogenesis, Pentose phosphate pathway, HMP shunt.. Biological oxidation: Electron Transport Chain, Chemiosmotic hypothesis, ATP synthesis, Oxidative phosphorylation, Substrate level phosphorylation, Uncouplers and Inhibitors of respiration.

UnitII **13hrs**

Amino acid metabolism: Deamination, transamination, transdeamination,decarboxylation, Urea cycle, Ketogenic and Glucogenic amino acids. Metabolism of aromatic amino acids, histidine, cystein and serine.

Nucleic acid metabolism: Biosynthesis, *de novo* and salvage pathways, catabolism of purine and pyrimidine

UnitIII **13 hrs**

Oxidation of fatty acids, α, β and ω types. Energetics of beta oxidization. Biosynthesis of fatty acids, Cholesterol biosynthesis, Ketone body formation, Interconversion of phospholipids.

Photosynthesis: Photosystems, Light harvesting complexes, cyclic and non cyclic electron transfer, photophosphorylation, Calvin cycle, C3 and C4 plants, CAM

References:

1. Biochemistry –LubertStryer , 3rd ed. , Freeman & co ,New York,1988
2. Bio chemistry –Zubay 2nd ed. Mac millan pub.,1988
3. Harpers review of Biochemistry. Martin *et, al*., 25th edition. Large medical pub. 2000.
4. Principles of instrumental analysis .DaSkooge Holt –Saunders,1985.
5. Principle of Biochemistry –A. Lehninger, David L. Nelson and M.M Cox CBS pub. 1993
6. Text book of biochemistry with clinical correlation. TM Devlin John Wily and sons, 5th Edition., 2002.

Skill component Identified:

Students will extend their knowledge of biochemistry fundamentals and will learn about important metabolic processes taking place in organisms. In this course, they will acquire a detailed knowledge about photosynthesis, metabolism of Saccharides, metabolism of nitrogen compounds and regulation. In laboratory, they will master the most important instrumental techniques required for work in biotechnological and other chemical laboratories.

BTS454 ENZYMOLOGY

No of Credits: 3

No. of Hours: 36

Objectives:

1. To make the students understand the basic structures & functions of enzymes & their role in physiology
2. To make the students appreciate the diversity of enzymes and their multiple roles in achieving systemhomeostasis.
3. To inculcate the knowledge & skills used in present day biotechnology industries, which find enzymes as one of the keytherapeutics.

Course Outcomes:

CO1 : Show the familiarity of the basic structures &functions of enzymes & their role in physiology.

CO2 : Explain the diversity of enzymes and their multiple roles in achieving system homeostasis.

CO3 : Apply skills in handling enzymes as key therapeutic ingredients in biotech industries

Unit–I **13 Hrs**

Enzyme catalysis: Nomenclature and classification, Isoenzymes, Biological role of enzymes, chemical nature of enzymes and characteristics of enzymes. Isolation of enzymes, enzyme assays, extraction of soluble and membrane bound enzymes. Purification of enzymes, Criteria of purity and determination of molecular weights of enzymes. Specificity of enzyme action – types of specificity, active site, Fischer 'lock-and-key' hypothesis and Koshland's 'induced-fit' hypothesis. Catalytic mechanisms – Acid-base catalysis, Covalent catalysis, Metal ion catalysis, electrostatic catalysis, and catalysis by preferential transition state binding and catalysis through proximity and orientation effects. Factors affecting enzyme catalyzed reaction

Unit–II **13 Hrs**

Enzyme Kinetics: Rates of reactions, transition state theory, Michaelis-Menten Equation, Significance of Vmax and Km, Lineweaver-Burk plot, Eadie – Hofstee and Hanes plot, Eisenthal and Cornish-Bowden plot.

Enzyme inhibition: Irreversible and Reversible inhibition – Competitive, Uncompetitive,

non-competitive, mixed, partial, substrate and allosteric inhibition, determination of Ki (Dixon plot).

Bisubstrate Reactions: Terminology, Sequential reactions, Ping pong reactions, Rate equations, Differentiating bisubstrate mechanisms and Isotope exchange.

Unit–III **10 Hrs**

Allosterism: Cooperativity-positive and negative cooperativity, Sigmoidal kinetics, MWC and KNF models, Aspartate carbamoyl transferase (ACTase).

Molecular mechanism of enzyme action: Mechanism of chymotrypsin, ribonuclease, and lysozyme.

Application of enzymes: In medicine – Reagents in clinical chemistry, assay in plasma enzymes, Enzymes and inborn errors of metabolism. In industry – Food, drink and other industries. Immobilized enzymes – Preparation, properties and applications.

Reference:

1. Enzymology And Enzyme Technology 1st Edition (2011) By S.M. Bhatt. S.Chand Publishing
2. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry By Trevor Palmer Horwood Publishing Ltd; 5th Revised Edition(2001)
3. Enzyme Technologies: Metagenomics, Evolution, Biocatalysis And Biosynthesis (Chemical Biology Of Enzymes For Biotechnology And Pharmaceutical Applications) By Wu-KuangYeh,Hsiu-Chiung Yang,James R. Mccarthy(2010). Publisher:Wiley-Blackwell
4. Enzyme Technologies: Pluripotent Players In Discovering Therapeutic Agent (Chemical Biology Of Enzymes For Biotechnology And Pharmaceutical Applications) By Wu-KuangYeh,Hsiu-Chiung Yang,James R. Mccarthy(2014). Publisher:Wiley-Blackwell
5. Enzyme Technology (1990) By Martin F. Chaplin,Christopher Bucke. Cambridge UniversityPress
6. Industrial Enzymes: Structure, Function And Applications (2007)ByJulio Polaina, Andrew P. Maccabe, Springer Publishing Group
7. Immobilization Of Enzymes And Cells (Methods In Biotechnology), 2006. By José M. Guisán. HumanaPress

BTS455 BIOSTATISTICS & BIOINFORMATICS

No. of Credits: 3

No. of hours: 36

Objectives:

1. Introduce the concept of statistics and its tools in biologicalsystem
2. To provide the basic knowledge about computers and information storagedevices
3. Application of computer software in handling biostatisticalproblems
4. To understand the role and application of bioinformatics

Course Outcomes:

CO1:Understand the application, approaches and the significance of statistical analysis in their experiments.

CO2: Analyse methodologies of statistics and their application in selection of the biological samples.

CO3: Show the knowledge and awareness of the basic principles and concepts of bioinformatics where biology, computer science and mathematics are closely related.

CO4: Experiment with the existing software tools effectively to extract information from large databases and to use this information in computer modelling.

CO5: Demonstrate the problem-solving skills, including the ability to develop new algorithms, an understanding of the intersection of life and information sciences, information theory, gene expression, and database queries.

Unit-I **10Hrs**

Introduction and definition of biostatistics, concept of variables in biological systems, collection, classification, tabulation, graphical and diagrammatic representation of numerical data, Measure of central tendency: Mean median and mode, and their relationship, Measure of dispersion: quantitative deviations, mean deviation, standard deviation, coefficient of variations. Correlation and regression, linear and quadratic regressions, Concept of Standard errors. Hypothesis testing (null &alternative hypothesis)

Unit-II **10Hrs**

Probability, concept of random experiment, various definition of probability, addition theorem of probability, random variables(discrete and continues), Probability distributions (viz. Binomial, Poisson and Normal) and their applications, Simple random sampling without replacement. Student 't-', 'F' and 'Chi' square
distribution (derivations not required) their properties and use. ANOVA.

Unit-III **16Hrs**

Bioinformatics- an overview, Definition and History, Applications of Bioinformatics. **Genomics**-Introduction to Genomics, Nucleotide Sequence Analysis, Pair wise Alignment, global and local alignment, and significance of alignment, Goals and types of alignment, Tools of sequence alignment, Homology sequence search, Parameters of Blast, BlastN, BlastP, Interpreting Blast Results.

Sequence formats- Homology and similarity. Introduction to Data mining, NCBI, EBI, DDBJ, Database search software: ENTREZ, SRS,Expasy.

Proteomics- Introduction to Proteiomics. Protein Sequence Databases, UNIPROT, Structure Database, PDB Sequence Analysis, definition of sequence analysis, Multiple sequence analysis, Parameters of CLUSTAL-W, interpretation of Clustal W Output, DNA Sequence Alignment, ProteinSequencealignment.RASMOL Display Styles Wire Frame, Ball And Stick, Space Fill, Ribbons, Cartoons. EMBOSS Introduction to emboss Software package or any other latest commercialsoftware.

References:

1. Bioinformatics(2002) BishopMartin
2. Molecular databases for protein and sequence and structure studies:Sillince
A. and Sillince M.
3. Sequence Analysis primers :Gribskov, M. and Devereux,J.
4. Bioinformatics: Sequence and Genome Analysis By DavidW.
Mount, *University of Arizona,Tucson*
5. Discovering Genomics, Proteomics, & Bioinformatics, SecondEdition
By A. Malcolm Campbell, *Davidson College;* Laurie J. Heyer, *Davidson College;* With a Foreword by Francis S.Collins

6. Biostatistics:P.N.Arora ,P.K.Malha
7. Introductory statistics for Biology: *Mahajan , S.K.*
8. Statistical Methods :*Mishra andMishra*

References:

1. Biotechnology, Biosafety and Biodiversity .Sivamiah Shantaram,Jane F Montegomery. Oxford and IBH pub., NewDelhi
2. Biotechnology and Law- IPR vol. 1 & 2 by Iver P. Cooper, Clark Boardman Callaghan,1993.
3. Principles of Management – P.C.Tripathi, P.N.Reddy – Tata McGrawHill,
4. Dynamics of Entrepreneurial Development & Management– Vasant Desai – Himalaya PublishingHouse
5. Entrepreneurship Development –Poornima.M.Charantimath– Small Business Enterprises Pearson Education – 2006 (2 &4).
6. Management Fundamentals – Concepts, Application, Skill Development – RobersLusier – Thomson
7. Entrepreneurship Development – S.S.Khanka –S.Chand&Co.
8. Management – Stephen Robbins – Pearson Education/PHI –17th Edition,2003

BTE458- FUNDAMENTAL BIOTECHNOLOGY (New OE)

Hours: 39

Course out comes:

CO1: Appreciate the intricacy existing between microbes, plants and animals.

CO2: Analyse the importance of microbes in various sectors.

CO3: Understand the importance of plants as a bioreactor and its crucial role in sustaining life on earth.

CO4: Understand the modern biological interventions which have eased the life of humans.

CO5: Understand how useful the microbes and plants are these days on contrary to the chemical agents.

UNIT I (13hrs)

Origin of life. Microbialdiversity – bacteria, viruses, fungi; Beneficial and harmful microbes. Normal microflora associated with humans and animals. Microbes in human and animal nutrition (e.g. ruminants and non-ruminants) and health. Interactions between microbes, plants and animals. Microbial biotechnology: Fermentation (e.g. ethanol, enzymes, hormones, biogas, biofuels, vitamins), Antibiotics and probiotics.

UNIT II (13hrs)

Plant biotechnology: Genetic manipulation (GM) of plants, GM plants (e.g. BT cotton, Golden rice, Flvr-savr tomato), Seed terminator technology. Litigations related to life (e.g. neem, Basmathi rice, turmeric). Plant tissue culture, synthetic seeds. Edible vaccines. Plantmicrobe associations, interactions (e.g. symbiosis, mutualism) and benefits. Plant cells to generate biochemicals and medicines. Environmental Biotechnology: Revegetation and energy plantations (e.g. Neem, Jatropha, Pongamia). Bioremediation (plant and microbial). Microbes in mining. Waste processing and utilization.

UNIT III (13 hrs)

Animal biotechnology: Transgenic animals (e.g. mice, sheep, fish). *In vitro* fertilization (IVF) and embryo transfer (ET), test-tube babies. Ethical issues (e.g. human and animal rights, surrogate mother). Animal cloning -Somatic and therapeutic cloning. Animal cell culture and organ culture. Animal cells as source of biochemicals (e.g. vaccines,

hormones). Animals as bioreactors (e.g. mice).

References

1. Biology of microorganisms. Brock, T.B. & Madigan, M.T., Prentice Hall, 1996
2. Basic Biotechnology. Ratledge, C. & Kristiansen, B., Cambridge Univ. Press, 2006
3. Microbial Ecology. Atlas, R.M.& Bartha, R. Benjamin Cummings, 1997
4. Microbial Biotechnology. Glazer, A.G., WH Freeman & Co., 1994
5. Biotechnology of Higher Plants. Russell, G.E. Intercept Pub., 1988
6. Plant Biotechnology. Mantell, S.H.& Smith, H. Cambridge University Press, 1983
7. Animal Transgenesis and Cloning. Houdebine,L.-M. John Wiley & Sons, 2003
8. Gene VII. Lewin,B., Oxford University Press, 2000
9. Environmental Biotechnology. Jogdand, S.N., Himalaya Publishing House, 2012

BTE459 - Environmental Issues (OE)

36 Hrs

Course out comes

CO1: The main objective of this paper is to create an awareness among the students about the environment

CO2: By the end of the course, the students will have a better appreciation for the environment and become responsible citizens

Unit-1 Global Environmental Issues: Green House effect – causes and associated hazards, Ozone layer depletion – causes and associated hazards, Deforestation, Human Population Growth. Environmental problems associated with urbanization, industrialization, modernization of agriculture. 12Hrs

Unit-2 Regional Environmental Issues: Forest and Wildlife management, desertification, reclamation of degraded land; Human intervention on wetlands, siltation and eutrophication, reclamation of wetlands, Mining and Environment, Open cast mining, Oil exploration and transportation, Deforestation and their impact on environment. 12 Hrs

Unit-3 Pollution: Air Pollution : Causes of air pollution, Some important pollutants of air (CO, SOX, NOX and HC and Particulates) – their sources and effects on living and non-living organisms. Water Pollution: Sources of pollution of surface and ground water, Types of water pollutants. Solid Waste – Sources, characterization, disposal and management. Soil Pollution sources of soil pollution, Pollution and residual toxicity from the application of insecticides, pesticides and fertilizers; Soil erosion. 12Hrs

Reference Books:

1. Fundamentals of Environmental Science: G. S. Dhaliwal, G. S. Sangha and P. K. Raina, Kalyani Publication
2. Environmental Chemistry : A. K. De
3. Environmental Chemistry : B.K. Sharma, and H. Kaur
4. Fundamentals of Ecology : E. P. Odum
5. Environmental Science (6th ed) (1997): Jr. G. T. Miller, Wadsworth Pub. Co.

BTE460 Biodiversity & it's Conservation (OE)

No. of Hours: 36

Course out comes

CO1: Students will be able to: Gain theoretical knowledge and appreciate the importance of biodiversity.

CO2: Understand the relevance of biodiversity in conservation.

CO3: Become familiar with and understand the key terminologies of Ecology.

CO4: Describe the levels of biodiversity organizations.

CO5: Know about Indian ecological/geographical diversity.

CO6 : Can create a awareness about Biodiversity depletion & its conservation.

14hours

Unit 1: Introduction to Biodiversity

Basic concepts & definitions, types of Biodiversity, biosphere, habitats, food chain, food web, Climatic Zones, Indian ecological/geographical diversity: Himalayan Region, Deserts, Gangetic plains, Semiarid region, Western Ghats, Coastal region; Hot spots in India.

8 hours

Unit 2: Patterns of Biodiversity

Introduction to biodiversity pattern, Species varying globally, Species varying locally, species varying over time, species – areas relationship.

Benefits of Biodiversity

14hours

Unit III: Biodiversity Conservation:

Causes and prevention of Plant and Animal biodiversity loss; Conservation of nature and natural resources - Soil, water and forests: IUCN Red List Categories and Criteria;

Conservation strategies – Ex-situ and In-situ conservation, protected ecosystems – Biosphere reserves, National parks, Sanctuaries, Botanical gardens, sacred groves; Wildlife conservation and wildlife conservation act.

References:

1. Daniel, J.C. A century of natural history. Bombay natural History Society, Bombay. M 697pp.

2. Dwivedi,A.P., 1993. Forests. International book Distributors, Dehra Dun. 352 pp.

3. Eugene, P. Odum, 1983. Basic Ecology. Saunders College, London.

4. Gugjisberg, C.A.W., 1970. Man and Wildlife, Arco Publishing Company Inc., New York.

5. Haywood, V.H. and Watson, R.T., 1995. Global biodiversity assessment. United Nations Environmental Programme,New York.

6. Korringa, P., 1976. Farming of marine organisms law in the food chain. Elsevier, Amsterdam. 264 pp.

7. Levinton, J.S., 1982. Marine ecology, Prentice Hall, Englewood Cliffs. 526 pp.

8. Lieth, H., 1989. Tropical rain forest ecosystems. Elsevier, Amsterdam. 713 pp.

9. Southwood, T.R.E., 1978. Ecological methods, Chapman and Hall, London. 524 pp.

10. Tiwari, S.K., 1985. Readings in Indian Zoogeography. Today and Tomorrow's Printers and Publishers, New Delhi. 604 pp.

11. Nybakkan, J.N., 1982. Marine Biology – An ecological approach. Harper and Raw Publ., New York.

12. Reddy, P.A., 2000. Wetland ecology. Cambridge University Press, London. 614 pp.

13. Krishnamoorthy, K.V 2003. An advanced textbook on Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. pp. 260.

14. Brummit, R.K. 1992, Vascular Plant Families and Genera, Royal Botanic Gardens, Kew, England.

1. 3rd Ed1992
   - Autoradiography to study the structure ofmolecules
   - Induction of tumors and itsprevention
   - Structure of sperms andeggs

     Spermatogenesis (e.g. grasshoppers)
   - Chick and Drosphila developmentalstages
   - Historical identification of germ layers of developing embryos
   - Induced breeding infishes
   - Isolation of DNA and RNA from bacteria, plants andyeasts
   - Southern and Northern blottingtechniques
   - Western Blotting
   - Studies on DNAreplication
   - Studies onvectors
   - Tiplasmid
   - Probes
   - Chromosomemapping
   - Sequencing
   - PCR techniques
   - Construction of DNAlibraries
   - Genomics andProteomics
   - Study ofmutagenesis
   - Extraction, isolation and purification of soluble and membrane boundenzymes
   - Enzymeassays
   - Study of enzyme kinetics (effect of substrate concentration, pH, temperature and metalions)
   - Determination of Km andVmax
   - Mechanism of enzymeinhibition
   - Immobilization of enzymes and theirapplications
   - Proximate analysis of foods and feeds (moisture, nitrogen, crude fiber, crude lipids andash)
   - Analysis of antinutritional factors-(e.g., phenolics, tannins, DOPA, trypsininhibitors)
   - Calculation of calorificvalue
   - Mineral analysis of foods andfeeds
   - Vitamin assay (water soluble and fat soluble)
   - Production and quantification of organic acids (e.g., citric acid, lactic acid, butyric acid)
   - Catabolism of purine andpyrimidine.
   - Fatty acidoxidation
   - Experiments on photosynthesis (C3 and C4plants)
   - Estimation of secondary metabolites (e.g., alkaloids,antibiotics)
     - *Practical exercises to be conducted with background of respective theory papers (BTH 451 ,BTH 452 ,BTS453, BTS454)

THIRD SEMESTER SYLLABUS

HARD CORE PAPERS	SOFT CORE PAPERS	OPEN ELECTIVE
BTH501 Plant Biotechnology	BTS503 Bioprocess Technology	BTE 508Immune system & Human health
BTH502 Animal Biotechnology	BTS504 Microbial Technology	BTE 509 Basics concepts in clinical Biochemistry
BTP506 Plant Biotechnology& Animal Biotechnology	BTS505 Nano Biotechnology	BTE 510 Applications of Biotechnology in Food science
	BTP507Bioprocess & Microbial Technology OR BTP507 Bioprocess Technology & Nano Biotechnology	

BTH501 PLANT BIOTECHNOLOGY

No of Credits: 4

No. of Hours: 52

Objective:

1. To understand the impact of biotechnology on the agricultural industry, the limitations of conventional cross-breeding techniques as a means of developing new plant products and why plants are especially suitable for genetic engineering. Outline several ways in which biotechnology might reduce hunger and malnutrition around the world
2. To learn different methods of in-vitro culture and maintenance of explants, role of gene banks, artificial seeds, cryopreservation, and tissue culture as a novel means of gene storage
3. To list and describe several methods used in plant transgenics emphasizing the use of *Agrobacterium* and the Ti plasmid as a gene vector.
4. Listing transgenic crops improved by genetic engineering. Outline the environmental impacts, both pros and cons, of crops enhanced by biotechnology. Analyze the health concerns raised by opponents of plant biotechnology.

Unit-I **13 Hrs**

Plant genome structure, gene families in plants, organization of chloroplast genome, mitochondrial genome and their interaction with nuclear genome, RNA editing in plant mitochondria. Mitochondrial DNA and Cytoplasmic male sterility. Plant breeding mechanism: types and applications

Plant Tissue Culture – Historical perspective; Lab set up,media components & sterilization, Totipotency, Planthormones

Unit-II **13 Hrs**

Micropropagation- Callus culture, Organogenesis, Meristem, embryo culture,Somatic

embryogenesis, their regulation and application; Artificial seed production; Somaclonal variation; Haploids: Androgenesis, Gynogenesis, Parthenogenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation. Physical, genetic, chemical and genotypic factors. Problems in plant tissue culture (Recalcitrance, Contamination, Phenolic Browning and Seasonal Variation);

Unit-III **13 Hrs**

Genetic Transformation – Cointegrate and binary vectors and their utility; Ti& Ri plasmid based vectors, Screenable and selectable markers; *Agrobacterium*-mediated gene delivery; Direct gene transfer - PEG-mediated; Transgenic stability, gene silencing and removal of marker genes. Characterization of transgenics; Marker-free methodologies; Plant secondary metabolites-Hairy rootculture

Process of Nitrogen fixation in legumes by *Rhizobium , Cyanobacteria and actinomycetes*, nif and nod genes.

Protoplast Culture and Somatic Hybridization – Protoplast isolation, culture and usage; Somatic hybridization- methods and applications; Cybrids and somatic cell genetics

Unit-IV **13 Hrs**

Transgenic plants — enhancing resistance to pests, nutritional value, modification of ornamental plants, bioengineered food, vegetable vaccines, plantibodies and biopharming.

Generation of agriculturally important plants: Expressing viral coat proteins and bacterial toxins in plants. New colours and patterns in flowers; Production of human proteins in plants. Development of transgenic plants for virus, bacteria, fungi, insect resistance, herbicide tolerant plants, Abiotic stress resistant plants.

References:

1. Biotechnology in Agriculture and forestry Bajaj YPS series. Springer Verlag pub, 1986.
2. Biotechnology of higher plants-Russell ,1988.
3. Plant Cell, Tissue & Organ Culture: Fundamental Methods by O. L. Gamborg (Editor) and G. C. Phillips (Editor) (2004)J.Narosapub.

4. Plant Biotechnology-Mantell and Smith-Cambridge univpress,1986.
5. Introduction To Plant Biotechnology/3rd Ednby Chawla H. S.(2009)
6. Plant Tissue Culture by Kalyan Kumar De (2008), Kalyani pub.,Kolkata
7. Plant Tissue Culture: Theory And Practice, 5th Revised Edition (2005) Author: Bhojwani S. S., Elsevier Science
8. Molecular Biotechnology: Principles and Applications of Recombinant DNA Hardcover – 4th Ed. (2010) by Bernard J. Glick,Jack J. Pasternak,Cheryl L. Patten. American Society for Microbiology

Skill component Identified

Students are introduced to the principles, practices and application of plant biotechnology, tissue culture, plant genomics, genetic transformation and molecular breeding of plants. Applied aspects of plant biotechnology in the sectors such as medicine, agriculture, industry will be explored. In laboratory, they will master the most important techniques required for work in many of the related companies.

BTH502 ANIMAL BIOTECHNOLOGY

No of Credits: 4

No. of Hours: 52

Objective:

1. Introduction to cell culture basics of asepsis, role of media & its components, various equipments used in cell culture.
2. Initiation of cell culture, tissue degradation methods, cell separation techniques, viability assessments, mass culture of cells
3. Applications of cell cultures in IVF, creating transgenic fishes, synthesis of commercial important molecules from cells .Animals used as biorectors

Unit-I **13 Hrs**

Animal tissue culture: History, laboratory design, aseptic conditions, methodology and media; Balanced salt solution and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements. Serum & protein free defined media and their applications; Equipments and materials for animal cell culture technology. Basic techniques: Mammalian cell culture *in vitro*; disaggregation of tissue and primary culture; maintenance of cell culture; Cell lines – Characteristics and routine maintenance. Measurement of viability and cytotoxicity. Cell separation techniques, Bioreactors used in animal cell culture

Unit-II **13 Hrs**

Biology and characterization of the cultured cells: measuring parameters of growth. Cell synchronization, Somatic cell fusion, Cell cloning. Organ and histotypic cultures. Application of animal cell culture: Stem cell cultures, embryonic stem cells and their applications. Cell culture based vaccines.

Unit -III **13 Hrs**

In vitro fertilization (IVF) & Embryo Transfer (ET); Sex determination or sex specific markers, sexing of sperm and embryos and Assisted Reproductive Technology (ART). *In*

vitro gamete maturation, Intracytoplasmic sperm injection, Cryopreservation of gametes and embryo. Animal cloning - reproductive cloning , therapeutic cloning, xenotransplantation

Unit -IV **13 Hrs**

Transgenic approach for improvements of animals with specific examples - Animals as bioreactors. Applications of biotechnology in Sericulture. Production of Transgenic fishes- Transfer of Antifreeze Protein gene, jelly fish Aquarin (GF) gene, and Stress protein to fishes. General steps to make and analyse Transgenic fish, Genetically Improved Farmed Tilapia (GIFT).

Genetic engineering for production of regulatory proteins: blood products, and hormones., Gene therapy, Types of gene therapy, somatic versus germ line gene therapy , mechanism of gene therapy, Immunotherapy ,gene knockout

References:

1. Animal Transgenesis and Cloning by Louis –MarleHoudebine John Wiley & Sons, 2003.
2. Animal cell culture and Technology by Michel Butler BIOS Scientific Publishers; 2nd edition, 2004.
3. Animal Cloning: The science of Nuclear transfer (The New Biology) by Joseph Panno Facts on File, 2004.
4. At the Bench: A laboratory Navigator by Kathy Barker.
5. Basic Cell Culture: A Practical Approach(Practical Approach Series) by J.MDavis ,2nd edition 2002 oxford university press, oxford.
6. Culture of animal Cells: A Manual ofBasicTechnique 4th edition by R. Ian Freshney Wiley-Liss,2000)
7. Gene VII, Oxford University Press ,NewYork,B.Lewin,2000.
8. Gene Biotechnology, Second Edition by William Wu, Michael J. Welsh ,Peter B. Kaufman , Helen H. Zhang CRC Press; 2ndEdition,2003.
9. Molecular Biotechnology , ASM Press , Washington , B.R Glick & J.J Pasternak, 1994.
10. Principles of Gene Manipulation by Blackwell Publishers; 6th edition, 2002,Sandy B. Primrose , Richard M. Twyman , Robert W.Old.

11. Principles of Cloning by Jose B .Cibelli, Robert P, Lanza, Keith Campbell Michael D. West AcademicPress,2002.
12. Recombinant DNA Technology, 2nd Edition, Scientific American Books, NewYork,J.D Watson , M .Gilman , J . Witkowski&M.Zoller,1992.
13. Studies in Biotechnology series 7_ Fish Biotechnology ,Dr. MM .Ranga& Dr. Q.J ShamniAgrobios (India), AgroHouse.

Skill component indentified:

General safety measures

Personal protection

Cell isolation techniques by physical method

Trypsinization

Viabilitycheck

Toxicity assessment & Determination of LD50

BTS503 BIOPROCESS TECHNOL

No. of Credits:3

No. of Hours: 36

Objectives:

1. To demonstrate, reinforce and extend the principles of bioprocess technology
2. To provide knowledge in microbial kinetics
3. To familiarize about types of fermentation process and optimization covering all areas of industrial microbiology

Course Outcomes:

CO1 : Be aware of bioreactors, design media and optimise process parameters.

CO2 : Explain different types of fermentation and bioreactors.

CO3 : Apply the principles of Bioprocess engineering for designing and analysis of biological reactors for industrially important primary and secondary products.

CO4 : Demonstrate the knowledge of Bioreactor, distillation, tray drying, chemical reactors, heat exchanger, Rheology and downstream processing.

CO5 : Show a sound knowledge of theoretical principles and practical considerations for the industrial production of several chemicals like acids, alcohols, antibiotics and cultivation of Mushroom.

Unit-I **10 hrs**

Basic principles in bioprocess, advantages of bioprocess over chemical process. Isolation and improvement of industrially important strains. Design of fermentation media, inoculum development, Sterilization- sterilization of medium, air and fermentors. Thermal death kinetics.

Unit-II **13 hrs**

Design of fermentors: criteria for ideal fermentor, aeration, agitation, valves, baffles, heat exchanges. Types of Fermentors- Waidhof-type fermentor, tower fermentor, cylindroconical vessels, air-lift fermentor, deep-jet fermentor, the cyclone column, thepacked tower, rotating disc fermentor. Animal cell culture fermentor – stirred fermentor, micro carrier encapsulation, hollow fiber chambers, packed glass bead reactors.

Cell immobilization techniques. Types of fermentation processes: submerged fermentation, surface or solid substrate fermentation, batch fermentation, continuous fermentation, kinetics of fermentation processes

Unit-III **13hrs**

Downstream processing of biological molecules: separation of cells, foam separation, flocculation, filtration, centrifugation (Basket and bowl centrifugation), cell lysis methods, physical and chemical methods, Large scale separation techniques like Distillation,solvent extraction, chromatography techniques, membrane filtration, ultra filtration, reverse osmosis, crystallization, spray drying, drum drying, freeze drying, whole broth processing. Biosensors- construction and application, fermentation economics

References:

1. Biochemical Engineering fundamentals,Baily&Ollis Mc Gram –Hillpub
2. Chemical engineering J.M Coulson PregamonPress
3. Comprehensive biotechnology, vol 1, 2, 3 & 4 Murray Moo Young. PergamonPress
4. Fundamentals of biotechnology P.Prave et al WCH Weinheinpub
5. Principles of fermentation technology P.F Stanbury& Whitaker PragmonPress

BTS504 MICROBIAL TECHNOLOGY

No. of Credits: 3
No. of hourse : 36

Objectives:

1. To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
2. The course prepares the students for the bulk production of commercially important modern Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures.

Unit-I **12hrs**

Microbial products: Microbial Biomass, Primary metabolites, Secondary metabolites, [Aminoacids (Glutamic acid, L lysine,) Vitamins and hormones (vitamin B12, vitamin A, riboflavin, gibberellins). Organic acids, and other industrial chemicals, (Lactic acid, acetone, glycerol). Antibiotics (Penicillin, tetracycline), Lantibiotics (peptide antibiotics)]Microbial enzymes, Transformed products. Gene cloning in microorganisms other than *E. coli* (*Salmonella*, *Rhizobium, Agrobacterium, Bacillus subtilis, Streptomycetes, Aspergillus niger*)

Unit-II **12 hrs**

Microbial Enzymes: Microbial production of enzymes (Protease, amylase, invertase, pectinase, xylanase) substrate, production, purification of enzymes, immobilization, their application in food and other industries

Microbial exopolysaccharides (EPS): Classification and applications (health, industrial, pharmaceutical and food); Alginate, Cellulose, Hyaluronic acid, Xanthan, Dextran, Gellan, pullulan, Curdlan, polysaccharides of lactic acid bacteria: Chitin, chitosan and chitin derivatives

Unit - III **12 hrs**

Microbial beverages: Production of wine, beer and vinegar.

Microbial food : Oriental foods, Baker’s yeast, cheese, SCP, SCO (PUFA) , Mushroom cultivation , sauerkraut, silage and probiotics.

Biofertilizers: *Rhizobium, Azotobacter, Azospirillum, Mycorrhizas,* Phosphate solubilizers Bioconservation, biofuels, gasohol, biogas; waste utilization to generate biofuel

References:

1. Biotechnology in Agriculture and forestry Bajaj YPS series. Springer Verlag pub, 1986.
2. Biotechnology of higher plants-Russell ,1988.
3. Plant Cell, Tissue & Organ Culture: Fundamental Methods by O. L. Gamborg (Editor) and G. C. Phillips (Editor) (2004)J.Narosapub.
4. Plant Biotechnology-Mantell and Smith-Cambridge univpress,1986.
5. Introduction To Plant Biotechnology/3rd Ednby Chawla H. S.(2009)
6. Plant Tissue Culture by Kalyan Kumar De (2008), Kalyani pub.,Kolkata
7. Plant Tissue Culture: Theory And Practice, 5th Revised Edition (2005) Author: Bhojwani S. S., Elsevier Science
8. Molecular Biotechnology: Principles and Applications of Recombinant DNA Hardcover – 4th Ed. (2010) by Bernard J. Glick,Jack J. Pasternak,Cheryl L. Patten. American Society forMicrobiology

Skill component Identified:

1) Analytical and PreparativeChromatography
2) Basic electrophoretic principles
3) Centrifuges used forseparation
4) UV/ VisibleSpectrophotometer
5) Chromatography – TLC , PaperChromatography
6) Buffers used in DownstreamLab.

BTS505 NANO BIOTECHNOLOGY

No. of Credits: 3

No. of Hours : 36

Course Outcomes:

CO1: Understand the fundamental principles of nanotechnology and their application to biology.

CO2: Use in academic platforms the concepts of nanotechnology, their application along with engineering and physics to the nano-scale and non-continuum domain.

CO3: Demonstrate the understanding of the Nano fabrication methods, design processing conditions to engineer functional Nano materials.

CO3: Evaluate current constraints, such as regulatory, ethical, political, social and economical, encountered when solving problems in living systems.

CO4: Apply and transfer of interdisciplinary systems and engineering approaches to the field of bio and nanotechnology projects.

CO5: Evaluate the state-of-the-art characterisation methods for Nano materials, and determine Nano material safety and handling methods required during characterisation.

Unit-I **13Hrs**

Fundamentals of Nanotechnology Definitions, Relationship and Differences of Nano and Nature: Nanoscopic Colours (Butterfly Wings), Bioluminescence (Fireflies), Tribology (Geckos sticky feet, lotus leaf effect). Introduction to hydrophilic and hydrophobic materials, Nanotechnology and time line, Future perspectives of Nanotechnology and Nanobiotechnology. Classification of nanomaterials: classification of nanomaterials into 0D, 1D, 2D and 3D, Relationship between dimension and shape of nanomaterials (Quantum dots, Quantum wires, Carbon nanotubes, Bucky balls, Fullerenes).

Unit-II 13Hrs

Synthesis methods for nanomaterials such as top to down and bottom to top, Biological synthesis method. Polymer, Nanocomposites, Supramolecular structures; DNA wires and Dendrimers., Magnetosomes, Protein based Self Assembled Nanostructure

Scopes, and applications of Biotechnology, Nanobiotechnology, Bio molecular

Nanotechnology, Biomedical Nanotechnology, Green Nanobiotechnology, Nanoscale assembly of cellular components (cell membrane and liposomes).Nanoscale assembly of microorganisms (virus).Proteins, Enzymes. Nanoparticles in medicine; Types and Areas of Impact, Drug encapsulation and targeting

Unit-III **13Hrs**

Characterization techniques: confocal microscopy, scanning electron microscope, transmission electron microscope, atomic force microscope. Crystallography and spectroscopic techniques (15 h) Basics of crystal lattice, crystallinity, Bragg's law, small angle X-ray, wide angle X-ray, powder X-ray, low energy electron diffraction FTIR, UV-Vis spectroscopy, Raman spectroscopy. Photoemission spectroscopy. Difference between absorbance and surface plasmon resonance Magnetic Characterisation techniques (15 h) Introduction to magnetism, Ferromagnetism, ferrimagnetism, antiferromagnetism, paramagnetism, effect of bulk nanostructuring of magnetic properties, Basics of magnetism, diamagnetic, paramagnetic and superparamagnetic structures

References:

Elements of Material Science and Engineering-H. Vanvlach (4th Edition) Nanotechnology: Principles and Practices., S. K. Kulkarni (3rd Edition) (Springer)

Fundamentals of Nanotechnolog: Gabor L. Hornyak, John J. Moore, H.F. Tibbals,□Joydeep Dutta (2nd edition)(CRC Press) Buddy Ratner Allan Hoffman Frederick Schoen Jack Lemons,

An Introduction to□ Materials in Medicine (Elsevier publication) (3rd edition)

Gary D. Christian, Analytical Chemistry, (5th Edition), (John-Wiley & Sons, Inc,) D. A. Skoog & D. M. West,

Principles of Instrumental Analysis, (2nd Edition) (Holt Reinhart Winston), K. A. Robinsons, Chemical Analysis, (1st edition) (Harper Collins Publishers),

J. Basset, R. C. Denny, C. H. Jaffery and J. Mendhan, Vogel's Text Book of□ quantitative Inorganic Analysis, (5th Edition), (ELBS)

- Preparation of Plant extract (Organic andaqueous),
- Crushing, grinding, maceration, homogenization, Filtration, Centrifugation, cold percolation extraction, hot extraction, using Sohxletapparatus
- Synthesis of gold NPs for plantsextracts
- Synthesis of Iron oxide nanoparticles by using chemicalmethods
- Study of FTIR spectroscopy for materialscharacterization
- Study of UV-Vis spectrophotometer for materialscharacterization
- Surface modification Nanoparticles withpolymers
- Synthesis of Ag nanoparticles using sodium borohydride (Creighton'smethod).
- Cell counting and cell viabilitystudy
- Estimation of particle size using particle sizeanalyser
    - Submerged and solid statefermentation
    - Estimation of microbialbiomass
    - Estimation of microbial enzymes, mycotoxins, organic acids andantibiotics.
    - Microbiological assays (antibiotics, amino acids andvitamins)
    - Properties of microbial exopolysaccharides (e.g., cell immobilization)
    - Uses of Chitin and itsderivatives
    - Pilot scale production of alcoholicbeverages
    - Microbial interactions with plants (rhizobia, mycorrhizas) and plantproduction
    - Assessment of nitrogen fixation (acetylene reduction test)
    - Phosphate solubilization in bacteria ,fungi andactinomycetes.
    - Qualities of biofuels (e.g. biodiesel ,biogas)
        - Isolation of microbes of industrialimportance
        - Instrumentation in bioprocesstechnology
        - Growth and death kinetics of microbialcultures
        - Cell encapsulation (immobilization) techniques anduses
        - Pilot-scale production of microbial (or plants or animal) cellproducts
        - Downstream processingtechniques
        - Methods of celllysis
        - Reverseosmosis
        - Dryingprocesses
        - Biosensers

Cleaning and sterilization methods for tissue culture

- Preparation of media,buffers
- Maintenance of cultures, (normal and tumor cell lines)

- Separation of peripheral blood mononuclearcells
- Cell counting(hemocytometer)
- Lymphocyte culturetechnique
- In vitro macrophage culture frommouse
- Preparation of human metaphasechromosomes
- Cell viabilitytests
- Cell proliferationassay
- Growth kinetics of cells inculture
- In vitro fertilization and embryo transfertechniques
- Cryopreservation techniques
- Cytotoxicity tests
- Estimation of plant hormones (e.g. auxins,gibberellins)
- Plant tissue culturemethods
- Callus culture (compact andfriable)
- Ovule and antherculture
- Cell suspensioncultures
- Embryogenesis
- Syntheticseeds
- Protoplastpreparation
- Protoplast fusiontechniques
- Plant cellimmobilization
- Methods of inducing resistance through tissueculture
- *Agrobacterium* mediated genetictransformation

* Practical exercises to be conducted with back ground of respective theory papers (BTH 501, BTH502,BTS503 andBTS504)

III semester

BTE 508 Immune System & Human health (New OE) 36Hrs

CO1: The students will be able to identify the cellular and molecular basis of immune responsiveness.

CO2: The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.

CO3: The students will be able to transfer knowledge of immunology into clinical decision

Unit 1: Immune system types & classification. Cell of immune system 10Hrs

Unit2: Definition of infection and disease -Classification of infections: localized, generalized, endemic, epidemic, sporadic and pandemic. Classification of diseases as communicable and non-communicable with examples. 13 Hrs

Unit 3: Sources of infection: Air, humans, animals, insects, soil, water and food. Methods of transmission of infection: Contact, inhalation, ingestion. inoculation,insects, congenitaland laboratory infections. Causes, prevention and treatment of infections /disease: Dengue, HIV, Tuberculosis, Typhoid, Malaria and Candidiasis. Sterilization and Disinfection. Vaccines and Immunization schedule. Chemotherapy - Use and abuse 13 Hrs

Reference Books:

1. John E. Hall, Medical Physiology by Guyton, Saunders, 12th edition
2. Mims' Medical Microbiology By (author) Richard Goering, By (author) Hazel Dockrell, By (author) Mark Zuckerman, By (author)Ivan M. Roitt, By (author) Peter L. Chiodini Saunders (W.B.) Co Ltd.
3. Benjamin E. (1996), Immunology – A short course 3rd Edition, John Wiley, New York
4. Kuby J. (1997), Immunology, 3rd Edition, W.H. Freeman & Co., New York
5. Roitt, I.M. (1997), Essential Immunology, 9th Edition, Oxford Black Well Science, London
6. Tizard I.R. (1995), Immunology – An introduction, 4th Edition, Philadephia Sauders College press.

BTE509 Basic concepts in Clinical Biochemistry (New OE) 36 Hrs

Course outcomes:

CO1: It trains the students to gain concepts of assessing the human physiology using biological fluid.

CO2: It illustrates the mechanism of metabolic disorders at molecular level.

UNIT I-Introduction to Clinical Biochemistry Definition and scope of clinical biochemistry in diagnosis, collection and preservation of biological fluids (blood, urine & CSF), normal values of important constituents of blood, CSF and urine. Requirements of setting up of clinical laboratory, collection preparation, preservation, and handling of clinical samples, quality control, Safety measures in clinical laboratory. 12 Hrs

UNIT II-Clinical Importance of Biomolecules Carbohydrates- Estimation of glucose, glycosurias, GTT's, hyper &hypoglycemia, blood glucose regulation and role of hormones; diabetic coma, Lipids- lipid profile estimation, hypercholesterolemia, hyperlipoproteinemia, atherosclerosis and it risk factors.Proteins -albumin, hypoalbuminemia, hypoproteinemia, Bence Jones proteins, proteins in CSF and their estimation. 12 Hrs

UNIT III – Hormones Definition and different classes of hormones; Thyroid hormone and their mechanism of action; Pituitary hormones and their role in biological systems; Hormone regulation, Role of insulin in modulating blood glucose level 12 Hrs

Reference Books:

1. Clinical biochemistry, metabolic and clinical aspects by William J. Marshall, Stephan K Elsevier science health.
3. Fundamentals of Clinical Biochemistry by Teiz, W.B-Saunders Company.
4. Clinical Biochemistry: An illustrated color text 3rd Ed. by Allan Gaw, Micheal Murphy, Robert Cowan, Denis O Reilly, Micheal Stewart and James Shepherd. Churchill Livingtons.

BTE510 Applications of Biotechnology in Food Science (New OE)

Course outcomes:

CO1: To know about the constituents and additives present in the food.

CO2: To gain knowledge about the microorganisms, which spoil food and food borne Diseases.

CO3: To know different techniques used for the preservation of foods & quality standards

CO4: To gain the knowledge about balanced diet, and its importance.

No. of Hours: 36 13hours

Unit 1

Scope of Food biotechnology, Difference between the modern biotechnology and the traditional biotechnology, Difference between Food technology and Food biotechnology

Foods produced through indigenous and modern biotechnical tools, merits and demerits of genetically modified foods,

Fermented Foods - Industrial production of Yoghurt, Cheese, Tempeh. Beer ,wine

Adulteration of food : Identification of adulterants both qualitative and quantitative; additives in foods; types, names, uses, maximum permissible limits.

Concept of Balanced Diet, Malnutrition – over and under. Basic Food Groups, Food Pyramid. 12hours

Unit 2

Food Chemistry : Vitamins- Importance, Water soluble vitamins, Fat soluble vitamins,

Proteins : Protein classification and structure, Nature of food proteins & its importance

Lipids : Classification of lipids, Physical properties of lipids. Chemical properties of lipids

Carbohydrates – Structure, classification & importance. 11hours

Unit 3

Food spoilage - definition, types, Food borne diseases and infections, food poisoning

Food Packaging and Storage Technology: Packaging material - Origin, types, chemistry, morphology and physical characteristics, advantages, defects.

Quality standards – Food Safety Act, FSSAI, ISO series, national laws and regulations: PFA, FPO, BIS and Agmark and international laws and regulations

References:

1. Meyer, Food Chemistry, New Age, 2004
2. 2.Maheshwari, D. K. et. al., Biotechnological applications of microorganisms, IK . International, New Delhi, 2006
3. Stanbury, P. F. et. al., Principles of Fermentation Technology, 2nd Edition, Elsevier, UK, 1995
4. Prescott and Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
5. Byong H. Lee, Fundamentals of Food Biotechnology, Wiley-Blackwell, 2014
6. Srilakshmi. Food Science, 4th Edition. New Age International Ltd, 2007.
7. Prescott L M, Harley J P, Klein D A., 2008. Microbiology 6th ed., WMC Brown Publishers
8. Pelczar MJ, Chan ECS, Krieg N. 1993. Microbiology 5th ed., Tata McGraw Hill Publishing Co. Ltd
9. Garbutt John, 1997. Essentials of Food Microbiology, Arnold London

FOURTH SEMESTER SYLLABUS

HARD CORE PAPERS	SOFT CORE PAPERS	OPEN ELECTIVE	Project/Dissertation
BTH551 Immunology	BTS552Environmental Biotechnology	**Nil**	**BTH557 :Project work & Dissertation**
BTP555Immunology	BTS553Agricultural Biotechnology		
	BTS554Food Biotechnology		
	BTP556 Environment Biotechnology & Agricultural Biotechnology/ Food Biotechnology		

BTH551 IMMUNOLOGY

No of Credits: 4

No. of Hours: 52

Objective:

1. Concept of Immunity, types of immunity, cells & organs involved in immune functioning
2. Foreign substance characteristic to evoke a immuneresponse
3. Exaggerated levels of immune response in hypersensitivity, auto immunediseases
4. Briefing foundation of humoral immunity & vaccine development

UnitI **13 Hrs**

History and scope of immunology. Types of immunity-humoral and cell mediated. Innate and adaptive immunity. Specificity and memory. Primary and secondary lymphoid organs; immunization

Cells involved in immune response- T- cells,B-cells. Clonal selection theory. Lymphocyte activation, clonal proliferation, differentiation. Effector mechanisms in immunity-macrophage activation.

UnitII **13Hrs**

Antigens: Definitions, antigen: Self antigens and foreign antigens, haptens, epitopes, adjuvants and mitogens. Foreign antigen's antigenicity. Protein antigens, carbohydrate antigens, bacterial cell surface antigens, blood group antigens, tumor antigens and viral antigens. Immunogens in vaccination. Bases of antigen specificity, forces of antigen. Antibody interaction, T-dependent and T-independent antigens, super antigens.

UnitIII **13Hrs**

Human and mouse MHC , Transplantation immunology. HLA in human health and disease HLA tissue typing. Immune –suppression in transplantation. Hypersensitivity reaction, treatment approaches. Immunological tolerance.

Autoimmune diseases, Thyrotoxicosis, Systematic Lupus Erythromatosis, Antinuclear

antibodies. Tumour immunology-tumor antigens, immunosurveillance, Immune deficiency diseases – AIDS; Immunological tolerance.

UnitIV **13Hrs**

Immunoglobulins: Isolation and purification of immunoglobulins. Structure of antibodies. Classes and subclasses of immunoglobulins, biological and chemical properties of Igs. Hyper variable region, isotopic, allotypic and idiotypic variations and idiotypic network. Biosynthesis, theories of formation, diversity of antibodies, genetics of Ig diversity, mechanisms contributing to antibody diversity, Ig genes, isotype switching, Ag-Ab reactions, specificity, affinity binding ofantibodies.

Vaccines: Immunization: Active immunization, passive immunization. Adverse reactions from vaccines, experimental immunization procedures, production of recombinant vaccines and their uses.

Transplantation Genetics and Immunology**:** Types of grafts, major histocompatibility gene complex, ABO blood group compatibility, host response to transplantation, immunosuppressive therapy.

References:

1. Jordan S.Pober Cellular and molecular immunology. – Abdul K.Abba, Andrew H. Lichtman, SaundersCo
2. Essential immunology- Ivan Riott 8th edition Blackwell scientificpub
3. Handbook of expt. Immunology vol. 1,2 .Wiler DM Blackwell scientificpub.
4. Immunology –Janis Kuby; Freeman and co publishers,2000
5. Immunology-3rdEdition .IvanRiott , Jonathan Brostoff and David Male. Mosby publishers
6. Immunobiology-3rd edition, Janeway and Travers .Churchill Livingstonepublications
7. Practical Immunology. Hudsonetal Blackwell scientific pub.,1986

Skill component identified :

Antigen and antibody reactions employed in diagnostics Antibody purification methods Immune cell structure/function and molecular basics and techniques of immunology .

BTS552 ENVIRONMENTAL BIOTECHNOLOGY

Objective:

- Understand the interactions between organisms and their environments, and the consequences of these interactions in natural populations, communities, and ecosystems evidenced by pollution.
- To learn the extent of pollution in different industries including agriculture by analyzing the permissible limits and indices of different pollutants
- Prevention of such bio-hazardous and chemicals accumulation in the environment using novel biotechnological methods using microorganisms and plants
- Consequences of genetically modified organisms and their impact on natural environment, rules and regulations while handling these organisms, issues of aquaculture industries and prevention.

Unit I **14 Hrs.**

Environmental pollution; Soil, water and air pollution; Indicator organisms and human pathogens (*Salmonella, Vibrio, Hepatitis A*)

Microbial degradation of toxic chemicals (pesticides, detergents, plastics). Degradation of organic compounds (cellulose, lignin, hydrocarbons: aliphatic, aromatic, alicyclic hydrocarbons)

Microbial deterioration of leather.

Microbial mining (with suitable examples), microbial influenced corrosion and remedies, bioaccumulation, biomagnification.

Unit II **14 Hrs**

Principles of microbial bioremediation, *in situ* and *ex situ* bioremediation,microbiological treatment of solid wastes- composting, land farming, bioreactors. Biological treatment of liquid wastes - aerobic and anaerobic treatments sewage and effluent treatments.

Pollution control measures, international and national pollution regulatory acts; Permissible limits and indices for pollutants; Hazardous wastes: microbial processing and disposal of dyes & paints, radioactive wastes, pharmaceuticals, refinery, distillery and leather industryeffluents.

Unit III **8 Hrs.**

Coastal regulatory zone (CRZ). Environmental issues of aquaculture; Biofilms and Biofouling – micro fouling and macro fouling; Biomaterials; Biomolecules from the sea; Issues associated with environmental release and monitoring of GMOs.

References:

1. Ecology-Odum
2. Environmental Biotechnology, Jogdanand ,Himalaya pubHouse
3. Environmental and Biochemistry Kudesia&JetleyPragathiPrakashanpub.
4. Microbial Ecology- Atlas andBartha
5. Microbial Biotechnology- Alexander.G, WH Freeman andcom.
6. Sewage and industrial effluent treatment John Arundel ,Blackwell sciencepub
7. Soil Microbiology,4th ed. N.S. SubbaRao ,Oxford& IBHpub.
8. Waste water engineering 3rded Metcalf &Eddy ,McGraw –Hill internationalEds.

Skill component Identified

The course content aims to make the students understand how biotechnology can help in monitoring or removing the pollutants and developing an understanding of new trends such as biofuels, renewable energy sources or microbial technologies which can minimize the harmful impact of pollutants in the environment.

BTS553 AGRICULTURAL BIOTECHNOLOGY

No ofCredits:3

No. of Hours:36

Course Outcomes:

CO1: Demonstrate the Understanding of the principles and the emerging concepts in agricultural biotechnology.

CO2: Explain the role that micro organisms like *Agrobacterium* plays in producing genetically modified plant crops.

CO3: Critically evaluate the application of plant and microbial biotechnologies for sustainable agriculture.

CO4: Discuss and analyse how modern agricultural biotechnology and genetic resources can be harnessed to achieve environmental sustainability.

CO5: Undertake the modernised farming practices both in plant and animals for betterment in a highly profitable manner

Unit I **10 Hrs.**

Bioinoculants Introduction and Importance of biofertilizers in agriculture, Mass culturing and quality control of microbial inoculants-mother culture, shake culture and large scale production of biofertilizers (Rhizobium, Azotobacter, Mycorrhiza, Actinorhiza) types of carrier materials, packing storage, shelf life and transportation of biofertilizers. Methods of application to seed, soil and nursery. Vermiculture, composting , current practices and production.

Biopesticides: *Bacillus thuringiensis,Trichoderma,Baculoviruses*

Unit II **16 Hrs.**

Integrated pest management. Breif introduction to entomology: Importance of JH and JH analogues in insect pest control. Insect pheromones and their applications. Biological control of insect pests and weeds using natural enemies, mass multiplication of predators and parasites. Biological control of plant pathogens using antagonistic fungi and antagonistic bacteria.

Unit III **10 Hrs.**

Applications of Biotechnology in Animal husbandry Introduction and importance of animal husbandry. Applications of biotechnology in poultry, aquaculture, sericulture, Improvement of poultry, disease resistance, recombinant vaccines for poultry, growth hormones for increasing biomass, fish breeding techniques, silkworm as bioreactor for the production of commercially important proteins; improvement of livestock, molecular pharming of products - (Pharmaceuticals through milk or genetically engineered cows).

BTS554 FOOD BIOTECHNOLOGY

No of Credits: 3

No. of Hours: 39

Objectives:

To enable the students

1. To know about the constituents and additives present in the food.
2. To gain knowledge about the microorganisms, which spoil food and food borne diseases.
3. To know different techniques used for the preservation of foods

Unit-I **13Hrs**

Fermented foods, milk-based products, fermented vegetables, fermented meats, fish, beverages, vinegar, mould fermentation - tempeh, soy sauce, rice wine. Enzymes in dairy industry, cheese making and whey processing, impact of enzyme technology (bioethanol, protein hydrolysates, bioactive peptides), Enzymatic processing of fruit juices; role of enzymes in baking, meat and meat processing, phytase in animal feeds, DNA-based methods for food authentication, comparative methods of toxicity testing in (novel) foods, biological approach to tailor-made foods, catabolic processes and oxygen-dependence reactions in food, application of generic technologies in food and nutritional sciences; anti-cancer components in foods.

Unit-II **13Hrs**

Functional foods and Biotechnology: Biochemical processing in the improvement of functional foods with targeted health benefits and increased nutrient value; applying molecular, biochemical, cellular and bioprocessing concepts, bio-mobilization of major nutrients such sterols, lipids, vitamins and minerals, use of specific phenolic metabolites from botanical species. Pre- and Pro-biotics, single cell protein, single cell lipids. Manipulation of fruit ripening process.

UnitIII **13Hrs**

Food processing, principles and practices, food ingredients and processing aids from biotechnological processes, corn sweeteners, bacterial starter cultures,cold-adapted

enzymes. Food spoilage, preservation, mycotoxins in food commodities. Genetically modified foods, designer foods, Nutraceuticals, detection of GM foods.

References:

1. W.C. Frazier And D.C. Westhoff – Food Microbiology, 4th Ed., Mcgraw-Hill Book Co.,
2. New York 1988.
3. J.M. Jay – Modern Food Microbiology, Cbs Pub. New Delhi,1987
4. T.P. Coultate – Food – The Chemistry Of Its Components, 2nd Edn. RoyalSociety, London, 1992.
5. B.Sivasanker–FoodProcessingAndPreservation,Prentice-HallOfIndiaPvt. Ltd. New Delhi2002

- Study of immune system inrats
- Blood film preparation and study of immunecells
- Histology of organs of immunesystem
- Study of insecthemocytes
- Production ofantiserum
- Isolation oflymphocytes
- Antigen-antibody reactions (*invitro*)
- Phagocytosis (*invitro*)
- Immunodottechnique
- Immunodiffusiontechnique
- Immunological diagnosis of pregnancy andinfection
- Demonstration of ELISA technique
- Production of Compost(methods)
- Vermicompost and itsanalysis
- Cultivation ofmushrooms
- Biogas (biofuels)production
- Waste water treatmentmethods
- Solid water treatmentmethods
- Experiments of biofouling andbiofilms
- Experiments on industrial waste treatment methods (e.g. distillery,whey)

- Bioinoculants : Isolation and mass production of: Rhizobium,Azospirillum,

- Azatobacter, Anabena, andAzolla
- Isolation of phosphate solubilizing microorganisms from soilsample.
- Estimation of phosphate by Fiskay-Subbaraomethod.
- Detection and quantification of mycorrhizae by root clearing technique from different crop plants.
- Study of root /stem nodules and study ofVAM.
- Assay of Biofertilizers (at least threetypes).
- Testing of antagonism by dual culture plate technique.
- Testing of antimicrobial property of antagonists culturefiltrate.
- Bio-insecticidal effect of biopesticides from microbial and plantsources.
- Protoplast fusion in Rhizobium for enhanced noduleformation.
- Baculovirus stocks –Preparation and titration using plaquecolony.
- Co-transfection of insect cells using linearized baculovirusstocks.
- Induced breeding of commercially important fishes.

Code No. of thepaper **Reg.No.**

Question Paper Format

M.Sc. BIOTECHNOLOGY

(TITLE OF THE PAPER)

Time: 3 Hours **Max.Marks:70**

PART A (Any Five)

(5 x4=20)

1.

2.

3.

4.

5.

6.

PART B (Any Five)

(5x6=30)

7.

8.

9.

10.

11.

12.

PART C **(2x10=20)**

13.

14.

15.

16.

SEMESTER EXAMINATION,MONTH YYYY

MSc.BIOTECHNOLOGY

BT-#:TITLE OF THE PAPER

TIME:5Hr **MARKS:70**

I.	Major experiment A(Principle,Procedure,Conducting ,Result & Discussion)	25
II.	Minor experiment B(Principle,flowchart,conducting ,Result & Discussion)	15
III.	Spotter C,D,E& F	10
IV.	Class Record	10
V.	VIVA	10

Certificate Course/ Value added course

QUALITY CONTROL MICROBIOLOGY-THEORY

Unit I **10Hr**

Principles and applications of GMP in pharmaceuticals and cosmetics : Principles – Applications and Definitions .The concept of Quality .Quality management and regulatory aspects -Premises and contamination control, location, design, structure, layout, services and cleaning. Personnel management, training, Hygiene and health. Documentation. Quality control and GCLP. Sterile and other products. Global regulatory and toxicological aspects of cosmetic preservation

Unit II **11Hr**

Analytical aspects for pharmaceutical and cosmetic Products - Quality control and GCLP. Sterile and other products. Validation. Cosmetics microbiology- testing methods and preservation. Antimicrobial preservation efficacy and microbial content testing . Validation method for cosmetics. Preservation strategy. Evaluation of antimicrobial mechanism

SUGGESSTED BOOKS:

1. Sharp John (2000) Quality in the manufacture of medicines and other healthcare products. Pharmaceutical Press.
2. Iyer S. (2003) Guidelines on cGMP and quality of Pharmaceutical products. D K Publishers Mumbai.
3. Philip A , Taylor and Francis (2006) Cosmetic Microbiology a practical approach.2nd Ed.
4. Denyer S p, Hodges N A and Gorman S P (2005) Hugo and Russell's Pharmaceutical Microbiology. Blackwell Publishing.
5. Bibek Ray and Arun Bhunia (2008) Fundamental Food Microbiology. 4th Ed. CRC Press.
1. Sharp John (2000) Quality in the manufacture of medicines and other healthcare products. Pharmaceutical Press.
6. Bhatia R and Ichhapujani R L (1995) Quality Assurance in Microbiology. CBS publishers and distributors.
2. Sharp John (2000) Quality in the manufacture of medicines and other healthcare products. Pharmaceutical Press.
8. Philip A , Taylor and Francis (2006) Cosmetic Microbiology a practical approach.2nd Ed.
9. Hillisch A and Hilgenfeld R (2009) Modern Methods of drug discovery. Springer

International Edition.

3. Kadam s s, Mahadik K R and Bothara K G (2009). Principles of medicinal Chemistry. Vol II Nirali Prakashan Pune.
4. Lemke T L and Williams D A (2008) Foye's Principles of Medicinal Chemistry. 6th Ed. Wolter Luwer, Lippincott Williams and Wilkins. N Delhi.

Quality Control Microbiology- (Practical's) **20Hr**

1. Sterility testing and reporting (as per Pharmacopia)
2. Microbial load in cosmetic product
3. Efficacy testing of preservatives like parabens
4. Efficacy of preservation and shelf life study.
5. Preparation of cosmetic product and its preservation study
6. Report on LAL and other tests for QC