

Deccan Education Society's
FERGUSON COLLEGE, PUNE
(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY
SECOND YEAR M.Sc. Biotechnology
SEMESTER –I

Academic Year 2017-2018

BTH5301: Animal Biotechnology (3C)

Sr. No.	Topic	Lectures
1	Concept of Tissue culture. Factors affecting the success of <i>in vitro</i> culture Physico chemical requirements Buffers, Balanced salt solutions and Growth Media types and formulation: natural, synthetic, sera and substitutes Maintenance of asepsis, Sterilization of media, reagents and labware Contamination: Types, Detection methods, Prevention methods Storage and transport of cell cultures Equipment required for ATC	15
2	Evolution of Cell line: Concept, properties of cell lines and types Cell Culture Systems: Monolayer, Suspension Organ Culture, Histotypic Organotypic Culture	10
3	Overview-livestock breed and their productivity, artificial breeding methods and hazards, marker assisted breeding of livestock. artificial breeding – in vitro fertilization and embryo transfer technology, artificial insemination ,germ cell storage, Introduction to animal genomics, different methods for characterization of animal genomes, SNP, STR, QTL, RFLP, RAPD, genetic basis for disease resistance	10
4	Applications Application of animal cell culture for <i>in vitro</i> testing of drugs, in production of human and animal viral vaccines and pharmaceutical proteins. Culture Scale up and mass production of biologically important compounds. Harvesting of products, purification and assays. Hybridoma Technology, Virus propagation	10

Learning Outcome:

The student should understand

1. Concept and different types in animal Cell culture
2. Use of molecular biology techniques genetically engineer the animals to improve sustainability, productivity and suitability for pharmaceutical, agricultural and industrial applications

Reference books:

1. R. Ian Freshney. Culture of Animal cells, 5rd Edition, 2010. A John Wiley & Sons, Inc., Publications, USA
2. R.W.Masters. Animal Cell Culture- Practical Approach, 3rd Edithion,2000, Oxford University Press. USA
3. Robert Lanza et al. Essentials of Stem Cell Biology”, Academic Press, 2nd edition, 2006.USA
4. Text book of Animal Husbandary, 8th edition, (1998) G.C. Banerjee,Oxford and IBH Publishin co.Pvt. Ltd. India
5. Molecular Biotechnology: 4th edition. (2010), Glick B.R., Pasternak J.J., Patten C. L., ASM press, USA
6. Gene Transfer to Animal Cells, 1st edition (2005), R. M. Twyman, Taylor & Francis USA.

BTH 5302 Bioprocess engineering & Fermentation Technology (3C)

Sr. No.	Topic	Lectures
1	<p>Introduction to fermentation and Basic aspects of bioengineering Introduction to fermentation: Fermentation, types. Basic Aspects of Bioengineering: Design of Fermenter / bioreactors – Design aspects of Stirred tank reactor and non- mechanically agitated bioreactors (Air lift and Bubble column) Kinetics of operation of bioreactors: Batch, Fed Batch and Continuous Processes. Design and operation of immobilized cell reactors. Mass transfer in Immobilized Bioreactor Aeration and agitation of fermentation broth: Mass transfer: Concept of mass transfer, Molecular diffusion and role in bioprocess, Two – film theory, Convective mass transfer, volumetric mass transfer (<i>KLa</i>), Liquid-Solid, Liquid-liquid and Gas- liquid mass transfer equations and significance in bioprocess. Aeration : Oxygen Uptake in cell cultures, Oxygen transfer from Gas bubble to Cell. Gas hold up, <i>KLa</i> importance, Determination of <i>KLa</i>, Factors affecting <i>KLa</i>. Agitation: Design of impellers and their flow patterns. Fermentation Broth rheology – Newtonian and Non Newtonian fluids, Factors affecting broth rheology, Power requirement for mixing Power number, Reynolds number, Flow regimes in fermentation tank (Laminar, turbulent and transition), Correlation between mass transfer coefficient and operating variables</p>	15
2	<p>Fermentation Media, Media Sterilization and monitoring of process variables Media components and their optimization. Sterilization of media: Kinetics of destruction of microorganisms, indicator organism Δt factor, designs of Batch and continuous sterilization (Δt factor calculation), equipment used. Filter sterilization. Monitoring of process variables: Types of sensors, Measurement and control of various parameters (pH, Temperature, dissolved oxygen, microbial biomass, inlet and exit gases, fluid flow, Pressure, Foam) P.I. D. control, Computer control of variables. Scale Up and Scale Down.</p>	10
3	<p>Molecular Engineering Important strains and pathways - Mutation, Protoplast fusion, parasexual cycle and genetic engineering for strain improvements, product formation and inhibition pathways and their regulations; applications in medicine, agriculture and industry. Industrially important microorganisms, preservation, Culture collection centers</p>	5

4	<p>Production and Downstream processing</p> <p>Concept of primary (growth associated) and secondary metabolites (Growth non -associated) metabolites, kinetics of growth and product formation. Yield coefficient and efficiency.</p> <p>Downstream processing and unit operations, General strategy of downstream processing, Production, recovery (with principles of techniques involved) and applications of:</p> <p>Vitamins (Vitamin C)</p> <p>Amino acids</p> <p>Enzymes</p> <p>Antibiotics</p> <p>Organic acids</p> <p>Vaccines(Conventional and Recombinant)</p> <p>Biotransformation product (steroid)</p> <p>Cheese.</p> <p>Exopolysaccharides.</p> <p>Effluent Disposal strategies used for Textile, dye, dairy, paper and pulp industries</p> <p>Fermentation economics</p>	15
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Learning Outcome: After completing the modules the students gain knowledge about:

1. Design of Fermenter/ bioreactors
2. Liquid-Solid, Liquid-liquid and Gas- liquid mass transfer equations and significance in bioprocess.
3. KLa and Importance
4. Fermentation Media,Media Sterilization and monitoring of process variables
5. Strain Improvement
6. Industrial Productions and Downstream processing

References:

- 1.A. H. Patel. (1985), Industrial Microbiology, Macmillan India Ltd.
- 2.Bioreactor Design and Product Yield (1992), BIOTOL series, Butterworths Heinemann.
- 3.Casida, L. E., (1984), Industrial Microbiology, Wiley Easterbs, New Delhi
- 4.Dilip K. Arora editor, Fungal Biotechnology in agriculture, food and environmental applications (Mycology), 2005. Marcel Dekker, Inc. New York.Basel
- 5.Indian Pharmacopia and British Pharmacopia (Latest Edn).
- 6.Lydersen B., N. a. D' Elia and K. M. Nelson (Eds.) (1993)Bioprocess Engineering: Systems, Equipment and Facilities, John Wiley and Sons Inc.
- 7.Operational Modes of Bioreactors, (1992) BIOTOL series, Butterworths Heinemann.
- 8.Peppler, H. L (1979), Microbial Technology, Vol I and II, Academic Press, New York.
- 9.Peter F. Stanbury. Principles Of Fermentation Technology, 2E, Elsevier (A Division of Reed Elsevier India Pvt. Limited), 2009
- 10.Prescott, S.C. and Dunn, C. G., (1983) Industrial Microbiology, Reed G. AVI tech books.
- 11.Reed G. Ed. Prescott and Dunn's Industrial Microbiology. 4thEd., CBS Pub. New Delhi.
- 12.Shuichi and Aiba. Biochemical Engineering. Academic Press 1982.
- 13.Stanbury, P. F. and Whittaker, A. (1984) Principles of Fermentation technology, Pergamon press.
- 14.Van Damme E. J. (1984) Biotechnology of Industrial Antibiotics, Marcel Dekker Inc. New York.
- 15.Wiseman A.(1985) Topics in Enzyme and Fermentation - Biotechnology, Vol. 1 and 2, John Wiley and Sons, New York

BTH5303 Human and Population Genetics (3C)

Sr. No.	Topic	Lectures
1	Pedigree Analysis in Humans: Symbols, construction of pedigree, molecular genetic data, significance of pedigrees	3
2	Genetic traits: Monogenic traits and inheritance pattern (autosomal, sex-linked inheritance, sex limited and mitochondrial inheritance) Quantitative Genetics: Polygenic traits and mode of inheritance, analysis of variation: genetic and environmental factors, Heritability, Inbreeding and consequences, Co-efficient of inbreeding and consanguinity.	4
3	Cytogenetics : Karyotyping: Classical karyotyping (banding techniques). Molecular karyotyping (FISH, M-FISH, SKY, QF-PCR and mBAND). Various karyotyping symbols used in human genetics.	5
4	Chromosomal Aberrations and Syndromes: Changes in chromosomal number: Euploidy, Aneuploidy. Polyploidy, Mosaics, Trisomy and Monosomy. Changes in chromosomal structure: Translocation, inversion, deletion and duplication. Autosomal and sex linked disorders. Abnormal karyotype and its implications. Chromosome abnormalities in cancer.	7
5	Environment and the Genome : (a) Imprinting and Epigenetics (b) Genetics of Cancer (Oncogenes and tumor suppressor genes) (c) Genetics of Ageing	8
6	Clinical detection of chromosomal abnormalities and Molecular genetic analysis approaches: Clinical tests to detect genetic disorders. Amniocentesis, CVS, ultrasound, detection of alpha feto protein. Application of molecular methodologies in genetic analysis, Gene-based therapeutic approaches, Mapping human genome, Polymorphism and population analysis – SNPs and genotyping using sequence analysis and microarrays. Ethics and limitations	10
7	Mendelian Genetics in random mating populations and discrepancies in human population: Human Population and gene pool concepts, modes of speciation, genotype and allele frequencies, variation. Hardy Weinberg's Law, genetic equilibrium, X linked loci, departure from equilibrium.	8

Learning Outcome:

The students should be acquainted with concepts in human genetics and its current applications

References:

1. Pasternak, An Introduction to Molecular Human Genetics, Fitzgerald, 2000
2. Gersen & Keagle, The Principles of Clinical Cytogenetics, Humana, 1999
3. Strachan & Read, Human Molecular Genetics, Wiley, 1999
4. Strickberger MW, Genetics, Prentice Hall-India, 2006
5. Hartl DL, Jones EW, Genetics: analysis of genes and genomes, Jones and Bartlett, Massachusetts)

BTH5304 Bioinformatics (3C)

Sr. No.	Topic	Lectures
1	Bioinformatics- Introduction and definition, History and Scope, Applications of Bioinformatics in various fields.	4L
2	<p>Nucleic Acid Sequence Databases :</p> <ul style="list-style-type: none"> • Nucleic acid sequence databases (GenBank, EMBL, DDBJ), Keyword-based search at Entrez Search Engine at NCBI. • Sequence Submission tools at NCBI, EMBL etc. <p>Protein sequence database: UniProtKB (SwissPort, TrEMBL).</p>	6L
3	<p>Open Access Bibliographic Resources and Literature Databases:</p> <ul style="list-style-type: none"> • PubMed, • MEDLINE, • PubMedCentral at NCBI 	2L
4	<p>Sequence Analysis:</p> <p>Various File Formats for Biomolecular Sequences: GenBank FASTA</p> <p>Basic Concepts of Sequence Similarity, identity, homology. Definitions of homologues, orthologues and paralogues genes</p> <p>EMBOSS tools: Primer Designing and Restriction Enzyme Mapping and Analysis.</p> <p>Basic concepts of sequence analysis: Global Pairwise Sequence Alignment Local Pairwise Sequence Alignment Needleman and Wunsch, Smith and Waterman algorithms for pairwise alignments, gap penalties, use of pairwise alignments for analysis of Nucleic acid and Protein sequences and interpretation of results.</p> <p>Databases Searches : BLAST FASTA</p> <p>Multiple Sequence Alignment: The need for MSA Basic concepts of various approaches for MSA (e.g. progressive, hierarchical, iterative etc.).</p> <p>Concept of Phylogeny: Molecular Phylogeny Various Methods of Phylogenetic Tree Construction</p> <p>Scoring matrices: Basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSSUM series.</p>	8L

5	<p>Derived Databases: Knowledge of the following databases with respect to: basic concept of derived databases, sources of primary data and basic principles of the method for deriving the secondary data, organization of data, contents and formats of database entries, identification of patterns in given sequences and interpretation of the same</p> <p>Sequence: InterPro, Prosite, Pfam, ProDom, Gene Ontology</p> <p>Structure classification database: CATH, SCOP, FSSP</p> <p>Protein-Protein interaction database: STRING</p>	8L
6	<p>Protein Structures Study: Biophysicochemical Properties, Secondary Structure of protein (alpha helices & beta sheets), Motifs, Tertiary and Quaternary Structure of the Protein.</p> <p>Methods for Protein Structure Prediction:</p> <ul style="list-style-type: none"> • Energy- and fragment-based methods • Evolutionary covariation to predict 3D contacts • Comparative protein modeling • Homology modeling • Protein threading • Side-chain geometry prediction <p>Structure Databases: PDB, NDB, PubChem</p> <p>Molecular visualization: Protein conformation and visualization tool (RASMOL, SPDBViewer, Cn3D and Jmol).</p> <p>Drug Discovery: Role of bioinformatics in drug discovery, target discovery, lead discovery, docking and prediction of drug quality.</p>	9L
7	<p>Genomics</p> <ul style="list-style-type: none"> • Overview of genome sequencing assembly and annotations. • Genome databases & analyzing genome sequences. <p>Proteomics:</p> <ul style="list-style-type: none"> • Metabolic Pathway databases (KEGG, MetaCyc, EcoCyc) • Computation of various parameters using proteomics tools at the ExPASy server. 	8L

Learning Outcome:

The students should acquire the knowledge about:

1. Various bioinformatics tools and techniques and how to use that for the analysis of the biological experimental data.
2. Concepts of various databases and various methods for the data retrieval, data storage, and data mining and use that data for the further analysis.
3. In- Silico approach for the protein modeling and drug discovery process.
4. Sequencing techniques and gene annotation as well as submission of the sequences to the various databases.

References:

1. Bioinformatics Sequence and Genome Analysis: David Mount.
2. Essential Bioinformatics: Jin Xiong Cambridge University Press
3. Introduction to bioinformatics, 2001. AH wood, T.K. Parry smith DJ, Pearson education Asia.
4. Bioinformatics: A practical guide to the analysis of genes and proteins – 2001 – AD Baxevanis & BFF Ouellette – Wiley Interscience – New York.
5. Bioinformatics: Methods and Protocols – 2000 – Stephen Misener & Stephen A. Krawetz, Humana Press, New Jersey.
6. Bioinformatics: Sequence, structure and databanks – 2000 – Des Higgins & Willie Taylor – Oxford University Press.
7. Bioinformatics: Methods and Protocols – 2000 – Stephen Misener & Stephen A. Krawetz, Humana Press, New Jersey.
8. Bioinformatics : Sequence, structure and databanks – 2000 – Des Higgins & Willie Taylor - Oxford University Press
9. Bioinformatics Databases, Tools and Algorithms: Orpita Bosu, Simminder Kaur Thukral

Sr. No.	Contents	No. of lectures
1.	Introduction to clinical research Drug Development Process <ul style="list-style-type: none"> • Overview of Drug Development Process including clinical trials phases 	1
2	Protocol Designing: <ul style="list-style-type: none"> • Definition of protocol, its importance and purpose • Protocol format: Chapters (Headings) and broad contents of protocol • Important scientific and administrative aspect included in protocol • Introduction to Research Methodology • Protocol writing team and role of each member • Clinical trial design: Types of study designs • Sampling, sample size, randomization, Inclusion & Exclusion criteria • Phases of clinical trial & Types of trials 	6
3	Good Clinical Practice (GCP)-ICH E6: <ul style="list-style-type: none"> • Ethical Principles and their origin • Ethics in clinical research: As per ICMR & GCP • Ethics committees: Roles & responsibility of IEC and IRB • Ethics in relation to vulnerable groups & special situations • Responsibilities of Sponsors, Investigators & Regulators • ICH: Purpose, regulations & guidelines • Informed consent and Informed consent form • Essential Documents 	6
4	Drug Regulatory Affairs (Clinical Trial) <ul style="list-style-type: none"> • Regulatory Authority in India (DCGI & CDSCO) • Schedule Y of Drugs & Cosmetics Act • International Scenario of Regulatory Aspects: FDA, CFR, 	3
5	Clinical Safety & Pharmacovigilance: <ul style="list-style-type: none"> • Definitions of AE, ADR, SAE, • Recording & reporting: Objectives & Importance • Pharmacovigilance: International procedures • Pharmacovigilance in India 	5
6	Monitoring of Clinical Trials <ul style="list-style-type: none"> • Monitoring and its role in clinical trials • CRF and other source documents relevant to monitoring 	2
7	Clinical Data Management	1
8	Practical for Protocol Design, CRF Design and source documentation	6

BTH5305- Clinical Research and Data Management

References:

1. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G.
2. Clinical Pharmacology, Scientific book agency, Laurence, DR and Bennet PN.
3. Clinical pharmacokinetics, Pub. Springer Verlab, Dr. D.R Krishna, V. Klotz
4. Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins
5. Drug interaction, Kven Stockley. Hamsten
6. Drug interaction, Basic Bussiness Publ, Bombay, J.K. Mehra
7. Clinical pharmacology and drug therapy Grahame smith and Aronson,
8. Text Book of Therapeutics Drug and Disease Management Hardbound. Richard A Helms,

BTH 5306: Computational tools in research (2C)

Sr. No.	Topic	Lectures
1	Research content writing Creating, Organizing & Formatting Research Content using MS Word Merge, Insert, View, Edit, Track Mode etc Organizing bibliography and formatting using Mendeley	6
2	Technology – based Communication Netiquettes: effective e-mail messages, Video conferencing, preparing CV, Bio data.	4
3	Research data organization Creating, Analyzing, Formatting Data & Content using Spreadsheets Insert, View, Edit etc. Managing Workbooks Data tabulation, Calculations, Equations and analyzing biological Data using statistical tools	8
4	Data Presentation Organizing Presentation Material Use of audio visual aids in presentation elements of presentation preparation: objective, subject, audience, Length of talk Managing & Delivering Presentations	6
5	Other modes of Presentation Poster Making, Model exhibits, Popular Science articles.	6

Learning Outcome:

The students should acquire the knowledge about:

- How research is communicated
- How data is analyzed and presented
- Presentation and research communication skills

References:

1. **Barass Robert**, Scientists Must Write: A Guide to Better Writing for Scientists, Engineers and Students (2002), *Routledge Publication, UK*
2. **Kuhn Thomas**, The Structure of Scientific Revolution (2012) 50th anniversary edition, *Chicago University Press, USA*
3. **Martha Davis**, Scientific Papers And Presentations 2nd edition (2004), *Academic Press*
4. **Maynard Smith, J.** The Problems Of Biology (1986), *Oxford University Press, Oxford*
4. **Richard P. Feynman**, The Pleasure Of Finding Things Out: The Best Short Works Of Richard P. Feynman (1999), Edited By Jeffrey Robbins, *Perseus Books, USA*
5. **Robert A. Day, Barbara Gastel**, How to Write and Publish a Scientific Paper 7th edition (2011), *ABC-CLIO, USA*
6. **Strunk, Jr., W. And White, E.B.**, The Elements of Style 5th Edition (2003), *Pearson Publication, Delhi*

BTH 5307: Biostatistics (2C)

Sr. No.	Topic	Lectures
1	Introduction: Biological variables, parameters of statistical data display. Types of scales: linear, power, log, circular (with biological examples) Curves and Equations: Linear, saturating, sigmoid, exponential, logistic, power, multinomial, algebraic, differential, partial differential.	6
2	Probability & Sample Probability Distributions: binomial and Poisson Frequency distributions: central tendency, dispersal, skewness, kurtosis, multimodality Sampling methods	6
3	Normal Distributions and applications Properties of Gaussian distributions Central Limit theorem Std. error and confidence limits	4
4	Hypothesis Testing (with biological examples) Principles of hypothesis testing, significance level, null hypothesis Type I and Type II errors Examples of hypothesis testing: comparison of means, t-test, Chi-square test Regression Correlation	10
5	Mathematical models Concept of models: growth and decay, population interactions, optimization Equilibrium solutions, Analytical solutions, numerical solutions and simulation	4

Learning Outcome:

The students should acquire the knowledge about:

- How data is analyzed and presented
- Statistical inferences based on statistical tools and techniques.

References:

1. R.G. Bartle and D.R. Sherbert 2nd edition, (1992), Introduction to real analysis, John Wiley, USA
2. Introductory biostatistics. 1st edition. (2003), Chap T. Le. John Wiley, USA
3. High Yield Biostatistics. (2001) Antony N Glaser. Lippincott Williams and Wilkins, USA
4. Introduction to Mathematics for Life Scientists. 3rd edition (1979). Edward Batschalet,
5. Mathematics for the Biological Sciences. Illustrated edition(1979) J.C. Acharya and
6. Lardner, Prentice Hall, USA

BTH 5308 Bioinstrumentation (2C)

Sr. No	Topic	No. of lectures
1.	Spectroscopic techniques: Introduction, Absorbance, Fluorescence, Circular dichroism, Vibrational spectroscopy, Raman spectroscopy, Electron spin resonance, Nuclear magnetic resonance spectroscopy, X-ray crystallography, Mass spectrometry	15
2.	Electron microscopy: Introduction, Transmission and Scanning electron microscope, Specimen preparation, Image reconstruction, Electron diffraction, Tunnelling electron microscope, Atomic Force Microscope	10
3.	Visit to instrumentation facility centre and report writing	5

Learning outcome:

The student is expected to know various tools used in modern biotechnological research.

References Books:

1. Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson and John Walker, 7th ed., 2010, Cambridge University Press, UK
2. Modern experimental biochemistry, Rodney Boyer, 3rd ed., 2000, Prentice Hall Publisher, USA.
3. <http://www.biophysics.org/ProfessionalDevelopment/SelectedTopicsInBiophysics/BiophysicalTechniques/tabid/2313/Default.aspx>
4. Biophysical techniques, Iain Campbell, 1st ed., 2012, Oxford University Press, UK.
5. Biophysics, V. Pattabhi, N. Gautham, 1st ed., 2002, Kluwer Academic Publishers and Narosa Publishing House, New Delhi
6. Biophysical Chemistry, AvinashUpadhyay, 2nd ed., 2009, Himalaya Publishing House, New Delhi

BTH5309-Research Methods I (2C)

Sr. No.	Topic	Lecture
1	Introduction to Research Methods Phases of Scientific Enquiry Problem identification/ beginning of scientific approach Asking the right question, review of literature and referencing Choosing an appropriate system/s, Design of a study, Observational Studies, Experimental Studies Data Collection, Data Analysis	2
2	Designing Research Formation of a query-hypothesis design Data collection methods Advantages & shortcomings and - explanation with examples Importance of controls in designing an experiment Different types of controls (Positive, negative and internal)	5
3	Research Methods Quantitative and Qualitative Quantitative Research Designs: Formation of a query-hypothesis design Data collection methods, Sampling and Sample Design Advantages & shortcomings and - explanation with examples Importance of controls in designing an experiment Different types of controls (Positive, negative and internal)	11
4	Analyzing and plotting Research Data Data distributions, Statistical tests for comparison of sample means and sample variance- t-test, non parametric tests, Correlation and Regression, Introduction to multivariate analysis Mathematical models Simulation as a tool to test these models	12

Learning Outcome:

The students should acquire the knowledge about:

- How research is designed, planned and executed
- How data is analyzed and presented
- Presentation and research communication skills

References:

1. **Anthony M. Graziano, Michael L. Raulin**, Research Methods: A Process Of Inquiry (2012) 8th Edition, , *Pearson Publication, Delhi*
2. **Barass Robert**, Scientists Must Write: A Guide to Better Writing for Scientists, Engineers and Students (2002), *Routledge Publication, UK*
3. **Barrow And Tipler**, The Anthropic Principle (1988), *Oxford University Press, Oxford*
4. **David B. Resnik**, The Ethics of Science: An Introduction (1998), *Routledge Publication, UK*
5. **Fisher R A**, The Design of Scientific Experiment (1971) 9th edition, *Collier Macmillan Publishers, London*
6. **Ganguli Prabuddh**, Intellectual Property Rights (2001), *Tata McGraw-Hill Publishing Company Ltd., Delhi*
7. **Jacob Bronowski And Bruce Mazlish**, The Western Intellectual Tradition (1960), *Harper & Row, New York*
8. **John D'Angelo**, Ethics in Science: Ethical Misconduct in Scientific Research (2012), *CRC Press, USA*
9. **Kuhn Thomas**, The Structure of Scientific Revolution (2012) 50th anniversary edition, *Chicago University Press, USA*
10. **Martha Davis**, Scientific Papers And Presentations 2nd edition (2004), *Academic Press*
- Maynard Smith, J.** The Problems Of Biology (1986), *Oxford University Press, Oxford*
- Maynard Smith, J.**, Current Controversies in Evolutionary Biology (1983), *Cambridge University Press, USA*
11. **Medawar, P. B. And Medawar, J. S.**, The Life Science: Current Ideas Of Biology (1977), *Wildwood House, London*
12. **Peter Raven et al**, Biology 9th edition (2010), *McGraw-Hill Education, Singapore*
13. **Popper Karl**, The Logic of Scientific Discovery (2004), *Routledge Publication, UK*
14. **Richard P. Feynman**, The Meaning Of It All: Thoughts Of A Citizen-Scientist (2005), *Basic Books, New York*
15. **Richard P. Feynman**, The Pleasure Of Finding Things Out: The Best Short Works Of Richard P. Feynman (1999), Edited By Jeffrey Robbins, *Perseus Books, USA*
16. **Robert A. Day, Barbara Gastel**, How to Write and Publish a Scientific Paper 7th edition (2011), *ABC-CLIO, USA*
17. **Robert R. Sokal and F. James Rohlf**, Introduction to Biostatistics 2nd edition (2009), *Dover Publication, New York*
18. **Scott, E. C.** Evolution Vs. Creationism: An Introduction. (2004), *University of California press, USA*
19. **Smith, Roger**, The Norton History Of The Human Sciences, New York: W.W. Norton, 1997. **Strunk, Jr., W. And White, E.B.**, The Elements of Style 5th Edition (2003), *Pearson Publication, Delhi*
20. **Wolpert, L.**, The Unnatural Nature of Science (1992), *Faber & Faber, London*

BTH5310: Animal Biotechnology (2C)

Sr. No.	Topic	Practicals (6P X 5H)
1	Initiation of cell culture from chick embryo	1P
2	Subculture and maintenance of cell line established in laboratory	2P
3	Study of effect of different proliferative agents or inhibitors on cell growth by viable count analysis	2P
4	Chromosome preparation from cell line	1P

Learning Outcome:

After completion of the practical the students should be able to,

Initiate primary culture and passage it without contamination

Analyze effect of different factors on growth of cell line

BTH-5311 Exercises in Bioprocess Engineering (2C)

S. NO.	Practical	6Px 5hrs
1	Screening and identification (Genus Level) of a production strain (enzyme /antibiotic) from soil samples.	1
2	Maintenance of the isolated production organism (Agar slants/ glycerol stocks /soil culture/ lyophilization) at least two methods. Optimization of different parameters of the isolated organism (conventional and Statistical design).	2
3	Calculation of Del factor for the fermentation medium sterilization	1
4	a.Inoculum build up of the isolated organism for use in bench top fermentation b.Study of Working of lab bench fermenter (with production of enzyme or antibiotic using screened organism),Study of different parts and assembly of the bench top fermenter c.Assay of product formed (Bioassay or Enzyme assay).	1
5	Solid state fermentation : Lab scale production of a product	1

Learning Outcome:

After completing the practical module the students should be acquainted with the techniques in:

1. Screening and identification of a production strain
2. Optimization of different parameters and sterilization cycle designing of the isolated organism
3. Working of lab bench fermenter and down stream processing.
4. Solid state fermentation

BTH5312: Exercises in Bioinformatics (2C)

Sr. No.	Topic	Practical (10P x 3H)
1	Publicly available Database study and searching	1
2	Retrieval of sequences and Sequence analysis by: BLAST, FASTA	1
3	Multiple Sequence Analysis: ClustalW (JalView), MUSCLE, T-Coffee	1
4	Phylogenetic tree construction: Phylip, FIGTREE	1
5	Visualization and study of 3D molecular structures – RASMOL, Swiss PDB viewer	1
6	Potential energy calculations- Swiss PDB viewer	1
7	Mutation and energy minimization of proteins- Swiss PDB viewer	1
8	Homology Modeling- Swiss PDB viewer, ExPASy	1
9	Protein classification, domain identification, signature matching - PFAM, Prodom, Prosite	1
10	IMGT database search for IG, TR and MH	1

Learning outcome:

After completing the practical module the students should be acquainted with:

1. Various databases used for Retrieval of sequences and Sequence analysis
2. Softwares for multiple sequence alignment and phylogenetic studies
3. Visualization and study of 3D molecular structures
4. Protein classification, domain identification, signature matching

BTH5313 Scientific Report Writing (1C)

- The students will be briefed about the technique of report writing.
- All the students will be asked to select a topic for report writing and submit the report which will be assessed by the teachers.

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SYLLABUS UNDER AUTONOMY
SECOND YEAR M.Sc. Biotechnology
SEMESTER –II

Academic Year 2017-2018

BTH5401 Genomics and Proteomics (4C)

Sr. No.	Topic	Lecture
1	Genomics	15
	<p>Genomics and Proteomics overview, omes and omics, Concepts and applications Transition from a single gene to genomics. Genome overview at the level of Chromosome (with model organisms example) Strategies for large scale DNA sequencing- Whole genome analysis techniques, Next generation sequencing methods; Organization, structure and mapping of genomes Genome Annotation, Comparative Genomics, Structural and functional Genomics</p>	
2	Transcriptomics and Microarray	10
	<p>Introduction to transcriptomics and expression profiling. DNA and RNA Microarray –Preparation, working and analysis. Microarray databases and bioinformatics tools. Investigative techniques –EST, SAGE, SNP</p>	
3	Applications	5
	<p>Metagenomics, Toxicogenomics, Pharmacogenomics, Gene disease association</p>	
4	Proteomics	15
	<p>Proteomics – introduction, concept and applications; Introduction, Concept, application, advantages and limitations of Structural and Functional Proteomics with one example for each.</p>	
5	Techniques in Proteomics	10
	<p>Protein separation techniques, Strategies in protein identification, 2D Gel electrophoresis, Isoelectric Focusing (IEF). Mass spectrometry in proteomics - Principle, techniques, components and variations (HPLC, ESI, MALDITOF, FT-MS, MS/MS, Quadrupole) and analysis, applications. Protein- Protein interactions- experimental and computational - two hybrid, Phage display; Protein Microarray - Preparation, working and analysis. Proteomics and Microarray databases and allied bioinformatics tools.</p>	

6	Applications	5
	Peptidomics/Drug discovery, Toxicoproteomics, Biomarkers in disease diagnosis, Identification and characterization of novel proteins.	

Learning Outcome:

The students should acquire the knowledge about:

- The current focus on whole genome sequencing, comparing genomes its applications in drug targeting and disease association
- To analyze whole proteomes and to understand protein networks and protein-protein interactions.

Reference Books:

1. Bioinformatics - From Genomes to Drugs (2001) Thomas Langauer (editor) Wiley-VCH; 1st edition
2. Bioinformatics-Sequence and Genome Analysis (2004) David W Mount Cold Spring Harbor Laboratory Press; 2nd edition
3. Broad-based Proteomics strategies: a practical guide to proteomics and functional screening David R M Graham et al J.Physiol 2005, 563.1, 1-9
4. Comparative Genomics Webb Miller et al Annu.Rev.Genomics Hum.Genet 2004, 5, 15-56
5. Discovering genomics, Proteomics and Bioinformatics (2006) A. Malcolm Campbell,laurie J. Heyer Benjamin Cummings; 2nd edition
6. DNA microarrays and gene expression (2002) P Baldi and G W Hatfield Cambridge University Press
7. Essential Bioinformatics (2006) Jin Xiong Cambridge University Press; 1st edition
8. Functional Genomics: Methods and Protocols (2003) M J Brownstein, A B Khodursky Humana Press
9. Genome analysis and bioinformatics (2009) Sharma T R I.K. International Publishing House Pvt. Limited
10. Genome and proteome annotation: organization, interpretation and integration G A Reeves et al J.Roy.Soci. 2009,6, 129-147
11. Introduction to genetic analysis (2008) Griffiths et al W. H. Freeman
12. Introduction to genomics (2007) Arthur M. Lesk OUP Oxford
13. Principles of proteomics (2004) Twyman Richard Taylor & Francis
14. Protein Expression: A practical approach (series 1999) editor B. D. Hames Oxford University Press
15. Proteomics from protein sequence to function (2001) Pennington SR, Dunn MJ.,Stephen R BIOS
16. Review: Protein identification methods in Proteomics Kris Gavaert and Joel Vandekerchhove Electrophoresis 2000, 21, 1145-1154
17. Transcriptomics (2003) Virendra Gomase VDM Publishing.

BTH5402: Development, Stem Cell and Regenerative Biology (4C)

Sr.No	Topic	Lectures
1	Gametogenesis and fertilization: Mechanisms of Fertilization, Acrosome reaction, blocks to polyspermy, egg activation (capacitation). Early embryonic development: Metabolic activation, cytoplasmic rearrangement	10
2	Patterns of cleavages and blastulation in Drosophila, sea urchin, frog, chick, mouse and human. Cell –cell interaction and signaling during morphogenesis in early embryo; Pattern formation	10
3	Fate maps and gastrulation in vertebrate & invertebrate models. Neurulation and primordial organ rudiments, neural crest cells. Molecular mechanisms of animal development (homeotic genes, DNA methylation and epigenetic gene regulation).	10
4	Cellular basis of differentiation, trans-differentiation, metaplasia and regeneration, cell lineages Stem cell self-renewal and pluripotency: molecular mechanisms Cell cycle regulation in stem cells. Embryonic, Adult and Induced Pleuripotent Stem cell niches	10
5	Isolation, characterization and maintenance of embryonic stem cells, adult stem cells, embryonic germ cells, embryonic carcinoma cells	5
6	Stem cells in tissue engineering, Gene therapy and therapeutic application of stem cells - Neurodegenerative disorders, spinal cord injury, diabetes, burns and orthopedic applications of stem cells.	5
7	Genetic Manipulation of stem cells, overview of different methods of introduction of a viz. micronuclear injection method, transduction with recombinant retroviruses, targeted gene insertion, cre-LoxP recombination and production of transgenic animals. Mouse models to study human disorders	10

Learning Outcome:

The students should understand the concept of differentiation, plasticity & trans differentiation
Properties of stem cells and their application in regenerative medicine

Reference books:

1. Development Biology, 9th edition, (2010), Gilbert S.F.(Sinauer Associates, USA)
2. Principles of Development, 4th edition (2010), Wolpert L and Tickle C, Publisher: Oxford University Press, USA.
3. Essentials of Stem Cell Biology, 2nd edition, (2009) Robert Lanza, et al. Elsevier Academic Press, USA
4. Stem cells and the future of regenerative medicine, 1st edition, (2002), National research council and Institute of medicine, National Academic press, Washington DC
5. Molecular Biotechnology: 4th edition. (2010), Glick B.R., Pasternak J.J., Patten C. L., ASM press, USA

BTH5403-Research Methods II (2C)

Sr. No.	Topic	Lecture
1	Research Ethics Social implications of research, bio-safety issues Animal experimentation ethics, wild-life ethics and human experimentation ethics	5
2	Data fudging and plagiarism	2
	Scientific Communication Importance of scientific communication Types of scientific communications Logical organization of scientific data and documentation	3
3	Different modes of scientific communication Details of – Proposal writing, Research paper writing, Thesis writing Oral forms of scientific communication- Popular and Scientific talks, Poster presentations	15
4	Legal forms of communication of science Ethics in scientific communication IPR, patent submissions	5

Learning Outcome:

The students should acquire the knowledge about:

- How research is designed, planned and executed
- How data is analyzed and presented
- Presentation and research communication skills

References:

1. **Anthony M. Graziano, Michael L. Raulin**, Research Methods: A Process Of Inquiry (2012) 8th Edition, , *Pearson Publication, Delhi*
2. **Barass Robert**, Scientists Must Write: A Guide to Better Writing for Scientists, Engineers and Students (2002), *Routledge Publication, UK*
3. **Barrow And Tipler**, The Anthropic Principle (1988), *Oxford University Press, Oxford*
4. **David B. Resnik**, The Ethics of Science: An Introduction (1998), *Routledge Publication, UK*
5. **Fisher R A**, The Design of Scientific Experiment (1971) 9th edition, *Collier Macmillan Publishers, London*

6. **Ganguli Prabuddh**, Intellectual Property Rights (2001), *Tata McGraw-Hill Publishing Company Ltd., Delhi*
7. **Jacob Bronowski And Bruce Mazlish**, The Western Intellectual Tradition (1960), *Harper & Row, New York*
8. **John D'Angelo**, Ethics in Science: Ethical Misconduct in Scientific Research (2012), *CRC Press, USA*
9. **Kuhn Thomas**, The Structure of Scientific Revolution (2012) 50th anniversary edition, *Chicago University Press, USA*
10. **Martha Davis**, Scientific Papers And Presentations 2nd edition (2004), *Academic Press*
- Maynard Smith, J.** The Problems Of Biology (1986), *Oxford University Press, Oxford*
- Maynard Smith, J.**, Current Controversies in Evolutionary Biology (1983), *Cambridge University Press, USA*
11. **Medawar, P. B. And Medawar, J. S.**, The Life Science: Current Ideas Of Biology (1977), *Wildwood House, London*
12. **Peter Raven et al**, Biology 9th edition (2010), *McGraw-Hill Education, Singapore*
13. **Popper Karl**, The Logic of Scientific Discovery (2004), *Routledge Publication, UK*
14. **Richard P. Feynman**, The Meaning Of It All: Thoughts Of A Citizen-Scientist (2005), *Basic Books, New York*
15. **Richard P. Feynman**, The Pleasure Of Finding Things Out: The Best Short Works Of Richard P. Feynman (1999), Edited By Jeffrey Robbins, *Perseus Books, USA*
16. **Robert A. Day, Barbara Gastel**, How to Write and Publish a Scientific Paper 7th edition (2011), *ABC-CLIO, USA*
17. **Robert R. Sokal and F. James Rohlf**, Introduction to Biostatistics 2nd edition (2009), *Dover Publication, New York*
18. **Scott, E. C.** Evolution Vs. Creationism: An Introduction. (2004), *University of California press, USA*
19. **Smith, Roger**, The Norton History Of The Human Sciences, New York: W.W. Norton, 1997. **Strunk, Jr., W. And White, E.B.**, The Elements of Style 5th Edition (2003), *Pearson Publication, Delhi*
20. **Wolpert, L.**, The Unnatural Nature of Science (1992), *Faber & Faber, London*

BTH5404: Agricultural Biotechnology

S. No.	Topic	Lectures
1	Fundamental biotechnology: gene cloning, PCR: types and applications Introduction to DNA fingerprinting and profiling techniques: biochemical markers and DNA based (genic and random) markers; repertoire of DNA fingerprinting techniques Molecular markers: Molecular basis of dominant and co-dominant markers, RFLP, MAAP (Multiple Arbitrary Amplicon Profiling) and other PCR based markers (DNA Amplification Fingerprinting, Arbitrarily Primed PCR, RAPD, SSRs, STMS, SCARs, Inter-SSRs, AFLP, Intron spanning markers SNP based marker assays (CAPs, dCAPs, dHPLC, molecular beacons, 5'nuclease assay/Taqman assays)	7
2	Other applications of molecular markers: Genotyping tools as plant variety protection, DNA bar-coding technology, establishing clonal fidelity	3
3	Functional analysis of genes:, RNA-mediated interference; gene knockoffs; site directed mutagenesis, insertional mutagenesis; Gene traps/ T-DNA insertion lines Gene expression: microarray profiling; SAGE; SNPs/variation; gene expression and transcript profiling; EST contigs;, allele/gene mining; synteny and comparative genomics Eco-TILLING (Targeting induced local lesions in the genome), high-throughput genotyping techniques: Diversity Array Technology (DArTs), SNP and tiling arrays	5
4	Plant pathology: Importance, definitions and concepts of plant diseases, Host pathogen interaction, recognition concept and infection, disease development- role of enzymes, toxins, growth regulators; defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance.	5

Learning outcome:

After completion of the syllabus students are expected to understand-

1. Different types of molecular markers
2. Application of molecular markers in identification and improvement of crop traits
3. Functional analysis of genes for crop improvement
4. Plant pathology and genetics of disease resistance

References:

1. Till, Bradley J., Troy Zerr, Luca Comai, and Steven Henikoff. "A protocol for TILLING and EcoTilling in plants and animals." *Nature protocols* 1, no. 5 (2006): 2465-2477.
2. Barkley, N. A., and M. L. Wang. "Application of TILLING and EcoTILLING as reverse genetic approaches to elucidate the function of genes in plants and animals." *Current genomics* 9.4 (2008): 212-226.
3. Varshney, Rajeev K., Kailash C. Bansal, Pramod K. Aggarwal, Swapan K. Datta, and Peter Q. Craufurd. "Agricultural biotechnology for crop improvement in a variable climate: hope or hype?" *Trends in plant science* 16, no. 7 (2011): 363-371.

4. Collard, B. C. Y., M. Z. Z. Jahufer, J. B. Brouwer, and E. C. K. Pang. "An introduction to markers, quantitative trait loci (QTL) mapping and marker-assisted selection for crop improvement: the basic concepts." *Euphytica* 142, no. 1-2 (2005): 169-196.
5. Madesis, Panagiotis, Ioannis Ganopoulos, Argiriou Anagnostis, and Athanasios Tsaftaris. "The application of Bar-HRM (Barcode DNA-High Resolution Melting) analysis for authenticity testing and quantitative detection of bean crops (Leguminosae) without prior DNA purification." *Food Control* 25, no. 2 (2012): 576-582.
6. Kane, Nolan C., and Quentin Cronk. "Botany without borders: barcoding in focus." *Molecular Ecology* 17, no. 24 (2008): 5175-5176.
7. Talbot, Nicholas J. *Plant-pathogen interactions*, Vol. 11, 2004. Taylor and Francis, CRC Press, USA

BTH5405: Food Technology (2C)

S.no	Topic	Lectures
1	<p>Classification of food: Health food, ethnic food, organic food functional food, nutraceuticals, fabricated foods, convenience foods, GM foods, space foods</p>	1
2	<p>Food Chemistry, Biochemistry and Nutrition: definition, scope and importance; water in food, water activity and shelf life of food;</p> <p>Carbohydrates classification, physical and chemical properties of sugars, functional properties and uses of pectic substances, gums and dietary fiber in food; browning reaction in food: enzymatic and non-enzymatic browning, their occurrence and applications in food; starches: functionality of starch in foods, gelatinization and retro-gradation of starches, modified starches, resistant starches.</p> <p>Lipids classification, properties-lipolysis, auto-oxidation, rancidity and flavour reversion, role of food lipids in flavour</p> <p>Proteins structures of protein and amino acids; physical, chemical and functional properties of proteins, functional properties of food proteins, modification of food protein in processing and storage and its implications, texturized, denaturation of protein, gel formation.</p> <p>Enzymes sources, properties, role of enzymes in dairy, starch and sugar, juice/beverage, and meat industry</p> <p>Food adulterants, toxicants Types and methods of detecting food adulterants and toxicants</p>	5
3	<p>Food Microbiology sources of microorganisms in foods; microbial growth, growth curve; factors affecting growth-intrinsic and extrinsic factors controlling growth of microorganisms microbiological criteria of foods and their significance</p> <p>Foods microbiology and public health food poisoning, types of food poisonings, important features etc; bacterial agents of food borne illness, food poisoning by <i>Clostridium</i>, <i>Salmonella</i>, <i>E. coli</i>, <i>Staphylococcus</i> etc.; non -bacterial agents of food borne illness, mycotoxins HACCP system and food safety used in controlling microbiological hazards</p> <p>Food spoilage methods of isolation and detection of microorganisms or their products in food; conventional methods; rapid methods (newer techniques) -immunological methods; fluorescent, antibody</p>	4
4	<p>Food processing and Packaging Scope and importance of food processing- Properties of food- Physical, thermal, mechanical, sensory. Raw material preparation- cleaning, sorting, grading, peeling.</p> <p>Canning, Food processing of the following:</p>	5

	<p>Grain products and oil processing, Processing of jam, jelly, marmalade, squash, candies, and pickles, pectin from fruit waste, tea, coffee, chocolate and; Milk and milk products processing:Animal products processing: Drying and canning of fish, post mortem changes, tenderization and freezing of meat, egg powder.</p> <p>Food additives : Definitions, uses and functions of Acid, Base,Buffer systems, Salts and chelating/sequestering agents, Masticatory substances. Low calorie and non nutritive sweeteners, Polyols.Antioxidants, Emulsifying and stabilizing agents, Anti-caking agents,thickeners, Firming agents. Flour bleaching agents and Breadimprovers. Anti microbial agents / Class I and Class II preservatives as per PFA Act. Colorants, Flavoring agents and related substances, Clarifyingagents. Gases and Propellants.Tracers and other additives. Concept of QA,QC,HACCP,ISO. Sensory analysis of food.</p> <p>Introduction to Food Packaging: definition, factors involved in the evolution and selection of a food package, functions of food packaging (containment, protection, convenience and communication).</p> <p>Paper and paper based packaging materials, Plastic packaging materials Metal packaging materials Glass packaging materials Aseptic packaging of foods Modern packaging techniques</p>	
5	<p>Specialty foods: Nutraceuticals, Functional foods, Neutrigenomics Scope, importance and renewed emphasis on speciality foods, health foods, functional foods.</p> <p>Nutraceuticals, infant and baby foods, adolescent/ teen age foods, foods for pregnant ladies and nursing mothers, geriatric foods. Concept of neutrigenomics</p> <p>Food recommended and restricted in metabolic disorders and disturbances, gastrointestinal disorders; fever and infection; liver, gall, bladder and pancreatic disturbances; blood, circulatory and cardiac diseases; urinary and musculoskeletal diseases; allergies.</p> <p>Health benefits/ mode of action of PUFA/ gamma linolenic acids,antioxidants, dietary fiber,oligosaccharides, sugar alcohols, peptides andproteins, glycosides, alcohols, isoprenoides and vitamins, choline, LAB, phenolics, flavonols, minerals and other miner food constitutes</p> <p>Genetically modified foods : health claims and concerns</p> <p>Prebiotics and Probiotics.</p>	3
6	Food legislation	2

Learning outcome: After completing the course students should be acquainted with-

1. Basics of Food Chemistry , Microbiology
2. Technologies involved in Food processing and Packaging.
3. Concept of Nutraceuticals, Functional foods, Neutrigenomics
4. Food legislation

References:

1. Anthony M. Graziano, Michael L. Raulin, *Research Methods: A Process Of Inquiry* (2012) 8th Edition, , *Pearson Publication, Delhi*
2. Barass Robert, *Scientists Must Write: A Guide to Better Writing for Scientists, Engineers and Students* (2002), *Routledge Publication, UK*
3. Barrow And Tipler, *The Anthropic Principle* (1988), *Oxford University Press, Oxford*
4. David B. Resnik, *The Ethics of Science: An Introduction* (1998), *Routledge Publication, UK*
5. Fisher R A, *The Design of Scientific Experiment* (1971) 9th edition, *Collier Macmillan Publishers, London*
6. Ganguli Prabuddh, *Intellectual Property Rights* (2001), *Tata McGraw-Hill Publishing Company Ltd., Delhi*
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8. John D'Angelo, *Ethics in Science: Ethical Misconduct in Scientific Research* (2012), *CRC Press, USA*
9. Kuhn Thomas, *The Structure of Scientific Revolution* (2012) 50th anniversary edition, *Chicago University Press, USA*
10. Martha Davis, *Scientific Papers And Presentations* 2nd edition (2004), *Academic Press*
Maynard Smith, J. *The Problems Of Biology* (1986), *Oxford University Press, Oxford*
Maynard Smith, J., *Current Controversies in Evolutionary Biology* (1983), *Cambridge University Press, USA*

BTH5406: Bio-entrepreneurship Development (2C)

Sr. No.	Topic	Lectures
1.	Entrepreneurship: definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.	5L
2.	Entrepreneurial Motivation: motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programmes.	5L
3.	Types of Enterprises and Ownership Structure: small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, Ltd. companies and co-operatives: their formation, capital structure and source of finance.	5L
4.	Projects: identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.	5L
5.	Management of Enterprises: objectives and functions of management, scientific management, general and strategic management; introduction to human resource management: planning, job analysis, training, recruitment and selection, etc.; marketing and organizational dimension of enterprises; enterprise financing : raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis, balance sheet its analysis..	5L
6.	Institutional Support and Policies: institutional support towards the development of entrepreneurship in India, technical consultancy organizations, government policies for small scale enterprises.	5L

Learning Outcome:

1. At the end of this course students can able to develop the business plan and fundamentals of Management and Administration.
2. Will understand various the aspects of the entrepreneurship, how to start with the entrepreneurial venture, market research, human resource management, various financial institutions, financial planning, taxation aspects.
3. Various Legal forms of the business for registration of the small scale industries, agencies for the registration of the companies

References:

1. Udyamita (in Hindi) by Dr. MMP. Akhouri and S.P Mishra, pub. By National Institute for Entrepreneurship and Small Business Development (NIESBUD), NSIC-PATC Campus, Okhla

2. Entrepreneurial Development by C.B Gupta and N.P Srinivasan, Publisher Sultan Chand & Sons, 1992. Everyday Entrepreneurs - The harbingers of Prosperity and creators of Jobs - Dr. Aruna Bhargava.

BTH5407 Biotechnology Practical VIII (10C)

BTH5408 Market Analysis and Research Proposal Writing (1C)

- The students will do one market survey and write a research proposal for funding agency (Buisness)