

M.Sc. BIOTECHNOLOGY CURRICULUM

Total number of Credits: 90

Code No.	Course	Hours/Week			Credits	Maximum Marks		
		Lecture	Tutorial	Practical		CA	SEE	Total
SEMESTER 1								
Core	Core 1 Cell and Developmental Biology	4	0	0	4	40	60	100
Core	Core 2 Microbiology	4	0	0	4	40	60	100
Core	Core 3 Biochemistry	4	0	0	4	40	60	100
Core	Core 4 Biochemistry and Microbiology Practical	0	0	4	2	40	60	100
DSE	DSE 1 Molecular Genetics	4	0	0	4	40	60	100
DSE	DSE 2 Bioinstrumentation	4	0	0	4	40	60	100
SEC	Soft Skill 1/ Sector Skill Course	2	0	0	2	40	60	100
		22	0	4	24			
SEMESTER II								
Core	Core 5 Genetic Engineering	4	0	0	4	40	60	100
Core	Core 6 Bioprocess Technology	4	0	0	4	40	60	100
Core	Core 7 Immunotechnology	4	0	0	4	40	60	100
Core	Core 8 Genetic Engineering & Bioprocess Technology Practical	0	0	4	2	40	60	100
Core	Core 9 Immunotechnology Practical	0	0	4	2	40	60	100
DSE	DSE 3 Genomics and Proteomics	4	0	0	4	40	60	100
SI	Internship	0	0	4	2	40	60	100
SEC	Soft Skill 2/ Sector Skill Course	2	0	0	2	40	60	100
		18	0	12	24			

SEMESTER III								
Core	Core 10 Plant Biotechnology	4	0	0	4	40	60	100
Core	Core 11 Animal Biotechnology	4	0	0	4	40	60	100
Core	Core 12 Environmental and Nanobiotechnology	4	0	0	4	40	60	100
Core	Core 13 Plant and Animal Biotechnology Practical	0	0	4	2	40	60	100
DSE	DSE 4 Pharmaceutical Biotechnology	4	0	0	4	40	60	100
DSE	DSE 5 Bioinformatics and IPR, & Bioethics	4	0	0	4	40	60	100
SEC	Soft Skill 3/ Sector Skill Course	2	0	0	2	40	60	100
		22	0	4	24			
SEMESTER IV								
Core	Core 14 Research Methodology and Biostatistics	4	0	0	4	40	60	100
GE	-----	4	0	0	4	40	60	100
Core	Project Work	0	0	20	10	40	60	100
		8	0	20	18			

CA - Continuous Assessment ,

SEE - Semester End Examination

List of Discipline Specific Elective Courses

1. Molecular genetics
2. Bioinstrumentation
3. Tissue Engineering and Stem Cell Biology
4. Genomics & Proteomics
5. Fermentation Technology
6. Medical and Herbal Biotechnology
7. Pharmaceutical Biotechnology
8. Bioinformatics, IPR & Bioethics
9. Project Management and Biotech products Entrepreneurship

List of Generic Elective Course

1. Biomedical Waste Management
2. Biotechnology and Human Welfare
3. Environmental Biotechnology
4. Mushroom Cultivation and Medicinal Plant Gardening

List of Skill Enhancement Courses

1. Soft Skill I
2. Soft Skills II
3. Soft Skills III

Syllabus

Core Courses

CELL AND DEVELOPMENTAL BIOLOGY 3024

Course Objective: (Skill Development)

To understand the basics of cell and developmental biology such as cell organelles, cell cycle cell signals, fertilization, embryogenesis and developmental differentiation.

UNIT I Biomembrane and cell organelles 9

Membrane structure and function: structure of models membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, electrical properties of membranes. Structural organization and function of intracellular organelles: nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, cell wall, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

UNIT II Nucleic acid, cell cycles and cell signals 9

Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons. Cell division and cell cycle: mitosis, meiosis, their regulation, steps in cell cycle and their control cycle. Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors signal transduction pathway, second messengers, regulation of signaling pathway, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

UNIT III Cell communication and Cancer biology 9

Cellular communication: regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Cancer: genetic rearrangement of progenitor cells, oncogenes, tumor suppressor genes, cancer and cell cycle, virus- induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

UNIT IV Developmental differentiation 9

Embryonic development, cellular differentiation, organogenesis, metamorphosis, genetic basis of development, stem cells, programmed cell death, aging and senescence. Concepts of

development: potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradient; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

UNIT V Fertilization and embryogenesis

9

Gametogenesis: fertilization and early development: production of gametes, cell surface molecule in sperm egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage blastula formation, embryonic fields, gastrulation and formation of germ layer in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Total: 45hrs

Course Outcomes:

- CO-1: List about basic cell biology, developmental biology principles and biomembrane and its functions
- CO-2: Explain about the various cell organelles and nucleic acid structure and functions.
- CO-3: Summarize on cell cycles of mitosis and meiosis with cell signaling and communications
- CO-4: Explain about cancer biology and oncogenesis
- CO-5: Analyze on different aspects of embryo development and study about Gametogenesis of Male and female.

TEXT & REFERENCE BOOKS

1. Verma, P.S. and Agarwal, V.K. "Cell Biology". S. Chand Publication. 2008.
2. Arumugam N, "Cell Biology", Saras Publication, 2014
3. Arumugam N, R P Meyyan, "Cell Biology and Molecular Biology", Saras publication, 2014.
4. Lodish, H. Berk, A., Kaiser, Krieger, Scott, Bretscher, Ploegh and Matsudaria, P. "Molecular Cell Biology". Media connected, W. H. Freeman and company, 6th edition. 2008.
5. Cooper, G.M. and Hausman, R.E. "The Cell". Molecular approach. A.S.M press. 4th edition. 2007.
6. Pollard, T.D. and Earnshaw, C. "Cell Biology". 2nd Edition. 2008.

7. Weaver, R.F. "Molecular Biology". McGraw Hill International. 2008.
8. Williams, L and Wilkins. "Cell and Molecular Biology". B.I. Publication. 8th edition. 2005.
9. Davide, Sadava, "Organelle structure and function". Panima publishing.2004.

Course Objective: (Skill Development)

To educate and train the students for lab techniques of Cell Biology and Developmental Biology

List of Experiments**Cell Biology**

1. Microscopy: Types and Application
2. Measurement of cell size by micrometry
3. Cell counting - RBC and WBC
4. Microtome, Fixation, Embedding, Sectioning, Staining.
5. Histochemical methods for proteins, carbohydrates, lipids and enzymes.
6. Mitosis and Meiosis. Preparation of metaphase chromosomes from cultured cells.

Developmental Biology

7. Culture of Drosophila
8. Culture of Drosophila result analysis
9. Chick embryo development (24hrs, 48hrs, 72hrs and 96hrs)
10. Demonstration on mouse embryo separation

Total: 15 hours**Course Outcome:**

- CO-1: Understand cell biology lab practices and skilled in microscope operations
- CO-2: Illustrate on RBC and WBC count in blood
- CO-3: Examine on microtome tissue sectioning and histochemical analysis
- CO-4: Analyze the cell division of mitosis and meiosis in cultured cells
- CO-5: Explain the culturing Drosophila and its observations, know about embryo development using chick embryo and embryo separation techniques using mouse model.

TEXT & REFERENCE BOOKS

1. Gunasekar, . P. “Laboratory Manual in Microbiology”. New Age International Private Ltd. Publishers, New Delhi, Chennai. 1995
2. Jayaraman J, “Laboratory Manual in Biochemistry” (5th reprint) New Age International Publishers Mumbai, Chennai, 1996.
3. M. Prakash, C.K. Arora, “Biochemical techniques”, Anmol Publications (I) Ltd New Delhi. 1998.
4. Ian Freshney R. “Culture of Animal Cells: A Manual of Basic Technique”, Wiley-Liss, 2005.
5. David T. Plummer, “An Introduction to Practical Biochemistry”, Tata McGraw Hill Publishing Company Ltd. New Delhi. 3rd Edition, 2006.

Course Objective: (Employability)

To provide detailed knowledge about taxonomy and diversity of microbes, growth, functions and diseases caused by them.

UNIT I 12

Microbial Taxonomy, systematics, identification: Taxonomical hierarchy species-type strains: culture collections; binomial nomenclature; system of classification - phonetic, numerical taxonomy. General characteristics used in classification- five kingdoms, six kingdoms and eight kingdom systems. Classification of microbes using DNA analysis, proteins, rRNA analysis and phylogeny.

UNIT II 12

Nutritional requirements and types of microorganisms, Uptake of nutrients by microorganisms. Photosynthetic microorganisms. Nitrate and sulfur oxidizing bacteria, Nitrate and sulfate reducing bacteria. Nitrogen fixation. Hydrocarbon transformation. Role of microorganism in agriculture, food and dairy industry.

UNIT III 12

Host – parasite relationship, normal microflora. Infection types and mode of disease transmission. Causative agent, pathogenesis and control measures of typhoid, cholera, tuberculosis, AIDS, hepatitis, malaria and candidiasis. Antimicrobial agents and their mode of action – antibacterial, antiviral, antifungal, antiparasitic agents.

UNIT IV 12

Mutation and Mutagenesis: UV and chemical mutagens; Types of mutation; Ames test for mutagenesis. Plasmids and Transposons. Methods of genetic analysis – Transformation, Conjugation, Transduction. Bacterial genetic maps with reference to E. coli, viruses and their genetic system – Phage life cycle, Genetic systems of yeast and Neurospora.

UNIT V 12

Role of microorganisms in food production (SCP) dairy and non-dairy products. Fuel (ethanol), pharmaceuticals (antibiotics), biofertilizers (BGA), biopesticides (Bacillus thuringensis), biopolymers, biosurfactants, vitaminB12, protease, glutamic acid. Secondary metabolites. Biogas

production, biocomposting and biotransformation

Total: 60 Hours

Course Outcome:

CO-1: Recall about microscopy and Prokaryotic and eukaryotic cells and classification

CO-2: Demonstrate about the nutritional requirement for microbial growth and role of microbes in various fields.

CO-3: List about various microbial diseases and antimicrobial chemicals and its actions.

CO-4: Explain about mutation and various plasmids and gene transfer mechanism.

CO-5: Importance of microorganisms in food industry and various applications of microbes.

TEXT & REFERENCE BOOKS

1. Pelczar MJ, Chan ECS, and Krieg NR. Microbiology, Tata McGraw Hill Publishing Company, 5th Edition. 2006.
2. Prescott LM, Harley JP and Klein DA. Microbiology, McGraw Hill, 6th Edition, 2005.
3. Talero KP and Talero A. Foundations in Microbiology, McGraw Hill, 4th Edition, 2002.
4. Benson HJ. Microbiological Applications: A Laboratory manual in General Microbiology, McGraw Hill. 7th Edition, 1999.
5. Salle AJ. Principles of bacteriology, Tata McGraw-Hill Publishing Company Ltd. New Delhi. 7th Edition, 1986.
6. Modi HA. Elementary Microbiology (Volume- 1 Fundamentals of Microbiology). Akta Prakashan Nadiad, Publication. 1995.
7. Freifelder D. Microbial Genetics, Narosa Publishing House. 1995
8. Maloy SR, Cronan JE and Freifelder D. Microbial Genetics, Jones Barlett Publishers. 2nd Edition, 1994.
9. Cappuccino JG and Sherman N. Microbiology - A Laboratory Manual, , Editors: Wirth AE and Olsen L. nology: concepts, applications and perspectives, Wiley VCH publishers, 5th Edition

Course Objectives (Skill Development)

To develop understanding and provide scientific basics of the life processes at the molecular level and explain the structure, function and inter-relationships of biomolecules and their deviation from normal and their consequences for interpreting and solving clinical problems.

UNIT I Biochemical Organization and Bioenergetics 12

Bioenergetics - and biological oxidation – general concept of oxidation and reduction, electron transport chain, oxidative phosphorylation, uncouplers and theories of biological oxidation and oxidative phosphorylation. High energy compounds, ATP cycle, Calculation of ATP during oxidation of glucose and fatty acids.

UNIT II Biomolecules – Carbohydrates & Lipids 12

Carbohydrates – classification, properties. Starch, glycogen, dextrin, inulin, cellulose, metabolism of carbohydrates – gluconeogenesis, glycogenolysis, glycolysis. citric acid cycle, pentose phosphate pathway. Lipids – Classification, properties, Sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, metabolism of lipids, oxidation of fatty acids, α,β - oxidation and biosynthesis of ketone bodies, cholesterol, porphyrin biosynthesis, metabolism of bile pigments.

UNIT III Biomolecules – Proteins & Nucleic Acid 12

Proteins and amino acids – Classification, properties, biosynthesis of amino acids and proteins, essential amino acids, metabolism of amino acids and proteins, Nitrogen balance. Nucleic acids – genetic code, nucleic acids, and structure of DNA and RNA, purine biosynthesis and pyrimidine biosynthesis.

UNIT IV Vitamins, Hormones, Enzymes 12

Physical and chemical properties, structure of haemoglobin, immunoglobulins and nucleoprotein, classification and their properties, occurrence, functions, requirements, deficiency manifestations and role of vitamins as coenzyme, chemical nature and properties, hormones, Nomenclature, enzyme kinetics, classification and their properties, mechanism of action, enzyme induction and

inhibition, coenzyme significance and enzymes of clinical importance – Enzyme Markers.

UNIT V Biochemistry Of Clinical Diseases

12

Scope of clinical biochemistry, Diabetes mellitus, atherosclerosis, fatty liver, and obesity, hormonal disorders, aging, inborn errors of metabolism organ function tests.

Total: 60 Hours

Course Outcomes

- CO-1: Understand the basis of the cell and its structure and importance Bioenergetics, ATP and other high energy compounds.
- CO-2: Illustrate the structure and Metabolism of carbohydrates and Lipids.
- CO-3: Summarise the structure and Metabolism of proteins and Nucleic acids.
- CO-4: List the function of hormones, vitamins, action and regulations of enzymes.
- CO-5: Explain the Scope of clinical biochemistry and clinical disorders.

TEXT & REFERENCE BOOKS:

1. Lehninger A.L., Nelson D.L. and Cox M.M. Principles of Biochemistry. CBS publishers and distributors, 7th edition, 2016
2. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. Harpers Biochemistry. Appleton and Lange, Stanford, 24th edition, 1996
3. Thomas M. Devlin. Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers, 7th edition, 2010
4. Burtis & Ashwood W.B. Tietz Textbook of Clinical chemistry. Saunders Company, 2nd Edition, 1993.
5. Lubert Stryer W.H. Biochemistry. Freeman and company, New york, 6th Edition, 2006
6. Donald Voet & Judith G. Voet. Biochemistry. John Wiley and Sons ,Inc.4th.edition, 2010
7. Rama Rao, Textbook of Biochemistry. UBS Publishers' Distributors Pvt. Limited, 9th edition 2006
8. Deb. Textbook of Biochemistry. New Central Book Agency (p) Ltd, 9th edition , 2001

Course Objectives: (Employability)

To enable the students to learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids and to learn about the microbial techniques Like culture techniques, Staining techniques and Biochemical analysis.

List of Experiments:**Biochemistry**

1. Qualitative tests for carbohydrates.
2. Qualitative analysis of amino acids & proteins.
3. Quantitative estimation of protein using Lowry's Reagent.
4. Quantitative analysis of urea in serum.
5. Quantitative estimation of serum cholesterol by Libermann Burchard's method
6. Chromatography: Separation of amino acid by Thin Layer Chromatography.
7. Extraction and assay of acid phosphatase from potato.

Microbiology

1. Sterilization of glassware, media
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes;
Solid: Pour plates, streak plates, slants, stabs.
4. Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram's Staining Capsule staining, Spore staining
5. Isolation of microbes from water, air, soil and plant surface
6. Growth curve, Optimization of microbial growth – PH, Temperature
7. Catalase test – Oxidase test – Urease test – IMViC test.

Total: 30 Hours

Course Outcomes:

Upon completion of the laboratory sessions, the students will be able to

- CO-1: Understand the basic principles of biochemical estimations and assays
- CO-2: Analyze various biomolecules both quantitatively and qualitatively.
- CO-3: Explain the various methods of enzyme assays needed for clinical research.
- CO-4: Examine of microbes from water, air, soil and plant surface.
- CO-5: Elaborate on microbial techniques like culture techniques, Staining techniques and Biochemical analysis.

TEXT & REFERENCE BOOKS

1. Jayaraman J., Laboratory Manual in Biochemistry, 2nd Edition, New Age International Private Limited, January 2011.
2. . Sawhney S. K, Randhir Singh Eds, Introductory Practical Biochemistry, 5th or later edition, Narosa Publishing House, New Delhi, 2014.
3. Gupta R.C. and Bhargavan S. Practical Biochemistry., CBS; 5th edition, 2018.
4. David T. Plummer, “An Introduction to Practical Biochemistry”, Tata McGraw Hill Publishing Company Ltd. New Delhi. 3rd Edition, 2006
5. Cappuccino, J.G. and N. Sherman “Microbiology: A Laboratory Manual”, 4th Edition, Addison-Wesley, 1999.
6. Collee, J.G. et al., “Mackie & McCartney Practical Medical Microbiology” 4th Edition, Churchill Livingstone, 1996.

Course Objective: (Employability)

To provide fundamental theoretical knowledge about Genetic Engineering, Cloning Vector, molecular techniques.

UNIT-I Introduction to genetic engineering **12**

Introduction to genetic engineering: Importance and outline of genetic engineering, organization of gene and genome, gene expression- Enzymes in genetic engineering- Endo and exonucleases - Restriction endonucleases- types, and mechanism of action, Ligases - types and mechanism of action, linker, adaptor, homopolymer tailing - Polymerases types and mechanism of action- other enzymes

UNIT-II Cloning Vectors and their applications **12**

E. coli Vectors - Plasmids (Properties, types, In vitro construction-pBR322, pUC), Bacteriophage- lambda and M13 (Biology, Classes, in vitro construction of cloning vectors), Cosmids and phagemids and its properties- vectors for gram positive and gram-negative bacteria -Plant viral vectors- animal viral vectors- Cloning in Yeast- Expression vectors.

UNIT-III Isolation and Transfer **12**

Plasmid isolation and purification method- nucleic acid and protein electrophoresis -nucleic acid staining and labelling - types of gene transfer- molecular probes - Selection and screening of recombinants – Blotting techniques - hybridization techniques – Autoradiography

UNIT-IV Modern Techniques

PCR technology – concept, types, primer design- DNA synthesis - DNA sequencing methods - DNA microarray technology - Molecular markers and types- Chromosome walking and jumping - DNA finger printing - DNA Foot printing- RNA interference.

UNIT V Applications **12**

Site directed mutagenesis- Protein engineering - Gene therapy – types- Application of genetic engineering in medicine and agriculture- antisense technology- Industrial applications of rDNA technology- recombinant vaccines- Genetically modified organism- Ethical, legal and social

issues

Total: 60 Hours

Course Outcomes:

- CO-1: Understand the basics of gene cloning, genetic engineering tools, nucleic acid manipulating enzymes and various modern techniques used in rDNA technology.
- CO-2: Summarize about genetic engineering techniques, molecular probes and blotting techniques.
- CO –3: Make use of various molecular techniques and their application such as DNA sequencing and fingerprinting.
- CO –4: Explain about Gene transfer technologies and its application the Agriculture and Forensic science
- CO –5: Discuss About vaccines, protein engineering, GMOs organisms and Gene therapy

TEXT & REFERENCE BOOKS:

1. Old.R.W and Primrose S.B. Principles of Gene manipulation: An introduction to genetic engineering, Blackwell Sciences, U.K. 1998.
2. Brown T.A., Gene cloning and DNA analysis, Wiley Blackwell science. 6th edition, 2010.
3. Watson, Molecular Biology of the gene, Person education, Singapore.5th edition, 2004
4. Kreuzer-Massey, Recombinant DNA and Biotechnology, ASM Press, 2001
5. Alcamo, I. Edward. DNA Technology, Academic Press, 2001
6. Walker J.M. and R. Rapley, Molecular Biology and Biotechnology, 4th edition. 2006
7. Glick, B.R. and J.J. Pasternak, Molecular Biotechnology. Panima Publishing House, New Delhi, India. 2002.
8. Primrose, S.B. Molecular Biotechnology. Panima Publishing House, New Delhi, India. 2001.
9. Winnacker, E.L., Genes to Clones. Panima Publishing House, New Delhi, India. 2003.
10. Singh B.D., Molecular biology and Genetic Engineering, Kalyani publishers.2005

Course Objective (Employability)

To provide the students with the basics of bioprocess principles and bioreactor engineering. To develop bioengineering skills for the production of biochemical products using integrated biochemical processes.

UNIT I: Introduction to Bioprocess Technology **12**

Scaling up of a Bioprocess, Upstream Processing, Downstream Processing, Fermentation- Types of Fermentation, Its significance in Industry, Submerged Fermentation and Solid-state fermentation, batch fermentation and continuous fermentation, Chemostat Fermentation.

UNIT II: Design of Fermentation Process **12**

Kinetics of substrate utilization, biomass growth and product formation, inhibition on cell growth and product formation. Design and operation of continuous cultures, chemostat in series, batch and fed batch cultures, total cell retention cultivation.

UNIT III: Bioreactor Design & Construction **12**

Basic configuration of Fermentor, Batch, continuous and fed batch cultivation, cell recycle cultivation, High cell density cultivation, two stage cultivation, packed bed reactor, airlift reactor, fluidized bed reactor and bubble column reactor. Media design and optimization for fermentation process, Thermal death kinetics of microorganism, Sterilization of liquid media and air, Design of batch and continuous sterilization, Biomass estimation - direct and indirect methods.

UNIT IV: Downstream Processing **12**

Filtration, centrifugation, cell disruption, liquid/liquid extraction, dialysis, Purification, Drying, Packing and labelling. Good Manufacturing Practices, Biosafety - laws and concerns at different levels- individual, institution and society. Forms of IPR and process of patenting.

UNIT V: Fermentation Derived Products **12**

Industrial production of Primary metabolites and secondary metabolites- shikimic acid, flavanoids Fermentative production of alcohol, citric acid; Amino acid – Phenylalanine; Vitamins – Riboflavin; Antibiotics – Penicillin; Microbial production of enzymes- amylase,

protease, cellulase; SCP production.

Total Hours: 60

Course Outcome:

- CO-1: Understand on operation modes and select appropriate bioreactor configurations based upon the nature of bioproducts and cell lines and other process criteria.
- CO-2 Explain type of Bioprocess and standard Lab practices.
- CO-3: To Design bioreactor and control process of bioreactor.
- CO-4: List out different techniques involved in downstream processing.
- CO-5: Maximize Industrial production conditions through fermentation

TEXT & REFERENCE BOOKS

1. Stanbury P.F., A Whitaker and S.J.Hall , Principles of Fermentation Technology, Elsevier. 2008.
2. Kalichelvan P.T. and I Arul Pandi, , Bioprocess Technology, MJP Publishers, Chennai, 2009.
3. Shuler M.& F.Kargi, Bioprocess Engineering, Prentice Hall (I) Ltd., N.Delhi. 2002.
4. Mansi E.M.T., C.F.A. Bryce. A.L..Dmain, A.R.Alliman. Fermentation Microbiology and Biotechnology, , Taylor and Francis. New York, 2009.
5. Cassida L.E, Industrial Microbiology, John Wiley and Sons Publishers. 1968.

GENETIC ENGINEERING AND BIOPROCESS TECHNOLOGY PRACTICALS 0042

Course Objective: (Employability)

To educate and train the students for lab techniques of genetic engineering and gene cloning. To learn - microbial process fundamentals, enzyme catalysis. Bioreactor design and analysis.

List of Experiments:

Genetic Engineering

1. Isolation of genomic DNA and Plasmid DNA
2. Estimation and identification of nucleic acids and protein (AGE, SDS).
3. Transformation, selection of transformed colonies and preservation
4. Blotting Techniques – Southern, Northern
5. PCR and Manual DNA sequencing (Demo)

Bioprocess Technology

1. Growth optimization of Bacteria – Estimation of Biomass, calculation of specific growth rate, Yield coefficient.
2. Growth optimization of Algae - Estimation of Biomass, calculation of specific growth rate, Yield coefficient.
3. Effect of pH on enzyme activity
4. Effect of temperature on enzyme activity
5. Immobilization of enzymes – Entrapment Method
6. Effect of different substrate for the production of citric acid by *Aspergillus niger* by solid substrate fermentation and estimation of citric acid

Total : 30 Hours

Course Outcome

- CO-1: Demonstrate training in isolation of Bacterial Culture.
- CO-2: Illustrate genomic and plasmid DNA isolation and Agarose gel electrophoresis and SDS-PAGE

- CO-3: Students will be given practical training in Purification and Quantization of nucleic acids and about selection of transformed colonies and preservation.
- CO-4: Explain about biological and kinetic concepts underlying bioprocesses engineering
- CO-5: Elaborate the procedures for the design and control of industrial scale fermentation and biological waste treatment processes.

TEXT & REFERENCE BOOKS:

1. Sambrook, J, E.F. Fritsch and T. Maniatis, Molecular Cloning, A Laboratory Manual, Cold Spring Harbor Laboratory Press, New York. 2000.
2. Glover, D.M. and B.D. Hames, DNA Cloning a Practical Approach. IRL Press, Oxford. 2000.
3. James, J.G. and V.B. Rao, Recombinant DNA Principles and Methodologies. Marcel Dekker Publications, New York. 2001.
4. Maliga, P., Methods in Plant Molecular Biology. A Laboratory Course Manual, Cold Spring Harbour Laboratory Press, New York. 2000.
5. Bailey and Ollis, — Biochemical Engineering Fundamentals, McGraw Hill (2nd Ed.), 1986.
6. Shuler and Kargi, — Bioprocess Engineering —, Prentice Hall, 1992.
7. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications., 1995
8. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Butterworth-Heinemann., 3rd Edition, 2016.

Course Objectives (Skill Development)

To provide wider and global perspective of techniques involved as well as the genetic basis of the immunological diseases and their cure, with an ability to discriminate, evaluate, analyse and synthesis existing and new knowledge, and integration of the same for enhancement of knowledge

UNIT I Introduction to Immunotechnology 12

Brief history of Immunotechnology, immune system, components of immune system, Innate and adaptive immune system, external and internal barriers, phagocytosis. Antigen clearance mechanism.

UNIT II Antibodies & Immunodiagnosis 12

Monoclonal and polyclonal antibodies – their production and characterization – Western blot analysis – Immuno electrophoresis, SDS-PAGE – Purification and synthesis of antigens – ELISA principle and applications – Radio immuno assay (RIA) principles and applications – Non isotopic methods of detection of antigens – Enhanced chemilluminescence assay

UNIT III: Cellular Immunology 12

PBMC separation from the blood; identification of lymphocytes based on CD markers; FACS; Lympho -proliferation assay; Mixed lymphocyte reaction; Cr51 release assay; macrophage cultures; cytokine bioassays- IL2, gamma IFN, TNF alpha; HLA typing.

UNIT IV: Immunopathology 12

Preparation and storage of tissues, identification of various cell types and antigens in tissues – Isolation and characterization of cell types from inflammatory sites and infected tissues, functional studies on isolated cells – Immuno cytochemistry – Immuno fluorescence, Immuno-enzymatic and Immuno-ferritin techniques, immuno-electron microscopy.

UNIT V: Molecular Immunology 12

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

Total: 60 Hours

Course Outcome

- CO-1: Summarize on techniques like developing diagnostic tests, characterization of lymphocytes, and purification of antigens.
- CO-2: Explain on the molecular events involved in immunological processes and their regulation
- CO-3: Illustrate health problems with an immunological background.
- CO-4: Analyze molecular immunology for diagnosis of disease.
- CO-5: Develop approaches of immune intervention

TEXT & REFERENCE BOOKS

1. Roitt, Ivan. Essential Immunology, Blackwell Scientific, 9th Ed, 1997.
2. Goldsby, R.A., Kindt, T.J., Osborne, B.A & Kerby, J. Immunology., W.H Freeman, 5th Ed, 2003.
3. Jenni, Punt, Sharon, Stanford, Patricia, Jones and Judith, A, Owen, “Kuby Immunology”, WH Freeman & Co., 8th Edition, 2018.
4. Ashim K. Chakravarthy, “Immunology and Immunotechnology”, Tata McGraw-Hill, 2006.
5. Weir, D.M & Stewart, J. Immunology, Churchill Livingstone, 8th Ed., 1997.

Course Objectives (Skill Development)

To teach advanced techniques and skills required in diagnosis, treatment and research in Immunotechnology. To acquire knowledge concerning the principles and applications of immunoassay procedure.

LIST OF EXPERIMENTS

1. Collection of Blood, Serum and Plasma
2. Methods of bleeding (Eg. Tail bleeding, Intravenous, intraorbital)
3. Collection of serum, storage and purification of total IgG (salt precipitation).
4. Blood smear identification of leucocytes by Giemsa stain
5. Identification of various types of immune cells in peripheral blood smear
6. Agglutination reactions: Determination of hemagglutination titer of IgM antibodies using human RBC
7. Double immunodiffusion (Ouchterlony Double Diffusion)
8. Radial immunodiffusion test
9. Antigen-antibody reaction-Haemagglutination, precipitation-Widal and VDRL
10. Affinity chromatography for antibody purification.
11. ELISA-DOT and plate ELISA
12. Western blotting

Total: 30 Hours**Course Outcome**

- CO-1: Summarize on immune system cells and tissues.
- CO-2: Understand on immunological and clinical tests.
- CO-3: Illustrate on collection and storage of serum.

- CO-4: Explain on Immunodiffusion techniques.
- CO-5: Discuss on ELISA and Western blotting.

REFERENCE BOOKS

1. Edward A. Greenfield. Antibodies: A Laboratory Manual, Cold Spring Harbor Laboratory Press, 2nd Edition, 2014
2. John E. Coligan.et al. Current protocols in immunology, New York: Wiley Interscience, 2003.
3. Practical Immunology Frank C. Hay and Olwyn M.R. Westwood, Blackwell Science Ltd., 4th edition, 200

Course Objectives (Employability)

The objective of the course is to give students new knowledge and widening of the knowledge acquired in other courses by handling classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production.

UNIT I: History of plant tissue culture. 12

Concept of totipotency. Application of plant tissue culture- Agriculture, horticulture, forestry, cryopreservation, germplasm conservation. Design of Plant tissue culture laboratory. Nutritional requirements of plant tissue culture. Composition of MS media, Gamborg's media, Nitch's media, White's media and their preparation. Plant growth regulators. Sterilization techniques.

UNIT II: Plant micropropagation 12

Micro grafting, advantages of hairy root culture and culturing of meristem and shoot tip. Establishment and maintenance of callus and suspension culture. Somatic embryogenesis- Synthetic seeds.

UNIT III: Haploid plant production 12

Anther and microspore culture, triploid production, embryo culture and embryo rescue. In vitro pollination and fertilization. Protoplast isolation – fusion and culture regeneration. Somatic hybrids and cybrids. Somaclonal and gametoclonal variation.

UNIT IV: Plant genome organization. 12

Role of RFLP in plant breeding. DNA bar-coding in plants. Transposable elements in plant. Plant transformation technology: Ti and Ri plasmids, binary & co-integrated vector systems; viral vectors and their applications; 35S and other promoters; genetic markers; reporter genes; virulence genes; Cloning Strategies; Gene transfer methods in plants – Direct DNA transfer methods, Agrobacterium mediated gene transfer.

UNIT V: Application of gene transformation in plant 12

Insect resistance, fungus resistance, virus resistance, drought, cold resistance, saline resistance,

Transgenic plant with vitamin A, Gene silencing in crop plants, Terminator seed technology, Production of therapeutic antibodies, edible vaccine. Extraction of secondary metabolites using plant tissue culture.

Total: 60 Hours

Course Outcome

Students will be able to

- CO-1: List the principles and processes in plant biotechnology.
- CO-2: Understand the concept of Plant Biotechnology.
- CO-3: Distinguish between different plant tissue culture techniques
- CO-4: Apply different techniques to produce better crop using the principles of biotechnology
- CO-5: Discuss on different Transgenic and concepts of Plant Metabolic Engineering

TEXT & REFERENCE BOOKS

1. Hammond J, McGarvey P and Yusibov V. Plant Biotechnology, Springer verlag. 2000
2. Satyanarayana U. Biotechnology, Books and Allied (p) Ltd., 3rd revised edition, 2005
3. Bhojwani SS and Razdan MK. 2004. Tissue Culture Theory and Practice. 2004
4. Paul Christou and Harry Klee. 2004. Hand Book of Plant Biotechnology Vol.I & II, John Wiley & Sons. 2004
5. Gupta PK. Elements of Biotechnology, Rastogi and Co. Meerut. 1996
6. Chawla. HS. Biotechnology in crop improvement, International Book. 1998
7. Slater, Scott and Fowler. Plant Biotechnology (The genetic manipulation of plants), Oxford University, UK, 2003.

Course Objective: (Employability)

To educate and train the students for lab techniques of plant tissue culture and its manipulation.

Plant Biotechnology

1. Sterilization techniques – Glass wares, media and laminar air flow chamber
2. Preparation of plant tissue culture media, Surface sterilization methods of explants and seed culture
3. Establishment of callus cultures
4. Micro propagation
5. Development of root and shoot by varying hormonal concentration
6. Hardening and green house transfer

Animal Biotechnology

7. Sterilization Technique in Animal tissue culture.
8. Preparation of animal cell culture medium.
9. Preparation of single cell suspensions from animal tissue
10. Preparation of Animal cell monolayer and Trypsinization of monolayer
11. Sub culturing of cell lines
12. Cell counting and Cell viability assay
13. Embryonated egg inoculation.

Total: 30 Hours**Course Outcome:**

- CO-1: Understand the maintenance of culture lines
- CO-2: Demonstrate on callus propagation of plants and Preparation of tissue culture medium
- CO-3: Summarize on membrane filtration and preparation of single cell suspension from spleen
- CO-4: Elaborate on Cryopreservation techniques for cell culture and gain practical training in the cell counting and viability assays.
- CO -5: Discuss on the organized preparation of the scientific reports for the experiments.

TEXT & REFERENCE BOOKS

1. Chawla H.S., "Plant biotechnology Laboratory Manual for Plant Biotechnology", Oxford & IBH Publishing Co. Pvt. Ltd., 2004.
2. Ritu Mahajan, Jitendra Sharma, R.K. Maharajan, "Practical Manual of Biotechnology", Vayu Education of India, 2010.
3. Michael R. Green, Joseph Sambrook, "Molecular Cloning: A Laboratory Manual", Fourth Edition, 2014.
4. Ian Freshney R. "Culture of Animal Cells: A Manual of Basic Technique", Wiley-Liss, 2005.
5. William Wu, Michael J. Welsh, Peter B. Kaufman, Helen H. Zhang, "Methods in Gene Biotechnology", CRC Press, New York., 1997
6. Melody S. Clark. "Plant Molecular Biology - A Laboratory Manual", Springer
7. Publication New York., 1997
8. Bruce A. White, "Methods in Molecular Biology", Chapman and Hall, London,
9. New York., 1997
10. Melody S. Clark. "Plant Molecular Biology - A Laboratory Manual", Springer, 1997

ENVIRONMENTAL AND NANOBIO TECHNOLOGY 4 0 0 4

Course Objective: (Employability)

Students will understand the importance of living beings and their role in Environment, and importance of Nanoscience in biotechnology.

UNIT I Introduction 12

The scope of environmental biotechnology; Biodegradation of macromolecules; biodegradation of xenobiotics; Heavy metal pollution; bioremediation of metal contaminated soils; spilled oils and grease deposits and synthetic pesticides.

UNIT II Bioremediation 12

Phyto-remediation. Degradation of pesticides and other toxic chemicals by microorganisms- degradation of aromatic and chlorinated hydrocarbons and petroleum products. Treatment of municipal waste and Industrial effluents.

UNIT III Biomining and biofertilizer 12

Biomining, Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM).

UNIT IV Introduction to Nanotechnology 12

History and Scope of nanotechnology. Nanostructures: Nanometer, Quantum dots, Fullerenes Nanorods, Nanotubes, Nanofibres. Properties of Nanomaterials. Carbon nanotubes and their properties. Nanocomposites and Nanomachines.

UNIT V Applications of bionanotechnology 12

Nanobiotechnology and future perspectives. Biological nanostructures. Nanolithography. Application of nanobiotechnology in health and life sciences. DNA and Protein as Nanostructures. Nanoparticles in drug delivery and Biocompatibility.

Total: 60 Hours

COURSE OUTCOME:

On completion of the course, the student should be able to:

- CO-1: Understand on fundamentals of Environmental science and how the macromolecules and gene modifying substances are degraded.
- CO-2: Outline how plants are used in remediation and how, Aromatic and Chlorinated Hydrocarbons are degraded
- CO-3: Explain how the microbes and plants are used in Biomining of minerals / metals and to know different types of Biofertilizers including bacteria, algae and fungi.
- CO-4: List the importance of Nanotechnology an Interdisciplinary science and able to identify different types of Nanostructures
- CO-5: Elaborate DNA and Protein as a Nanostructure and how the Nanomaterials are serving as drug delivering agents.

TEXT & REFERENCE BOOKS:

1. Kumaresan V, N Arumugam, Environmental Biotechnology ,Saras,2014
2. Sandhya Jadhav, A Text Book of Environmental Biology and Biotechnology 2nd Edition Vision, Publications 2012
3. Evans,G.M and Furlong J.C. Environmental biotechnology: theory and application.John Wiely and Sons. 2003.
4. Manahan, S.E. Environmental science and technology. Lewis, New York, 1997.
5. Metcalf and Eddy (eds). Wastewater engineering: treatment and reuse, Tata McGraw-Hill, New Delhi. 2003.
6. Pradipta Kumar Mohapatra, “Environmental Biotechnology”, I.K. International Publishing House; 1st Ed. Edition,2007.
7. ManasiKarkare, Nanotechnology: Fundamentals and Applications, I K International Publishing House Pvt. Ltd ,2008.
8. Charles Poole, Frank Owens, Introduction to Nanotechnology, Wiley 2007.

Course Objective: (Employability)

The Wide scope for animal biotechnologists is there as they can be absorbed by the biotechnology industry, research organizations, food – processing units and pharmaceutical industry.

UNIT-I Animal cells **12**

Aseptic techniques, elements of aseptic environment, safety and risk assessment, biohazards. Culture media, types of media. Physical, chemical and metabolic functions of different constituents of culture medium; role of carbon dioxide, serum, growth factors, glutamine in cell culture; serum and protein free defined media and their applications.

UNIT-II Cell culture **12**

Primary cell culture: isolation of tissues from chick embryo, mouse and human biopsies. Methods of maintenance of tissues, continuous and established cell cultures. Organ culture: types and limitations, histotypic and organotypic cultures. Cell separation techniques, cryopreservation. Cell-cell interaction. cell death – apoptosis and its determination.

UNIT-III Cell techniques **12**

Gene transfer method in Animal, Cytotoxicity assays, characterization of cultured cells, molecular techniques in cell cultures: in situ hybridization, cell fusion methods, production of monoclonal antibodies, somatic cell hybridization and cell cloning and selection.

UNIT-IV Embryology **12**

Collection and preservation of embryos; culturing of embryos; gametogenesis and fertilization in animals, Artificial insemination, *In vitro* fertilization and stem cell research. Ethical issues in animal biotechnology.

UNIT-V Transgenics, Animal Husbandry and Dairy Science **12**

Transgenic animals; production and application; transgenic animals as models for human diseases; Breeding methods of Cattle and buffalo Milking methods and principles, Clean milk production, Feeds and feeding, Conservation of fodder, Housing for dairy animals and Common animal diseases .

Total: 60 Hours

Course Outcome:

- CO-1: Demonstrate on Animal tissue culture techniques and about Medium used in Animal Biotechnology
- CO-2: Understand the various cell culture technique and explain Gene transfer methods in animals
- CO-3: Explain about Artificial insemination and IVF and well versed with organ culture
- CO-4: Discuss and gain knowledge about Animal disease
- CO-5: Elaborate on Growth hormones and well versed with Transgenic Animal

TEXT & REFERENCE BOOKS

1. Ranga, M. M. Animal Biotechnology, Agrobios India, Jodhpur. India., 2nd Edition, 2003
2. Freshney, R.I., Animal Cell Culture: A Practical Approach. John Wiley Publications, New York. 4th Edition, 2000
3. Glick, B.R. and J.J.Pasternack., Molecular Biotechnology. Blackwell Science, U.K, 3rd Edition, 2003
4. Gordon, I., Laboratory Production of Cattle Embryos., CAB International. New Delhi. 2nd Edition ,2003
5. Houdebine, L.M., Transgenic Animals: Generation and Use., CRC Press, New york, 5th Edition, 1997
6. Jenkins, N., Animal Cell Biotechnology Methods and Protocol. Humana Press, Totowa, New Jersey and Panima Publishing Corporation, New Delhi., 1999
7. Yagasaki, K., Y. Miura, M. Hatori and Y. Nomura, Animal Cell Technology: Basic and Applied Aspects. Vol. 13 .Springer-Verlag, New York., 2008
8. Primrose, S. B., R. M. Twyman and R. W. Old, Principles of Gene Manipulation., Blackwell Science Publishing Company, Germany., 4th Edition. 2001
9. Portner, R., Animal Cell Biotechnology: Methods and Protocols. Vol. 24 Springer-Verlag, New York, LLC, 2007

RESEARCH METHODOLOGY AND BIOSTATISTICS 4 0 0 4

Course objective: (Skill Development)

To provide fundamental theoretical knowledge about Research Methodology, and Biostatistics.

UNIT-I: Introduction 12

Definition- Objectives- Types- Significance of Research- Steps in research process Criteria for good research. Defining and formulating a research problem- Literature survey- Development of working hypothesis.

UNIT-II: Research Design: 12

Definition and related concepts, Basic principles of experimental designs- Informal and formal experimental designs; Sampling design: Steps in sample design, Non-probability sampling and Probability sampling -random sampling; Measurement and scaling techniques- Methods of data collection - Execution of project -Processing and analysis of data- Hypothesis testing - Interpretation and report writing- Steps and layout of research report- Types of report, review paper writing and presentation.

UNIT-III: Qualitative and Quantitative Research 12

Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

UNIT-IV: Statistical Methods 12

Measures of Central tendency -Mean, Median, Mode– Measures of Dispersion- Range, Quartile Deviation, Standard Deviation and Coefficient of variation. Correlation and regression analysis: Correlation: Types of Correlation-Methods of studying correlation- Regression: Regression Lines and Regression equations - simple problems.

UNIT-V: Testing of Hypothesis 12

Introduction-Tests of Significance for small samples: t-test -F-test (variance –Ratio test), Chi-Square tests - Analysis of Variance : One way and Two Way Classifications Basic Principles of

Experimentation – Completed Randomized Design – Randomized Block Design- Latin Square Design.

Total: 60 Hours

Course outcome:

- CO-1: Understand on fundamentals of research and learn about research problem
- CO-2: Analyse the data for research purpose
- CO-3: Explain on sampling and its importance and gain knowledge on Basics on Qualitative and Quantitative Research
- CO-4: Evaluate on merging the two approaches and apply statistics and interpretation in Biological studies
- CO-5: Explain on different statistical parameters in application in biology, Hypothesis and Analysis of Variance

TEXT & REFERENCE BOOKS

1. Kothari CR, Research Methodology: Methods and techniques, 2nd Edition, New age International Publishers, 2010
2. Gurumani N. Research Methodology for Biological Science, MJP Publishers, Chennai. 2006
3. S.P.Gupta, Statistical Methods. Sultan Chand & Sons, New Delhi, 2012
4. S.C. Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons, 3rd Edition, 2001.
5. P.R. Vital, Business Statistics, Margham Publications, Second Edition, 2012
6. Beri. G, Business Statistics, Tata McGraw Hill Publishing Company Limited, 2009.
7. S.P. Rajagopalan and R. Sattanathan, Business Statistics and Operations Research, Vijay Nicole Pvt. Ltd. 2nd Edition, 2009.

Course objective:

Students should do research on their own interest or research guide interest on any biotechnology topic for 6 month in the university or any industries or laboratories. After the research, he/she should submit the detailed reports about the research in a dissertation and should present it to an external examiner.

- Students should do research on their own interest or research guide interest on any biotechnology topic for 6 month in the university or any industries or laboratories.
- The candidates shall undertake the major project work in the Sixth Semester either in the Department concerned or in industries, institutes or any other organizations and the project report shall be submitted at the end of the Sixth semester.
- In case the candidate undertakes the project work outside the Department, the Staff concerned within the Department shall be the Main guide and the Staff/scientist under whom the work is carried out will be the Co-guide. The candidate shall bring the attendance certificate from the place of project work carried out.
- After the research, he/she should submit the detailed reports about the research in a dissertation and should present it to an external examiner.
- Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.
- The report will be evaluated by duly appointed teaching faculty from head of department

Syllabus

Discipline Specific Elective Courses

Course Objective: (Skill Development)

To provide fundamental knowledge about Genetics, mutations, DNA repair, RNA and protein synthesis

UNIT-I: Introduction and theory **12**

Genetics: Principles of Mendelian inheritance, linkage, recombination, genetic mapping; extra chromosomal inheritance; prokaryotic and eukaryotic genome organization, regulation of gene expression, gene mutation and repair, chromosomal aberrations (numerical and structural), monopoly, polyphyly, & paraphyly taxon.

UNIT-II: Inheritance and Sex determination **12**

Development of genetics: gene versus allele concepts(pseudo alleles); quantitative genetics and multiple factors; incomplete dominance, polygenic inheritance, multiple alleles ; linkage and crossing over; methods of gene mapping, including molecular maps(idea of mapping functions)sex chromosomes and sex linked inheritance, sex determination and molecular basis of sex differentiation; mutations.

UNIT-III: Mutation and DNA repair **12**

Microbial genetics: Types of mutation; UV and chemical mutagens; selection of mutants; Ames test for mutagenesis; bacterial genetic system transformation, conjugation, transduction, recombination, plasmids, transposons; dna repair; regulation of gene expression; repression and induction; Operon model; bacterial genome with special reference to *E.coli*; phage λ and its life cycle RNA phages; RNA viruses; retroviruses; basic concept of microbial genomics.

UNIT-IV: Transcription **10**

Transcription factors and machinery , formation of initiation complex, transcription activators and repressors, RNA polymerase, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation structure and function of different types of RNA, RNA transport.

UNIT-V: Translation **14**

Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors

and their regulation, elongation and elongation factors termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proofreading, translation inhibitors, post-translational modification of proteins, role of chromatin in regulating gene expression and gene silencing.

Total: 60hrs

Course Outcome:

- CO-1: Recall on principles in genetics and genome organization in cells
- CO-2: Understand the inheritance of character and the sex determination
- CO-3: List on various types of mutation and its causes and its repair system
- CO-4: Explain about operon system in gene control and the transcription procedure
- CO-5: Discuss about different types of RNA and Student can able to explain translation procedure

TEXT & REFERENCE BOOKS

1. Phundan Singh, “Molecular genetics”, IBDC Publishers,2010.
2. Sabyasachi Roychoudhuri, “A Textbook of Genetics and Molecular Biology”, New Central Books Agency; 1st edition, 2011.
3. Sarin, “Genetics”, - Tata McGraw hill, 1991.
4. Gardner, Simmons and Snustd,“Principles of Genetics”, John Wiley & Sons; 8th Edition, 1991.
5. HartlD.L.G,“Basic genetics”, Jones and publishers, 1991.
6. Date J.W. “Molecular Genetics of Bacteria”, Wiley and sons, 1994.

Course Objective: (Employability)

To provide fundamental theoretical knowledge to the students about bioinstruments and bio methods, its principle and operation methods.

UNIT-I: 12

Microscopic Techniques: Visualization of cell and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission electron microscope, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing method in microscopy.

UNIT-II: 12

Biophysical method : Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy ,structure determination using x-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasmon resonance methods.

UNIT-III: 12

Histochemical and immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry, in situ localization by techniques such as FISH and GISH, Separation techniques: Chromatography

UNIT-IV: 12

Radio labeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioisotopes material, safety guidelines.

UNIT-V: 12

Types of PCR, Introduction to Next generation sequencing techniques – Nanopore and Ion torrent, Applications - Personal Genomics, Metagenomics, Separation Techniques: types of Chromatography

Total Hours: 60

Course Outcome:

- CO-1: Understand on Basics of Microscopy, its operation and maintenance and learning advanced microscopes like SEM, TEM, STEM, FESEM etc and image processing for microscopical studies.
- CO-2: Illustrate about the analysis of biomolecules using spectroscopy and Applications of NMR and ESR in determination of biomolecules
- CO-3: Explain on antigen antibody reactions and detect molecules in living cells using FISH and GISH
- CO-4: Apply radio-isotopes in detection and measurement of biomolecules and to learn biological imaging of tissues using radio-isotopes
- CO-5: Explain on isolation and purification of genetic materials and sequencing genomes and RFLP, RAPD and ALP techniques

TEXT& REFERENCE BOOKS

1. Veerakumari L., Bioinstrumentation, Publishers; 1st edition, 2011.
2. Webster, Bioinstrumentation ,Wiley India Private Limited , 2007.
3. John G Webster, Bioinstrumentation. John Wiley & Sons, New York, Physical John, 2004.
4. Robyt F., Bernard J. White, Biochemical Technique: Theory and Practice, - Waveland PrInc; Reprint edition, 1990.
5. Wilson, K., Walker, J. E. J. Wood, K., Walker, J, Principles and techniques of practical biochemistry Cambridge University Press, Cambridge, 5th Edition, 2000.
6. Michael R. Green, Joseph Sambrook, Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, U.S, 4th Edition, 2014

TISSUE ENGINEERING AND STEM CELL BIOLOGY 4004

Course Objective: (Employability)

To provide fundamental theoretical knowledge to the students about Tissue Engineering in animal cell and Stem Cell Biology.

UNIT I Basic biology of tissue engineering 12

Basic biology of tissue engineering; the basis of growth and differentiation – morphogenesis and tissue engineering. In vitro control of tissue developmental – Growth factors; Role of basic fibroblast growth factors and angiogenesis. Biomaterials in tissue engineering. Cell-Based Therapies, Tissue Morphogenesis.

UNIT II Biomaterials and bioreactors 12

Biomaterials Scaffolds, Scaffold Fabrication and Tailoring, Bioreactor technologies; Bioreactor modulation of Tissue formation, Bioreactor cultivation of functional tissues and its applications. Bio artificial pancreas, renal replacement devices. Structural tissue engineering – Bone regeneration through cellular engineering-Brain implants –Neural stem cell – Periodontal applications – Artificial womb. Synthetic.

UNIT III Introduction to stem cell 12

Stem cell – Definition, characterization, Pluripotent stem cells, Self renewal and differentiation, hierarchy, Stem cell niche, Niche specification - Drosophila germ line stem cells. Types of stem cells: Adult stem cell from amniotic fluid, cord blood and tooth primordial. Neural stem cells and its applications.

UNIT IV Cell signals and its pathways 12

Characteristics of stem cell – cell cycle, Ras/ Raf pathways, P13K cell signaling, p53 check points, Role of LIF pathways in cell cycle control. Stem cell communications – gap junctions, cell fusions, HOX genes, upstream transcriptional factors, Tran differentiation, cell fusion.

UNIT V Applications of stem cells 12

Therapeutics applications of embryonic stem cells, Bone marrow stem cells, Adipose derived stem cells and Hematopoietic stem cells in heart regeneration and neural defects. Ethics in human stem cell research; Controversy surrounding human embryonic stem cell research,

societal implications: women, low-income, Different religious views, Current Ethical Guidelines in India, Ethical views of other countries and how this affects advancement of science Policy.

Total : 60hrs

Course Outcome:

- CO–1: Understand on fundamentals of tissue engineering, tissue morphogenesis.
- CO–2: Illustrate about the Biomaterials Scaffolds, Scaffold Fabrication and Tailoring, Bioreactor technologies; Bioreactor modulation of Tissue formation and Structural tissue engineering – Bone regeneration through cellular engineering-Brain implants –Neural stem cell.
- CO–3: Explain on types of stem cells and characterizations.
- CO–4: Discuss about Ras/Raf pathways and stem cell communications.
- CO–5: Elaborate about therapeutics applications of embryonic stem cells and Bone marrow stem cells, Adipose derived stem cells and controversy surrounding human embryonic stem cell research.

TEXT & REFERENCE BOOKS

1. Jonathan Slack ,Stem cells- A Very Short Introduction, Oxford, 2012.
2. Bernhard O. Palsson ,Sangeeta N. Bhatia, Tissue Engineering, Prentice Hall; 1st edition, 2003
3. Robert P. Lanza, Robert Langer and Joseph Vacanti. Principles of tissue engineering. Academic Press.4th edition, 2013
4. Micklem.H.S.,LoutitJohn.F., Tissue grafting and radiation, Academic Press, New York.2004.
5. Penson, Balducci.D.,Tissue cultures in biological research, Elsevier, Amsterdam.2004.
6. Robert Lanza, John earhart, Brigid Hogan, Douglas Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut, Essentials of Stem Cell Biology,Academic Press,2009.
7. Robert Lanza. “Essential of Stem Cell Biology” Academic Press, 2005.
8. James Thomson et al; “Handbooks of Stem Cells’ Embryonic / Adult and Fetal Stem Cells” Vol I and II, Academic Press 2004.

Course Objective (Employability)

To provide the students a broader knowledge on the structure and function of genomes, the technologies developed for genomics, functional genomics and proteomics.

UNIT-I: Organization of genomes **12**

Introduction: Genome, Genomics, Omics and importance, General features, C-value paradox. Gene identification; gene prediction rules and software; Genome databases; Annotation of genome. Genome diversity: taxonomy and significance of genomes – bacteria, yeast, Caenorhabditis, Homo sapiens, Arabidopsis, etc.

UNIT-II: Mapping genomes **12**

Genetic mapping – i) Cross breeding and pedigree analysis, ii) DNA markers - RFLPs, SSLPs, SNPs Physical mapping - Restriction mapping, Fluorescent in situ hybridization, Radiation hybrid mapping and Sequence tagged site mapping.

UNIT-III: Genomics **12**

Genome projects: The Human genome project, HapMap Project, The 1000 genome project, and The ENCODE Project. Structural genomics: Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing Understanding a genome sequence: locating the genes in a genome sequence, determining the functions of individual genes and by studying the activity of a protein coded of an unknown gene

UNIT-IV: Technological Applications of Proteomics techniques **12**

Qualitative and quantitative proteome analysis; Proteome characterization techniques – 2D-gel electrophoresis, DIGE, Mass Spectrometry – Concepts, Ionization (MALDI, ESI, Nanospray, Mass Analyzers – Time of Flight, Magnetic sector, Quadrupole, Orbitrap; MS-MS approaches, Peptide Mass fingerprinting and Post Translational Modifications Interactomics

UNIT-V: Protein engineering **12**

Protein protein interaction assays - Two-hybrid methods, TAP/ GFP tags, Phage Display, Protein chips; Proteome-wide interaction maps, Proteomics workflows ; Protein Engineering; An

introduction to systems biology.

Total: 60 Hours

Course Outcome:

- CO-1: Understand the organization of genomes in multiple levels of taxonomy
- CO-2: Illustrate methodologies and approaches used for the study of structural and functional genomics.
- CO-3: List on various genome mapping and sequencing methods, genomic markers, microarray technology and methods for proteomics
- CO-4: Analyze on importance of milestone of genome project
- CO-5: Explain genome evolution and Synthetic genomes and their applications

TEXT & REFERENCE BOOKS

1. Brown T. A., Genomes 3. Garland Science Publishing, New York, 2007
2. Dunham, I., Genome Mapping and sequencing. Horizon Scientific, 2003
3. Graur, D and W H Li, Fundamentals of molecular evolution. Sinauer Associates. 2000
4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. Genetics from Genes to Genomes. McGraw Hill., 2004
5. Lewin B. Genes VIII. Oxford University Press. Oxford, 2003
6. The Human Genome, Nature Vol. 409, 2001.
7. The Drosophila Genome, Science Vol. 267, 2000.
8. The Caenorhabditis elegans genome, Science Vol. 282., 1998
9. The Arabidopsis Genome, Nature vol. 408, 2000
10. Primrose, S. B., and. Twyman. R M., Principles of gene manipulation and Genomics, Blackwell Publishing MA. USA, 7th Edition, 2006.

Course Objective: (Employability)

To provide knowledge about the fermentation technological process for industrial importance.

UNIT-I: Introduction to fermentation technology **12**

Introduction to fermentation technology; interaction between chemical engineering, microbiology and biochemistry. History of fermentation introduction to fermentation processes, microbial culture selection for fermentation processes. Media formulation and process optimization.

UNIT-II Bioreactors and its design **12**

Bioreactors: Functions, design, aeration and agitation, sterilization instrumentation and control. Types of bioreactors, continuous and Fed-batch cultures, Garden's fermentation classification, design and operation of fermenters, basic concepts for selection of a reactor, packed bed reactor, fluidized bed reactor, trickle bed reactor, bubble column reactor and scale up of bioreactors.

UNIT III Industrial microbes **12**

Production of industrial starters: isolation, maintenance and development of microorganisms. Starter utilization, immobilization of biocatalysts: kinetics effects, inactivation kinetics biocatalysts in non-conventional media (biphasic, organic, ionic liquids, supercritical fluids).

UNIT IV Downstream process **12**

Downstream processing. Recovery of particulate matter, product isolation, distillation, centrifugation, whole broth processing, filtration, aqueous two – phase separation, solvent extraction, chromatography and electrophoresis.

UNIT V Monitoring data and analysis **12**

Monitoring of bioprocesses – On-line data analysis for measurement of important physio-chemical and biochemical parameters. Computer based data acquisition, monitoring and control- LABVIEW software.

TOTAL : 60hrs

Course Outcome:

- CO-1 Understand the fundamentals of fermentation technology, interaction between chemical engineering, microbiology and biochemistry.
- CO-2: Summarize about different Bioreactors: Functions, design, aeration and agitation, sterilization instrumentation and control.
- CO-3: Explain about the production of industrial starters: isolation, maintenance and development of microorganisms and Starter utilization and immobilization of biocatalysts.
- CO-4: Illustrate on Downstream processing, Recovery of particulate matter, product isolation, distillation and Monitoring of bioprocesses
- CO-5: Analyze the On-line data for measurement of important physio-chemical and biochemical parameters, Computer based data acquisition and Monitoring and control- LABVIEW software.

TEXT & REFERENCE BOOKS

1. Kalaiselvan P T, I Arul Pandi, Bioprocess Technology (Volume 1), MJP Publishers; 1st edition, 2007.
2. Stanbury F, A Whitaker, Principles Of Fermentation Technology, Elsevier; 2 editions, 2008
3. Mukhopadhyay, S.N. processes biotechnology fundamentals, Viva Books Pvt. Ltd., 2001.
4. Keith Wilson and John Walker, Practical Biochemistry-principles and Techniques, Cambridge, 5th Edition, 2000.
5. Coulson and Richardson JF, chemical engineering-volume 3 (Chemical and biochemical reactors and process controls ed. Richardson, J.F., Peacock, D.G., First Indian ed. Asian Books Pvt. Ltd., 1998.
6. Bailey and Ollis, Biochemical Engineering Fundamentals, McGraw-Hill, 1990.
7. Ho, W.S.W. and K.K. Sirkar, Membrane Handbooks, Van Nostrand Reinhold, N.Y., 1992

MEDICAL AND HERBAL BIOTECHNOLOGY

4004

Course Objective: (Skill Development)

To provide detailed knowledge about medicinal and herbal biotechnology and its products.

UNIT-I: Introduction to medical biotechnology

12

Introduction to medical biotechnology and its scope. Disease Diagnosis and Therapy- ELISA and hybridoma technology,- DNA vaccine, - Gene Therapy,- Toxic genomics. DNA, RNA, Protein in Drug Development. Diagnosis of disease by Proteomics. Separation and identification techniques for protein analysis. Development of antibody based protein assay for diagnosis.

UNIT-II: Diagnosis and medical coding

12

Diagnosis and Kit Development- Use of enzymes in clinical diagnosis, Use of biosensors for rapid clinical analysis.- Diagnostic kit development for microanalysis. Introductions to medical coding and transcription. Importance of ICD9 and ICD10.

UNIT-III: Introduction to Stem Cell Biology

12

Introduction to Stem Cell Biology, Fate Mapping of Stem Cells, Stem Cell Pattern: Stem Cell Pattern of Cell type switching in Schizosaccharomyces pombe. The Notch/LIN-12 Communication System, Cell Cycle Control, Checkpoints, and Senescence of Dividing Somatic Cells. Drosophila Ovary: An In Vivo Stem Cell System, Male Germ-line Stem Cells, Primordial Germ Cells as Stem Cells, Embryonic Stem Cells, Trophoblast Stem Cells, Hematopoietic Stem Cells, Mesenchymal Stem Cells, Adult Bone Marrow stem cells, Epidermal Stem Cells: Liver Stem Cells, Pancreatic Stem Cells, Stem Cells in the Epithelium of the Small Intestine and Colon

UNIT-IV: Introduction to Herbal medicine

12

Study of history and scope of herbals. Important medicinal herbs in treating diseases. . Phytochemistry of medicinal plants- alkaloids- flavones- flavonoids and xanthones - furocoumarins - glycosides - naphthoquinones - phenols and acylphloroglucinols - resins, oleoresins and gum resins. Saponins - sesquiterpene - sterols and steroid like compounds - tannins and terpenes. Introduction to analysis and quality controls of herbal products (TLC, HPLC, IR, NMR, and mass spectroscopy).

Biotechnological methods of plant propagation - Micropropagation– Somatic Embryogenesis and somaclonal variation. Herbal gardening and maintenance - Standardization of cultivation protocols of selected medicinal plants; in vitro production of secondary metabolites. Polyhouse technology. Important diseases of medicinal plants and their management. Alternative method of secondary metabolite production - Organ culture, Cell culture, Biotransformation (Microbial and Plant cells) - Scale up - Enhancement of product formation by elicitation.

Total : 60 hrs

Course Outcome:

- CO-1: Understand about medical biotechnology and its scope and about the disease diagnosis, therapy –ELISA, hybridoma, proteomics.
- CO-2: Demonstrate about diagnostic kit development for microanalysis and Importance of ICD9 and ICD10.
- CO-3: List out the basics of Stem Cell Biology, Fate Mapping of Stem Cells, Stem Cell Pattern: Stem Cell Pattern of Cell type switching in Schizosaccharomyces pombe, Trophoblast Stem Cells, Hematopoietic Stem Cells and Mesenchymal Stem Cells.
- CO-4: Apply the important medicinal herbs in treating diseases and phytochemistry of medicinal plants and methods of analysis and quality controls of herbal products (TLC, HPLC, IR, NMR, and mass spectroscopy).
- CO-5: Explain about Biotechnological methods of plant propagation. - Micropropagation – Somatic Embryogenesis and somoclonal variation. Herbal gardening and maintenance. Alternative method of secondary metabolite production

TEXT & REFERENCE BOOKS

1. Trivedi P. C., Herbal Drugs and Biotechnology ,Pointer Publishers , 2009.
2. KhadabadiS. S., B. A. Baviskar S. L. Deore, Pharmacognosy and Phytochemistry: A Comprehensive Approach (Pharmacognosy),PharmaMed Press; 1 edition2014.
3. Prathibha Nallari ,V.VenugopalRao,Medical Biotechnology, Oxford University Press ,2010.

4. Agrawal S.S. and M. Paridhavi, Herbal Drug Technology, University press 2007.
5. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (ed), Concepts in Biotechnology, University, Press, 1996.
6. Anderson, F.J Illustrated History of the Herbals. New York: Columbia University press. 2009.
7. Kayser, O,R.H. Muller. Pharmaceutical Biotechnology - Drug Discovery and clinical applications. Wiley - VCH.2004.
8. Garywalsh. Biopharmaceutical, biochemistry and biotechnology.2003.
9. Robert Lanza. “Essential of Stem Cell Biology” Academic Press, 2005.
10. James Thomson et al; “Handbooks of Stem Cells’ Embryonic / Adult and Fetal Stem Cells” Vol I and II; Academic Press (2004).

Course Objective: (Employability)

To provide knowledge on principles of drug development, manufacturing, design and its importance in Pharmaceutical industry and Controlled Drug Delivery Systems.

UNIT 1: Basics Of Pharmacology, Drug Action & Metabolism **12**

History and Principle of pharmacology. Drug names and Classification systems. Route of drug administration, pharmacodynamics, pharmacokinetics – Absorption, Distribution, Metabolism and Excretion of drugs / metabolites, prodrugs, protein binding of drugs

UNIT 2: Drug And Its Treatments **12**

Chemo therapeutic drugs- Protein synthesis inhibitors, Anti mycobacterial, anti-fungal, anti-protozoal, antiviral, anticancer, anti-inflammatory drugs, Production of Ergot alkaloids, Probiotics. Human Insulin, Human Growth Hormone, Production of recombinant vaccines. Monoclonal antibodies.

UNIT 3: Controlled Drug Delivery Systems **12**

Concepts, Route of delivery - design of oral controlled drug delivery - dissolution controlled release system, diffusion-controlled release system and oral osmotic pump. Parenteral controlled drug delivery – liposomes, osmotic pump (implants). Transdermal drug delivery.

UNIT 4: Principles of Drug Manufacture **12**

Solid dosage forms – introduction to types of tablets, excipients, granulation techniques, compression machinery, processing problems, Coated tablets - types – enteric coated tablets, film coated tablets and sugar coated tablets. Evaluation of coated tablets. Production of hard and soft gelatin capsules, liquid dosage form – suspension and emulsion. Semisolid dosage form – ointment, GMP

UNIT 5: Biopharmaceuticals & Bioactivity **12**

Various categories of therapeutics like Laxatives, Analgesics, Contraceptives, Antibiotics and Hormones. Biochips, Biofilms, Biosurfactants.

Total: 60 Hours

Course Outcomes:

- CO-1: Understand different pharmaceutical parameters for the current and future biotechnology related products on the market.
- CO-2: Illustrate on biotechnological and pharmaceutical products, current medicines and their applications in therapeutic and diagnostic fields.
- CO-3: Analyze different types of Controlled Drug Delivery Systems.
- CO-4: Explain on current topical and newly emerging aspects of pharmaceutical biotechnology.
- CO-5: Elaborate the progress on the new drug to market and grasping the current regulatory acts and safety norms of the modern pharmaceutical industries.

TEXT & REFERENCE BOOKS:

1. Sivakumar.S M, Pharmaceutical Biotechnology. 2003
2. Sambamurthy.K, Pharmaceutical Biotechnology. 2006
3. Pharmaceutical Biotechnology (PB) Vyas S.P. / Dixit V. ISBN : 9788123906140, 2011
4. Walsh, Biopharmaceuticals: Biochemistry and Biotechnology, 2e (PB) ISBN : 9788126530014, 2011
5. Agrawal S.S. and M. Paridhavi, Herbal Drug Technology, University press 2007.
6. Kayser O., R.H. Muller. Pharmaceutical Biotechnology - Drug Discovery and clinical applications. Wiley - VCH. 2004

Course Objectives (Skill Development)

Students will understand the importance of Computing in Biological Sciences, Intellectual Property Rights (IPR), and Bioethics

UNIT I Biological Databases 12

Nucleic Acid sequence Databases: Genbank, NCBI, EMBL, DDBJ; Protein Sequence Databases: Swiss Prot, PIR; Structural Databases: PDB, CATH, SCOP and specialized databases.

UNIT II Tools for Bioinformatics 12

Pairwise alignment –Dotplots –scoring matrices –Blosum Matrices –PAM Matrix –Gap Penalty Alignment Algorithms: Needleman –Wunsch Global Alignment Algorithm ; Smith –Waterman Local Alignment Algorithm. Genome aligners- BLAST, MUMmer, Avid, LAGAN and Multi LAGAN. Protein gene prediction method - ORF finder, restriction analysis, secondary structure prediction. Homology modeling and drug designing.

UNIT-III IPR – Types 12

Introduction and the need for IPR, WTO, GATT, TRIPS, WIPO - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret, Indian patent act. IPR in current scenario with case studies.

UNIT-IV Bioethics 12

Introduction to bioethics, ethical issues in preclinical (animal) studies, & clinical studies- Ethical principles, Ethical guidelines-ICMR, Institutional Ethics - Institutional Ethics committees, Institutional review board, SOPs, ethical issues based on methodology of clinical research. The ethics of clinical research in developing countries.

UNIT V Biosafety 12

Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level, General guidelines for rDNA research. Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

Total: 60 Hours

Course Outcome:

On completion of the course, the student should be able to:

- CO-1: Define types of data and collection of data and basic statistics like mean, mode and median. Measuring central tendency, Kurtosis.
- CO-2: Understand about percentiles, variability, standard deviation and application of the same in the sample data and Sample distribution.
- CO-3: Summarize about the importance of IPR, Copyright and other Intellectual Property.
- CO-4: Explain about Patent law, International agreement and WHO's patent detail and importance of Bioethics in Science
- CO-5: Analyze about general Ethical guidelines and Understand Institutional Ethics committees, Institutional review board, SOPs in ethics.

TEXT & REFERENCE BOOKS:

1. Attwood T K, D J Parry-Smith, "Introduction to Bioinformatics", Pearson Education, 2005.
2. David W Mount, "Bioinformatics sequence and Genome analysis", Second Edition, Cold Spring Harbor Laboratory Press, 2013.
3. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
4. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
5. Tom L Beauchamp, Jeffrey Khan, LeRoy Walters, Anna C Mastroanni. (2013) Contemporary issues in Bioethics.
6. Neil C. Jones and Pavel A. Pevzner, "An Introduction to Bioinformatics Algorithms", MIT Press, 2005.
7. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
8. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>

PROJECT MANAGEMENT AND BIOTECH PRODUCTS ENTREPRENEURSHIP

4 0 0 4

Course Objective: (Entrepreneurship)

To provide detailed knowledge about Project Management and Biotech products Entrepreneurship that motivates the students in industrial firms.

UNIT I Introduction to Project management 12

Project management – framework; concept of a project, capital expenditure, Importance & difficulties, Phase of capital budgeting, feasibility study: overview. Resource allocation: elementary investment strategy, portfolio planning tools, strategic position & action evaluation.

UNIT II Project formulations 12

Financial identification & formulation- scouting for project idea, preliminary screening and project rating index. Market & demands analysis- market survey, characterization of market, forecasting & planning, profit potential of industries; porter model. Technical analysis- analysis of inputs, technology, product mix, capacities, location, civil works, charts, lay outs, work schedule.

UNIT III Project management plans 12

The triple constraints in project management, project management activities, project management objective, project management documents, project control variables, project management & clinical trials, role of project management in clinical trials, major roles of a project manager in a CRO, ensuring project success.

UNIT IV Business plan 12

Business plan preparation- sources of product for business -pre feasibility study-criteria for selection of products- ownership-capital- budgeting project profile preparation- matching entrepreneur with the project- Feasibility report preparation and evaluation criteria.

UNIT V Business development and biotech companies 12

Introduction & stages of business development-start-up phase, growth phase, maturity phase, decline phase. Outsourcing in clinical research, reasons for outsourcing to contract research organization, the India advantage, scope and future of CRO, list of clinical research

organizations in India, list of IT companies offering service in clinical research. role of business development manager.

Total : 60hrs

Course Outcome:

- CO–1: Understand about the project management – framework; concept of a project, capital expenditure.
- CO–2: Demonstrate on ideas, preliminary screening and project rating index and Technical analysis- analysis of inputs, technology, product mix, capacities, location, civil works, charts, lay outs, work schedule.
- CO–3: Illustrate on triple constraints in project management and will have an idea about project management & clinical trials, role of project management in clinical trials.
- CO–4: List about Business plan preparation- sources of product for business and will have an idea about matching the entrepreneur with the project- Feasibility report preparation and evaluation criteria. .
- CO–5: Explain about stages of business development-start-up phase, growth phase, maturity phase, decline phase and Outsourcing in clinical research.

TEXT AND REFERENCE BOOKS

1. Hisrich “Entrepreneurship”, Tata McGraw Hill, New Delhi, 2001.
2. Khanka S.S., Entrepreneurship development”, S. Chand and company limited, New Delhi, 2001
3. Craig Shimasaki, Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies [Kindle Edition] Academic Press; 1 edition, 2014.
4. Kumawat, H. S.. Modern Entrepreneur And Entrepreneurship Theory Process PracticeNeha Publishers & Distributors, 2013.
5. Erik Larson (Author), Clifford Gray, Project Management: The Managerial Process with MS Project (The Mcgraw-Hill Series Operations and Decision Sciences) 6th Edition, 2013.
6. Meri Williams, The Principles of Project Management, SitePoint; 1 edition, 2008.

INTERNSHIP

0042

Course objective: Students should go for training in any biotechnological industry or laboratories and learn their laboratory techniques by hands on training. After the training, students should submit detailed reports about the training in an assignment.

- For the benefit of the students, it has been mandatory to attend a minimum of one internship/ Mini project during semester vacation
- Students should go for Internship/ Mini projects in any biotechnological industry or laboratories and learn their laboratory techniques by hands-on training.
- After the Internship/ Mini project, students should submit detailed reports about the Internship/ Mini project in printed format.
- Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.
- The report will be evaluated by a duly appointed teaching faculty from the head of department.

Total: 30hrs

Syllabus

Generic Elective Courses

BIOMEDICAL WASTE MANAGEMENT

4004

Course Objective: (Employability)

This course aims to provide knowledge about source, types, handling, collection, and disposal and also ensure the proper and safe management of biomedical waste.

UNIT-I: Introduction to biomedical waste **12**

Introduction, Definition, Scope and importance of biomedical waste. Categories of biomedical wastes (Human Anatomical Waste, Animal Waste, Microbiology & Biotechnology Waste , Waste sharps, Discarded Medicines and Cytotoxic drugs, Solid Waste, Liquid Waste, Incineration Ash and Chemical Waste).

UNIT-II: Health impacts biomedical waste **12**

Health impacts of biomedical wastes. Direct and Indirect hazards, Potential health hazards of BMW. Infectious agents in the biomedical wastes. Monitoring and controlling of cross infection (protective devices)

UNIT-III: Handling of biomedical waste **12**

Biomedical waste - Handling rules, segregation, collection, transportation, disposal-color coding and type of container for disposal of biomedical wastes. Disposal technologies (sharp disposal pit, deep burial pit and secured land fill).

UNIT IV Treatment and management of biomedical waste **12**

Treatment and management of biomedical wastes-on site - pretreatments, treatment-in-site and off-site (common treatment facilities).Liquid waste treatment by different technologies. Conventional treatment technologies (wet thermal and incineration)

UNIT V Legislation policies and rules of biomedical wastes **12**

Environment and legislation policies and rules for handling and management of biomedical wastes. CPCB guidelines. WHO guidelines for biomedical wastes.

Total: 60hrs

Course Outcome:

- CO-1: Understand of the basics, the Scope and importance of biomedical wastes and about types of wastes and composition.

- CO–2: List about Potential health hazards of biomedical wastes.
- CO–3: Summarize the principles and methods of disposal of biomedical wastes and secured land fill.
- CO–4: Assess on different technologies of treatment and management of biomedical wastes and Conventional treatment technologies
- CO–5: Explain about the rules, policies and guidelines of biomedical wastes and understand the WHO guidelines for biomedical wastes

TEXT AND REFERENCE BOOKS

1. Sharma – Holistic approach to Hospital Waste Management published by Dept. of Bhide A. D. and B.B.Sundaresan, “Solid Waste Management – Collection, Processing and disposal” Mudrashilpa Offset Printers, Nagpur, 2001.
2. Goel S. L, Health Care System and Hospital Administration, Balaji World of Books 2009.
3. Radhakrishnan R, Biomedical Waste Management, Neha Publishers & Distributors, 2007.
4. .Behera P K, Sustainable Bio-Medical Waste Management (2 Vols.) Dominant Publishers And Distributors 1993
5. Hosetti, B. B. Prospects and perspective of solid waste management, 2006.
6. Glynn Henry J and Gary. W. Heinke, “Environmental Science and Engineering”, Prentice Hall of India, 2004.
7. Bhide A. D and B.B.Sundaresan, “Solid Waste Management – Collection, Processing and disposal” Mudrashilpa Offset Printers, Nagpur, 2001.
8. Glynn Henry J and Gary. W. Heinke, “Environmental Science and Engineering”, Prentice Hall of India, 2004.

BIOTECHNOLOGY AND HUMAN WELFARE

4 0 0 4

Course Objective: (Employability)

This course has been designed to introduce the various techniques in the modern era of biotechnology. It focuses on industrial biotechnology, agriculture and medical biotechnology and molecular techniques for forensic science.

UNIT I Industrial Biotechnology **12**

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

UNIT II Agricultural Biotechnology **12**

Agriculture: N₂ fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III Environmental Biotechnology **12**

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

UNIT IV Biotechnology in Forensic science **12**

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

UNIT V Biotechnology in medicine **12**

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.

Total: 60hrs

Course Outcome:

- CO –1: Remember about the products of industrial biotechnology and gain knowledge relevant to the applications of agriculture biotechnology.
- CO–2 Show interaction between plants and microbes and the various techniques involved in environmental biotechnology.

- CO-3: Outline about the degradation of hydrocarbons and agricultural wastes
- CO-4: Darme about the molecular techniques of forensic science and various methods of DNA finger printing
- CO-5: Demonstrate Students about health care products, receive knowledge about human genome project and recombinant live vaccines

TEXT AND REFERENCE BOOKS

1. Patnaik, "Textbooks of Biotechnology", McGraw Hill Education (India) Private Limited.2012.
2. Satyanarayana, U, "A Textbooks of Biotechnology", Books and Allied (p) Limited, 2013.
3. Sateesh MK, "Bioethics and Biosafety", I. K. International Pvt Ltd, 2010.
4. Sree Krishna V, "Bioethics and Biosafety in Biotechnology", New age international publishers, 2007.
5. Purohit S.S. "Agricultural Biotechnology", Agrobios, 3rd edition, 2010.
6. Kumaresan V," Biotechnology P, Saras Publication, 2015
7. Kumaresan V, N Arumugam, Environmental Biotechnology ,Saras,2014
8. SandhyaJadhav ,A Text Book of Environmental Biology and Biotechnology, Vision, Publications, 2nd edition, 2012
9. Clark DP and Pazdernik NJ. "Biotechnology-Appling the Genetic Revolution". Elsevier Academic Press, USA.2009.
10. Alan Scragg, "Environmental Biotechnology", Oxford; Second edition, 2007.

Course Objective: (Employability)

The topic represents a stand-alone, progressive topic leading the student through the key aspects of environmental microbiology prior to its subsequent application within environmental biotechnology.

UNIT I Biofuels **12**

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

UNIT II Bioremediation **12**

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes.

UNIT III Phyto-remediation **12**

Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation of aromatic and chlorinated hydrocarbons and petroleum products.

UNIT IV Wastewater treatment and biofertilizer **12**

Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

UNIT V Biomining **12**

Biomining, Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium).Environmental significance of genetically modified microbes, plants and animals.

Total : 60hrs**Course Outcome:**

- CO–1: Understand the importance of conventional fuels and their environmental impacts
- CO–2: Apply the Bioremediation to the environment and degradation of lignin and cellulose using microbes and water contaminated with oil spills
- CO–3: List about the various techniques involved in Phyto-remediation and about the degradation of pesticides and other toxic chemicals by micro-organisms.

- CO-4: Explain about the various methods in wastewater treatment and the Algal and fungal biofertilizers
- CO-5: Explain about Bioleaching and importance of Genetically modified microorganisms.

TEXT AND REFERENCE BOOKS

1. Pradipta Kumar Mohapatra, "Environmental Biotechnology", I.K. International Publishing House; 1st Edition, 2007.
2. Satyanarayana, U, "A Textbook of Biotechnology", Books and Allied (p) Limited, 2013.
3. Purohit S.S. "Agricultural Biotechnology", Agrobios, 3rd edition, 2010.
4. Alan Scragg, "Environmental Biotechnology", Oxford; Second edition, 2007.
5. Hans-Joachim Jordening and Jesef Winter, "Environmental Biotechnology – Concepts and Applications", Wiley VCH, 2004.
6. Metcalf and Eddy, "Waste Water Engineering", Tata McGraw hill, 4th edition, 2003
7. Alicia L. Ragout De Spencer, John F.T. Spencer. "Environmental Microbiology: Methods and Protocols", Humana Press, 2004.
8. Milton Wainwright, "An Introduction to Environmental Biotechnology", Springer, 1999.

MUSHROOM CULTIVATION AND MEDICINAL PLANT GARDENING

4 0 0 4

Course Objective: (Entrepreneurship)

To learn the cultivation of various mushrooms and to create self-employment for the students.

Unit 1: Introduction **12**

Introduction to Mushroom - History of Mushroom - Ecology of Mushroom -Life cycle of Mushroom. classification of mushrooms, nutritional and dietary values of mushrooms as source such as protein, carbohydrates, fibre, vitamins and minerals, therapeutic properties, mushroom collections from field

Unit 2: cultivation techniques **12**

Mushroom cultivation techniques- Erections of mushroom culture sheds and maintenance (tools, equipment and prerequisites). Fungal Isolation techniques, preparation of mother culture- pure culture, selection of stock, spawn production – mother spawn production. Basic elements for Mushroom growth and farm settings

Unit 3: Spawn Multiplication **12**

Multiplication of spawn - Precautions, characters, and storage of spawn; substrate production, culturing of mushrooms; harvesting, post-harvesting processes, and key machinery and equipment required.

Unit 4: Cultivation techniques for selected mushrooms **12**

Cultivation techniques for commercially viable mushrooms - paddy straw mushroom, button mushroom and milky mushroom – spawning, substrate preparation, growth, packing, and maintenance of suitable environmental conditions. Factors influencing mushroom cultivation and harvesting. Mushroom delights.

Unit 5: Medicinal Plant Gardening **12**

Types of medicinal plants, Secondary metabolites- Bioactive constituents, Medicinal plants cultivation methods and gardening.

Total : 60 hours

Course Outcome:

CO –1: Student will understand about mushroom and its classification

CO –2: Illustrate about the Mushroom cultivation techniques

CO –3: Student will plan to about: Spawn Multiplication

CO –4: Student will Demonstrate about the cultivation methods of Selected mushrooms

CO –5: Explain about types of medicinal plants and its cultivation and gardening

TEXT & REFERENCE BOOKS:

- 1.Suman, B.C and V. P. Sharma. Mushroom Cultivation in India, Daya Publishing House. 2007
- 2.Subrata Biswas, M. Datta, S.V. Ngachan. Mushrooms: A Manual for Cultivation. PHI Learning Private limited, New Delhi. 2012.
- 3.Singh, M., Vijay, B., and Kamal, S., and Wakchaure, G.C. Mushrooms: Cultivation, Marketing and Consumption. Directorate of Mushroom Research, Indian Council of Agricultural Research, Solan, India, p.266. 2011
- 4.Oei, P, and van Nieuwenhuijzen, B. Small-scale mushroom cultivation. Digigrafi, Wageningen, The Netherlands, p.86. 2005
5. Training Manual on Mushroom Cultivation Technology. United Nations - Economic And Social Commission for Asia and the Pacific, p.139.
6. Milan S. Stankovic. Medicinal Plants and Natural Product Research, MDPI publishers, Switzerland, 2020
7. M.C. Joshi. Hand Book of Indian Medicinal Plants, Scientific Publishers, 2019

SKILL ENHANCEMENT COURSE

Course Objective: (Skill Development)

- To enable participants Business Communication Skills
- To enhance participants E-mail writing skills
- To impart Leadership and Team Bonding skills

	Credit Hours
1. READING COMPREHENSION AND VOCABULARY	06
Filling the blanks – Cloze Exercise – Vocabulary building – Reading and answering Questions.	
2. LISTENING AND ANSWERING QUESTIONS.	06
Listening and writing – Listening and sequencing sentences – Filling in the blanks – Listening and answering questions.	
3. GROUP DISCUSSIONS	06
Why GD part of a selection process – Structure of a GD – strategies in GD – Team Work – Body Language	
4. CONVERSATION.	06
Face to face Conversation and Telephone conversation.	
5. SELF- INTRODUCTION AND ROLE PLAY	06
Total	30 Hours

Course Outcome

At the end of this course the students will be able to,

- CO 1 Prioritize power of understanding and aids assimilation of vocables. Vocabulary to charge communication with educated words
- CO 2 Develop comprehensive knowledge through listening leading to answering questions
- CO 3 Build observation power and infuse self-confidence through group discussions
- CO 4 Identify methodology for befitting constructional ability
- CO 5 Experiments with inward looking and visualization of the ‘otherness’ of situations

Books Recommended

- Barun K. Mitra. Personality Development and Soft Skills. Oxford University Press. New Delhi.2011.

- S.P. Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010. Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009.
- Tiko, Champa & Jaya Sasikumar. Writing with a Purpose. OUP. New Delhi. 1979

Web Source:

- <https://www.skillsyouneed.com/ips/communication-skills.html>
- <https://blog.smarp.com/top-5-communication-skills-and-how-to-improve-them>
- <https://blog.hubspot.com/service/phone-etiquette>

Course Objective: (Skill Development)

- To enable students to develop their communication skills effectively
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence through communication

Credit Hours

1. PRESENTATION SKILLS	06
Elements of an effective presentation – structure of presentation – voice modulation – Audience analysis – Body language	
2. SOFT SKILLS	06
Time Management – Articulateness – Assertiveness – Stress management	
3. RESUME / REPORT PREPARATION / LETTER WRITING	06
Structuring the resume / Report – Business letters – E-Mail Communication	
4. INTERVIEW SKILLS	06
Kinds of Interviews – Required by Skills – Corporate Culture – Mock Interviews	
5. 30 FREQUENTLY ASKED QUESTIONS	06
Total	30 Hours

Course Outcome

At the end of this course the students will be able to,

- CO1 Illustrate the essential of presentation skills, thoughts, structure, voice modulation, audience analysis and body language
- CO2 Utilize the psychological skills pertaining to time management, articulation, assertion and stress management
- CO3 Construct methodology for preparation of resume, reports, business letters and email communication
- CO4 Appraise learners with varied skills needed for expose to interviews
- CO5 Categorize the nature of questions asked usually in interviews

Books Recommended

- Barun K.Mitra. Personality Development and soft skills. Oxford University Press. New Delhi. 2011.
- S P Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.
- Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009

Web Sources:

- <https://www.skillsyouneed.com/ips/communication-skills.html>
- <https://www.businessnewsdaily.com/5836-top-interviewing-skills.html>
- <https://gdpi.hitbullseye.com/Group-Discussion.php>

SOFT SKILLS III

2002

Course Objective: (Skill Development)

- To enable students to develop their soft skills and Body Language
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence to excel at Interviews

	Credit Hours
UNIT-I	06
Powerful Presentation	
UNIT-II	06
Reinforcement	
UNIT-III	06
Using visual aids	
UNIT-IV	06
Types and Methods of Presentations	
UNIT-V	06
Obstacles to Presentation	
Total	30 Hours

Course Outcome:

- CO1 To develop participants social and professional skills
- CO2 To help participants manage time effectively
- CO3 To build a strong resume to suit corporate requirements
- CO4 To face interviews confidently
- CO5 To enhance their aptitude abilities

Books Recommended:

- Roz Townsend: Presentation Skills for the Upwardly Mobile, Emerald, Chennai.
- Prasad, H. M. How to Prepare for Group Discussion and Interview. NewDelhi: Tata McGraw-Hill Publishing Company Limited, 2001.
- Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

Web Sources:

- <https://www.skillsyouneed.com/ips/communication-skills.html>
- <https://venngage.com/blog/presentation-skills/>
- <https://gdpi.hitbullseye.com/Group-Discussion.php>

SECTOR SKILL COURSE

COURSE OBJECTIVE: (Employability)

To understand the fundamentals in clinical research

Unit I**7 hours**

Introduction to Clinical Research, Clinical Trial Terminologies, History of Clinical research, CPCSEA Guideline & Pre-clinical Trials, Drug Discovery & Development,

Unit II**7 hours**

Introduction to Toxicity Studies, Definition of clinical trial, Different Phases of clinical research: Subtypes of Phase 1,2,3, and 4, E –clinical trial, Bioavailability & Bioequivalence Studies [BA/BE]

Unit III**6 hours**

Drug Regulations & Ethics in Clinical Research: Background of ethics, Declaration of Helsinki, Belmont Report, Informed consent Process, Nuremberg code

Unit IV**5 hours**

History of Indian regulations, Schedule – Y- Appendices, ICMR (Indian Council of Medical Research) Guidelines, Indian GCP (Good Clinical Practice), ICH GCP (International Conference on Harmonisation)

Unit V**5 hours**

Drugs & magic remedies Act 1954, Drug prices control order, CTRI-Clinical trial registry of India, Regulations for AYUSH, An Introduction to Clinical Data Management, Data Management Standards.

TOTAL 30 HOURS**COURSE OUTCOMES**

CO-1: To understand the basic the guidelines for conducting pre-clinical trial and research

CO-2: Will Know about various phases of clinical trials

CO-3: Knowledge about the ethics in clinical research

CO-4: To acquire knowledge Indian regulations in clinical research

CO-5: They would have studied in detail about Indian act for drug regulation

TEXT AND REFERENCE BOOKS

1. Spriet A., Dupin-Spriet T., Simon P. Methodology of Clinical Drug Trials, 2nd Edition. Publisher: Karger.
2. SheinChung Chow, Jen-Pei Liu. Design and Analysis of Clinical Trials: Concepts and Methodologies, 3rd Edition. Publisher: Wiley.
3. Lionel D. Edwards, Anthony W. Fox, Peter D. Stonier. Principles and Practice of Pharmaceutical Medicine, 3rd Edition. Publisher: Wiley-Blackwell.

MEDICAL CODING AND PHARMACOVIGILANCE & SAFETY MONITORING 2 0 0 2

Course Objective: (Employability)

The paper is designed to provide basics in medical coding and to learn importance pharmacovigilance for clinical research students.

UNIT-I INTRODUCTION TO MEDICAL CODING 12

Professional over view and specific responsibilities. Standardization of coding and coding over view. History ICD and CPT. ICD – 9, ICD – 9CM, ICD -10. ICD – 9 - CM versus ICD – 10 – CM. Coding accuracy.

UNIT-II CPT CODE 12

CPT – Medical coding, structure of CPT codes. Three categories of CPT codes.

Absence of codes and special cases. EM Coding.

UNIT-III PHARMACOVIGILANCE 12

Introduction, definition, aim and objective of Pharmacovigilance study. Method, Plans, procedures, scope of Pharmacovigilance study. Pharmacovigilance study in India.

UNIT-IV SAFETY MONITORING 12

Basics in pharmacogenomics process of monitoring. Safety monitoring boards. Monitoring of quality assurance. Introduction to GPP. Risk management, guidance, assessing adverse and serious adverse events. Reporting of AE & SAE.

UNIT-V PRACTICES AND SAFETY SIGNALS 12

Introduction to good reporting practices and safety signals. Case reports, Case series, data mining, and causality report. International drug monitoring procedures. Health care information for comprehensive Pharmacovigilance surveillance.

Total Hours 60

Course Outcome:

CO-1: Understand the basics in Medical Coding and transcription. Also introduced to ICD, CPT and Coding accuracy.

CO-2: Demonstrate the categories of CPT codes and coding rituals.

CO-3: Interpret the importance of Pharmacovigilance study for clinical researchers and Plans, procedures, scope of Pharmacovigilance study.

CO-4: Analyze how monitoring boards function and their responsibilities and basics of pharmacogenomics.

CO-5: Categorize the good reporting practices and safety signals and International drug monitoring procedures will also be learnt.

TEXT AND REFERENCE BOOKS:

1. Linda Campbell, Medical Transcription Fundamentals and Practice, Prentice Hall-Gale, 1993.
2. Gupta S.K, Textbook of Pharmacovigilance, Japee publications, India, 2011.
3. Ravi N Humbarwadi, Quick Learner's Pharmacovigilance, Amazon, 2003.
4. Eric T Herfindel, Dick R. Gourley, Textbook of Therapeutics Drug and Disease management, 6th edition, 2012.
5. Janet woodcock, Frederick Ognibene, john overbeke, Assuring data quality and validity in clinical trials for regulatory decision making, 2003.
6. Marilyn takahashi Fortney Otis Diehl, Medical transcription guide: do's and dont's, 2003.

Course Objective: (Entrepreneurship)

- To provide the analytical knowledge of clinical laboratory testing and its diagnosis.

UNIT I HEMATOLOGY 14

Specimen –definition, types. Collection and transport of specimen. Specimen preservation and storage. Hematology - Blood and its constituents, collection of blood various anticoagulants and their uses. Total Leukocyte Count(TC), Differential count(DC), Erythrocyte Sedimentation Rate(ESR) Red blood cells count(RBC), Platelet count, Packed cell volume(PCV), Mean cell volume(MCV), Hb estimation Bleeding time(BT), Clotting time(CT). Blood bank -Blood grouping(ABO system & Rh system), Identification of malarial parasites.

UNIT II CLINICAL PATHOLOGY 10

Complete urine routine examination –physical, chemical and microbiological examination of urine, Culture and sensitivity. Complete routine examination of sputum and feces. Semen analysis. Examination of CSF.

UNIT III CLINICAL SEROLOGY AND IMMUNOLOGY 12

Common serological tests - Rheumatoid arthritis, Pregnancy test, Widal (slide and tube test), VDRL, HBs antigen, carbohydrate reactive protein test. Clinical manifestations and lab immunological diagnosis of AIDS, MOTT, Legionellosis, Chicken guinea, Helicobacter pylori and SARS.

UNIT IV CLINICAL MICROBIOLOGY 12

Clinical manifestation and laboratory diagnosis of bacterial pathogens-Enteric pathogens (E.coli, Shigella, Salmonella and Vibrio), pyogenic organisms (Staphylococcus and Streptococcus), Spirochetes (Leptospira), Mycobacterium, B. anthracis and Rickettsia. Virology, Mycology and Parasitology - Clinical manifestation and laboratory diagnosis of Rabies and Poliomyelitis, Dermatophytes and E.histolytica.

UNIT-V MOLECULAR DIAGNOSTICS TECHNOLOGY 12

Molecular techniques for analysis of biochemical disorders. Assays for the diagnosis of inherited diseases. Bioinformatics tools for molecular diagnosis. Antibody based diagnosis –monoclonal antibodies as diagnostic reagents. Diagnosis of diseases by using ELISA and Western blot. DNA diagnostics – PCR and array-based diagnosis. Clinical proteomics - protein microarray for disease diagnosis. Ethics in molecular diagnosis.

Total Hours: 60

Course Outcome:

CO-1: Recall the principle and various methods of collection, transport and storage of different clinical samples and basics of hematology.

CO-2: Infer about diagnostic methods of clinical pathology specimens i.e. complete routine examination of blood, urine, sputum, feces, CSF and semen.

CO-3: Understand the principles and procedures of different serological tests in Diagnosis.

CO-4: Summarize the interactions between bacteria, Virus, fungi and parasitic microorganisms and the humans and Clinical manifestation and laboratory diagnosis of bacterial, Viral, fungal and parasitic infections.

CO-5: Utilize the principles and techniques of molecular diagnosis and the ethics involved in molecular diagnosis.

TEXT & REFERENCE BOOKS:

1. Naigaonkar. A.V. and M.D.Burande, A manual of Medical Laboratory Technology, NiraliPrakasan, Pune, India, 3rd edition, 2004.
2. Praful.B.Godkar, Clinical Biochemistry Principles and Practice, Bhalani Publishing House, Bombay, India, 1994.
3. Anathanarayan R. and C K JayaramPaniker, Textbook of Microbiology, Ninth Edition, Jain publications, 9th edition, 2013.
4. Pradeep Kumar N.S., Manual of Practical Pathology, CBS Publishers and Distributors Pvt Ltd, New Delhi, 2011.
5. Geo. F. Brooks, Janet S. Butel and Stephen A, Medical Microbiology, Morse 23rd Edition, 2010.
6. Betty.A.F., Daniel.F.S and A.S.Weisfeld, Bailey and Scott's Diagnostic Microbiology, Mosby(Elsevier), 2002.
7. Prakash M, C.K. Arora, Biochemical techniques, Anmol publication (1) Ltd New Delhi, 1998.