Rayat Shikshan Sanstha's

SADGURU GADGE MAHARAJ COLLEGE, KARAD.

(An Empowered Autonomous)

Accredited By NAAC with 'A^{+} (3.63 CGPA)' Grade

ISO- 9001-2015 Certified

Affiliated to Shivaji University, Kolhapur

Bachelor of Science (B. Sc. III)

DEPARTMENT OF BIOTECHNOLOGY (ENTIRE)

Under the Faculty of Science and Technology

Regulations in accordance with **National Education Policy**
to be implemented from Academic Year 2025-2026

Syllabus For

B. Sc. Part – III (Biotechnology-Entire)

SEMESTER V & VI

(Syllabus to be implemented from June 2025)

Rayat Shikshan Sanstha's

SADGURU GADGE MAHARAJ COLLEGE, KARAD.

(An Autonomous College)

Regulations and Guidelines as per NEP 2020

Syllabus for Bachelor of Science Part- III (Biotechnology- Entire)

1. **Title:** B.Sc. III Biotechnology (Entire)
2. **Year of Implementation:** 2025-2026
3. **Duration:** One Year
4. **Pattern:** Semester wise
5. **Medium of Instruction:** English
6. **Structure of Course:**

   a. **Semester V:**
   Theory: 60 Papers
   Practical's: 02

   b. **Semester VI:**
   Theory: 06 Papers
   Practical's: 02

7. **Examination Pattern:**

   ❖ Internal Evaluation for Theory Papers: **10 Marks**

   i) **Semester-V: Continuous Compressive Evaluation (CCE-I)** for the major and minor subjects.

   ii) **Semester-VI: Continuous Compressive Evaluation (CCE-II)** for the major and minor subjects.

   ❖ Each Theory paper having a **40 Marks**

   -Nature of Theory Question Paper:

   Q.1- Multiple Choice Questions (All are compulsory) **:** 08 Marks

   Q.2- Long Questions (2 out of 3) **:** 16 Marks

   Q.3- Short Notes (4 out of 6) **:** 16 Marks

   Total **: 40 Marks**

- Practical Examination will be conducted semester wise of **100 Marks** for each subject.

- Practical Exam Question Paper Nature:

Q.1 (a) – Major Experiment	: 20 Marks
Q.1 (b) – Minor Experiment	: 10 Marks
Q.2 (a) – Major Experiment	: 20 Marks
Q.2 (b) – Minor Experiment	: 10 Marks
Q. 3 Spotting (5 Spot)	: 10 Marks
Q. 4 Viva voce	: 10 Marks
Q.5 Certified Journal	: 10 Marks
Q.6 Tour Report/ Case Study	: 10 Marks
Total	**: 100 Marks**

8. Preamble:

Biotechnology is a field that combines basics of life science (biology) and technology. It has been one of the most fast-growing fields in last few decades. Biotechnology can be classified in four categories – green biotechnology (agricultural biotechnology), white biotechnology (industrial biotechnology), red biotechnology (medical biotechnology) and blue biotechnology (marine biotechnology). With development of advanced techniques such gene editing and gene manipulations biotechnology can also be divided as conventional biotechnology and advanced biotechnology/modern biotechnology. Conventional Biotechnology involves usage of natural resources such as plants, animals, microorganisms at optimum conditions to obtain higher yields of commercially important products of biological origin. In Modern Biotechnology genetic engineering approach is used to obtain high yielding recombinants to obtain commercially important products of biological origin. Stem cell research, Tissue engineering, Site specific drug delivery techniques are examples of Modern Biotechnology. The realm of Biotechnology involves understanding and application of basic sciences such as Physics, Chemistry and Mathematics as well as applied sciences such as Microbiology, Food technology, Bioinformatics, Recombinant DNA technology. State of the art technologies such as Artificial Intelligence and Machine learning are now being explored for their application in Biotechnology. Biotechnology is one such course that provides an educational environment where STEM- Science Technology Engineering and Mathematics are not only taught but practiced together. India has recently implemented its NEP2020- New educational policy. One of the major objectives of NEP is to bridge gaps in education and industry by empowering the students by providing them with training in skill-based courses. To provide such training there is a need to develop courses/syllabi with subjects which provide knowledge about the current and most relevant technologies. Along with the training of basics of core subject the students need to be exposed to subjects such as entrepreneurship and intellectual property rights to inculcate

interest in product development. The proposed credit-based curriculum ensures the requirement of academia and industry. Theory supplemented with extensive practical skill sets will help a graduate student to avail the opportunities in the applied fields (research, industry or institutions) without any additional training. Benefit of society and sustainable development. The policy mainly focuses on flexibility in education, multidisciplinary approach, creativity, developing critical thinking and critical thinking. Keeping these mottos in mind, the new syllabi has been designed which will also help students to develop skill sets required when Biotechnology is chosen as a career.

9. Programme Outcomes:

- To introduce different Biotechnological aspects.
- To develop aptitude of students in the field of research.
- To impart knowledge in basic and applied aspects of life sciences
- To make students aware of various applications of Biotechnology and develop their practical skill sets.
- To inculcate scientific, social and environmental awareness in students

10. General Objectives of the Program:

- To introduce the concepts in various allied subjects.
- To enrich students' knowledge in basic and applied aspects of life sciences.
- To help the students to build interdisciplinary approach in teaching/learning & in research.
- To inculcate the sense of scientific responsibilities and social awareness.
- To help students build-up a progressive and successful career in academia and industry.
- To make the students knowledgeable with respect to the subject and its practicable applicability.
- To promote understanding of basic and advanced concepts in Biotechnology.
- To expose the students to various emerging areas of Biotechnology.
- To prepare students for further studies, helping in their bright career in the subject.
- To expose the students to different processes used in industries and in research field.
- To prepare the students to accept the challenges in life sciences.
- To develop skills required in various industries, research labs and in the field of human health.

11. Program Specific Outcomes:

- The present course curriculum will generate skilled human resource required in academia andIndustry.
- The student will be able to achieve basic and advance knowledge based

proficiency in appliedsubjects of life sciences.

- It will create and develop students with interdisciplinary mind set for learning science.
- Student will improve problem solving aptitude using scientific methods in biotechnology andallied subjects.
- Student will adopt scientific approach for implications of biotechnology in society, environmentand education.
- It will demonstrate knowledge and learn various biological processes at cellular and molecularlevel and get expertise in the different techniques used in the fields of Biotechnology.

Student will learn to design and perform experiments in the labs to demonstrate the concepts, principles and theories learnt in the classroom.

Department of Biotechnology .B.Sc.-III
Programme structure

Sem	DSC (Major)		DSE (Minor-I)	OE/GE	AEC (Language)	Value Added Courses	SEC	IKS	Summer Internship	Research Project / Dissertation	Total Credits
	Mandatory	Elective									
V	N-MJT-BT-501 (Basics in Genetic Engineering) (2) N-MJT-BT-502 (Research Methodology) (2) N-MJT-BT-503 (Applications of biotechnology in Agriculture (2) N-MJT-BT-504 (Developmental. Biology) (2) N-MJP-BT-507- Laboratory Exercises in Techniques in Genetic engineering and Research Methodology (4) N-MJP-BT-508 Laboratory Exercises in Techniques in Agricultural Biotechnology and Developmental Biology (4)		**N-MJT-BT-510** Microbiology: Food & Microbial biotechnology (2)	- -	N-AEC –BT-530 English for communication-III (2)	--	- -	- -		N-FP-BT-509 RESEARCH Project (2)	22
	W-L/W=8+16=24	--	W-L/W=2+0=2	--	W-L/W=2+0=2	--	--	--	W-L/W=2+0=2	--	WL/W=14+16=28
VI	N-MJT-BT-601 (Advances in Genetic. Engineering.) (2) N-MJT-BT-602 (Industrial Biotechnology) (2) N-MJT-BT-603 (Application of biotechnology in health) (2) N-MJT-BT-604 (Advances in Bioinformatics) (2) N-MJP-BT-607- Laboratory		N-MNT-BT-610 (2) Microbiology: (Clinical Bacteriology & Virology)	- -	N-AEC –BT-630 English for communication-IV) (2)	--	--	- -	N-OJT-BT-609 On Job Training (2)	--	22

	Exercises in Techniques in Advances in Genetic engineering & Industrial Biotechnology (4) N-MJP-BT-608 Laboratory Exercises in Application of Biotechnology in health & Bioinformatics. (4)										
	W-L/W=8+16=24	--	**W-L/W=2+0=2**	--	W-L/W=2+0=2	--	--	--	--	--	W-L/W=12+16=28
Credits	**16+16=32**	--	**4+0=4**	--	**4+0=4**	--	--	--	**4+0=4**	--	**44**
Level 7 Option 3 : Students who want to undertake 3-year UG Programme will be awarded UG Degree in the relevant Discipline /Subject (Biotech)upon securing 132 credits) or continue studies for Bachelor with Biotech with (Honor's/Research) Degree i.e to Level 8											

B.Sc. III Biotechnology (Entire)

Credit framework and Evaluation Pattern

Evaluation Pattern-: Semester- V									
Subject codes	**Name of Course**	**TH/ PR**	**CCE**		**SEE**		**Total**		**Credits**
			Max.	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	
N-MJT-BT-501	Basics in Genetic Engineering	TH	10	04	40	16	50	16	2
N-MJT-BT-502	Research Methodology	TH	10	04	40	16	50	16	2
N-MJP-BT-507	Laboratory Exercises in Techniques in Genetic engineering and Research Methodology	PR	-	-	100	40	100	40	4
N-MJT-BT-503	Application of Biotechnology in Agriculture	TH	10	04	40	16	50	16	2
N-MJT-BT-504	Developmental Biology (Plant and Animal)	TH	10	04	40	16	50	16	2
N-MJP-BT-508	Laboratory Exercises in Techniques in Agricultural Biotechnology and Developmental Biology	PR	-	-	100	40	100	40	4
N-AEC –BT-530	English for communication- III	TH	10	04	40	16	50	16	2
N-MNT-BT-510	**Microbiology:** Food & Microbial biotechnology.	TH	10	04	40	16	50	16	2
N-RP-BT-509	Field Project	PR	-	-	50	20	50	20	2
						Total	**550**		**22**

B.Sc. III Biotechnology (Entire)

Credit framework and Evaluation Pattern

Evaluation Pattern-: Semester- VI									
Subject codes	**Name of Course**	**TH/ PR**	**CCE**		**SEE**		**Total**		**Credits**
			Max.	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	
N-MJT-BT-601	Advances in Genetic Engineering	TH	10	04	40	16	50	16	2
N-MJT-BT-602	Industrial Biotechnology	TH	10	04	40	16	50	16	2
N-MJP-BT-607	Laboratory Exercises in Techniques in Advances in Genetic engineering & Industrial Biotechnology	PR	-	-	100	40	100	40	4
N-MJT-BT-603	Application of Biotechnology in Health	TH	10	04	40	16	50	16	2
N-MJT-BT-604	Advances in Bioinformatics	TH	10	04	40	16	50	16	2
N-MJP-BT-608	Laboratory Exercises in Application of Biotechnology in Health & Bioinformatics	PR	-	-	100	40	100	40	4
N-AEC –BT-630	English for communication- IV	TH	10	04	40	16	50	16	2
N-MNT-BT-610	**Microbiology:** Clinical Bacteriology & Virology	TH	10	04	40	16	50	16	2
N-OJT-BT-609	On Job Training	PR	-	-	50	20	50	20	2
Total							**550**		**22**
Grand Total= 550+550							**1100**		**44**

Programme Outcome (POs)

1.	**Basic concepts in Biotechnology:**
	Aims to train students in Biotechnology where engineering and technology principles could be used to probe biological questions or to develop technologies, devices and systems that require substantive expertise in Biology, Agriculture, Pharmaceutical, Industrial, as well as Clinical Research components.
2.	**Thinking skill:**
	The students in this program acquire knowledge, critical thinking skills and experience in conducting cutting edge research. This program develops human capital for advanced scientific research and entrepreneurship.
3.	**Problem solving skills:**
	Problem solving skills and relevant biological technologies which provides a strategic roadmap for India's emergence as a global biotechnology innovation and manufacturing hub, which also highlighted importance of human resource development and need for nurturing tailor-made human capital for advanced strategic research and entrepreneurship
4.	**Laboratory skills:**
	Laboratory skills and exposure to a variety of important experiments at appropriate levels that illustrate phenomena discussed in the lecture classes. Instrumentation and experimental techniques; methods for quantitative analysis of data and measurement uncertainty.
5.	**General skills:**
	General knowledge of the development of biotechnology and the nature of scientific inquiry, particularly the progression from classical biotechnology to the modern biotechnology, ideas of genetic engineering, molecular biology, plant and animal biotechnology, bioinformatics, biochemistry and relativity.
6.	**Contemporary areas of biotechnology:**
	Contemporary areas of biotechnology inquiry as introduced in upper-level biotechnology and interdisciplinary elective courses, as well as in faculty-mentored undergraduate research available to all majors who seek this experience.
7.	**Communication skills:**
	Written and oral communication skills for dissemination of scientific results in report, article, or oral presentation formats, standard citation methods, ethics in science and scholarship and its importance to scientific inquiry and professionalism.
(*key-topic areas as given in the Mission Statements of the Biotechnology (Entire) undergraduate program are: i) Biochemistry, ii) Genetic Engineering, iii) Molecular Biology, iv) Microbiology, v)Plant and Animal Biotechnology, vi)Industrial biotechnology, vii) Experimental methods.)	

Programme Specific Outcomes (PSOs):

PSO1:	Undergraduate students will be able to demonstrate and apply their knowledge of cell biology, biochemistry,microbiology, bioinformatics and molecular biology to solve the problems related to the field of biotechnology.
PSO2:	Undergraduate students will be able to demonstrate and apply the principles of bioprocess engineering in the design,analysis, optimization and simulation of bioprocess operations.
PSO3:	Students will be able to gain fundamental knowledge in animal and plant biotechnology and their applications.
PSO4:	Students will be equipped to understand three fundamental aspects in biological phenomenon: a) what to seek; b) how to seek; c) why to seek?
PSO5:	Student will be able to (a) Describe fundamental molecular principles of genetics; (b) Understand relationship between phenotype and genotype in human genetic traits; (c) Describe the basics of genetic mapping; (d) Understand how gene expression is regulated.
PSO6:	Students will be able to (a) elaborate concepts of biochemistry with easy to run experiments; (b) familiarize with basic laboratory instruments and understand the principle of measurements using those instruments with experiments in biochemistry.
PSO7:	Students will be able to understand various facets of molecular procedures and basics of genomics, proteomics and metabolomics that could be employed in early diagnosis and prognosis of human diseases.
PSO8:	Students will able to applied bioinformatics knowledge in drug designing, genetic engineering and phylogenetic analysis.
PSO9:	Students will be able to gain hands on experience in gene cloning, protein expression and purification. This experience would enable them to begin a career in industry that engages in genetic engineering as well as in research laboratories conducting fundamental research.

Course Outcomes (COs)

Sr. No.	Name of the course	Course Outcome
1.	Genetic Engineering	• The objectives of this course are to teach students with various approaches to conducting genetic engineering and their applications in biological research as well as in biotechnology industries. • Genetic engineering is a technology that has been developed based on fundamental understanding of the principles of molecular biology and is reflected in the contents of this course.
2.	Research Methodology	• This course will give a broad overview of research and development carried out in industrial setup towards drug discovery. • On completion of this course, students should be able to understand basics of R&D in drug discovery and should be able to apply knowledge gained in respective fields of pharmaceutical industry.
3.	Application of Biotechnology in Agriculture	• Students will learn introduction to agricultural biotechnology, its scope, role of it in India, world, concept of urban agriculture. • Student will learn how to make draught and herbicide tolerant verities. Students will learn how to produce biofertilizer and biopesticide. • Students will learn how to use molecular markers in plant breeding. Students will learn how to develop transgenic plants for disease resistance using different techniques.
4	Developmental Biology (Plant and Animal)	On completion of this subject, students should be able to: • Describe the morphological processes that transform a fertilized egg into a multicellular organism • Explain the molecular, biochemical and cellular events that regulate the development of specialized cells, tissues and organs during embryonic development • Students are able to co-relate the knowledge of developmental biology with other subjects like Molecular biology, Biochemistry, physiology and Genetics.
5.	Food & Microbial biotech	• The students will understand the basics of food science and nutrition, food spoilage, and preservation, nutraceutical also learn to integrate science with day to day life, nutrition and quality control. • Can become independent researchers and make impactful contributions to the field of Food Biotechnology. • Can take up the jobs of Quality control in various organisations besides research and academics.

6.	Industrial Biotechnology	Students should be able to: • Appreciate relevance of microorganisms fromindustrial context. • Carry out stoichiometric calculations and specifymodels of their growth. • Give an account of design and operations of variousbioreactors and downstream processes. • Calculate yield and production rates in a biologicalproduction process, and also interpret data • Critically analyze any bioprocess from market pointof view.
7.	Application of Biotechnology in Health	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
8.	Bioinformatics	Student should be able to : • Develop an understanding of basic theory of these computational tools; • Gain working knowledge of these computational toolsand methods; • Appreciate their relevance for investigating specific contemporary biological questions; • Critically analyze and interpret results of their study.
9.	Clinical Bacteriology and Virology	Students will be able to describe: • Pathogenicity mechanisms of infectious diseases. • To describe diagnostic methods in clinical microbiology and virology. • To explain antibiotic susceptibility tests and some of bacterial and viral infection agents. • To explain other bacterial infection agents such as Mycobacteria, Actinomycetes and Spirochetes.

SEMESTER-V

Subject Code	Title of Paper
N-MJT-BT-501	Basics in Genetic Engineering
N-MJT-BT-502	Research Methodology
N-MJP-BT-511	Techniques in Genetic engineering and Research Methodology
N-MJT-BT-503	Application of Biotechnology in Agriculture
N-MJT-BT-504	Developmental Biology (Plant and Animal)
N-MJP-BT-512	Techniques in Agricultural Biotechnology and Developmental Biology
AEC-III	English- III
N-MNT-BT-510	Microbiology: Food & Microbial biotech

N-MJT- BT-501 Basics in Genetic Engineering

Credit: 02 **Total Lectures: 30**

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

Topic No.		Lectures 30
	Credit I	
1	**Molecular Tools in r-DNA technology-** Introduction and Scope, Enzymes and its applications, Restriction enzymes- types(I,II,III), nomenclature, recognition sequences, cleavage patterns, modification of cut ends (linkers and adaptors), application –RFLP, Restriction mapping. **Enzymes in r-DNA technology-** Alkaline phosphatases, DNA ligases T4 and *E. coli* Ligases, Methylase , Reverse Transcriptases, S1 nucleases, Polymerases- Holoenzyme, Klenow enzymes (T4DNA polymerases, Taq DNA polymerases), Polynucleotide kinase, Ribonuclease	09
2.	**Cloning Vectors:** Introduction, Properties of good vectors, Properties of good hosts, Cloning & expression vectors (pET28a), Cloning Vector and its Types- *E. coli* vector - plasmid – (pBR 322 and pUC18), Bacteriophage vectors –(M13Vectors) Cosmid vector, Phagemid vectors (pBlue script II KS/SK) , Yeast vector- (YAC and BAC), Animal vectors – (Simian Virus 40), Plant vector– (Ti plasmid, Ri plasmid), Shuttle vector-(pJBD 219), Selection of recombinant vector.	08
	Credit II	
3.	**Nucleic Acid Hybridisation:** Nucleic Acid and plasmid purification, Probe Preparation, Methods of labeling probes. Radio labeling – Nick translation, End labeling, Primer extension. Non Radiolabelling - Biotin, dioxygenin, fluorescent dyes, FISH, Applications of probes.	07
4.	**DNA Sequencing-** Maxam Gilbert method, Sanger Coulson method, Automated DNA sequencing. **Blotting technique-** Southern Blotting, Northern Blotting, Western blotting, Dot blotting.	06

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 Nucleic acid hybridization.

References:

1) Molecular Biotechnology – Principles & applications of Recombinent DNA GlickB.R.&Padtranak
2) Gene cloning & manipulating – Christopher
3) An introduction to genetic engineering–Nicholl D.S.T.
4) Principle of gene manipulation: An introduction to genetic engineering – Old R.W. & Primrose S.B.
5) Gene VIII–Lewin
6) Fundamentals of Biotechnology–S. S. Purohit
7) Fundamentals of Biotechnology–H. S. Chawala
8) Genetic engineering– P.K. Gupta
9) Principle of Biochemistry–Wilson &Walker
10) Plant genetic engineering –P. K. Gupta
11) Molecular Biotechnology of gene –S. N. Jogdand
12) Protein Biotechnology–M. Philopse
13) Molecular Biotechnology –Principle & practicesby Channarayappa
14) Biotechnology – R. C. Dubey
15) Molecular cloning (VolI, II, III)–Sambrook and Russel

N-MJT-BT-502: Research Methodology

Credits -02 **Lectures – 30**

Learning Objectives:

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

Topic No.		Lectures 30
	Credit I	
1	**Basic in research:** 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.	**08**
2.	**Scientific writing skills:** 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.	**07**
	Credit II	
3.	**Data collection, documentation and Biostatistics:** Sampling Design: Meaning ,Concepts ,Steps in sampling ,Criteria for good sample design, Maintaining a laboratory record, Tabulation and generation of graphs. Imaging of tissue specimens and application of scale bars. The art of field photography. Classification of Biological data, Frequency distribution, Tabulation, Graphical representation of data, Measures of central tendency (Mean, Median, Mode), Dispersion – Mean deviation & standard deviation, Correlation – Scattered diagram, Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient.	**08**
4.	**Scientific Communication:** Journals: standard of research journals - impact factor - citation index. Information retrieval - access to archives and databases, search engines - Google, PubMed - national informatics center network services. Online data base library.	**07**

Learning Outcomes:

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

Reference:

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

N-MJP-BT-511: Techniques in Genetic Engineering and Research Methodology

Credits: 04

Sr. No.	Practical	Major/Minor
Techniques in Genetic Engineering		
1.	Calculation of molecular size of digested DNA	Minor
2.	Construction of restriction map of plasmid DNA	Minor
3.	Western blotting technique	Major
4.	Southern blotting technique	Major
5.	Elution of Plasmid DNA from Agarose gel.	Minor
6.	Digestion of DNA using different restriction enzymes and study their restriction pattern.	Minor
7.	Induction of gene Expression of glutathione *S*-transferase (GST) in *E. Coli* and determination of Molecular weight by SDS-PAGE.	Major
Techniques in Research Methodology		
1.	Experiments based on research terms, process, the principle activities, skills and ethics associated with the research process.	Minor
2.	Propose a research study on given topic and justify the theory as well as the methodological decisions, including sampling and measurement.	Minor
3.	Identifying research problems and To write an effective research proposal.	Major
4.	Diagrammatic representation of data: Bar diagram and Pie diagram	Major
5.	Collection, Classification and tabulation of data	Minor
6.	Graphical representation of data: Histogram and Ogives	Major
7.	Measures of dispersion: Problems on Range and standard Deviation	Major

N-MJT-BT-503: Application of Biotechnology in Agriculture

Credits -02 **Lectures – 30**

Learning 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.

Topic No.		Lectures 30
	Credit I	
1	**Methods for crop Improvement** Introduction and Acclimatization, Breeding for self and cross Pollinated plants and vegetatively reproducing plants, selection (clonal, pure line and mass), Hybridization and Mutation breeding.	**7**
2	**Somatic hybridization-** Definition, protoplast, fusion technique, selection of hybrids, symmetric and asymmetric hybrids, cybrid production. **Artificial Seed-**Definition, Techniques, factors affecting, applications limitations. **Germplasm Conservation-**Introduction, *In-situ* conservation, *Ex-situ* conservation, cryopreservation, Techniques of Cryopreservation, applications, limitations.	**7**
	Credit II	
3	**Transgenic Plants** Herbicide resistant–Glyphosate resistance, Phosphinothricin resistance, Fungal and Bacterial disease resistance approaches-PR 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. GM Foods, ethical & socio-economic, legal and environmental issues. Forms of protection -IPR and IPP- Patents, copyright, trademark, trade secret and PBR	**10**
4	**Bio-fertilizers–** Definition, Principle, Mass production and field application– *Rhizobium, Azotobacter, Azospirillum, Acetobacter, Azolla, Cyanobacteria*, PSB, VAM. **Bio-pesticide –** Definition, production and applications of Bacterial, fungal, viral and Plant origin Bio-pesticides.	**6**

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:

1) Biotechnology – U. Satyanarayana
2) A text book of plant breeding –B.D. Singh
3) Medical biotechnology – S.N. Jogd and
4) Advances in Biotechnology-S. N. Jogadand
5) Introduction to plant breeding–R. C. Chaudhary
6) A text book of Biotechnology -R. C. Dubey
7) Pharmaceutical Biotechnology– S. P. Vyas, V. K. Dixit
8) Biotechnology – B. D. Singh
9) Fundamentals of agriculture biotechnology–S. S. Purohit
10) Animal & cell biotechnology– Ian, Freshney
11) Animal cell biotechnology–Buttler
12) Methods in cell biology –Volume57
13) Agriculture application of Microbiology-Neeelima Rajvaidya.

N-MJT-BT-504: Developmental Biology (Plant and Animal)

Credits -02 **Lectures – 30**

Learning Objectives:

- To learn concept of plant embryology
- To understand different developmental stages in plants and animals
- To learn concept of animal embryology
- To understand concept of Differentiation and Regeneration.

Topic No.		Lectures 30
	Credit I	
1	**Pollen germination and Meristem organization-** Pollen germination Pollen germination, factors affecting. **Self-incompatibility-** Definition, types and its genetic control. Plant **Meristem-** Plant Meristem, organization and differentiation Organization of shoot apical Meristem Organization of root apical Meristem.	**8**
2	**Plant Embryology** **Gametogenesis and Fertilization in plants:** Gametogenesis in Plants, Development of male and female Gametophyte, Process of fertilization in Angiosperm. Development of Embryo and Endosperm, Types of endosperm in Angiosperm. **Apomixsis**: Introduction, Definition, Types, Significance. **Polyembryony**: Introduction, Definition, Types, Significance.	**7**
	Credit II	
3	**Animal embryology** **Gametogenesis, gametes and fertilization in Animals:** Gametogenesis in animals, Types of eggs and sperms in animals, Fertilization in animals. **Early development in animals:** Types and patterns of cleavages in animals, Cell specification and axis formation, Blastulation, gastrulation in frog and chick up-to the formation of three germ layers, Embryonic induction, Foetal membranes, Types and significance of placentae.	**8**
4	**Differentiation and Regeneration :** Cell lineages, Determination, Commitment -specification and determination, Differentiation, Dedifferentiation, Rediffrentitation, Trans-differentiation, Developmental Plasticity. **French flag anatomy** Role of gene/s in patterning and development (anterior, posterior and dorsal ventral axis) of *Drosophila.* **Regeneration :** Definition, mechanism, factors affecting regeneration.	**7**

Learning Outcomes:

Students should acquire the basic knowledge of:

- The concept of plant embryology.
- The different developmental stages in plants and animals.
- The concept of animal embryology with reference to Chick.
- The Differentiation and Regeneration.

References:-

1. Development Biology, 9th edition, (2010), Gilbert S.F. (Sinauer Associates,USA).
2. Foundations of Embryology–Patten
3. Cell and Developmental Biotechnology– Raj Narian Desikar
4. Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany- Subramurti
5. Plant Anatomy and Embryology-S. N. Pandey, A. Chadha
6. David M. Hill, Craig Martiz and Barke Mable, Molecular systematics
7. Plant Anatomy– E. Cutter.
8. The Embryology of Angiosperm – Bhojawani. S. S. and Bhatnagar. S. P. (Vikas Publ. House, New Delhi)
9. An Introduction to the Embryology of Angiosperm.–P. Maheswari.
10. Principles of Development, 4th edition (2010), Wolpert L and Tick C, Publisher: Oxford University Press, USA.
11. Burgess J.(1985) An Introduction to Plant Cell Development (Cambridge Univ. Press, UK)
12. TaizL, Zeiger E (2010)–Plant physiology (Sinauer Associates, USA).
13. Sharma HP(2009)–Plant embryology: Classical and experimental (alphasci)
14. Steeves TA & Sussex IM (2004) – Patterns in plant development. (Cambridge Univ. Press, Cambridge, New York).
15. Cell and Developmental Biotechnology.- Rajnarian Desika

N-MJP-BT-512: Techniques in Agricultural Biotechnology and Developmental Biology

Credits: 04

Sr. No.	Practical's	Major/Minor
Techniques in Agricultural Biotechnology		
1	Isolation of *Azotobacter*	Major
2	Isolation of *Rhizobium* from root nodules	Major
3	Isolation of PSB from soil.	Major
4	Production of Biofertilizer - *Azotobacter*/PSB	Major
5	Isolation of *Trichoderma/Bacillus thuringenisis*	Minor
6	Production of Biopesticide–*Trichoderma/Bacillus thuringenisis*	Minor
7	Production of Artificial seed	Minor
Techniques in Developmental Biology		
1.	Methods of studying plant development: a) Dissection b) Sectioning c) Maceration d) Staining e) Mounting	Major
2.	Effect of boron / calcium on pollen tube germination in Vinca rose or any other suitable sample	Minor
3.	Effect of temperature on cell viability in pollen grains/yeast using Trypan blue/ acetocarmine.	Major
4.	Microsporogenesis: anther squash technique Development of male and female gametophytes. Developmental stages during plant embryogenesis in dicotsandmonocots	Minor
5.	Study of different types of eggs.	Minor
6.	Study of staging & staining of Chick embryos(18h, 24 h, 48h,72h)	Major
7.	Cytochrome C- oxidase activity in a developing chick embryo.	Major
8.	Alizarin stain to study limb development in chick embryo/ Regeneration of cartilage / bone	Major
9.	Live observations of Developmental stages of. C.elegans/Dictyotelium/Drosophila/zebrafish	Minor

N-MJT-BT-510: Microbiology: Food & Microbial biotechnology

Credits -02 **Lectures – 30**

Learning Objective:

- 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

Topic No.		Lectures 30
	Credit I	
1	**Microbial Production and Supplements**: Introduction to food biotechnology and related industries. **Microbial Production-** Enzymes (amylase –koji fermentation), Antibiotics(Penicillin),Vitamins (B12), Amino acids(Lysine), Organic acid (Citric acid). **Dietary supplements:** Single cell Protein (SCP) production, mushrooms production technology, large scale production of algae and yeast.	**8**
2	**Fermented Foods, Beverages & Food Packaging:** **Fermented foods of India:** Dairy products, Cheese production technologies, Fermented Pickles– Sauerkraut, Beverages– Beer, Wine (Red table and white table). **Food Packaging:** Definition, selection of a food package. Types of packaging materials and their functioning properties; Aseptic packaging of foods: sterilization techniques of packaging materials.	**6**
	Credit II	
3	**Food Spoilage, preservation & toxicity:** **Types of spoilage**- Physical, Chemical and Biological (auto and microbial) **Preservation methods-** Physical methods(High and Low temperatures, Drying, Irradiation), Chemical methods (Salt, sugar, organic acids, SO2, NO2). **Food Toxicity**–Mycotoxin (Aflatoxin), Exotoxin *(Staphylococcal*), Neurotoxin (Botulinum) **Food borne illness-** Shigellosis, Amoebiasis, Aspergillosis.	**8**
4	**Food Safety and Quality Control:** Introduction, Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. **Role of international regulatory agencies:** USFDA and International Organization for Standards (ISO). **Indian food laws and standards:** Prevention of Food Adulteration	**8**

	(PFA) Act, Fruit Products Order (FPO), Meat Products Order (MPO), Cold Storage Order (CSO), Role of AGMARK Standard, Bureau of Indian Standards (BIS) and Food Safety and Standards Authority of India (FSSAI).	

Learning outcome:-

After completing the credit student should gain the-

- 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:

1. Text Book of Biotechnology –Dr. H. K. Das
2. Industrial Microbiology & Biotechnology –Arnold L.
3. Fermentation Technology– Jayantrao Acharekar
4. Basic Biotechnology–Colinand Bjrorn
5. Frontiers in Microbial Biotechnology–Bisel P.S.
6. Industrial Microbiology–Prescotand Dunn
7. Principle of Fermentation Technology–Stanbury P.F., Whitekar H., Hall S.J.
8. Bioprocess Engineering: Principles–Nielson T. and Villadeson J.
9. Industrial Microbiology-L. E. Casida
10. Fermentation Biotechnology- H. A. Modi
11. Industrial Microbiology-A. H. Patel
12. Food Biotechnology-Varun Mehta

SEMESTER-VI

Subject Code	Title of Paper
N-MJT-BT-601	Advances in Genetic Engineering
N-MJT-BT-602	Industrial Biotechnology
N-MJP-BT-611	Techniques in Advances in Genetic engineering & Industrial Biotechnology
N-MJT-BT-603	Application of Biotechnology in Health
N-MJT-BT-604	Advances in Bioinformatics
N-MNT-BT-612	Techniques in Biotechnology in Health & Bioinformatics
AEC-IV	English- IV
N-MNT-BT-610	Microbiology: Clinical Bacteriology & Virology

N-MJT-BT-601: Advances in Genetic Engineering

Credits -02 **Lectures – 30**

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.

Topic No.		Lectures 30
	Credit I	
1	**Synthesis of Gene and DNA library:** Chemical synthesis, Phosphotriester approach, Phosphitetriester approach, synthesis of complete gene, Isolation desired gene from DNA,. Construction of cDNA and genomic library, Screening methods of libraries-immunological screening and colony or plaque hybridization.	07
2	**PCR and its application** Primer designing**,** annealing temperature, PCR Efficiencies**,** Fidelity of thermostable enzymes. Steps in PCR reaction, Types of PCR – RT-PCR, real time PCR, touch down PCR, hot start PCR, colony PCR, Applications-site directed mutagenesis, Molecular diagnostics, viral and bacterial detection Introduction to molecular identification --16 s r RNA18 s r RNA, and Barcode	08
	Credit II	
3	**Cloning methodologies** Insertion of Foreign DNA into Host Cells: Agrobacterium mediated gene transfer , Transformation,, Transduction, Transfection: Chemical methods- $CaCl_2$ coprecipitation, polycation mediated gene transfer. Physical methods- Liposomes, microinjection, electroporation, biolistics, liposomes, microinjection, macroinjection. **Screening of recombinants**-Direct selection, Insertional inactivation selection, Blue white selection, Expression based screening (HART) Fluorescent Activated Cell Sorter, South–Western Screening.	08
4	**Application of r-DNA technology-** Construction and expression of Human peptide Hormone Genes (Insulin, Somatotrophin and Somatostatin), Production of transgenic animal -knockout mice. Gene Silencing- Introduction, Principle of Si-RNA and mechanism of Si-RNA technology **Molecular Markers** Introduction, Types-Morphological, Biochemical, Genetic Markers-RFLP, RAPD, AFLP, SSR.	07

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:

1) Molecular Biotechnology–Principles &applications of Recombinent DNA: Glick B.R. & Pastranak
2) Gene cloning & manipulating–Christopher
3) An introduction to genetic engineering–Nicholl D.S.T.
4) Principle of gene manipulation: An introduction to genetic engineering–Old R.W.&Primrose S. B.
5) GeneVIII–Lewin
6) Fundamentals of Biotechnology–S.S.Purohit
7) Fundamentals of Biotechnology–H.S.Chawala
8) Genetic engineering– P.K. Gupta
9) Priciple of Biochemistry – Wilson&Walker
10) Plant genetic engineering –P. K.Gupta
11) Molecular Biotechnology of gene –S. N. Jogdan
12) Protein Biotechnology–M.Philopse
13) Molecular Biotechnology–Principle &practices by Channarayappa
14) Biotechnology – R. C. Dubey
15) Molecular cloning(VolI,II,III)–Sambrook and Russel

N-MJT-BT-602: Industrial Biotechnology

Credits -02 **Lectures – 30**

Learning 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.

Topic No.		Lectures 30
	Credit I	
1	**Introduction to Fermentation technology :** 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 fermenter- Stirred tank fermenter, Airlift fermenter, Tower fermenter, Tubular fermenter, Bubble cap fermenter, Aeration and agitation of fermentation broth. Enzyme kinetics.	**7**
2	**Microbial Screening, Scale up and strain improvement:** Primary and secondary screening, Primary screening of antibiotics, organic acids and amines, enzymes, vitamins and amino acid producers, volatile component degraders, organisms using specific carbon and nitrogen sources. Secondary screening of antibiotic producers, Scale up of fermentations, Strain improvement- concept and methods -mutation, genetic recombination. Maintenance and preservation of industrially important cultures.	**8**
	Credit II	
3	**Fermentation Media:** 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. Optimization of media, Factors affecting fermentation process.	**7**
4	**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, ultra sonication, 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, drying and packing.	**8**

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:

1) Text Book of Biotechnology –Dr. H. K. Das
2) Industrial Microbiology &Biotechnology –Arnold L.
3) Fermentation Technology– Jayant Acharekar
4) Basic Biotechnology–Colin and Bjrorn
5) Frontiers in Microbial Biotechnology–Bisel P.S.
6) Industrial Microbiology–Prescott and Dunn
7) Principle of Fermentation Technology– Stanbury P.F.,Whitekar H., Hall S.
8) Bioprocess Engineering: Principles–Nielson T. and Villadeson J.
9) Industrial Microbiology-L. E. Casida
10) Fermentation Biotechnology-H. A. Modi
11) Industrial Microbiology-A. H. Patel

N-MJP-BT-611: Techniques in Advances in Genetic Engineering and Industrial Biotechnology

Credits: 04

Sr. No.	Practical	Major/Minor
Techniques in Genetic Engineering		
1.	DNA Amplification by PCR	Minor
2.	c-DNA cloning by Reverse Transcription PCR	Major
3.	Optimization of Annealing Temperature by PCR	Major
4.	RFLP analysis.	Minor
5.	RAPD analysis	Minor
6.	*Agrobacterium* mediated gene transformation in plants	Major
7.	Transformation of Competent Cells with recombinant plasmid DNA and Screening of selection of recombinant.	Major
Techniques in Industrial Biotechnology		
1.	Primary screening of amylase producers by Replica Plate technique.	Minor
2.	Screening and isolation of antibiotic producing organism from soil (Crowded plate/Giant colony method).	Major
3.	Antibiotic sensitivity test using paper disc method.	Minor
4.	Determination of Minimum inhibitory Concentration (MIC) of antibacterial compound.	Minor
5.	Production of alcohol/ wine and analysis: i) Alcohol ii) pH and Total acidity iii) Reducing sugar	Major
6.	Production, Recovery and estimation of Citric Acid	Minor
7.	Isolation of Vitamin B12 requiring mutants.	Major
8.	Production, Recovery and estimation (Bioassay) a of Primary metabolite (Growth factor)	Major
9.	Production, Recovery (Filtration, Solvent extraction)and estimation (Bioassay)a of Secondary metabolite (Antibiotic)	Major

Industrial Visit- Wine Industry, Food Processing Industry.

N-MJT-BT-603: Application of Biotechnology in Health

Credits -02 **Lectures – 30**

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

Topic No.		Lectures 30
	Credit I	
1	**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.	**7**
2	**Vaccines:** Concept and types of vaccine, Subunit vaccines- Hepatitis B vaccine, Foot and Mouth disease Vaccine, DNA Vaccines, Edible Vaccines, Recombinant vaccines- Cholera Vaccine, Vaccinia Virus Vaccine.	**7**
	Credit II	
3	**Monoclonal Antibodies, Biosensor and Gene therapy:** **Monoclonal antibodies-** Introduction, Hybridoma technology, Application- Diagnostics, Therapeutics. **Biosensors**- Introduction, Principle, Types, applications. **Gene therapy –** Introduction Approaches-ex vivo (therapy for adenosine deaminase deficiency) and in vivo gene therapy (Gene therapy strategy for cancer)	**8**
4	**Public Health :** Introduction, DNA sample preparation, Methods of Diagnosis- radioactive and Non-radio detection. Detection of Infectious diseases (Tuberculosis, malaria, AIDS, Corona), Detection of genetic diseases (Cystic fibrosis, Sickle cell Anemia, Huntington's, Duchenne muscular dystrophy (DMD).	**8**

Learning Outcomes:

- After completing the credit-
- 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:

1)Biotechnology –U.Satyanarayana
2) A textbook of plant breeding – B.D . Singh
3) Medical biotechnology – S.N. Jogdand
4) Advances in Biotechnolog S.N.Jogadand
5) Introduction to plant breeding – R . C. Chaudhary
6) A text book of Biotechnology - R. C. Dubey
7) Pharmaceutical Biotechnology – S. P . Vyas ,V. K. Dixit
8) Biotechnology – B. D.Singh
9) Animal & cell biotechnology– Ian, Freshney
10) Animal cell biotechnology–Buttler
11) Methods in cell biology –Volume57

N-MJT-BT-604 Advances in Bioinformatics

Credit: 02 **Total Lectures: 30**

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 MS-EXCEL and analysis and representation of the data

Topic No.		Lectures 30
	Credit I	
1	**Introduction to Bioinformatics** Introduction, Definition, history of Bioinformatics, Computers in Biology and Medicines, Internet, and related programs; Networking HTTP, HTML, WAN, LAN, MAN, approaches of bioinformatics. **Information Resources**: Introduction, aim and objectives, National Centre for Biotechnology Information (NCBI), National Library of Medicine (NLM), and National Institute of Health (NIH), EBI, Sequence retrieval system (SRS): Entrez, DB Get.	**8**
2	**Introduction to Genomics and Proteomics databases**: **Genomics:** Human Genome Project (HGP), Goal and applications, final draft of HGP (complete information resources covered). Nucleic acid sequence database: Gene Bank, EMBL, DDBJ. **Proteomics:** Introduction, concept of proteome, Tools and techniques in proteomics- 2D electrophoresis , PAGE , Isoelectric focusing, MALDI TOF , EST, microarray. **Protein sequence Databases**: PDB, Swiss- Prot, TrEMBL, UniPort.	**7**
	Credit II	
3	**Sequence Alignment and Phylogenetic analysis:** **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 involved in construction of phylogenetic tree: distance based and Character based method. **Phylogenetic analysis tools:** Phylip, Clustal W.	**8**

4	**Drug designing Structure-based drug designing:**Introduction; Structure-based drug designing approaches, Target Identification and Validation, homology modeling and protein folding, receptor mapping, active site analysis and pharmacophore mapping, Grid maps. **Ligand-based drug designing and Docking:** Introduction; Ligand-based drug designing approaches, Lead Designing, combinatorial chemistry, High Throughput Screening (HTS), QSAR, Database generation and Chemical libraries, ADME property.	**7**

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

1) Bioinformatics methods and applications .S.C.Rastogi, N.Mendiratta,P.Rastogi.

2) Principle of bioinformatics. P.Shanmughavel.

3) Computational DrugDesigning.David C.Young

4) Computational Drug Design: A Guide for Computational and Medicinal Chemists.David C. Young

5) An introduction to Bioinformatics.T.K.Attwood,Parry-SmithD.J.

6) Atextbook of bioinformatics.Sharma,Munjal,Shankar.

N-MJP-BT-612: Techniques in Biotechnology in Health and Bioinformatics

Credits: 04

Sr. No.	Practical's	Major/Minor
Techniques in Biotechnology in Health		
1	Analysis of Milk- a) Estimation of lactic acid. b) Estimation of total fat. c) MBRT	Major
2	Antimicrobial activity of crud plant extract using - Disc Diffusion Assay, Well diffusion assay.	Major
3	Microbial Limit Test for contamination Testing.	Minor
4	Microbial examination of food products.	Minor
5	Water analysis of food and dairy industries.	Major
6.	To perform quantitative estimation of residual chlorine in water samples.	Minor
Techniques in Bioinformatics		
1.	Introduction to PUBMED Central database using the ENTREZ search engine.	Minor
2.	Getting the amino acid and gene sequences by exploring and querying the protein and nucleic acid Sequence data base.	Minor
3.	Similarity search for nucleotide and protein using the BLASTn, BLASTp and interpretation of the results.	Major
4.	Protein and nucleic acid pair-wise sequence alignment by using Clustal W and Construction of PhylogeneticTree using ClustalW.	Major
5.	Analysis of Secondary and tertiary structure of protein using visualizing software like Pymol or Rasmol.	Minor
6.	Calculation of PI/MW of protein and Prediction of this condary structure of protein using Ex Pasy web tool (GOR method).	Major
7.	Energy calculation of the biomolecules using molecular mechanics and quantum mechanics.(Argus lab)	Minor
8.	Use of SNP databases at NCBI and other sites.	Minor

N-MNT-BT-610 Microbiology: Clinical Bacteriology & Virology

Credit: 02 **Total Lectures: 30**

Learning Objectives:

The students will gain adequate knowledge about:

- Different classes of bacteria and viruses that infect human regarding their pathogenicity.
- Laboratory characteristics and different methods for laboratory diagnosis of infections caused by bacteria and Viruses.
- They will also be able to select and interpret the different diagnostic tests for bacterial and viral infections.

Topic No.		Lectures 30
	Credit I	
1	**Clinical Bacteriology :** Historical development in Bacteriology, Classification of Pathogenic bacteria, Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels, General methods of isolation and identification of pathogenic bacteria.	**8**
2	**Gram positive bacteria :** Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S. aureus, B. anthracis, C. botulinum, C.diphtheriae M.tuberculosis, M. leprae.* **Gram negative bacteria:** Morphology, pathogeneis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli, P. aeruginosa, S. typhi, S. dysenteriae, H. influenzae, V. cholerae, M. pneumoniae, Rickettsiaceae.*	**7**
	Credit II	
3	**Virology:** General characteristics of viruses, Classification of animal viruses. Isolation, Identification, Cultivation and Purification of animal viruses.Antiviral chemotherapy. Viral Zoonotic infection. Viral vaccines. Interferons. Laboratory Diagnosis of Virus Infection, Control of viral diseases & Antivirus Therapy	**8**
4	**Classification of viruses** : based on the nucleic acid content: DNA viruses- Poxvirus, Herpes virus, Adeno virus, Hepatitis B virus. RNA viruses – Retrovirus, Picorna virus, Reo virus, Herpes virus, Rhabdo virus, Toga virus, Paramyxo virus	**7**

Learning Outcomes:

The students should acquire the knowledge about:

- Different classes of bacteria and viruses .
- Different methods for laboratory diagnosis of infections caused by bacteria and Viruses.
- Different diagnostic tests for bacterial and viral infections.

References:

1) Moselio Schaechter, Cary Engleberg, N.Barry I. Eisenstein, Gerald medoff.
2) Mechanisms of microbial disease, 3rd ed, Lippincott Williams & Wilkins, 1999.
3) Ananthanarayan and Jayaram Paniker. Textbook of Microbiology, 4th ed. Orient Longman, 2000.
4) Mandel, G.L. Bennet, J.E. and Dolin, R. 1995. Principles and practice of infectious disease. 4th edi. Churchil Living stone. New York.
5) Richman, Whitley, Hayden. Clinical virology. Churchill Livingstone, New York. 1997.
6) David. M.Knipe & Peter M.Harley. Fundamental Virology, 4th Ed., Lippincott Williams & Wilkins, 2001.
7) S.J. Flint Enguist, L.W. Krug RM, Racaniello V.R., A.M.Skalka. Principles of Virology, A.S.M. Press, Wasington, 2000.

Nature of Question Paper:

- **Theory Examination -**

	Nature of Question Paper	
Q. No.1	**Multiple choice based objective type (four options for each question be given)**	**08 Marks**
Q. No. 2	**Attempt any two of the following (out of three)**	**16Marks**
Q. No. 3	**Attempt any four of the following (out of six)**	**16 Marks**
Total		**40 Marks**
	Internal Examination (CCE)-Unit Test	**10 Marks**
Grand Total	**Grand Total Marks**	**50 Marks**

- **Practical Examination:**

A) The practical examination will be scheduled as given below; practical exanimation should be conducted for minimum 5 hours on each day. separate examiner should be appointed and conducted in 3 consecutive days for each subject.

B) Each candidate must produce a certificate from the Head of the Department in his/her college stating that he/she has completed in a satisfactory manner the practical course on the guidelines laid down from time to time by Academic Council on the recommendation of Board of studies and has been recorded his/her observations in the laboratory journal and written a report on each exercise performed. Every journal is to be checked and signed periodically by a member teaching staff and certified by the Head of the Department at the end of staff and certified by the Head of the Department at the end of the year. Candidates are to produce their journal at the time of practical examination. Candidates have to visit the Biotechnological institutes and satisfactorily complete their report as per the syllabus. The report of the same should be duly certified by the Head of the Department and submit the respective reports at the time of examination.