New Cours

SCT-1.4: b – Biostatistics

About course:
Biostatistics is the development and application of statistical methods to a wide range of topics in biology. It encompasses the design of biological experiments, the collection and analysis of data from those experiments and the interpretation of the results.

Objective of the course:
This course provides an introduction to a variety of statistical methods of use in describing and analyzing biological data. It includes a laboratory component in which biological data are analyzed using statistical software.

Course learning objective (CLO):
After finishing this course, students should be able to:

1. Recognize the importance of data collection and its role in determining scope of inference.
2. Demonstrate a solid understanding of interval estimation and hypothesis testing.
3. Choose and apply appropriate statistical methods for analyzing one or two variables.
4. Use technology to perform descriptive and inferential data analysis for one or two variables.
5. Interpret statistical results correctly, effectively, and in context.
6. Understand and critique data-based claims.
7. Appreciate the power of data.

Details of content:

Unit I: Statistics: **08 hrs**

Introduction and role its role in science, Data-types and scales of measurement. Descriptive Statistics - measures of central tendency, positional averages, measures of dispersion, skewness and kurtosis - Definition and properties. Presentationtables, diagrammatic and graphical methods. Exploratory Data Analysis using descriptive measures and graphical tools.

Unit II: Probability theory: **08 hrs**

random experiment, simple events, sample space - types of events, probability of an event, rules of probability, conditional probability, Bayes' theorem. Probability distributions: random variables - discrete and continuous type, Bernoulli, Binomial, Poisson and normal distributions - applications.

Unit III: Sampling methods **06 hrs**

population and sample, parameter and statistic, concept of a random sample, simple random sampling, stratified sampling, systematic sampling, sample size determination.

Unit IV: Correlation: **04hrs**

bivariate data, correlation, scatterplot, correlation coefficient and its properties, testing for correlation coefficient, rank correlation. Regression: linear relationship, linear regression model, simple linear regression, fitting the regression model, coefficient of determination, standard error of the estimated model. Testing regression coefficients.

Unit V: **12 hrs**

Random experiments and its sample spaces, random variables, cdf, pdf and pmf, absolutely continuous and discrete distributions. Continuous univariatedistributions :Weibull, lognormal, Pareto, Laplace, Cauchy, Logistic, inverse Gaussian distributions, extreme value distributions. – Properties and applications. Generating functions-probability generating function, moment generating functions. Truncated distributions.

Unit VI: **08hrs**

Functions of random variables and their distributions using Jacobian of transformation. Probability integral transformation. Independence, sum of independent random variables, convolutions, conditional expectation. Independence of mean and variance of a random sample from normal population.

Unit VII **08hrs**

Multivariate normal distribution. Marginal and conditional distribution and properties. Independence of sample mean vector and sample covariance matrix. Wishart distribution-its properties and application.

References:

1. R.C. Campbell.(1974) : Statistics for Biologists, Cambridge University Press
2. Christopher Chatfield (1981) : Statistics for Technology, Chapman and Hall
3. Douglas A. Lind, William C. Marchal, Samuel A. Wathen(2012), "Basic Statistics for Business & Economics" McGraw-Hill Education
4. Harry Frank and Steven C Athoen (1997) : Statistics: Concepts & Applications, Cambridge University Press. 5. J.Medhi (1992): Statistical Methods : An Introductory Text, Wiley Eastern Limited.
5. C R Kothari and gauravgarg, Research methodology methods and techniques, third edition.
6. Introduction to biostatastics and research methods: P S SSundarRao, J. Richard.

SCT-1.4: c – ENZYMOLOGY

About the course:
Enzymology is the branch of biochemistry aiming to understand how enzymes work through the relationship between structure and function and how they fold into their native state.

Objective of the course:
The major learning objective of the course is to understand the theories of enzyme kinetics, the mechanisms of enzyme catalysis, and the mechanisms of enzyme regulation in the cell. At the conclusion of the course students should be able to: Describe the methods used in enzyme kinetics.

Course Learning Objective (CLO):
At the conclusion of the course students should be able to

- Describe and use the equations of enzyme kinetics.
- Describe the methods used in enzyme kinetics.
- Describe the principles of enzyme inhibition.
- Describe the mechanisms of enzyme catalysis.
- Describe the catalytic mechanisms employed by the most well-characterized enzymes.
- Describe the mechanisms of enzyme regulation

Unit I: Introduction to Enzymes: **8hrs**
Nature of enzymes, localization, isolation, purification and characterization of enzymes. Criteria of purity of enzymes, fold purity. Nomenclature and IUB classification of enzymes. Enzyme specificity, specific activity, assay methods; coupled enzyme assays, continuous, end point and kinetic assay. Units of enzyme activity, IU and Katal. Industrial and Biomedical applications of enzymes.

Unit II: Enzyme kinetics: **8hrs**
Michaelis-Menten equation, initial velocity approach, steady state approach. Vmax, Km and their significance. Linear transformation of Michaelis-Menten equation; Lineweaver-Burk plot, Eadie-Hofstee, Wolf and Cornish-Bowden. Scatchard plot. Rate of a reaction, order and molecularity. Ist order reaction kinetics. Rectangular hyperbola, Michaelis- Menten equation as rectangular hyperbola, asymptote, linear transformation, calculation of slope, intercept. Effect of pH, temperature and substrate concentration.

Unit III:Enzyme Inhibition: **10hrs**
Types of reversible inhibitors - competitive, non-competitive, un-competitive and mixed inhibitors. Partial inhibition, substrate inhibition and allosteric inhibition. Irreversible inhibition.
Mechanisms of action of specific enzyme: Chymotrypsin; zymogen activation, acid-base catalysis, charge relay network. Lysozyme, alcohol dehydrogenase, ribonuclease, carboxypeptidase A, RNA as an enzyme.

Unit IV: Kinetics of bi-substrate reactions: **8 Hr**
Sequential mechanism, compulsory order and random order mechanism, non-sequential mechanism, ping pong mechanism, distinction between different kinetic pathways using primary and secondary plots. Inhibition studies in the characterisation of bi-substrate reactions.

Unit V: Mechanisms of enzyme catalysis: **8hrs**
Active site structure; methods of determining active site structure, isolation of ES complex, affinity labelling, chemical modification studies and active site structure investigation.
Nature of enzyme catalysis: Transition state theory, proximity and orientation, orbital steering, acid base catalysis,

covalent catalysis, metal ion catalysis, nucleophilic and electrophoilic catalysis, intramolecularcatalyses, entropy effects. Effect of temperature and pH on enzyme catalysed reaction.

Unit VI: Coenzymes: **10hrs**

The mechanistic role of the following coenzymes in enzyme catalyzed reactionsnicotinamide nucleotides, flavin nucleotides, pyridoxal phosphate, coenzyme A, thiamine pyrophosphate and biotin, Folate coenzymes. Monomeric and oligomeric enzymes: Monomeric enzymes-the serine proteases, zymogen activation. Sulphahydryl enzymes-papain. Oligomeric enzymes-isoenzymes (LDH) and multi-enzyme complexes- (Pyruvate dehydrogenase complex).

Unit VII: Allosteric enzymes: **6hrs**

Binding of ligands to proteins - Co-operativity, the Hill equation, equilibrium dialysis technique. Sigmoidal kinetics: The MWC and KNF models. Significance of sigmoidal behaviour. Allosteric enzymes and metabolic regulation. Study of ATCase- as typical allosteric enzyme.

REFERENCES

1) Fundamentals of Enzymology, Price.NC. And Stevens. L., Oxford University Press.
2) Enzymes- Biochemistry, Biotechnology, Clinical chemistry- Palmer, T., Affiliated East-West press.
3) Fundamentals of Enzyme Kinetics, Segel I H; Wiley Interscience-Wiley.
4) Biochemical calculations, 2ndEdition By Irwin H. Segel. John Wiley & Sons,
5) Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.
6) Fundamentals of Ezymology; 3rd Edn. Nicholas C. Price and Lewis Stevens, Oxford University Press (2012).
7) Enzyme Kinetics and Mechanism; Paul F. Cook, W. W. Cleland, Garland Science (2007).
8) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry; Trevor Palmer (Edn) Horwood Chemical Science Series.
9) Introduction to Enzyme and Co-enzyme Chemistry. Ed. T. Bugg, (2000), BlackwellScience.
10) An Introduction to Enzyme and Coenzyme Chemistry; Timothy B. Bugg, (1997) Jonesand Bartlett publishers.
11) Lehninger Principles of Biochemistry; D.L. Nelson and M.M. Cox, 6th Edn. MacMillan Publications (2012).
12) Principles of Biochemistry; Smith et al., Ed. McGraw Hill,(1986).

PRACTICAL: SCP-1.4: b - Biostatistics

I) Measurement and Sampling
II) Stem-and-Leaf Plots and Frequency Tables
III) Summary Statistics
IV) Probability
V) A Binomial Problem
   1. Probability distribution:
   2. a probability histogram
   3. cumulative probability
   4. Normal probability problem Z table
VI) Confidence Interval for a Mean
VII) Testing a Mean
VIII) Paired Samples and Their Differences
IX) Independent Sample and their Differences
X) Inference About a Proportion
XI) Cross Tabulated Counts
   1. Cross-tabulation
   2. 95% confidence interval for prevalence difference:
   3. Expected frequencies under H0
      Chi-square table

PRACTICAL: SCP-1.4: c – ENZYMOLOGY

I) Effect of Amylase activity on Starch
II) Determination of α-amylase activity
III) Effect of pH on amylase activity
IV) Investigation effect of temperature on the activity of lipase
V) Hydrolysis of sucrose by yeast β-Fructofuranosidase
VI) Determination of Hydrolyzed Sucrose Solution by benedict quantitative method
VII) Estimation of lipase activity
VIII) Indirect estimation of lactate dehydrogenase
IX) Detection of Enzymes
X) Detection of Enzyme mixture

HCT 2.2: MICROBIOLOGY

48 hrs

Unit 1
Scope and Development of Microbiology:
Characteristics and classification of microorganisms, Structure of Prokaryotic and eukaryotic microorganisms.

3 hrs

Unit 2
Sterilization techniques:
Physical and chemical methods. 2 hrs

Unit 3
Microbiological Media:
Definition, components, types and preparation of enrichment and preservative media, Cultivation of microorganisms- culture media, Isolation of microorganisms- serial dilution, streak plate, pour plate and spread plate method. Characterization and identification of colonies, preservation of culture.

5 hrs

Unit 4
Staining techniques and methods in microbiology:
Staining – simple and differential, fluorescent, negative staining and structural staining – capsule, spore and cell wall and reserve food material.

4 hrs

Unit 5
Nutrition and growth:
Nutritional requirements, growth and growth curve- counting of bacteria, synchronous growth and continuous culture growth as affected by environment factors. 4hrs

Unit 6
General Characters of Microorganisms:
General characters of viruses, Prokaryotes (Bacteria, Rickettsia, Mycoplasma and Blue Green Algae) and Eukaryotes (Protozoa, algae and Fungi)

2 hrs

Unit 7
Bacteriolo
gy:
Ultra structure and classification of bacteria Importance of Archaea in Bacteriology (Halophiles, Methanogenes, Hyperthermophillic, Archaea, Thermoplasma). 4 hrs

Unit 8
Viruses
:
Structure, Classification, cultivation and replication of viruses example of herpes, pox, Adenoviruses, Retroviruses, viriods and prions. 4
hrs

Unit
9
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i:

References.

1. Tamarin, R.H, (2000): Principles of genetics, 6th Ed. WMC Brown Publications, London.
2. Snustad,P.D. Simmons,M.J (2000) Principles of genetics, 2nd Ed, John Wiley and Sons. Inc, N.York.
3. Fairbanks, D.J. and Andersons, W.R. (1999), Genetics- Continuity of Life, Books and Cole, New York.
4. Lewin, B (2000): GENES Vol VII Oxford University Press, New York
5. W,M. (2000) An Introduction to Genetic Analysis, 7th Ed, W.H.Freeman New York
6. Streips and Yasbin, Modern Molecular Biology. (2001) Niley Limited.
7. Lodish,H.D., Boltimore,A.Berk,B.L., Zipursky,P. Mastsydairs and J.Darnell (2004): Molecular Cell Biology, Scientific American Books Inc, New York.
8. John Ringo (2004), Fundamental Genetics, Cambridge University Press.
9. Klug, W.S. and Cummins: Concepts of Genetics, 7th Ed (2003) Pearson education.
10. Howell, S.H., (1998): Genetics and Plant Development, CAB Cambridge.
11. Winter,P.C, Hickey, G.I and Fletchear,H.I (1999) Instant notes in Genetics Viva Books Private limited, New York.
12. Strickberger,M.W (2000) Genetics Prentice –Hall of India private ltd, New Delhi.
13. Brown,T.A. (1998) Genetics – A molecular approach 3rd Ed, Chapman and Hall, London.
14. Miesfeld,R.L (1999) Applied molecular genetics, John Wiley and sons Inc, New York.

Structure, Classification of fungi- Typical study of Penicillium and Yeast. 4 hrs

Unit 10

Microbial diseases:

Diseases reservoirs- Epidemiological terminologies, infectious and disease transmission, Respiratory diseases caused by bacteria and virus- Tuberculosis, sexually transmitted diseases- Gonorrohoea, Syphilis, AIDS. Diseases transmitted by animals- (Rabies, and Plague). Insects and Ticks- Richettsia, lyme diseases and Malaria, food and water borne diseases, Public Health and water quality, pathogenic Fungi.

4 hrs

Unit 11
Antibiotics and chemotherapy:
Antimicrobial Agents- Factors influencing antimicrobial activity and phenol Coefficient test. Definition and classification of antibiotics- Penicillins and Cephalosporins. Broad – spectrum antibiotics, Antifungal antibiotics, mode of action.

2 hrs

Unit 12
Food microbiology:
Microbes in food, food spoiling and toxins.

4 hrs

Unit 13
Plant microbe interaction:
Rhizosphere, Phyllosphers and Sphermosphere microbes, Plant growth promoting bacteria (PGPR) Legume spmbiosis, endophytes –VAM.

2 hrs

Unit 14.
General account of soil, aquatic and atmospheric microbiology. 4 hrs

References:

1. Pelczar, M.J.Chan, Eosa and Kreig, N.R, 1993, Microbiology Mcgraw Hill Inc, New york.
2. Prescott, L.M. Heviey,J.P. and Klein,D.A., 1996, Microbiology, WMC Brown Publishers, New York.
3. Holt,J.S.Krieg, N.R.Sneath, P.H.S. and Williams,S.T. 1994 Bergey's manual of systematic Bacteriology, 9th Ed Williams and Wilkins, Baltimore.
4. Sullia,S.B., and Shantaram,S. 1998 General Microbiology, Oxford IBH, New Delhi.
5. Microbiology : Fundamentals and Applications. Purohit Agrobois.
6. Edward Alcamo,I. 1997, Fundamentals of Microbiology 5th Ed, Adelison Wesley Longman. Inc New York.
7. Madigan,M.T., Martinco,J.M. and Parker.J. 1997 Brock Biology of Microorganisms. 8th Ed. Mcgraw Hill Inc, New york.
8. Matthews, R.E.F. 2005 Plant virology.
9. Alexander. 1997. Introduction to soil Microbiology, John Wiley and sons Inc, New York.
10. Frazier, W.C. and Westhaff, D.C.1998 Food Microbiology, TATA Mcgraw Hill, New Dehhi Publications

HCT 2.3: IMMUNOLOGY

About Immunology:
Immunology as a Medical course manages physical, chemical and physiological characteristics of the components of the immune system. Immunology is the branch of biomedical science that deals with the study of an organism's immune system, in both health and disease.

Course Objective:
The objective of this course is to provide Students with detail understanding of different cells of the immune system and their role in immune protection as well as application of immunological techniques. The course will provide knowledge about role of immune system in pathogenesis of cancer, autoimmune disease, AIDS and different infectious diseases.

Course Learning Outcomes (CLO):
Students will be able to
1. Immunology, immune system, properties of immune system, types of immunity
2. Concept of antigen, antigenic determinants, hapten, factors affecting antigencity
3. Immunoglobulin, structure, types and functions
4. Basic of bioprocess technology, concept and significance of bioprocess technology, concept of bioreactor, designing of fermenter and types of fermentation.
5. Screening of microorganisms, storage and preservation of industrially important microorganisms
6. Culture collection and culture collection centres, national: NCIM, MTCC and international ATCC

Detail contents: **60 hrs**

Unit 1 Introduction - Cells and organs of immune system: **05 hrs**
The Immune system – innate and adaptive immunity. Phagocytes, lymphocytes, T-cells, B-cells, Cytotoxic cells, lymphoid organs, thymus of fabricus spleen , lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT) lymphocytes traffic, cytokines, chemokines, interleukins, interferons.

Unit 2 Immunoglobulin molecule and cytokines: **05 hrs**
Structure, classes and function of Ig molecules, isotypes, antibody diversity, tIg supergene family complement fixing antibiotics and compliment cascade. Structure, receptors and signal transduction, modulation of immune response, cytokine profile of disease.

Unit 3 Humoral response and T-cell activation: **08 hrs**
Primary and secondary immune response, cell mediated immune response, balance between humoral response complementary system. Development, helper cell, cytotoxic cell, autoreactive T-cells and memory T-cells.

Unit 4 Antigen – Antibody interaction and immunotechnology: **08 hrs**
Self and non-self recognition, antigenicity and immunogenecity, epitope mapping, paratopes, nature of B-cell and T-cell epitopes, haptens, carbohydrate antigens, blood group antigens and synthetic peptides as antigens.
Valency of antigen, precipitin, agglutination reactions, Affinity, avidity and cross reactivity. Immuno double – diffusion, Inmmunoelectrophoresis, single radial immunofusion, haemagglutination and complement fixation, direct and indirect immunofluorescence.

Unit 5 Hypersensitive reactions and Autoimmune response: **16 hrs**
Type – I (Ig E), Type – II (Ig mediated), Type – III (Immuno complex mediated), Type – IV (Cell mediated) reaction. Animal and human models, role of MHC & T-cells, Prevention of autoimmune response. Graft versus Host reaction and rejection, autoimmunity, xeno transplantation, immunosuppressive therapy. Autoimmune diseases – Hashimoto's diseases, systemic lupus erythematosis, Multiple sclerosis, Myasthenia gravis and their treatment.

Unit 6 Major Histocompatibility complex and Tumor Immunology: **08 hrs**
Structure and functions of MHC and the HL – A systems, Gene regulations and Ir – genes. Tumor immunology – tumor specific antigens and Immuno response to tumors. Theory of surveillance, immune diagnosis of tumor, tumor markers – alpha foetal proteins, Carcino embryonic antigen cells etc, genetic control of immune response.

Unit 7 Immune regulation and Immunobiotechnology: **10 hrs**

Immunosuppression, tolerance, immunopotentiation, Hybridoma technology – immunization of animals, Isolation of stimulated spleen cells, myeloma cell lines used and fusion partners, fusion methods, production, detection and applications of monoclonal and polyclonal antibodies, conventional vaccines, viral vaccines, peptide vaccines, genetically engineered vaccines. Production and applications of lymphokines.

References:

1. Abbers, A.K, Lichtman, A.H, Pobers, J.S (1998): Cellular and molecular Immunology. W.B, Sounders company. Philadelphia.
2. Iven Roitt (1993): Essentials of immunology. Black Well scientific Publications, Oxford.
3. Mayforth, R.D (1993): Designing antibodies. Academic Press New York.
4. Roitt, Brostoff. Male: Immunology 7th Ed. Panima book distributors, New Delhi.
5. Paul, W.E, (1990) Fundamental Immunology. Raven Press New York.
6. Kuby Immunology 4th Ed.
7. Immunology by Eli Benjamin, Richard Coico, Geoffrey Sunstine. (2000).
8. Klaus D. Elgert (1996). Immunology – Understanding of immune system. Wiley – liss New York.
9. Tizard, I.R (1995) Immunology 4th Ed. Sounders College Publication.
10. a) BIOTOL – Series (1993) Cellular interactions and immunobiology Butterworth- Heinemann.

b) BIOTOL–Series (1993) Technological applications of immunochemical Butterworth-Heinemann.

c) BIOTOL – Series (1993) Defense mechanisms. Butterworth - Heinemann.

11. Medical microbiology – Cruick Shank et al.
12. Hand Book of Experimental Immunology – D.M Weir (Ed) Vol 1 – 5.

PRACTICALS
2nd SEMESTER

PRACTICAL HCP 2.1: MOLECULAR GENETICS

1. Single Cell Isolation
2. Isolation of Auxotrophs
3. Isolation of Antibiotic resistant organisms
4. Study of growth curve
5. Isolation of DNA
6. Denaturation of DNA
7. Renaturation of DNA
8. Amines test
9. Enzyme induction of beta-galactosidase synthesis in E.coli
10. Estimation of DNA
11. Estimation of RNA

PRACTICAL HCP 2.2 MICROBIOLOGY

1. Safety measures in microbiology laboratory and aseptic techniques.
2. Study of Instruments – Autoclave, Hot Air Oven, Laminar air Flow, Incubator, pH meter etc.,
3. Cleaning and sterilization of glass wares.
4. Preparation of nutrient broth and nutrient agar slant and sterilization.
5. Differential and Selective media
5. Culture of microorganisms using various methods: Enumeration: serial dilution methods, plating.
6. Isolation and maintenance of organisms: Isolation of bacteria from terrestrial/marine samples
6. Study of colony characters.
7. Simple and differential staining procedure – staining of Endospore, Flagella, cell wall, capsule and negative staining.
8. Biochemical Tests used for identification of bacteria, fermentation of sugars, starch hydrolysis, gelatin liquefaction, catalase test, IMVIC and oxidase test.
9. Isolation of microorganisms from soil sample and determination of numbers of colony forming units.
10. Study growth curve of E.coli cells.
11. Effect of antibiotics and bacterial growth – paper disc and cup plate method.
12. Effect of pH on growth of microorganisms.

PRACTICAL HCP2.3 IMMUNOLOGY AND IMMUNOTECHNOLOGY

1.Study of cells / organs of Immune system
2.WBC and RBC count
3.Preparation of different types of antigens
  a)Whole cell antigens
  b)Purified proteins
4.Demonstration of antigen administration to animals Mice / Rat
  a)Intra muscular
  b)Intra venial
  c)Intra peritoneal
  d)Intradermal
5.Production of polyclonal antiserum
6.Determination of Bleeding Time (BT) and Clotting Time (CT)
7.Separation of serum / plasma from whole blood
8.Blood film preparation and identification of cells.
9.Estimation of Hemoglobin
10.Determination of Blood groups and Rh factor
11.Electrophoretic separation of serum proteins
12.Determination of antibody titer of the serum
13.Precipitation of Immunoglobulins from serum by ammonium sulphate precipitation
14.Partial purification of ammonium sulphate precipitated Immunoglobulins by dialyzing against phosphate buffered saline

SCT-3.3: c – Bio Separation Techniques

About the course:

Bioseparation is the name given to the practice of purifying biological products on a large-scale, using fundamental aspects of engineering and scientific principles. The end goal of bioseparation is to refine molecules, cells and parts of cells into purified fractions.

Objective of the course:

To cover the fundamentals, and design concepts of various downstream purification steps (unit operations) involved in a biochemical process. Students will be able to describe theory, principle, design, application and possible integrations of unit operations in bioprocessing.

Course Learning Objective(CLO):

In this course, students would learn about

- principles and strategies behind various separation technique in biotechnology.
- latest development in the field of purification of commercially important bioproducts including biomass, protein
- metabolites produced from fermentation and process industries.

Details of contents:

Unit I: Removal of insoluble **08hrs**

An overview of Recovery processes, Removal of microbial cells and other solid matters from fermentation broth, Coagulation and Flocculation. Cell disruption techniques: Mechanical and non-mechanical methods, Filtration and Centrifugation.

Unit II: Isolation of Bio molecules **08hrs**

: Protein precipitation and separation; Aqueous-twophase extraction; Supercritical extraction, Reverse micelles extraction; Adsorption-desorption process: isotherms.

Unit III: Chromatographic techniques **12hrs**

Principles and practice of liquid chromatography, gradient elution chromatography, ion-exchange chromatography, size exclusion chromatography, reversed phase chromatography, hydrophobic interaction chromatography, affinity chromatography; HPLC and its applications.

Unit IV: Cell disruption methods **06hrs**

Liquid-liquid extraction; Reverse osmosis and ultrafiltration, drying, crystallization, storage and packaging; Treatment of effluent and its disposal.

Unit V: Media formulation **06hrs**

Inocula development and Sterilization; Aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; Scale up and scale down process

UnitVI: Membrane separation **10hrs**

Membrane materials and organization; Filter modules; Micro filtration, Ultra filtration; Reverse Osmosis, Electrophoresis Dialysis, Electrodialysis; Advance membrane based separation process, e.g. Pervaporation, membrane bioreactor, membrane distillation etc.

Unit VII: Crystallization and Drying **10hrs**

Crystallization: properties of a crystal, crystal growth and purity; Drying: different moisture content, drying kinetics, relative humidity, Industrial driers.

References:

1. Nooralabettu Krishna Prasad, Downstream Process Technology, 1st Ed., Phi learning Pvt. Ltd, New Delhi, 2010
2. B. Sivasankar, Bioseparations: Principles and Techniques, 1st Ed., Prentice Hall, 2005
3. Michael L. Shuler, FikretKargi, Bioprocess Engineering – Basic Concepts, 2nd Ed., Pearson Education India, 2015
4. SahiraNsayefMuslem, Shatha Ali Shafiq,Bioseparation techniques- CreateSpace Independent Publishing Platform; 1st edition,2014
6. Ajay Kumar, AbhishekAvasthi, Bioseparation Engineering – I.K. International pvt. Ltd.,2009

11. To evaluate the effect of drugs on cell proliferation.
12. Cloning of monolayer cells.
13. Cryopreservation of cultured cells.

PRACTICAL:SCP-3.3: b –INDUSTRIAL BIOTECHNOLOGY

1. Fermentation of wheat bran/ cellulose/ birchwood xylan by *Trichoderma*
2. Analysis of spent broth
3. Purification and precipitation secreted proteins from spent broth
4. 2D gel electrophoresis of precipitated protein
5. Estimation of cellulase activity of cellulose degraders
6. Estimation of cellulose/xylanase activity in broth and precipitated protein fraction
7. Production of algal biomass.
8. Microbial production of Vitmain B12 and assay
9. Fermentation of lignocellulolytic biomass
10. Detection of GMO food
11. Microbial load of canned foods
12. Analysis of preserved food stuff for presence of pathogens
13. Detection of viable, non-viable and viable but nonculturable cells by fluorescence microscopy in GMO products
14. Visit to Bioprocessing plant

PRACTICAL:SCP-3.3: c – Bio Separation Techniques

1. Cell disruption by enzymatic digestion
2. Cell disruption by ultra sonication
3. estimation of protein by lowry's method
4. estimation of proteins by bradford method
5. Extraction of collagen from rat tails
6. Purification of penicillin
7. Soxhlet extractor
8. Detection of alcohol concentration
9. Amino Acid
10. Chitosan Extraction

PRACTICAL: SCP-4.4: b - Microbial Biotechnology

I) Media, sterilisation and disinfection
1. Preparation of culture media
2. Pouring a plate
3. Storage of media
4. Sterilisationvs disinfection
5. Sterilisation using the autoclave/pressure cooker
6. Sterilisation of equipment and materials
7. Choice, preparation and use of disinfectants

II) Inoculation and other aseptic procedures
1. Essential points
2. Using a wire loop
3. Using a pipette
4. Flaming the neck of bottles and test tubes

III) Working with bacteria and yeast Streak plate
1. Pour plate
2. Using a spreader
3. Spread plate
4. Working with moulds
5. Incubation

IV) Essential methods for maintaining, preparing and using cultures
1. Obtaining suitable cultures
2. Pure cultures
3. Maintaining stock cultures
4. Checking cultures for contamination
5. Preventing contamination of cultures and the environment
6. Aseptic transfer of cultures and sterile solutions

PRACTICALS: SCP-4.4: c - Food Technology

I) Introduction to food laboratory
II) Laboratory equipment and usage
III) Protocol for the preparation of reagents
IV) Proximate analysis of food samples
1) Determination of Proteins
2) Determination of Carbohydrates
3) Determination of Fat
4) Determination of Moisture content
5) Determination of ash content
6) Determination of fiber content
V) Determination of chemical constituents of food
VI) Microbial analysis of food
VII) Good manufacturing practices for food
VIII) Food preservation techniques

SCT-4.4: c - Food Technology

About the course:

Food technology is a branch of food science that deals with the production, preservation, quality control and research and development of the food products. Early scientific research into food technology concentrated on food preservation.

Objective of the course:

- Basic terms used in study of food and nutrition
- Methods of assessment of nutritional status
- Functions of food-physiological, psychological and social
- Understanding relationship between food, nutrition and health

Course Learning Objective(CLO):

- Appreciate the relationship between food, nutrition and health.
- Explain digestion, absorption, functions and food sources of various nutrients.
- Understand the concept of balanced diets and menu planning.
- Describe different methods of cooking and ways to prevent nutrient losses
- Plan and prepare meals and nutritious dishes for various age groups.

Details of contents:

Unit-I: Food chemistry **08hrs**

definition and importance. Carbohydrates- Definition and importance, classification, sources, functions, physico-chemical properties, functional properties of sugars and polysaccharides in foods.

Unit-II: Dietary fibre and food applications **08hrs**

Effect of processing on nutritional quality of carbohydrates. Water-Water in foods, Types of water in foods: Water activity-Definition, measurement of water activity, role and importance of water activity in foods

Unit-III: Proteins and amino acids **12hrs**

Definition and importance, classification, sources, functions, physico-chemical properties and functional properties of proteins. Browning reactions in foods. Protein concentrates, isolates and hydrolysates and their applicationsLipids: -Definition and importance, classification, sources, functions, physical and chemical properties, functional properties, , rancidity and reversion, types of rancidity, factors leading to rancidity and reversion, changes in lipids during storage and processing.

Unit-IV: **4hrs**

Minerals, vitamins, pigments, flavours and anti-nutritional compounds. Changes in vitamins and minerals during storage and processing.

Enzymes: -Definition, importance, classification and properties; - Enzymatic browning in foods and industrial applications of enzymes.

Unit-V: Food Additives **04hrs**

Food Additives: Definition, importance, classification and properties; Toxicology - evaluation techniques and uses.

Unit-VI: Food & Nutrition **8hrs**

Food groups: Typical composition - Essential nutrients: - sources, deficiency diseases; requirements and recommended dietary allowances -Digestion, absorption, transport and metabolism of nutrients in human system

Unit-VII: Food Microbiology **6hrs**

Introduction to Microbiology - Introduction to microbiology; Microorganisms – Definition, Classification

.Microbial growth pattern.

Unit-VI: Microbial growth in food **10hrs**

Intrinsic, extrinsic and implicit factors o survival of microorganisms in foods. Effect of injury on growth or survival. Biochemical changes - fermentation, putrefaction and lipolysis. Antagonism and synergism in microorganisms.

Reference:

1. Banawart GJ. 1989. Basic Food Microbiology. 2nd Ed. AVI Publ.Frazier J &Westhoff DC. 1988.
2. Food Microbiology. 4th Ed. McGraw Hill.
3. Garbutt J. 1997. Essentials of Food Microbiology. Arnold Heinemann.
4. Jay JM, Loessner MJ & Golden DA. 2005. Modern Food Microbiology 7 Ed.Springer.
5. Ray B. 2004. Fundamentals of Food Microbiology.3rd Ed. CRC.
6. Robinson RK. (Ed.). 1983. Dairy Microbiology. Applied Science.
7. Steinkraus KS. 1996. Handbook of Indigenous Fermented Foods. Marcel Dekker.

2nd SEMESTER

PAPER –HCT: 2.1: MOLECULAR BIOLOGY

45 hrs

Unit 1

Physical basis of Heredity: Introduction, concepts and theories of Mendelian genetics, chromosome theory of inheritance, Unit of Heredity, Genes, Alleles, Multiple alleles, Cis and Trans test Nucleus, nucleolus and extra chromosomal inheritance.

.

4 hrs

Unit 2

Genetic material:

Nucleic acids as genetic material, chemical nature of DNA and RNA; Types of DNA and RNA.

4 hrs

Unit 3

DNA Replication:

Prokaryotic and Eukaryotic DNA replication. Mechanism of DNA replication, enzymes and accessory proteins involved in DNA replication. **4 hrs**

Unit 4

Mutation:

DNA Damage, repair and molecular mechanism of recombination, **5 hrs**

Unit 5

Transcription:

Central dogma, role of DNA in Protein synthesis, general feature of RNA synthesis, RNA polymerase, mechanism of transcription in Prokaryotic and eukaryotic. Post transcription, modification of RNAs capping and poly adenylation, split gene – Introns, exons and splicing, reverse transcription. **6 hrs**

Unit 6

Translation:

Genetic code and its elucidation, Wobble hypothesis, structure and composition, of Prokaryotic and eukaryotic ribosome, structure of mRNA and tRNA. Events of Protein synthesis, (Amino acid activation, initiation, elongation and termination) in Prokaryotic and Eukaryotic. Post -Translation modification of proteins, inhibitors of translation. **6 hrs**

Unit 7

Regulation of Gene expression:

The Operon concepts, Lactose Operon,Tryptophan Operon and catabolic repression, steroid induced gene expression. **4 hrs**

Unit 8

Molecular Mapping of Genome:

Physical maps, Physical Mapping and map Based cloning, choice of mapping, Population, simple sequence repeat loci, southern and florescence *in situ* hybridization for genome analysis, RFLP, RAPD, AFCP analysis and application. **6 hrs**

Unit 9

Genome sequencing:

Genome sizes, Organelle genomes, Genomic library, YAC, BAC Libraries, Strategies for sequencing genome-Packaging, transfection and recovery of clones, Application of sequence information for identification of defective genes.

6 hrs

References.

1. Tamarin, R.H, (2000): Principles of genetics, 6th Ed. WMC Brown Publications, London.
2. Snustad,P.D. Simmons,M.J (2000) Principles of genetics, 2nd Ed, John Wiley and Sons. Inc, N.York.
3. Fairbanks, D.J. and Andersons, W.R. (1999), Genetics- Continuity' of Life, Books and Cole, New York.
4. Lewin, B (2000): GENES Vol VII Oxford University Press, New York
5. W,M. (2000) An Introduction to Genetic Analysis, 7th Ed, W.H.Freeman New York
6. Streips and Yasbin, Modern Molecular Biology. (2001) Niley Limited.
7. Lodish,H.D., Boltimore,A.Berk,B.L., Zipursky,P. Mastsydairs and J,Darnell (2004): Molecular Cell Biology, Scientific American Books Inc, New York.
8. John Ringo (2004), Fundamental Genetics, Cambridge University Press.
9. Klug, W.S. and Cummins: Concepts of Genetics, 7th Ed (2003) Pearson education.
10. Howell, S.H., (1998): Genetics and Plant Development, CAB Cambridge.
11. Winter,P.C, Hickey, G.I and Fletchear,H.I (1999) Instant notes in Genetics Viva Books Private limited, New York.
12. Strickberger,M.W (2000) Genetics Prentice –Hall of India private ltd, New Delhi.
13. Brown,T.A. (1998) Genetics – A molecular approach 3rd Ed, Chapman and Hall, London.
14. Miesfeld,R.L (1999) Applied molecular genetics, John Wiley and sons Inc, New York.

SCT-2.4: c - Enzyme Technology

About the course:
Enzyme technology is one of the corner stones of Industrial Biotechnology. The research in this area involves both fundamental and applied enzymology, biocatalysis, molecular modelling, structural biology and diagnostics.

Objective of the course:
The objective of this course is to give knowledge about nomenclatures, characteristics and mechanism of enzymes, their biochemical calculation for enzyme kinetics, various applications of enzymes that can benefit food industry.

Course Learning Objective (CLO):

1. Distinguish the fundamentals of enzyme properties, nomenclatures, characteristics and mechanisms

2. Apply biochemical calculation for enzyme kinetics

3. Compare methods for production, purification, characterization and immobilization of enzymes

4. Discuss various application of enzymes that can benefit human life

5. Discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.

Details of the contents:

Unit I: Industrial uses of enzymes **12hrs**
sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheese production. Clinical enzymology - Enzymes as thrombolytic agents, antiinflammatory agents, digestive aids. Therapeutic use of asparginase, streptokinase. Diagnostic enzymes. Immobilization of enzymes and their applications. Abzymes.

UnitII: Immobilized enzymes **10hrs**
Principles & techniques of immobilization - commercial production of enzymes; amylases, proteases, cellulose, artificial enzymes, industrial applications, fermentation, enzymes modification, site directed mutagenesis; immobilized enzyme in industrial processes.

Unit III: Biotransformation **8Hrs**
Types of bioconversion reactions: Oxidation, Reduction, Hydrolytic reactions, Condensations, Transformation of steroids and sterols, Transformation of nonsteroid compounds: L-Ascorbic acid, Prostaglandins, Antibiotics

Unit-IV: Factor affecting enzyme activity and catalysis **10hrs**
pH, subsrate and enzyme concentration, temperature, coenzyme and cofactors, Mechanism of action of enzymes involving two/more substrates. Role of metal ions in enzyme catalysis.

Unit-V: Enzyme inhibitions **6hrs**
Kinetics of competitive, non-competitive & uncompetitive inhibitions; nucleophilic& electrophilic attack; role of metal ions in enzyme catalysis.

Unit-VI: Structure and function of enzymes **06hrs**
Lysozyme, chymotrypsin, DNA polymerase, RNase, proteases. Enzyme regulation and control of their activity. Introduction to allosteric enzymes and isozymes.

Unit-VII: Structure and function of coenzyme **08hrs**
reactions involving TPP, pyrodoxal phosphate, nicotinamide, flavin nucleotide, coenzyme A and biotin. Industrial

utilization of enzymes, food, detergents, energy, waste treatment, pharmaceuticals and medicine.

References:

1. Enzyme kinetics: Dixon W. B.
2. General Enzymology :Kulkarni & Deshpande
3. Enzyme Assays:J. Raymond
4. Genes VII, BenjeminLewin, 1994. Oxford University Press. Oxford
5. Principles of Biochemistry, AL. Lehninger, D.L. Nelson and M. M. Cox. 1993. Worth Publishers, New York.

HCT-1.3: Biophysical and Biochemical techniques

About Course:

Biophysics, also known as biological physics, is an interdisciplinary science that applies the principles of physics and chemistry and the methods of mathematical analysis and computer modeling to understand how the mechanisms of biological systems work.

Course Objective:

Introduce the Students to the fundamental concepts of physics applicable in biological systems.

Course Learning Outcomes (CLO):

Students will be able to

1. Concept of electromagnetic radiation, absorption spectrum, Beer's law and Lamberts law
2. Principle, working and applications of spectrophotometer and AAS
3. Concepts of chromatography and concept of partition coefficient
4. Principle, methodology and application of various chromatographic techniques
5. Principle, methodologies and application of electrophoric separation of biomolecules.

Detail of Content: **Total 60 hrs**

Unit 1 Introduction to Biophysics: **10 hrs**

Scope of Biophysics, Physical laws, Interaction of living and non-living matters, chemical foundations of Biophysics. Characterization of biological macromolecules, Hydrodynamic properties of biomolecules -Viscosity, Diffusion, Osmosis, Partial specific volume and Gibbs-Donnan effect.

Unit 2 Microscopic techniques: **10 hrs**

Principle and application of light microscope, Phase contrast, Dark field, Fluorescence microscope, Electron Microscopy, Atomic force microscopy. Negative staining and Con-focal microscopy. Microtomy and staining for light and electron microscopy.

Unit 3 Chromatography techniques: **10 hrs**

Planar and column chromatography, principle and application of paper chromatography, TLC, Gel filtration chromatography, Ion –Exchange chromatography, Affinity chromatography, Liquid chromatography, HPLC and gas chromatography.

Unit 4 Electrophoresis and blotting techniques: **8 hrs**

Principle and application of PAGE, SDS-PAGE, Iso-electric focusing, 2D electrophoresis, Agarose gel electrophoresis, capillary electrophoresis, Immunoelectrophoresis, Southern, Northern and Western blotting.

Unit 5 Spectroscopy: **10 hrs**

Electromagnetic spectrum of light, simple theory of absorption of light by biomolecules, Beer-Lambert's law, types of detectors. Principle and application of UV, Visible luminometry and IR spectroscopy, Fluorescence spectroscopy, ESR, NMR, Atomic absorption spectroscopy, Mass spectroscopy, Raman spectroscopy, X-ray crystallography, Flow cytometry. Biological importance of Lasers, Microwaves and Radiations.

Unit 6 Radio isotope techniques: **06 hrs**

Nature of radioactivity, detection and measurement. GM counter and Scintillation counter, Auto radiography, Safety aspects and applications

Unit 7 Protein and DNA sequencing : **06 hrs**

Automatic analyzers for amino acids, Proteins sequenator, Nucleotide sequencing system, peptide and Poly nucleotide synthesizers. Human genome project and its applications

References:

1. Upadhyay. A., Upadhyaya, K., and Nath , N., 1995, Biophysical chemistry. Himalayan publishing house.
2. Pattabhi, V., and N. Goutham, 1999. Biophysics Narosa publishing house.
3. Friefelder, D., 1990. Physical Biochemistry. 2nd Ed. W.H.
4. Jayaraman, J., 1988. Laboratory manual of Biochemistry. Wiley Eastern limited, New Delhi.
5. Boyer, R.F., 2001 Modern experimental Biochemistry 3rd Ed. Benjamin/Cummins Publications Co.
6. Wilson and Walker, J. 1995 Practical Biochemistry principles and techniques. Cambridge University press.
7. Holde, K.E., Holinson, W.C and Shwig House of Pub. 1998. Principles of physical chemistry. Prentice-Hall Inc. New York.
8. Hobson, D. and Pick, H. 1998. Analytical 3rd Ed. Addison Wisley Longman, Essentials
9. T.A. Brown Molecular biology.LABFAX. 2nd – TBA.
10. Micklos, D. DNA science – A first course 2nd
11. Biological Instrumentation & Methodology by Bajpai, P.K

SCT: 3.3a ANIMAL BIOTECHNOLOGY, IPR and BIOETHICS

Course Objective:

The objective of this course is to enable Students to develop basic skills for vertebrate cell culture, maintenance of cell lines and in vitro application of cell and molecular techniques and also to understand the principles of animal cloning and its applications.

Course Learning Outcomes (CLO):

Students will be able to

1. Understand the fundamental scientific principles that underlie cell culture
2. Acquire knowledge for isolation, maintenance and growth of cells.
3. Develop proficiency in establishing and maintaining of cell lines.
4. Acquire knowledge in animal cloning and its applications.

Detail Content **60 hours**

Unit-1Animal cell, tissue and organ culture: **08 hrs**
Historical perspectives, development and scope, characterization and differentiation of cells. Requirements for animal cell, tissue and organ culture. Animal cell culture layout, Biosafety regulation. equipments and materials for animal cell culture. Aseptic handling facilities and types of contamination.

Unit 2 Cell culture media and Scaling up of cell culture: **12 hrs**
Media composition, defined media, synthetic media, natural media, Serum and protein free defined media and their applications. Types of cell lines (primary, secondary and continuous), cell banking.
General methods and culture parameters, monolayer culture, suspension culture, immobilized culture, cell line preservation and authentication, cryopreservation. Mass cultivation of animal cell in Bioreactors, evaluation of culture kinetics.

Unit 3 Avian and mammalian cell culture: **08 hrs**
Isolation of mouse and chick embryos, human biopsies, methods for primary culture, nomenclature of cell lines, sub culture and propagation, immortalization of cell lines, cell line designation, selection of cell line and routine maintenance. Stem cell culture and its applications.

Unit 4 Cell separation and characterization: **08 hrs**
Density based, magnetic and fluorescence based cell sorting. Characterization of cells based on morphology, chromosome analysis, DNA content, RNA and protein, enzyme activity, antigenic markers, Cell viability and cytotoxicity assays, Cell synchronization, micromanipulation, cell transformation and applications of animal cell culture.

Unit 5 Tissue engineering and organ culture: **08 hrs**
Choice of models, organ culture, and histolytic culture, Filter-well inserts, neuronal: Growth factors for in situ tissue regeneration, 3D culture, biomaterials in tissue engineering, approaches for tissue engineering of skin, bone grafts, nerve grafts, Hemoglobin based blood substitutes, bio artificial or biohybrid organs. Limitations and possibilities of tissue engineering.

Unit 6 Applications of animal biotechnology: **08 hrs**
Hybridism technology and production of monoclonal antibodies. Applications of animal cell culture in biopharmaceuticals. Transgenic animals Methods of obtaining transgenic animals and their importance. Production of useful proteins in transgenic animals - blood products and vaccines. IVF-embryo transfer technology in human and livestock, IVF-embryo transfer technology in human and livestock Mechanism of protein and steroid hormone action and importance of hormones as a biotechnological product.

IPR and BIOETHICS

Unit 7 Bioethics and Intellectual Property Rights: **08 hrs**

Ethical issues related to biotechnology and biomedical research and their impact to living system. Socioeconomic Impacts of Biotechnology: bioremediation and environmental impacts of release of GMOs, social issues to biotechnology.

Intellectual property rights, and Intellectual Property protection, patents and methods of application of patents, Trade secret, copy rights, trade mark, legal implications, farmers rights, plant breeder's rights. International and National conventions on Biotechnology and related areas. GATT, TRIPS, Biodiversity convention, etc.

References:

1. Ian Freshney(2001) Culture of animal cells 3red Edn Wiley Liss.
2. Sashidhar, R (2006) Abnimal biotechnology, MJP Publishers.
3. al Subramanian et al 1998 Concept in Biotechnology. Hyerabad University press.
4. Prakash, M and Arora, C.K1998 Cell and tissue culture. New Anmol Publications.
5. Harrison Maurees, Arae Ian, F 1997 General techniques of cell culture, Cambridge University Press.
6. Bhaskar rao, Dig Marti, Harshieta, Dig Marti, Sambasiva, and Ambashiva Rao 1997 Advanced biotechonology New Delhi, Discovery publishing House.
7. Butler, M and Dawson, M 1994 Cell culture lab Fax Bios scientific Publication litd. Oxford.
8. Jenni, P. Mathev and David Barnes, 2001 Methods in cell biology, Vjol.57 academic press.
9. Mac, E, Hadley, endocrinology 5th Edn, Low price Edn, pearson education.
10. Nigel Jenkins Animal cell biotechnology, Methods and protocol Human press.

PRACTICAL:HCP 3.2

50 Hrs.

1.Preparation of plant tissue culture media and Organ culture (Shoot tip, nodal and leaf culture)
2. Callus culture: Initiation and regeneration.
3. Anther culture for the production of haploids.
4. Isolation, culture and fusion of protoplasts
5. Isolation of plant genomic DNA from pea shoot tip/ Cauliflower by CTAB method 6. Agrobacterium culture, selection of transformants
7. Suspension culture and production, separation and estimation of secondary metabolites β- carotene from carrot and anthocyanin from beetroot
8. Study of VAM, isolation of spores, arbuscles and vesicles from roots
9. VAM culture
10. Organic pharming and Mushroom Cultivation
11. Study and culture of biocontrol agents (Trichoderma viridae, Trichoderma harzianum, Aspergillus awamori)

SCT: 3.3 b INDUSTRIAL BIOTECHNOLOGY

UNIT-1: Scope of food and industrial biotechnology. **3Hrs.**

UNIT-2: Microbiological examination of food, principles of food preservation (Sterilization, pasteurization, canning and packing). Importance of microorganisms in food production. **6Hrs.**

UNIT-3: Factors affecting the growth and survival of micro-organisms in food: Microbial growth, intrinsic and extrinsic factors and productive food microbiology. **4Hrs.**

UNIT-4: Microbiology of food: Cereal products, brewing, fermented food products, protein products, food additives and ingsredients, fsruits, vegetables, meat and sausage product, large scale cultivation of edible mushrooms. **6Hrs.**

UNIT-5: Fermentation of mild products and its analysis. **4Hrs.**

UNIT-6: Biological nitrogen fixation: mass lproduction and field application of biofertilisers: Rhizobium. Azotobacter, Azospicillam. Cynabacyteria, Azolla, Vesicular and Arbuscular Mycorrhiza (VAM). **4Hrs.**

UNIT-7: Microbiological assays: Microbiological assay of vitamins, antibiotics and aminoacids. Advantages and disadvantages of microbiological assays. **4Hrs.**

UNIT-8:Bacterial agents of food borne illness: Salmonella, Clostridium, Vibrio, Shigella and E.Coli. **4Hrs.**

UNIT-9: Non bacterial agents of food borne illness: Protozoa, algae, fungi, helminthes, nematodesandviruses. **4Hrs.**

UNIT-10: Energy biotechnology: Biomass solar energy technology, photosynthesis, Agriculture and forestry, conversion to fuels, cell free system, use of micro organisms in mineral, beneficiation and iol recovery. Immoabilization of microbes. **6Hrs.**

UNIT-11: Patents and seacret processes: Patent concept, composition of of patent, characteristics of patent, protection of rights of inventor and cost patent. **3Hrs.**

REFERENCES

01. Ananth, N. 2000: A Text Book of Microbiology-Vol. IV, Surabhi Books, Ssrinagar, Bangalore.
02. Singh, B.D 2001, Biotechnology, Kalyani Publishers, Ludhiana.
03. Wulf, Crueger and Annelies, Biotechnology-A Textbook of Industrial Microbiology Cuger-Panima Publishing Corporation. New Delhi.
04. Malik, V.S and Sridhar, P. 1992: Industrial Biotechnology.
05. Frazier, W.C and Westhaff, D.C. 1998: Food Microbiology Tata McGraw Hill, Delhi.
06. Patil. A.H. 1984. Industrial Microbiology.
07. Casida, L.E. 1968. Industrial Microbiology.
08. Jay James. M. 1996. Modern Food Microbiology CBS Publishers, New Delhi.
09. Prophet, S.S., Mathur 1996 Biotechnology-Fundamentals and applications, Agro botanical Publishers, New Delhi.
10. Bains and Williams 1998. Biotechnology From A to Z, Oxford University Press, New-York.

PRACTICAL:HCP 3.1 B, Based on Paper B.T:3.2

2. Study of fermentor- Demonstration.
3. Production and isolation of antibiotics (Pencillin and Streptomycin)
4. Production and analysis of Single cell protein (Spirulina and yeast)
5. Production of yoghurt and estimation of lactic acid at different time intervals
6. Production of wine – estimation of percentage of alcohol, total acidity & volatile acidity in wine.
7. Production and assay of α-amylase from Aspergillus niger
8. Purification and assay of α amylase by simple precipitation using sodium sulphate, poly amines and organic solvents and immobilization

HCP 3.4 - ENTREPRENEURSHIP AND STARTUP STUDIES

About Course:

Course Objectives: This course provides the students awareness about the biotechnology enterprise and global scenario of biotechnology industries; provides exposure to management principles and helps to develop skills to work with interdisciplinary team.

Course Outcomes: (CLO):
Students will be able to
1. Prepare a project report for biotechnology entrepreneurship.
2. Address the market challenges for a new enterprise.
3. Setup enterprise for a new biotechnology product.
4. Assess the global market scenario of their product.

Content details: **45 hours**

Unit I: Concept of entrepreneurship, fundamentals of marketing, market analysis.

Unit-II: Entrepreneurship Traits & Motivation: Establishment and marketing of biotechnology company, Growth of entrepreneurship, Marketing and selling of Biotechnology products, Effective advertising.

Unit-III: Entrepreneurial Development: Training, Institution in aid of entrepreneur, Power and importance of Positioning of a company name and product, Types of registrations. Trademark, Trade secret.

Unit-IV: Start-up: Setting up of a small industry, layout of the company, instrumentation, manpower, location of an enterprise, steps of starting small industry, Incentive & subsidies for industry, Problems of entrepreneurship, The Art of Negotiation, Workable marketing and the strength of distribution. Opportunities and lessons in international marketing.

Unit-V: Problem and Solution of Entrepreneurship: Risk and benefit, Steps involved in commercialization of a biotechnological product, Case studies.

REFERENCE BOOKS:
1. Dynamics of Entrepreneurial development & management; Vasant Desai, Himalay. Publications.
2. Entrepreneurship reflection & investigation; M.S. Bisht & R.C. Mishra, Chugh Publication.
3. Entrepreneurship development in India; Samiuddin, Mittal Publication.
4. Innovation, Product Development and Commercialization: Case Studies and Key Practices for Market.
5. Science Business: The Promise, the Reality, and the Future of Biotech by Gary P. Pisano Harvard Business School Press: 2006.
6. Design and Marketing of New Products by Urban and Hauser, ISBN-0-13-201567-6.
7. Putting Biotechnology to Work: Bioprocess Engineering (1992) Commission on Life Sciences, The National Academy Press.

Paper code: OET: 3.8: GENERAL BIOTECHNOLOGY

M.Sc. Biotechnology Program Overview:
Biotechnology harnesses the core principles of engineering living organisms to generate controlled processes or products for human and environmental welfare related to the environment, biopharmaceutical, industrial, healthcare, food or agro-industries. Through this Biotechnology program students are prepared with in-depth and wide knowledge related to biotechnology and its applications, as well as the next generation of scholars and teachers.

Total Credits: 04 **Total hours: 60**

Unit 1: General Biotechnology: **02hrs**
Introduction, history and scope of biotechnology, different branches of biotechnology.

Unit 2: Cell and Molecular biology **10 hrs**
Biomolecules. Cell organelle structures and functions, DNA replication, transcription, translation, post translation modifications, and recombination, DNA damage and repair. Cell signaling: introduction, types of signaling and receptors.

Unit 3: Microbial Biotechnology **10hrs**
Diversity and reproduction of microorganisms, nutritional requirements of microbes, growth curve, pathogenic microorganisms, food microorganisms and industrially important microorganisms.

Unit 4: Plant and Animal Biotechnology **14hrs**
Introduction, Invitro culture, plant tissue culture method, plant tissue culture and media composition, plant genome, markers, transgenic and hybrid plant production, Introduction to animal biotechnology, methods of animal tissue culture, minimal and defined media for animal cell culture, cell lines, different types of cell line, cryopreservation, pharmaceutical applications, transfection, stem cells.

Unit 5: Molecular immunology and immunological techniques **10hrs**
Cells and organs of immune system, innate and adaptive immunity, B cell and T cell development, antigens and antibody, hypersensitivity, immune and autoimmune disorders, tumor biology, immune techniques.

Unit 6: Bioprocess engineering and technology **4hrs**
Fermentation and its types, different types of fermented foods, types of fomenter, downstream processing.

Unit 7: Environmental Biotechnology **10hrs**
Bioremediation, bioagumenataion, biostimulation, and biodegradation. Brief account on bioplastics. Scope and advantages of microorganisms in environmental biotechnology.

References:

1. iGenetics: A Molecular Approach; Peter J Russell
2. Janis kuby ; Immunology
3. Molecular Cell Biology 6th Edition, by Harvey Lodish
4. Molecular Biology of the Gene (7th Edition) by James D. Watson , Tania A. Baker, et al.
5. *Industrial Microbiology: An Introduction* Michael J. Waites BSc, PhD, CBiol, MIBiol
6. Prescott's Microbiology 8th Edition by Joanne Willey (Author), Linda Sherwood (Author), Chris Woolverton (Author)
7. R IAN Freshney, Culture of animal cells, Sixth Edition, Wiley- Blackwell publication
8. Fundamentals of Intellectual Property (English) 1st Edition (Paperback, Dr. Kalyan C. Kankanala) Publisher: Asia Law House ISBN: 9789381849514, 938184951X Edition: 1st Edition, 2012
9. Bioethics and Biosafety, by M.K Satheesh, I K International Publishing House Pvt. Ltd

4th SEMESTER

50 Hrs.

HCT:4.1 MEDICAL BIOTECHNOLOGYAND NANOTECHNOLOGY

UNIT-1: Medical Biotechnology:Scope and Importance **2Hrs.**

UNIT-2: Cancer Biology: Types of tumors, pre disposing factors, cellular changes involved in tumor formation. Genes associated with cancer (Oncogenes and Tumor suppressivegenes). Methods of tumor detection, tumor markers, treatment of cancer chemotherapy, radio therapy, immunotherapy and agene therapy.

8Hrs.

UNIT-3: Microbial diseases in humans: Mode of infection, symptoms, epidemiology and control measures of diseases casued by Viruses(AIDS, Hepatits-B, Rabies, HSV-1)
Vacterial (Typhoid, STD, TB, Plague), Fungi (ASpergillosis, Histoplasmosis, Cryptococcosis), Protozoa (Malaria, Amoebiasis) **6Hrs.**

UNIT-4: Diagnostics: Applications of immunological and molecular diagnostic methods(RIA,ELISA, PCR, and DNA finger printing) in forensic science and disease diagnosis.

5Hrs.

UNIT-5: Stem cells: Types, sources,, properties, and applications of stem cells in tissue repair, tissue engineering and regenerative medicine. **5Hrs.**

UNIT-6: Human genome project and its applications: Example of genes identified with various human diseases, molecular detection of pre symportmatic genetic diseases, Importance in health care, pre-natal diagnosis, genetic manipulation and ethical implications.

5Hrs.

UNIT-7: Gene therapy: Human diseases targeted for gene therapy, vectors and other delivery systems for gene therapy. Ex vivo and in vivo gene therapy, tissue of choice for gene therapy. In-vitro gene therapy and gene therapy of genetic diseases. Eg. Neurological, Metabolic disorders and Cystic fibrosis, gene therapy for Acquired diseases (ADA gene in SCID), Cardiovascular, Cancer etc. Importance of humanized antibodies and lplasminogen activating factor in treating thrombosis.

5Hrs.

UNIT-8: Nan biotechnology: Intoruction, types and synthesis of nonmaterial. Nano biosensors, drug and gene delivery, disease diagnostics and cancer therapy Risk potential of nonmaterial.

4Hrs.

UNIT-9: Pharmacobiotechnology: Role of biotechnology in the production of pharmaceutical products.

3Hrs.

UNIT-10: Ethical issues involved in stem cell research: Use of cell cultures as alternative for animal model for research, testing of drugs on human volunteers, use of animals for research and testing. Animal cloning, human cloning, ethical and social issues, organ transplantation and xeno transplantation.

8hrs

REFERENCES:

01. Strokes, J., et al,1993, Clinical miacrobiology-7th Edn.,
02. Colle, J.G., 1989, Practical Medical microbiology, Churchill living stone.
03. Jawetz, E., Melonick, J.L., Adelberg, E.A. Review of Medical microbiology, Prentice Hall, 1987.
04. Mackie, and McCarthy 1996. Medical microbiology, Vol-I, Microbial infection Vol-II, Practical Medical microbiology, churchil living storn.
05. Nester, Roberts, Pearsall, Anderson. 1998. Microbiology-a human perspective, 2nd Edn., McGraw-Hill.

06. Warren, Levinson. 2000. Medical microbiology and immunology. Examination and Board review, 8th Edn., McGraw Hill.
07. Credric, A. Mims 2004. Medical microbiology-3rd Moshy Inc.
08. Leslic collier, john oxford 2000. Human virology: A Text book of students of medicine, dentistry and microbiology 2nd Ed., Oxbord university Press.
09. Topley and Wilson. Principles of Bacyteriology, Virology and Immunity, Edward Arnold.
10. Hoghl and Mottet. Clinical microbiology, J.B Lippincott company.
11. Kenneth, J.R. Medical Microbiology- introduction to infectious diseases, printice Hall Int.
12. Anthnarayana, R. and C.K. Jayaram paniker, 1997. Text Book of Microbiology, Orient Longman.

PRACTICAL: HCP 4.1

Blood urea analysis by diacetyl monoxyme method
1. Analysis of acid and alkaline phosphatase from serum samples
2. Estimation of serum cholesterol
3. Blood sugar analysis by Folin -Wu method
4. Estimation of Creatine and Creatinine from urine samples
5. Study of cancer cell and visit to cancer research Institute
Sterilization of plastic ware and glass ware used in animal cell culture.
6. To demonstrate the principle and functioning of commonly used instruments in animal biotechnology lab.
7. Preparation of various media used for animal cell culturing.
8. Trypsinization of monolayer and subculturing.
9. To perform SRID, DID for disease diagnosis.
10. Immunoelectrophoresis for detection of pathogens.
11. To perform biochemical tests for identification of pathogens.
12. To detect blood groups of the given samples.
13. To perform TLC, DLC of the given blood samples.
14. To study the microbial flora of skin.
15. To determine the microbial content of dental cavities.
16. To perform widal for diagnosis of typhoid.
17. To perform VDRL for diagnosis of syphilis.
18. To demonstrate the effect of different antibiotics on bacterial pathogens.

REFERENCE BOOKS;

1. Molecular Biology of the Cell:- Alberts etal., 1983.
2. Molecular Biology of the Gene:- J.D. Watson.
3. Molecular Cell Biology:- Darncil etal.,
4. The Gene:- Benjamin Levine.
5. Bacteial Plasmids:- P.Breda.
6. Genetic Engineering Vol I-IV Willamson (Ed).
7. Gene Cloning:- Glover, 1984.
8. Recombinant DNA:- Watson etal., 1983.
9. Vectors:- Rodrignes and Denhardt, 1987.
10. Experiments with gene fusion:- Sil Havy etal.,
11. Tailoring enes for Crop improvement:- an Agricultural propective Bresenting G, Haads, J. Kosuge, T. Hollasender, A.
12. DNA technology:- Edward Alccuno. J. 1990.
13. Commerical Biotechnology:- OTA, 1984.
14. DNA Science:- Michols, D.A. 1990.
15. DNA Finger printing:- Krawizak, M and Schmidtke.J. Bcos 1984.
16. Gene expression technology:- Hgoeddel, A.IP. 1991.
17. Genetically Engineered Organisms:- Fenmchanm. J.R. S. 1991.

50 Hrs.

HCT.3.2 PLANT BIOTECHNOLOGY

02 Hrs.

UNIT-1: Plant tissue culture: Introduction to cell and Tissue culture. Tissue culture as a technique to produce novel plants and hybrids.

01Hrs.

UNIT-2: Tissue culture media (Composition and preparation)

02Hrs.

UNIT-3: Initiation, maintenanace of callus and suspension culture and single cell clones.

02Hrs.

UNIT-4: Organogenesis: Somatic embryogenesis, transfer and establishment of wholel lplants in soil.

02Hrs.

UNIT-5: Shoot tip culture: rapid clonal prolpagation and production of virus free plants.

01Hrs.

UNIT-6: Embryo culture and Embryo rescuer.

02Hrs.

UNIT-7: Protoplast isolation and fusion. Selection of hybrids cells and regeneration of hybrid plants. Symmetric and asymmetric hybrids, and hybrids.

02Hrs.

UNIT-8: Anther, pollen and ovary culture for production of haploid plants and homozygous lines.
UNIT-9: Cry preservation, slow growth and DNA banking for germ plasma conservation.

01Hrs.

UNIT-10: Basic techniques in r-DNA technology: Biolistics (Paricle bombardment) Elecroration, microinjection and Agrobacyterium mediated gene transfer. T-plasmid derived vector systems, structure and restriction site. The mechanism of T-DNA transfer from Agro bacterium to plant cells Marker and reporter genes used in plant system Manipulation of gene expression in plants. Isolation and uses of different promoters, production of marker free transgenic plants.

07Hrs.

UNIT-11: Plants transformation Technology: Basis of tumor formation, hairy root, features of Ti and Ri Plasmids, mechanisms of DNA Transfer, role of virulence genes, use of Ti and Ri as vectors, Binary vectors, use of 355 and other promoters. Genetic markers, use of reporter gene with interns, luse of scaffold attachment regions, methods of nuclear transformation, viral vetors and their applications, Multiple gene transfers, vector-less of direct DNA transfer. Transformation of monocots, trans gene stability and gene silencing.

06 Hrs.

UNIT-12: Application of plant transformation in plant productivity and performanance: Herbicide resistance, Phosphoinothricin, Glyph sate, sulfoyurea urea, atrazine, insect resistance/Bt genes, Non Bt like protease inhibitors, alpha amylase inhibitor, virus resistance coat protein mediated, nucleo capsid gene disease resistance, 1-3 B gluconase, RJP antifungal proteins, thoinins, PF Proteins, nematode resistance Aabioticstress, post harvest losses, long self life of fruits and flowers use of ACC synthase, polygalactourancase, and ACC oxidase, Male

sterile lines, bar and barnase systems. Carbohydrate composition and storage ADP glucose pyrophosphates.

05Hrs.

UNIT-13: Molecular marker aided breeding: RELP mapa linkage analysis, RAPD markers. STS micro satellites SCAR(sequence Characterized Amplified Regions)SSCP (Single strand conformational polymorphism) AFLP, QTL, Map based cloning, molecular markers.

04Hrs.

UNIT-14: Plant genomics: Arabidopsis thaliana (Mad-Box gene) as a model for plant genomics and Plant proteomics, Rice genome project. Genetic diversity and phyllogenetic studies.

02Hrs.

UNIT-15: Chloroplast transformation:Advantage, vector, success with tobacco and potato

04Hrs.

UNIT-16: Metabolic Engineering and Industrial products: Plant secondary metabolites, control mechanisms and manipulation of phenylpropaniod pathway. Alkaloids, industrial enzymes, biodegradable plastics, Polyhydroxy

butyrate, therapentic proteins, lysosomal enzymes, antibodies, edible vaccines, purification strateies. Oleosin lpaartitioning.

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