

Rayat Shikshan Sanstha's
Yashavantrao Chavan Institute of Science, Satara
(Autonomous)
Proposed Syllabus for Bachelor of Science Part III

1. Title: **B.Sc. Biotechnology (Entire)**

2. Year of Implementation: 2020-21

3. Preamble: Shivaji University, Kolhapur

4. General Objectives:

- Reconstruction and redesigning of the courses to suite local needs.
- More emphasis on applied aspects of biotechnology
- To develop aptitude of students in the field of research.
- Enrichment of basic knowledge in areas of Biotechnology

5. Duration: One Year

6. Pattern: Semester wise

7. Medium of Instruction: English

8. Structure of Course:

a. Semester V :

Theory: 05 Papers

Practical's: 03 Papers

b. Semester VI :

Theory: 05 Papers

Practical's: 03 Paper

9. Structure of Course:

B. Sc. III SEMESTER– V (Duration – 6 Months)								
Sr. No	SUBJECT CODE	TEACHING SCHEME						
		Theory			Practical			
		No. of lectures	Hours	Credits	Subject	No. of lectures	Hours	Credits
1	BBTT-501 Basics in Genetic Engineering	3	2.4	2	BBTP-506 Techniques in Genetic Engineering and Industrial Biotechnology-I	8	6.4	4
2	BBTT-502 Industrial Biotechnology	3	2.4	2				
3	BBTT-503 Application of Biotechnology in Agriculture	3	2.4	2	BBTP-507 Techniques in Application of Biotechnology in Agriculture and Animal Husbandary/ Bioanalytical tools/ Bionanotechnology	8	6.4	4
4	BBTT-504 A Research Methodology	3	2.4	2				
	BBTT-504 B Bio-analytical Tools							
	BBTT 504 C Bio-nanotechnology							
5	BBTT- 505 Numerical Skills	3	2.4	2	BBTP-508- Project	8	6.4	4
	Total of SEM IV	15	12	10		24	19.2	12
TOTAL NO OF CREDITS FOR SEMESTER V: 22								

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE ,SATARA

COURSE STRUCTURE UNDER AUTONOMY

B. Sc. BIOTECHNOLOGY (ENTIRE)

B. Sc. III SEMESTER– VI (Duration – 6 Months)

Sr. No	SUBJECT CODE	TEACHING SCHEME						
		Theory			Practical			
		No. of lectures	Hours	Credits	Subject	No. of lectures	Hours	Credits
1	BBTT-601 Advances in Genetic Engineering	3	2.4	2	BBTP-606 Techniques in Genetic engineering and Industrial Biotechnology-II	8	6.4	4
2	BBTT-602 Food and Microbial Biotechnology	3	2.4	2				
3	BBTT-603 Application of Biotechnology in Health	3	2.4	2	BBTP-607 Techniques in health biotechnology and Computational Biology/Mathematics	8	6.4	4
4	BBTT 604 A IPR, Bioethics and Quality management	3	2.4	2				
	BBTT-604 B Computational Biology							
	BBTT 604 C Application of Mathematics in Biology							
5	BBTT- 605 Entrepreneurship	3	2.4	2	BBTP-608- Project	8	6.4	4
	Total of SEM VI	15	12	10		24	19.2	12
TOTAL NO OF CREDITS FOR SEMESTER VI: 22								
TOTAL NO OF CREDITS FOR SEMESTER V+ VI: 44								

• Student contact hours per week : 32 Hours (Min.)	• Total Marks for B.Sc.-III (Excluding English) : 700
• Theory lectures and practical : 48 Minutes Each	• Total Credits for B.Sc.-III (Semester V & VI) : 44
• AECC - Ability Enhancement Compulsory Course- English	
• BBT : B.Sc. Biotechnology for Semester V BBTT-501 to BBTT-510 and for Semester VI BBTT-601 to BBTT-610)	
• Course list as per enclosed Annexure. <i>Separate passing is mandatory for Theory, Internal and Practical.</i>	
• Practical Examination will be conducted at semester end.	

Other Feature:

A) Library:

Reference and Textbooks, Journals and Periodicals

B) Specific Equipment's:

Computer, LCD Projector, Visualizer, Smart Board

C) Laboratory Equipment's:

Sr No.	Name of Instrument
1	Atomic Absorption Spectrometer
2	Autoclave Vertical
3	Bacteriological Incubator
4	Binocular Research Microscope CX 21i
5	BOD Incubator
6	Centrifuge Remi R-4C
9	COD refluxing unit
10	Colorimeter
11	Combined pH and Conductivity Meter
12	Compound Microscope
13	Conductivity Meter
14	Deep freezer
16	Dissection microscope
17	Distillation assembly
18	Flame Photometer
19	Hemocytometer
24	Horizontal Electrophoresis unit
25	Horizontal Laminar Airflow
26	Hot Plate
27	Lux Meter
29	Microcentrifuge
30	Microscope camera device
31	Microwave Oven
32	MiniCentrifugeRemi
33	Mixer
34	pH Meter
35	Refractometer
38	Refrigerator
39	Rotary Shaker
40	SonicatorWaterbath
42	Spectrophotometer UV-Vis

43	Stabilizer
44	Thermal Cycler
45	Ultra microtome
46	UV transilluminator
47	Vacuum pump
48	Variable type power pack
49	Vertical Electerophoresis Unit
51	Visible Spectrophotometer
52	Water bath
53	Weighing balance

Rayat Shikshan Sanstha's,
Yashavantrao Chavan Institute of Science, Satara (Autonomous)

Department of Biotechnology

Syllabus under Autonomy B.Sc. III Biotechnology

Subject	Paper
SEMESTER V	
BBTT 501	Basics in Genetic Engineering
BBTT 502	Industrial Biotechnology
BBTT 503	Application of Biotechnology in Agriculture
BBTT 504 A	Research Methodology
BBTT 504 B	Bioanalytical Tools
BBTT 504 C	Bionanotechnology
BBTT 505	Numerical Skills
BBTP 506	Techniques in Genetic Engineering and Industrial Biotechnology-I
BBTP 507	Techniques in Application of Biotechnology in Agriculture and Animal Husbandry/ Bioanalytical tools/ Bionanotechnology
BBTP 508	Project-I

BBTT 501: Genetic Engineering

Credit: 02

Lectures:45

Learning Objectives:

The students should acquire the knowledge about:

- Basics of vectors, nucleic acids, and r-DNA technology.
 - Basics of molecular Tools and Primer designing
 - Basics of DNA Sequencing, Blotting technique and its application
-

Unit I

12

Molecular Tools in r-DNA technology : Introduction and Scope, Enzymes and its application,

Restriction enzymes- types (I, II, III), Nomenclature, recognition sequences, cleavage patterns, modification of cut ends (linkers and adaptors), application, Restriction mapping.

Enzymes in r- DNA technology: Alkaline phosphatases, DNA ligases T4 and *E. coli* Ligases, Methylases, Reverse Transcriptases, S₁ Nucleases, Polymerases-Holoenzyme, Klenow enzymes (T4 DNA Polymerases, Taq DNA Polymerases), Polynucleotide kinase, Ribonuclease.

Unit II

12

Cloning Vectors: Introduction, Properties of good vectors, Properties of good host, Cloning & expression vectors, Types-*E.coli* vector: plasmid (pBR 322 and pUC18), Bacteriophage vectors (λ phage vector, M 13 Vectors), Cosmid vector, Phagemid vector (pBlue script II KS/SK), Yeast vector (YAC and BAC), Animal vectors (Retroviral, Simian Virus 40), Plant vector (Ti plasmid, Ri plasmid), Shuttle vector (pJBD 219), Selection of recombinant vector.

Unit III

12

Nucleic Acid Hybridisation : Nucleic Acid and plasmid purification, Probe Preparation, Methods of labelling probes: Radio labelling – Nick translation, End labeling, Primer extension

Non Radiolabelling – Biotin, dioxygenin ,fluorescent dyes, FISH, Applications of probes.

Unit IV

09

DNA Sequencing: Maxam Gilbert method, Sanger Coulson method and Automated DNA sequencing

Blotting technique: Southern Blotting, Northern Blotting., Western blotting, Dot Blot Technique.

Learning Outcome:

The students should acquire the knowledge about:

- Sequencing based technology and their applications.
- Understanding the cloning vector, Molecular Tools and its applications in research.
- Application of Nuclie acid hybridisation .

References:

- Molecular Biotechnology – Principles & applications of Recombinant DNA : Glick B. R. & Padtranak (Unit IV)
- Gene cloning & manipulating – Christopher (Unit III)
- An introduction to genetic engineering – Nicholl D.S. T. (Unit I)
- Principle of gene manipulation : An introduction to genetic engineering – Old R.W. & Primrose S. B. (Unit I)
- Gene VIII – Lewin (Unit IV)
- Fundamentals of Biotechnology – H. S. Chawala (Unit III)
- Priciple of Biochemistry – Wilson & Walker (Unit IV)
- Biotechnology – R. C. Dubey (Unit III)
- Molecular cloning (Vol I, II, III) – Sambrook and Russel (Unit II)
- Biotechnology Expanding Horizons- B. D. Singh (Unit I, II, III, IV)

Credits: 02

Lectures: 45

Objectives:

- To understand fermentation technology, Types of fermentations
 - To understand about Basic design of fermenter- Components and their functions,
 - To understand Downstream Processes in fermentation
 - To understand bioprocess technology
-

Unit I

12

Introduction to Industrial Biotechnology: Concept and range of fermentation technology, Types of fermentations (Batch, continuous, dual,multiple), Concept of solid state & submerged fermentation., Microbial metabolic products- Primary & Secondary products. Basic design of fermenter- Components of fermenter and their functions, Fermentation economics, Types of fermenters-- Stirred tank fermenter, Airlift fermenter, Tower fermenter, Tubular fermenter, Bubble cap fermenter. Aeration and agitation of fermentation broth.

Unit II

11

Microbial Screening, Scale up and strain improvement: Selection strategy and techniques, Primary and secondary screening, Primary screening of antibiotic, organic acid, enzyme, vitamin C and amino acid, Secondary screening of antibiotic producers. Scale up of fermentations. Production of Biogas, Microbial insecticides - Bacillus thuringensis.Strain improvement concept, Maintenance and preservation of industrially important cultures.

Unit III

11

Fermentation Media and sterilization: Composition of typical fermentation media. Criteria for typical fermentation medium Types of fermentation media, General role of media components water, carbon source, nitrogen source, minerals, precursors, growth factors, buffers, antifoams, oxidation-reduction potentials, inducers, inhibitors. Sterilization of media, Indicator microorganism, Batch and contineous sterilization, equipment used, Filter sterilization.

Downstream Process and Product Recovery: Downstream Processes in fermentation and bioprocess technology Solid and liquid separation. Flocculation and Flotation, filtration and centrifugation - Cell disruption by solid and liquid shear, ultrasonication, enzyme action and mechanical disruption, Product recovery and purification principle Precipitation, Crystallization. Liquid-Liquid extraction, Distillation (Fractional and Steam), Evaporation, Chromatographic separation (Principles), Adsorption and concentration, Membrane filtration, Lyophilization, spray drying.

Learning Outcomes:

After completing the credit student should gain the-

- Student will learn about fermentation technology, Types of fermentations,
- Student will learn Basic design of fermenter- Components and their functions,
- Student will learn Downstream Processes in fermentation,
- Student will learn about bioprocess technology.

References:

- Text Book of Biotechnology – Dr. H. K. Das, (Unit I, II)
- Industrial Microbiology & Biotechnology – Arnold L. (Unit I, III)
- Fermentation Technology – JayantoAcharekar (Unit I, II)
- Industrial Microbiology – Prescott and Dunn (Unit IV).
- Principle of Fermentation Technology – Stanbury P.F., Whitekar H., Hall S. (Unit I, III)
- Bioprocess Engineering : Principles – Nielson T. and Villadeson J. (Unit IV)
- Industrial Microbiology- L.E. Casida (Unit I, II)
- Industrial Microbiology- A.H.Patel (Unit I, III)
- Biotechnology-U. Satyanarayana. (Unit I, II)

BBTT-503 Application of Biotechnology in Agriculture

Lectures: 45

Credits: 02

Objectives:

- To learn techniques of Micropropagation.

- To understand knowledge about preservative techniques used for plants and seeds.
- To learn the techniques production and commercialization of biofertilizer and biopesticide.
- To gain the knowledge of advanced biotechnological application in agriculture.

Unit I

10

Methods for crop Improvement: Introduction , Acclimatization , Breeding for self and cross pollinated plants and vegetatively reproducing plants, selection (pure line and mass) hybridization and mutation, Somaclonal variations Haploids , Somatic embryogenesis.

Unit II

11

Somatic hybridization: Artificial Seed and Germplasm preservation , Somatic hybridization- Definition, protoplast fusion technique, selection of hybrids, symmetric and asymmetric hybrids, cybrid production, Artificial Seed – Definition, Techniques, factors affecting, applications limitations.

Germplasm preservation- Introduction, principle, Long term storage, short, medium storage techniques, factors affecting, cryopreservation, applications, limitations.

Unit III

13

Transgenic Plants: Herbicide resistant: Glyphosate resistance, Phosphinothricin resistance **Fungal and Bacterial disease resistance approaches:** PR proteins, Chitinase, Glucanase, RIPs proteins, **Virus resistance:** Virus coat proteins, Movement proteins, Transmission proteins, Satellite RNAs, Antisense RNAs, Ribozymes. **Insect resistance approaches:** BT protein (BT- Cotton, BT-Brijal), Non BT protein, **Transgenic plant with improved nutrition:** Golden Rice, Molecular farming,

GM Foods, ethical & socio-economic, legal and environmental issues, Forms of protection -IPR and IPP- Patents, copyright, trademark ,trade secret and PBR.

Unit IV

11

Biofertilizers and Biopesticide: Definition, Principle (Biological nitrogen fixation), Mass production and field application – Rhizobium, Azotobacter, Azospirillum,

Acetobacter, Azolla, Cyanobacteria, PSB, VAM , Biopesticide: Definition , production and applications of Bacterial , fungal, viral , Plant origin biopesticides.

Learning outcomes:

- Students should learn techniques of Micropropagation.
- Students should have knowledge about preservative techniques used for plants and seeds.
- Students should learn the production and commercialization of biofertilizer and biopesticide.
- Students should gain the knowledge of advanced biotechnological application in agriculture.

References:

- Biotechnology – U. Satyanarayana , 4th edition, unit I,III
- A textbook of plant breeding – B.D. Singh, 2nd edition , unit I
- Medical biotechnology – S. N. Jogdand 2nd edition , unit III
- Advances in Biotechnology- S.N.Jogadan 5th edition ,unit IV, I
- Introduction to plant breeding – R. C. Chaudhary 1st edition , unit I,III
- A textbook of Biotechnology - R. C. Dubey 5th edition ,unit IV, III,II,I
- Pharmaceutical Biotechnology – S. P. Vyas ,V. K. Dixit 1st edition unit III
- Biotchnology – B. D. Singh2nd edition , unit I,IV
- Fundamentals of agriculture biotechnology – S. S. Purohit 2nd edition , unit IV

BBTT 504 A Research Methodology

Lectures – 45

Credits -02

Learning Objectives:

- To give a background on the history of research and highlighting the methodologies used to do research.
 - To use the basis of these methodologies to understand and appreciate scientific ethics.
 - To use the framework of these methodologies for understanding effective lab practices, scientific communication and language.
-

Unit 1: Basic in research (12 L)

Definition and perspective - application perspective, objectives perspective mode of enquiry perspective.

selection of problems - stages in the execution of research; preparation of manuscript - report writing - format of journals - proof reading - sources of information; journals, reviews, books, and monographs-bibliography.

Preparation for Research -Choosing a mentor, lab and research question; Maintaining a lab notebook with date-wise entry.

Unit II: Scientific writing skills (12 L)

Problems while writing a scientific document, Scientific publication writing: Elements of a scientific paper including Abstract, Introduction, Materials & Methods, Results, Discussion, References, Drafting titles and framing abstracts.

Publishing scientific papers - the peer review process and problems, recent developments such as open access and non-blind review, Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

Characteristics of effective technical communication, Scientific presentations, Ethical issues.

Unit III: Data collection and documentation (12 L)

Maintaining a laboratory record, Tabulation and generation of graphs. Imaging of tissue specimens and application of scale bars. The art of field photography.

Comparison of means: chi square test, students t test, ANOVA with interpretation of data- introduction to MANOVA- statistical tables and their use - significance test and fixing levels of significance - use of statistical software like COSTAT and STATISTICA.

Unit IV: Scientific Communication: (9 L)

Journals: standard of research journals - impact factor - citation index. Information retrieval - access to archives and databases, search engines - google, PubMed - national informatics centre network services. Online data base library.

Learning Outcomes:

- Understanding of the methodologies of scientific research, applying these to recent published papers.
- Understanding of Data collection and presentation.
- Understanding and practicing scientific reading and to write an effect research proposal.

Reference:

- Writing the doctoral dissertation. Barrons Educational series, 2nd edition, Davis, G.B. and C.A. Parker, 1997. pp 160.
- Authoring a PhD, thesis: how to plan, draft, write and finish a doctoral dissertation, Duncary, P. 2003. Macmillan, pp 256.
- MS office, Sexena, S. 2001. Vikas Publishing House Pvt. Ltd., New Delhi
- Valiela, I. (2001). Doing science: Design, analysis, and communication of scientific research. Oxford: Oxford University Press.
- On being a scientist: A guide to responsible conduct in research. (2009). Washington, D.C.: National Academies Press.
- Gopen, G. D., & Smith, J. A. (n.d.). The Science of Scientific Writing. American Scientist, 78(Nov-Dec 1990), 550-558.

BTT 504 B Bio-analytical Techniques

Lectures: 45

Credits: 02

Objectives:

- To learn working principles of different analytical instruments
 - To learn action mechanism of different analytical instruments
 - Understanding applicability of instruments
-

Unit I:

11

Spectroscopy: Principle, action mechanism, instrument details and applications of: Fourier-transform infrared spectroscopy (FTIR), Liquid Chromatography Mass Spectroscopy (LC-MS), Plasma emission spectroscopy, Fluorescence spectroscopy, Luminometry, Circular dichroism/ Optical rotatory dispersion (CD/ORD) spectroscopy, Light scattering, Surface plasmon resonance (SPR), Inductively coupled plasma mass spectrometry (ICP MS)

Unit II

12

Immunochemical techniques: Introduction, Making antibodies, Immunoassay formats, Immuno microscopy, Lateral flow devices, Epitope mapping, Cell and tissue staining techniques, Immunocapture polymerase chain reaction (PCR), Immunoaffinity chromatography (IAC), Antibody-based biosensors, Therapeutic antibodies, ELISA reader.

Unit III

11

Tracer Techniques: Principles and applications of tracer techniques in biology, Measurement of alpha, beta and gamma radiations, Radiation dosimetry, Radioactive isotopes and half-life of isotopes, Autoradiography, Cerenkov radiation, Liquid Scintillation spectrometry.

Allied bio-analytical techniques: Principle, action mechanism, instrument details and applications of – Flow cytometry, Partition chromatography, Immunoaffinity chromatography (IAC), Fluorescence microscope, Atomic force microscopy, Capillary electrophoresis, Microchip electrophoresis, Next generation sequencing, PPSQ10 protein sequencing

Learning outcome:

- Student should be able to understand basic concepts of Bioinstruments
- Student should understand applicability of Instruments
- Student should be able to handle instruments during project

References:

- Introduction to Molecular Spectroscopy – C. N. Banwell (Unit I, IV)
- Practical biochemistry principles and techniques by Wilson and Walker. (Unit II, III)
- Bioinstrumentation: Veera Kumari. (Unit I, IV)
- Biophysical Chemistry - Upadhyay, Nath, Upadhyay (Unit IV)

BTT 505 C Nanobiotechnology

Lectures: 45

Credits: 02

Objectives:

- To understand general introduction of Nanoparticles.
 - To understand synthesis methods of nanoparticles.
 - To study basic knowledge of nanoparticles characterization.
 - To study the basic knowledge of functionalization of nanoparticles.
 - To study the overall ideas of nanoparticles and their biological application.
-

Unit I

11

Introduction to Nano world, Nano science and Nanotechnology: Nanoparticles, nanowires, thin films Applications in various fields viz. Physical and Chemical, Materials, life sciences. Nanobiotechnology: Introduction, Biomolecules as nanostructures and their applications in nanotechnology viz. Biosensors, separation of cells and cell organelles, cancer therapy, gene therapy etc.

Unit II

13

Synthesis of nanostructure: **Physical methods**– Mechanical methods, methods based on evaporation, sputter deposition, chemical vapour deposition (CVD), electric arc deposition. **Chemical methods:** Synthesis of nanoparticles by colloidal route, microemulsion, sol-gel method, chemical precipitation, pyrolysis. **Biological methods:** Synthesis using microorganism, synthesis using plant extracts, use of proteins and template like DNA.

Unit III

10

Properties and Characterization of nanomaterial:

Optical (UV-Vis / Fluorescence), X-ray diffraction, Imaging and size (Electron microscopy, Light scattering, Zetapotential), Surface and composition (ECSA, EDAX, AFM/STM), Magnetic, Electrical and Electrochemical.

Functionalization of Nanoparticles for biological applications:

Proteins- Lipids-RNA-DNA, Protein targeting –small molecules / Nanomaterial-Protein interaction.

Nanomaterial-cell interaction – manifestation of surface modification (polyvalency), Lipid nanoparticles for Drug Delivery, Inorganic Nanoparticles for Drug Delivery, metal / Metallic oxide nanoparticles (antibacterial/ antifungal/antiviral).

Learning outcome:-

Students should be able to understand:

- The general characterization techniques of nanoparticles.
- Diversity in nanoparticles synthesis process and sources.
- The Basic knowledge of nanotechnology.
- The basic and advanced knowledge of nanoparticles application.

Reference Books:

- Biological Nanostructures and Application of Nanostructures in Biology by Michael A Stroschio and Mitra Dutta (2004) , Kulwer Academic Publishers (Unit IV)
- Bionanotechnology, by David S. Goodsell (2004), John Wiley & Sons, Inc, Publication. (Unit I)
- BioNanotechnology, Elisabeth S. Papazoglou, Aravind Parthasarathy, First Edition (2007), Morgan & Claypool Publishers' series. (Unit II)
- Nano forms of carbon and its applications (2007) Prof.Maheshwar Sharon and Dr.Madhuri Sharon Manad Nanotech Pvt. Ltd. (Unit IV)
- Nanotechnology Basic science and emerging technologies (2005) Willson Kannangava, Smith, Simmons, Raguse Oversease Press (Unit I)
- Nanotechnology; Principals and Practices by Sulabha K. Kulkarni, (2009 Revised edition), Capital Publishing company, New Delhi. (Unit III)

BBTT 505: Numerical Skills

Lectures: 30

Credit: 02

Learning Objectives-

- To understand Mathematical Reasoning and Aptitude:
- To make students aware about some tricks in mathematics.
- To Study the some basic concepts of reasoning.
- To make students aware about competitive exams syllabus like SET/NET/JNU/IIT.

Unit 1:

15

Mathematical Reasoning and Aptitude: Mathematical Aptitude: Fraction, Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc. Number series, Letter series, Codes and Relationships. Mathematical Aptitude (Fraction, Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc)

Unit 2:

15

Logical Reasoning: Understanding the structure of arguments: argument forms, structure of categorical propositions, Mood and Figure, Formal and Informal fallacies, Uses of language, Connotations and denotations of terms, Classical Square of opposition. Analogies, Venn diagram: Simple and multiple use for establishing validity of arguments, Graphical representation (Bar-chart, Histograms, Pie-chart, Table-chart and Line-chart) and mapping of Data.

Learning Outcomes:

- Students should understand the basic fundamentals in basics of Math's and Reasoning
- Student should gain an insight in the fascinating topics like Graphical representation
- Create positive attitude towards Entrance exam and competitive exams.

References:

1. Quantitative Aptitude for Competitive Examinations by Dr. R. S. Agarwal.
2. NTA UGC - NET/SET/ JRF Paper I - Sikshan Evam Shodh Abhiyogita, second Edition
3. Vidyabhartee SET/NET Anivarya Paper Margadarshak 2017by Brijmohan Dayma
4. UGC NET Mathematical Sciences 2018 by Pawan Sharma

BBTP 506: Techniques in Genetic Engineering and Industrial Biotechnology

Credits: 04

Learning Objectives:

The students should acquire the knowledge about:

- Basics of nucleic acids, vectors and r-DNA technology.
- To understand about different Bioassay.
- To understand about. screening of technique
- To understand Purification, Immobilization and Activity of enzyme

SECTION A: Genetic Engineering

1. Calculation of molecular size of digested DNA	01
2. Construction of restriction map of plasmid DNA	01
3. Ligation of DNA	01
4. Purification of DNA fragment from agarose gel	01
5. Transformation of <i>E. Coli</i> and Selection of recombinants	02
6. <i>Agrobacterium</i> transformation in plants	01

SECTION B: Industrial Biotechnology

7. Primary screening of antibiotic producers by crowded plate technique	01
8. Primary screening of amylase producers by Replica Plate technique	02
9. Production of Amylase - Purification, Immobilization and Activity.	02
10. Production of alcohol and estimation by specific gravity method.	02
11. Production of sauerkraut	01
12. Production of wine	01

Learning Outcomes:

The students should acquire the knowledge about:

- Nucleic acids, vectors and genetic transformation basics.
- Understanding the cloning vector, Molecular Tools and its applications in research.

- Student will learn about different industrial technique.
- Student will learn about purification of enzymes.

References

- Sambrook, J., and Russell, D. W. (2006) The Condensed Protocols from Molecular Cloning:A Laboratory Manual, 3rd Ed., pp. 237–356, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY
- Glick BR, Pasternak JJ (1998). Principles and Applications of Recombinant DNA. .ASM, Washington D.C. p. 683
- Teresa K Attwood and David J. Parry-Smith (2001) Introduction to Bioinformatics, Pearson Education Asia,
- Bexavanis & Francis, Bioinformatics (2001) A practical guide to the analysis of genes and proteins, John Wiley and Sons
- Sadashivam And Manikam Biochemical methods: New Age international 1996 Biochemistry.
- Introduction to wine laboratory practices and procedures: Jean L. Jacobson 2006- Springer Science.
- Microbiology and technology of fermented foods: R. W. Hutkins. Blackwell pubshing.
- Microbial Techonology: Peple

**BBTP-507 Techniques in Agriculture Biotechnology and Research Methodology/
Bioanalytical tools/ Bionanotechnology**

Credits: 04

SECTION A: Agricultural Biotechnology

1. Isolation of *Azotobacter*
 2. Isolation of *Rhizobium* from root nodules
 3. Isolation of PSB from soil.
 4. Production of Biofertilizer- *Azotobacter*, PSB
 5. Isolation of *Trichoderma* / *Bacillus thuringensis*
 6. Production of Biopesticide – *Trichoderma* / *Bacillus thuringensis*
 7. Production of Artificial seed
-
- Introduction to wine laboratory practices and procedures: Jean L. Jacobson 2006- Springer Science.
 - Microbial Technology: Peple
 - Microbiology and technology of fermented foods: R. W. Hutkins. Blackwell publishing.
 - Sadashivam And Manikam Biochemical methods: New Age international 1996 Biochemistry.

SECTION B: (A) Laboratory exercises in Research Methodology:-

1. Experiments based on research terms, process, the principle activities, skills and ethics associated with the research process.
2. Explain the relationship between theory and research.
3. Propose a research study on given topic and justify the theory as well as the methodological decisions, including sampling and measurement.
4. To assess and evaluation a published journal article that uses one of the primary research methods in the field.
5. To perform chi square test and student's t test of given scientific data.
6. To perform ANOVA with interpretation of given scientific data.
7. To write an effective research proposal.
8. Poster presentation on defined topics.

References:-

- Writing the doctoral dissertation. Barrons Educational series, 2nd edition, Davis, G.B. and C.A. Parker, 1997. pp 160.
- Authoring a PhD, thesis: how to plan, draft, write and finish a doctoral dissertation, Duncary, P. 2003. Macmillan, pp 256.
- MS office, Sexena, S. 2001. Vikas Publishing House Pvt. Ltd., New Delhi
- Valiela, I. (2001). Doing science: Design, analysis, and communication of scientific research. Oxford: Oxford University Press.
- On being a scientist: A guide to responsible conduct in research. (2009). Washington, D.C.: National Academies Press.
- Gopen, G. D., & Smith, J. A. (n.d.). The Science of Scientific Writing. American Scientist, 78(Nov-Dec 1990), 550-558.
-

SECTION B: (B) Bio-analytical Techniques

1. Demonstration of Fourier-transform infrared spectroscopy (FTIR)
2. Demonstration of high performance liquid chromatography (HPLC)
3. Demonstration of gas chromatography (GC)
4. Hands on spectrophotometer
5. Determine λ max of unknown sample by taking spectra
6. LC-MS data analysis
7. Data analysis of protein sequencing
8. Data analysis of Next generation sequencing
9. Estimation of Ca/Na in the soil using flame photometer.
10. Estimation of microelements in soil using AAS.

Learning outcome:

- At the end of this module, student is expected to know simple applied bioanalytical techniques.
- Models should bring clarity and hands on of different bioanalytical techniques.
- It should give knowledge about data analysis of different instruments.

References:

- Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson & Johan Walkar
- Bioanalytical Techniques by Abhilasha Shourie, Shilpa S. Chapadgaonkar
- Bioanalytical Techniques by Talluri Sekhar
- Analytical Methods:: Interpretation, Identification, Quantification by K.S. Viswanathan R. Gopalan

SECTION B: (C) Techniques in Nanobiotechnology

1. Synthesis of Al₂O₃ nanoparticles using Sol Gel method.
2. Synthesis of semiconductor (ZnS, CdS etc.) nanoparticles by Chemical method.
3. Synthesis of nanoparticles using Plant material.
4. Synthesis of nanoparticles using microbial sources.
5. Detection of nanoparticles in colloidal solutions using UV-Vis absorption technique.
6. Analysis of XRD, FTIR
7. Analysis of SEM and TEM pictures.
8. Applications of synthesized nanoparticles

Learning outcome:

- At the end of this module, student is expected to know simple applied nanoparticles synthesis techniques.
- Models should bring clarity in concepts of conformations of nanoparticles.
- It should give basic knowledge about nanoparticle application

References:

- A practical manual on synthesis of nanoparticles and its applications in biology by Dr V Deepa Parvathi, Dr. K. Rajgopal. Edition first
- Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials 1st Edition, Kindle Edition by Thomas Varghese (Author), K.M. Balakrishna
- Nano Materials Synthesis and Characterisation by Rajendran V
- A Laboratory Course in Nanoscience and Nanotechnology Hardcover – Import, 5 Dec 2014 by Gerrard Eddy Jai Poinern
- Nanotechnology Cookbook 1st Edition by Andrew Collins

BBTP 508: Project

4 Credits

1. Selection of the Project topic and allotment of project supervisor.
2. Preparation of Project Execution Plan : Time and Resource Allocation
3. Guidance by the Project Supervisor, for the self-study of relevant course topics and concepts by the student.
4. Self-study and reference work of relevant topics and concepts by the student.
5. The Project Work must involve practical work(wet lab.) related to selected discipline
6. Students are expected to work on “Project Work” for about 10 periods per week.
7. The project work must be allotted individually.
8. The student invests his energy, time and resources in a project. The project therefore should, if possible, have important bearing on some practical aspect. This will help student to justify his efforts on project.
9. It is the joint responsibility of student and project supervisor to maintain daily register book of his/her project work and has to be produced at the time of examination if asked.
10. Submission Process: Student should prepare 2 copies of the Project Report. At the beginning, the respective Project Supervisor must approve both copies positively before final examination. Then respective Head or Coordinator approves both copies of the Project Report.
11. The student has to submit one of these approved copies of project report, duly signed by the project Supervisor and Principal, before practical examination. The report will be assessed by both Internal examiner (The project supervisor), who will assign the marks. Theory, practical and project report shall form separate heads of passing.

BBTP 509: Numerical Skills

1 Credits

Learning Objectives-

- To solve Mathematical Reasoning and Aptitude using short cut key.
- To Study the some basic formula of reasoning.
- To make students aware about competitive exams syllabus like SET/NET/JNU/IIT.

Practical:

1. To calculate Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc. (give three example of each)
2. Identify Number series and Letter series of given example.
3. To understanding the structure of arguments: argument forms, structure of categorical propositions, Mood and Figure, Formal and Informal fallacies.
4. Uses of language, Connotations and denotations of terms
5. Draw Venn diagram using given information.
6. Show the Graphical representation and mapping from given Data.

Learning Outcomes:

- Students should understand the basics of Reasoning
- Student should gain an insight in the fascinating topics like ven diagram
- Create positive attitude towards Entrance exam and competitive exams.

References:

1. Quantitative Aptitude for Competitive Examinations by Dr. R. S. Agarwal.
2. NTA UGC - NET/SET/ JRF Paper I - Sikshan Evam Shodh Abhiyogita, second Edition
3. Vidyabhartee SET/NET Anivarya Paper Margadarshak 2017by Brijmohan Dayma
4. UGC NET Mathematical Sciences 2018 by Pawan Sharma

Rayat Shikshan Sanstha's,
Yashwantrao Chavan Institute of Science, Satara (Autonomous)

Department of Biotechnology

Syllabus under Autonomy B.Sc.III Biotechnology

Subject	Paper
SEMESTER VI	
BBTT 601	Advances in Genetic Engineering
BBTT 602	Food and Microbial Biotechnology
BBTT 603	Application of Biotechnology in Health
BBTT 604	IPR
BBTT 605	Computational Biology
BBTT 606	Application of Mathematics in Biology
BBTT 607	Bioenterprunership
BBTP 608	Techniques in Genetic Engineering and Industrial Biotechnology-II
BBTP 609	Techniques in application of Biotechnology in health and Computational Biology/Mathematics
BBTP 610	Project-II

BBTT 601: Advances in Genetic Engineering

Credit: 02

Lectures: 45

Learning Objectives:

The students should acquire the knowledge about:

- Basics of gene, cloning methodologies, and c-DNA technology.
- Basics of PCR, types of PCR and Primer designing
- Basics of recombinant DNA technology application and understanding different molecular markers.

Unit I

12

Isolation of Gene: Chemical synthesis (Phosphotriester approach, Phosphitetriester approach), Synthesis of complete gene, cDNA and genomic DNA library, Screening of libraries- immunological screening and colony or plaque hybridization.

Unit II

12

PCR and its application: Primer designing , Annealing Temperature, PCR efficiency , Steps in PCR reaction , Types of PCR – Inverse PCR, Anchored PCR, RT-PCR, Real time PCR, Nested PCR, Colony PCR, Applications, Advantages of PCR, Limitations.

Unit III

12

Cloning methodologies: Construction of plasmid (Somatostatin), Insertion of foreign DNA into host cells, Agrobacterium mediated gene transfer, Chemical methods- CaCl₂ coprecipitation, polycation mediated gene transfer. Physical methods- Liposomes, microinjection, electroporation, biolistics.

Screening of recombinants- Direct selection, Insertional inactivation selection, Blue white selection, Fluorescent Activated Cell Sorter

Unit IV

09

Application of r-DNA technology: Production of transgenics- Knockout mice, in medicines –Insulin

Gene Silencing- Introduction, Principle of Si-RNA and Si- RNA technology

Molecular Markers: Types of Marker- Biochemical, Morphological and genetic markers (eg.RFLP, RAPD, AFLP, QTL, SSR)

Learning Outcome:

The students should acquire the knowledge about:

- PCR based technology and their applications.
- Understanding the molecular markers and applications in research.
- Application of cloning and recombinant technology.

References:

- Molecular Biotechnology – Principles & applications of Recombinant DNA : Glick B. R. & Padtranak (Unit IV)
- Gene cloning & manipulating – Christopher (Unit III)
- An introduction to genetic engineering – Nicholl D.S. T. (Unit I)
- Principle of gene manipulation : An introduction to genetic engineering – Old R.W. & Primrose S. B. (Unit I)
- Gene VIII – Lewin (Unit IV)
- Fundamentals of Biotechnology – H. S. Chawala (Unit III)
- Principle of Biochemistry – Wilson & Walker (Unit IV)
- Biotechnology – R. C. Dubey (Unit II)
- Molecular cloning (Vol I, II, III) – Sambrook and Russel (Unit III)
- Biotechnology Expanding Horizons- B. D. Singh (Unit I, II, III, IV)

BBTT-602 Food and Microbial Biotechnology

Lectures 45

Credits: 02

Objectives:

- To make students aware of Food Biotechnology
 - To understand concepts of microbial biotechnology
 - To study the advantages of fermented food products
 - To aware the techniques of food preservation for avoid the spoilage and toxicity
 - To aware the impact of Genetically modified food on living things and human
-

Unit I

12

Microbial Cultures and Production

Concept of pure and mixed culture, Microbial growth kinetics basic concept (Batch, Continuous and Fed Batch), Microbial Production of Enzymes (amylase –koji fermentation), Antibiotics (Penicillin), Vitamins (B12), Amino acids (Lysine), Organic acid (Citric acid), Probiotics

Edible mushroom, commercial cultivation of mushroom, Single Cell Protein (Spirulina)

Unit- II

11

Fermented Foods and Beverages: Dairy Products – Cheese, Dahi, Yoghurt.

Indian Foods – Idli, Bakery Products – Bread, Fermented Pickles – Sauerkraut

Beverages – Beer, Wine (Red table and white table)

Unit- III

10

Food Spoilage, preservation & toxicity: Types of spoilage- Physical, Chemical and Biological (auto and microbial)

Preservation methods: High and Low temperatures, retort process for unrefrigerated storage, Controlled atmosphere and Anerobiosis, Radiations and Asepsis, Chemical preservatives (Salt, sugar, organic acids, SO₂, NO₂)

Food Toxicity – Mycotoxin (Aflatoxin), Exotoxin (*Staphylococcal*), Neurotoxin (Botulinum), Food borne illness- Shigellosis, Amoebiosis, Aspergillosis.

Impact of GM food on human health: Principle, Risk analysis and Regulations, Multidisciplinary perspectives of GM foods and impact Public health principles, Characteristics of food supply for public health, Food Safety, Capacity to supply nutritional adequacy, Sustainability, Capacity for Consumer choice, Accessibly and affordability to all.

Learning Outcome:

Student should understand:

- Basic concepts of microbial culture mass production.
- Basic Knowledge of fermented food production techniques.
- Different techniques used for food preservation and avoid toxicity preparation
- To study newly prepared genetically modified food analysis for market acceptance

References:

- Text Book of Biotechnology – Dr. H. K. Das (Unit 1)
- Industrial Microbiology & Biotechnology – Arnold L. (Unit 1, 2)
- Fermentation Technology – Jayanto Acharekar (Unit 2)
- Basic Biotechnology – Colin and Bjorn (Unit 4, 1)
- Frontiers in Microbial Biotechnology – Bisel P.S. (Unit 3)
- Industrial Microbiology – Prescott and Dunn (Unit 1, 2)
- Principle of Fermentation Technology – Stanbury P.F., Whitekar H., Hall S. J. (Unit1, 3)
- Industrial Microbiology- L.E. Casida (Unit 2, 3)
- Fermentation Biotechnology- H.A. Modi (Unit 3)
- Industrial Microbiology- A.H.Patel (Unit 3, 4)
- Food Biotechnology- Varun Mehta (Unit 4)

BBTT 603 Application of Biotechnology in Health

Learning Objectives:

- To understand about different vaccines.
 - To understand about recombinant vaccines.
 - To understand Forensic medicine and Public health.
 - To understand about Biosensor and Gene therapy.
 - To understand about Public health- Epidemiology
-

Unit I

10

Stem cells and transgenic technology: Characteristics of stem cells, Concept of stem cell progenitors. Concept of stem cell technology and its application. Transgenic technology & cloning in mammals. Transgenic animals and their applications E.g. -Mice and cattle. Study of separation stem cell from placenta

Unit II

11

Vaccines- Principle & practices: Concept and types of vaccine, preparation of vaccine, Subunit vaccines- Hepatitis B vaccine, Foot and Mouth disease Vaccine, DNA Vaccines, Edible Vaccines, Recombinant vaccines- Cholera Vaccine, Vaccinia Virus Vaccine.

Unit III

12

Monoclonal Antibodies, Biosensor and Gene therapy: Monoclonal antibodies- Production, Formulation, Applications- Diagnostics & Therapeutic Biosensors- Principle & their applications. Gene therapy – Introduction and types- Somatic & Germ line gene therapy. Current status and future trends in telepathology and digital pathology

Unit IV

12

Forensic medicine and Public health: Preparation of DNA sample, Approaches of DNA analysis- RFLP and PCR based, Nuclear hybridization methods DNA –DNA Hybridization, FISH Fluorescent In situ Hybridization, Immunodiagnostic test- Immunofluorescence. Public health- Epidemiology, Diagnosis of infectious diseases, Detection of genetic diseases, Diagnosis of cancers, Pathophysiology of Cancer, Crime Laboratory Analysts work in the lab in areas like microanalysis and DNA testing,

Learning Outcomes:

- After completing the credit student should gain the-
- Student will learn about different vaccines.
- Student will learn about recombinant vaccines.
- Student will learn Forensic medicine and Public health.
- Student will learn about Biosensor and Gene the

References:

- Kuby immunology [Thomas J Kindt; Richard A Goldsby; Barbara Anne Osborne; Janis Kuby] (Unit II, III.IV)
- Medical biotechnology – S. N. Jogdand (Unit IV)
- Advances in Biotechnology- S.N.Jogadand (Unit III, Unit IV)
- A textbook of Biotechnology - R. C. Dubey (Unit I, Unit III)
- Biotechnology – B. D. Singh (Unit I, Unit II)
- Animal & cell biotechnology – Ian, Freshney (Unit I, Unit IV)
- Animal cell biotechnology – Buttler (Unit I)
- Cell and Developmental Biotechnology.-Raj narian Desikar (Unit I)
- Agriculture application of Microbiology-Neeelima Rajvaidya (unit III, IV)
- Digital Pathology Hardcover – Import, 30 Jun 2017 by Liron Pantanowitz (Editor), Anil V. Parwani (Editor) (unit III)
- Cord Blood Stem Cells Medicine1st Edition - Catherine Stavropoulos-Giokas Dominique Charron Cristina Navarrete

BBTT 604 (A) IPR, Bioethics and Quality management

Lectures: 45

Credits: 02

Objectives:

- To learn concept of Intellectual Property Rights
 - To learn rules and regulation for patent filing
 - Understanding the dynamic role of entrepreneurship
 - Understand the quality control and management at industrial level
-

UNIT I

12

General Regime of Intellectual Property Rights: Concept of intellectual property; Types of Intellectual Property- Origin and Development- An Overview; Intellectual Property Rights as Human Right; Role and function of International Institutions- World Intellectual Property Organisation (WIPO) and World Trade Organization WTO; Introduction to copyright; trademark; Geographical Indications and The Protection of Plant Varieties and Farmers' Rights- Farmers rights acts 2001; authority and registry.

UNIT II

11

Patent Law: Introduction to patent laws - (a) Paris Convention (b) Patent Cooperation Treaty (c) WTO- TRIPS (d) Harmonisation of CBD and TRIPS

Indian Patent Law- (a) The Patents Act, 1970 (b) Amendments to the Patents Act (c) Patentable Subject Matter, Patentability Criteria (d) Procedure for Filing Patent Applications, Patent Granting Procedure (e) Revocation, Patent Infringement and Remedies (f) Relevant Provisions of the Biological Diversity Act, 2002 (g) Access and Benefit Sharing Issues

UNIT III

11

Bioethics and Biotechnology: Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private

funding, biotechnology in international relations, globalization and development divide. Introduction to bioethics: Social and ethical issues in biotechnology. Principles of bioethics. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics.

UNIT IV

11

Quality management: Introduction to quality assurance and quality control- Definition, concept

Building (premises) for manufacture of drugs, Packaging material, Personnel, hygiene, sanitation, waste and disposal, Quality control for: all instruments, clothing's, packing, processing line.

Quality management- Production Management and Documentation: ICH, ISO 9000 series, total quality management, validation for tablets and parenterals, practice of WHO GMP.

Industrial Safety: Industrial hazards and their prevention, fire, accidents, mechanical and electrical equipments, industrial effluent testing.

Outcome:

- Students will understand the rules and regulation regarding IPR.
- Students will understand the patent laws and patent filing.
- Students can understand fundamentals of Management and Administration.
- Students can understand the importance of quality control, management, and industrial safety.

REFERENCES:

- Ganguli Prabuddh 2001, Intellectual Property Rights, Tata McGraw-Hill Publishing Company Ltd.7. World Intellectual Property Rights (WIPO) (Unit I)
- Website <http://www.wipo.int/portal/index.html.en> (Unit I)
- Dr. B.L.Wadehra 2011, Law Relating To Intellectual Property, Fifth Edition, *Universal Law Publishing Co.Pvt. Ltd.* (Unit I)
- Feroz Ali, The Law of Patents, LexisNexis (Unit II)

- Ronald D. Slusky, Invention Analysis and Claiming – A Patent Lawyer’s Guide, Second Edition, American Bar Association, 2012 (Unit II).
Feroz Ali, The Touchstone Effect – The Impact of Pre-grant Opposition on Patents, LexisNexis, 2009 (Unit II).
- Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748 (Unit III).
- Quality Assurance of Pharmaceuticals- A compedium of Guide lines and Related materials Vol I & II, 2nd edition, WHO Publications, 1999 (Unit IV).
- Sidney H Willing, Murray M, Tuckerman. Williams Hitchings IV, Good manufacturing of pharmaceuticals (A Plan for total quality control) 3rd Edition. Bhalani publishing house Mumbai (Unit IV).

BBTT 604 (B) Computational Biology

Lectures:45

Credit: 02

Learning Objectives:

- To make students aware about various bioinformatics tools and techniques
 - To understand Concepts of various databases and various methods
 - To understand how to use bioinformatics tools for the analysis of the biological experimental data.
 - To learn Sequencing techniques and gene annotation
 - To teach students the applications of MSEXCEL and analysis and representation of the data
-

UNIT I

11

Introduction to Bioinformatics:-History, Computers in Biology and Medicines, Internet, and related programs; Networking HTTP, HTML, WAN, LAN, MAN, applications in communication.

Information Resources:- Introduction, aim and objectives, INSDC: International Nucleotide Sequence Database Collection (NCBI, DDBJ, EMBL), Sequence retrieval system (SRS): (Entrez, DBGet)

Genomics:- Human Genome Project (HGP)- Goal and applications, final draft of HGP

UNIT II

12

Proteomics: - Introduction to amino acids and protein, Proteome, Protein structure, **Primary protein sequence databases-** SWISS-PROT, PIR, MIPS, NRL-3D, TrEMBL, Annotation and applications **Secondary protein sequence databases:** PROSITE, PROFILE, PRINT, pfam, BLOCK, IDENTIFY; applications. **Other databases:** Literature database, PubMed, PubMed central,

Structural databases: Introduction, Difference between Primary structure and 3D structure, Protein databank (PDB), Molecular modelling databank (MMDB). CATH, SCOP, PdbSum

UNIT III

11

Sequence Alignment:- Introduction, Protein sequence, Nucleic acid sequence, Pair wise sequence alignment, Multiple sequence alignment, Local and Global sequence alignment, Algorithm used in sequence alignment, Matrices- Dot matrix, PAM, BLOSSOM.

Phylogenetic analysis: Introduction: Evolution, definition of phylogenetic tree, nodes, internodes, root, tree, styles; cladogram, phenogram, curvogram, Steps involved in construction of phylogenetic tree

Methods of phylogenetic analysis:- Distance method, Character based Method Phylogenetic analysis tool (Phylip, MEGA).

UNIT IV

11

Application software: Introduction to MSEXCEL-Use of worksheet to enter data, edit data, copy data, move data. Use of in-built statistical functions for computations of Mean, S.D., Correlation, regression coefficients, PCA etc

Use of bar diagram, histogram, scatter plots, etc. graphical tools in EXCEL for presentation of data. Introduction to MSWORD word processor editing, copying, moving, formatting, Table insertion, drawing flow charts etc

Learning Outcomes:

The students should acquire the knowledge about:

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

References:

- Bioinformatics - From Genomes to Drugs (2001) Thomas Langauer (editor) Wiley- VCH; 1st edition (Unit I,II)
- Bioinformatics-Sequence and Genome Analysis (2004) David W Mount Cold Spring Harbor Laboratory Press; 2nd edition (Unit I, III)
- 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 (Unit III,IV)
- Comparative Genomics Webb Miller et al Annu.Rev.Genomics Hum.Genet 2004, 5, 15-56 (Unit II)
- Discovering genomics, Proteomics and Bioinformatics (2006) A. Malcolm Campbell,laurie J. (Unit I, IV)
- Heyer Benjamin Cummings; 2nd edition (Unit II)
- DNA microarrays and gene expression (2002) P Baldi and G W Hatfield Cambridge University Press (Unit II)
- Essential Bioinformatics (2006) Jin Xiong Cambridge University Press; 1st edition (Unit I, III)
- Introduction to genetic analysis (2008) Griffiths et al W. H. Freeman (Unit II)
- Principles of proteomics (2004) Twyman Richard Taylor & Francis (Unit II)

BBTT 604 (C) Application of Mathematics in Biology

Lectures: 45

Credit -02

OBJECTIVE

- To understand data analysis of given samples.
 - To understand concept of correlation and regression.
 - To make inference about a sample based on information we get from a population.
 - To understand concept of statistic and its use in biological field.
-

Unit I:

11

Introduction to Statistics: Meaning of statistics, Scope of statistics in Biological and medical sciences, Collection of Data, types of data, constant, variable (Discrete and Continuous), Measures of central Frequency- Mean, Median, Mode, Measures of Dispersion- Standard Variation and coefficient variation, Theory of attributes- Notations, Class frequency, consistency of data, Coefficient of Association- Yule's coefficient of association, coefficient of colligation, examples.

Unit II:

12

BIVARIATE DATA: Definition of Bivariate data, Scatter plot, Correlation- Measuring correlation coefficient- a) Karl Pearson's method, coefficient of correlation b) Spearman's Rank Correlation coefficient, Regression – Concept of Regression, Regression of Equation of y on x and x on y, properties of regression coefficient (statement only)

Unit III:

11

Elementary of Probability: Random Experiment, sample space, mathematical or classical definition of probability, Conditional Probability, simple examples, Probability Distribution- Bernoulli, Binomial, Poisson Exponential and Normal distributions, p.m.f. / p.d.f, c.d.f. Of these distributions, Mean and variable of distribution

METHODS OF SAMPLING: Population, Sample, a) Sampling Method- simple random samples with and without replacement, Stratified sampling and its advantages, Systematic Sampling, Cluster Sampling b) Exact Sampling Distribution- Chi-square distribution, student t- distribution, F- distribution, concept of P- value.

Expected Outcomes:

- Students should understand the basic fundamentals of the statistics.
- Students should be able to do the data analysis statistically.
- Representation of the data in tabular format and graphical representation of the data.
- They should be able to draw the statistical inference based on the statistical tools and techniques.
- Students should understand the basic Probability and sampling.

Reference:

- Basics Statistics: B. L. Agarwal (Unit I, II, III, IV)
- Principles of Biostatistics. Marcello Pagano. (Unit I, II)
- Course Manuals: S-PLUS Command Line Essentials, The Analysis of Microarrays(Unit III, IV)
- Gupta & Kapoor: Fundamental of mathematical statistics. (Unit I, II)
- Thigale T. K. and Dixit P. G. (2003): A text book of paper- I for B.Sc. I, Nirali Publication, Pune. 3. Waiker and Lev: Elementary Statistical methods. (Unit I, II, III ,IV)
- Rohatgi V. K. and Sauh A. K. Md E. (2002) An Introduction to probability and statistics. (Unit I II ,III ,IV)
- Meyer P. L. (1970): Introduction, probability and statistical Application. (Unit I II III IV)
- Cochran, W.G.: Sampling Techniques, Wiley Estern L(Unit I, II)
- Fundamentals of Biostatistics. by Irfan A Khan. (Unit I II III IV)

- An introduction to Biostatistics. by PSS Sunder Rao. (Unit I II IV)
- Introduction to the Practice of Statistics by Moore and McCabe(Unit I II III IV)

BBTT 605: Bio-entrepreneurship

Lectures: 30

Credits: 02

Objectives:

- Understanding the dynamic role of entrepreneurship and small businesses
 - Organizing and Managing a Small Business
 - Financial Planning and Control
 - Forms of Ownership for Small Business
 - Strategic Marketing Planning
 - New Product or Service Development
 - Business Plan Creation
-

UNIT I:

15

An Overview of Entrepreneurs and Entrepreneurship: definition,

Basic principles and practices of management- Definition, concepts and application; Organization types, coordination, control and decision making in management

Characteristics for being an entrepreneur in biotechnology, Case studies of successful and unsuccessful bio-entrepreneurs

Core concept of Market: Identification and evaluation of market potential of various bio-entrepreneur sectors.

UNIT II

15

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.

Role of government and schemes, financial institutions in fostering bioentrepreneurship

Factors affecting biotech business: (finance, infrastructure, equipment, manpower, resources , project location, end product, quality issues, etc)

Outcomes:

- Students can able to develop the business plan
- Students can understand fundamentals of Management and Administration.
- Students will understand Legal forms of the business for registration of the small scale industries, agencies for the registration of the companies

References:

- Entrepreneurship And Business Of Biotechnology, Prof S N Jogdand, Himalaya Publisher (Unit I)
- Entrepreneurship Development, 2003, S Anil Kumar, New Age International (P) Ltd. Publishers (Unit I)
- Entrepreneurship for Everyone: A Student Textbook, 2009, Robert Mellor, Sage Publication Ltd. (Unit I)
- Exploring Entrepreneurship: Practices and Perspective, 1/e, 27 Jul 2011 Author(s): Richard Blundel& Nigel Lockett Oxford University Pres (Unit II)
- Entrepreneurial Development: Text and Cases,1992- Entrepreneurship Sultan Chand & Sons.(Unit II)
- Commercializing Successful Biomedical Technologies, 2008, Shreefal S. Mehta, Cambridge University Press (Unit II)
- Handbook Of Bioentrepreneurship, 2008 , Patzelt, Holger; Brenner, Thomas, Springer (Unit II).

BBTP-606 Techniques in Genetic engineering and Industrial Biotechnology-II

Credits: 04

Learning Objectives:

The students should acquire the knowledge about:

- Basics of nucleic acids, vectors and r-DNA technology.
- Basics of molecular Tools and PCR
- Basics of molecular markers, transformation, Blotting technique and its application
- To understand about different Bioassay.
- To understand about. Screening of Industrial important organism
- To understand Purification, Immobilization and Activity of enzyme

SECTION A: Genetic Engineering

1. DNA Amplification by PCR	01
2. cDNA cloning by Reverse Transcription PCR	02
3. RAPD analysis	01
4. a) Expression of gene in <i>E. Coli</i> (GST)	02
b) SDS PAGE	
5. Western blotting technique	02
6. Southern blotting technique	02

SECTION B: Industrial Biotechnology

1. Isolation of vitamin B12 requiring mutants.	01
2. Production of citric acid and Recovery.	01
3. Bioassay of Vitamin B12	01
4. Bioassay of Penicillin	02
5. Detection and isolation of pathogens spoiled food.	02
6. Fermentative production of Wine & and its estimation by Titrable acidity	01

References

- Sadashivam and Manikam Biochemical methods: - New Age international 1996 Biochemistry.
- Introduction to wine laboratory practices and procedures:- Jean L. Jacobson 2006- Springer Science.
- Microbiology and technology of fermented foods: R. W. Hutkins. Blackwell Publishing.
- Microbial Technology: Peple

Learning Outcome:

The students should acquire the knowledge about:

- Nucleic acids, vectors and genetic transformation basics.
- Understanding the cloning vector, Molecular Tools and its applications in research.
- Application of Nuclic acid hybridisation
- Student will learn about different industrial technique.
- Student will learn about purification of enzymes

References:

- Sambrook, J., and Russell, D. W. (2006) The Condensed Protocols from Molecular Cloning:A Laboratory Manual, 3rd Ed., pp. 237–356, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY
- Glick BR, Pasternak JJ (1998). Principles and Applications of Recombinant DNA. .ASM, Washington D.C. p. 683
- Teresa K Attwood and David J. Parry-Smith (2001) Introduction to Bioinformatics, Pearson Education Asia,
- Bexavanis & Francis, Bioinformatics (2001) A practical guide to the analysis of genes and proteins, John Wiley and Sons

**BBTP-607 Techniques in Applications of Biotechnology in Health and
IPR, Bioethics and Quality management/ Computational Biology/ Applications of
Mathematics in Biology**

No of Credits: 04

SECTION A: Applications of Biotechnology in Health

1. Analysis of Milk and milk products -
 - a) Estimation of lactic acid.
 - b) Estimation of total fat.
 - c) MBRT
2. Determination of antibacterial activity of crude plant extract.
3. Isolation of DNA from biological samples.
4. DNA fingerprinting-RFLP

SECTION B: IPR

1. Prior Art Searching
2. Drafting a patent
3. Case study related to quality control
4. Case study related to quality management
5. Practices of WHO

Learning outcome:

- At the end of this module, student is expected to know drafting of patent.

References

- Intellectual property rights 1st Edition, by Neeraj Pandey and Khushdeep Dharni.
- How to Patent an Idea in India by Prasad Karhad
- Patent drafting & specification writing by Dr. S.R Myneni

SECTION B: Computational Biology

Learning objectives:

- To make students aware about various bioinformatics tools and techniques
 - Use of bioinformatics tools for the analysis of the biological experimental data.
 - To teach students the applications of MSEXCEL and analysis and representation of the data
1. Introduction to PUBMED Central database
 2. Getting the amino acid sequences by exploring and querying the protein Sequence database.
 3. Getting the gene sequences by exploring and querying the nucleic acid Databases.
 4. Construction of Phylogenetic Tree
 5. Similarity search for nucleotide using the BLASTn
 6. Smilarity search for protein using the BLASTp
 7. Analysis of Secondary and tertiary structure of protein using visualizing software Rasmol.
 8. Prediction of the secondary structure of protein using ExPasy web tool (GOR method).
 9. Calculate PI/MW of protein using ExPasy web tool.
 10. Introduction to Microsoft Excel (Draw Graphs, Uses of formula)

Expected Outcomes:

- Understanding of various bioinformatics tools and techniques
- Knowledge about tools for the analysis of the biological experimental data.
- Applications of MSEXCEL and analysis and representation of the data

References:

- Bioinformatics-Sequence and Genome Analysis (2004) David W Mount Cold Spring Harbor Laboratory Press; 2nd edition (Unit I, III)
- 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 (Unit III,IV)

- DNA microarrays and gene expression (2002) P Baldi and G W Hatfield Cambridge University Press (Unit II)
- Essential Bioinformatics (2006) Jin Xiong Cambridge University Press; 1st edition (Unit I, III)

SECTION C: Applications of Mathematics in Biology

1. Calculation the mean for the given biological Data
2. Calculation of Standard error using Microsoft office excel
3. Introduction to SPSS/R- software
4. Analysis of Biological data using t-test
5. Drawing of VENN diagrams
6. Data representation as heat maps
7. Data analysis using PAST software

References:

- Biostatistics: A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics.
- Introductory Statistics. Fifth Edition. (2004) Prem S. Mann. John Wiley and Sons (ASIA) Pte Ltd.
- Biostatistics-An introductory text - (Auram Gold Stein).

BBTP 608: Project

4 Credits

1. Selection of the Project topic and allotment of project supervisor.
2. Preparation of Project Execution Plan : Time and Resource Allocation
3. Guidance by the Project Supervisor, for the self-study of relevant course topics and concepts by the student.
4. Self-study and reference work of relevant topics and concepts by the student.
5. The Project Work must involve practical work(wet lab.) related to selected discipline
6. Students are expected to work on “Project Work” for about 10 periods per week.
7. The project work must be allotted individually.
8. The student invests his energy, time and resources in a project. The project therefore should, if possible, have important bearing on some practical aspect. This will help student to justify his efforts on project.
9. It is the joint responsibility of student and project supervisor to maintain daily register book of his/her project work and has to be produced at the time of examination if asked.
10. Submission Process: Student should prepare 2 copies of the Project Report. At the beginning, the respective Project Supervisor must approve both copies positively before final examination. Then respective Head or Coordinator approves both copies of the Project Report.
11. The student has to submit one of these approved copies of project report, duly signed by the project Supervisor and Principal, before practical examination. The report will be assessed by both Internal examiner (The project supervisor), who will assign the marks. Theory, practical and project report shall form separate heads of passing.

BBTP 609: Entrepreneurship

Credits: 01

Learning Objectives:

- Business Plan Creation
 - Organizing and Managing a Small Business
 - Financial Planning and Control
 - Strategic Marketing Planning
-
1. Drafting of a project proposal for bank loan
 2. Costing of product
 3. Basic financial calculations (Ex. Calculation of interest)
 4. Strategies for solving the business problems
 5. Advertisement making
 6. Presentation on success story of an entrepreneur

Learning outcomes:

- Drafting of a business plan
- Understanding of Financial aspects
- Knowledge of Strategic Marketing Planning