"Education for Knowledge Science and Culture"

- **Dr Bapuji Salunkhe**

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE KOLHAPUR (AUTONOMOUS),

Syllabus For

Bachelor of Science Part - III

BIOTECHNOLOGY (ENTIRE)

SEMESTER V AND VI

(Syllabus to be implemented from June, 2023 onwards)

B.Sc- Part III Biotechnology Entire (Semester V and VI)

Course code	Name of Course	Course code	Name of course
Semester V		**Semester VI**	
DSE-1355-E	Basics in Genetic Engineering	**DSE-1355-F**	Advances in Genetic Engineering
DSE-1356-E	Industrial Biotechnology	**DSE-1356-F**	Food and Microbial Biotechnology
DSE-1357-E	Application of Biotechnology in Agriculture	**DSE- 1357-F**	Application of Biotechnology in Health
DSE-1358-E	Bio safety, Bioethics and Intellectual Property Rights	**DSE-1358-F**	Bioinformatics
AECC-E	English	**AECC-F**	English

AECC – Ability Enhancement Compulsory Course: English

DSE-1360 (Pr VIII)	Techniques in Genetic engineering and Bioinformatics	**DSE- 1361 (Pr- X)**	Techniques in Agricultural and health Biotechnology
DSE-1362 (Pr IX)	Techniques in Industrial Biotechnology	**DSE -1363 (Pr-XI)**	Project

Subject Offered **Sem-V:- E** **Sem-VI:- F**	**Course outcomes paper wise for B.Sc-III Biotechnology entire for 2023-2024**
DSC 1355E Basics in Genetic Engineering	At the end of this course students will be able to: CO 1. Understand the concept of cloning CO2. Demonstrate the techniques of DNA fingerprinting CO 3. Perceive knowledge about sequencing technology. CO 4. illustrate the importance of probe designing
DSC 1356E Industrial Biotechnology	At the end of this course students will be able to: CO1.Construct the design required to set up industrial fermentation. CO2. Draw a contrast between industrial & pilot fermentation CO 3. Discover various ways of media formulation for industrial scale. CO 4.Predict & illustrate the nature of industrial processes.
DSC 1357E Applications of biotechnology in Agriculture	At the end of this course students will be able to: CO 1. Outline the importance of Hybridization & mutation in crop improvement. CO2. Explain the techniques of artificial seed germination. CO 3. Discuss the strategies to develop transgenic plants CO 4.formulate biofertilizer.
DSC 1358E Bio safety, Bioethics and Intellectual Property Rights	At the end of this course students will be able to: CO 1. Learn the concept of Bio safety CO2. Understand the mechanism of Intellectual Property Rights. CO 3. Classify different characters & functions of Bioethics. CO 4.Elaborate the process. Intellectual Property Rights
DSC 1355F Advances in Genetic Engineering	At the end of this course students will be able to: CO 1. Reflect the importance of chemical synthesis of DNA. CO2. Differentiate various types of PCR & their applications. CO 3. Appreciate the importance of screening. CO 4.study impact of GM foods on human health.
DSC 1356F Food & Microbial Biotechnology	At the end of this course students will be able to: CO 1. Choose appropriate fermentation technology. CO2. Compare classical & Modern fermentation techniques. CO 3. Outline the importance of preservation. CO 4.study characteristics of food supply.
DSC 1357F Applications of biotechnology in Health	At the end of this course students will be able to: CO 1. Appreciate the exigency of stem cell technology CO2. Classify different types of vaccines CO 3.Explain the mechanism of Hybridoma technology. CO 4.Predict the nature of forensic medicines.
DSC 1358F Bioinformatics	At the end of this course students will be able to: CO 1. Outline the importance of Human Genome Project. CO2. List different types of structural database. CO 3. Explain the importance of phylogenetic analysis. CO 4. Construct drug molecules.

Semester - V

DSE-1351-E- Basics in Genetic Engineering Credit 2

Topic No.		Lectures 30
	Credit I	
1	**Enzymes 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), Alkaline phosphatase, DNA ligase T4 and *E. coli* Ligases, Reverse Transcriptases, Polymerases- Klenow enzymes, T4 DNA polymerases, Taq DNA polymerases, Polynucleotide kinase. **Cloning Vectors:** Introduction, Properties of good vectors , Cloning & expression vectors, Types- *E.coli* vector- plasmid – pBR 322 and pUC18 **Bacteriophage vectors** – λ phage vector, M 13 Vectors (λ replacement e. g. EMBL 3, EM BL 4 and λ insertional e.g. λ gt 10 and λgt 11) Cosmid vector, Phagemid vector e.g. pBlue script II KS/SK, Yeast vector- YAC and BAC , **Animal vectors** – Retroviral , **Plant vector** – Ti plasmid,Ri plasmid, shuttle vector- e.g. pJBD 219.	15
	Credit II	
2.	**Nucleic Acid Hybridization :** Probe Preparation, Methods of labeling probes. Radio labeling – Nick translation, End labeling, Primer extension, Non Radiolabelling – Biotin, dioxygenin, fluorescent dyes, Applications of probes. **DNA Sequencing and blotting technique** Maxam Gilbert method, Sanger Coulson method, Automated DNA sequencing, Southern Blotting, Northern Blotting, Western blotting.	**15**

References :

1. **Molecular Biotechnology – Principles & applications of Recombinent DNA : Glick B. 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. Jogdan**
12. **Protein Biotechnology – M. Philopse**
13. **Molecular Biotechnology – Principle & practices by Channarayappa**
14. **Biotechnology – R. C. Dubey 15.Molecular cloning (Vol I, II, III) – Sambrook and Russel**

DSE-1352-E- Industrial Biotechnology Credit 2

Topic No.		Lectures 30
	Credit I	
1	**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 Fermentor Components of Fermentor and their functions, Types of Fermentor- Stirred tank Fermentor, Airlift Fermentor, Tower Fermentor. **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. Microbiological assay	**15**
	Credit II	
2	**Fermentation Media** Concept of pure and mixed culture, 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, inducers, inhibitors. Optimization of media- Plackett and Burmann design, Factors affecting fermentation process. Microbial growth kinetics basic concept (Batch, Continuous and Fed Batch). **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, drying and packing.	**15**

References :

1. **Text Book of Biotechnology – Dr. H. K. Das**
2. **Industrial Microbiology & Biotechnology – Arnold L.**
3. **Fermentation Technology – Jayanto Acharekar**
4. **Basic Biotechnology – Colin and Bjrorn**
5. **Frontiers in Microbial Biotechnology – Bisel P.S.**
6. **Industrial Microbiology – Prescot 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 Microbology- L.E. Casida**
10. **Fermentation Biotechnology- H.A. Modi**
11. **Industrial Microbiology- A.H.Patel**

DSE-1353-E- Application of Biotechnology in Agriculture Credit 2

Topic No.		Lectures 30
	Credit I	
1	**Methods for crop Improvement** Introduction and Acclimatization, Breeding for self and cross pollinated plants and vegetative reproducing plants, selection (clonal pure line and mass), Hybridization and Mutation breeding. **Plant breeding markers**- RAPD, RFLP, AFLP **Somatic hybridization-** Definition, protoplast, fusion technique, selection of hybrids, symmetric and asymmetric hybrids, cybrid production. **Germplasm Conservation-** Introduction, *In-situ* conservation, *Ex-situ* conservation, cryopreservation, Techniques of Cryopreservation, applications, limitations.	**15**
	Credit II	
2	**Transgenic Plants** Herbicide resistant – Glyphosate resistance, Phosphinothricin resistance, Fungal and Bacterial disease resistance approaches- PR proteins, Chitinase, Glucanase, RIPs protein, Virus resistance –Virus coat proteins, Movement proteins ,Transmission proteins ,Satellite RNAs, Antisense RNAs, Ribozyme, Insect resistance approaches – Bt protein (Bt Cotton, Bt-Brinjal) , 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 **Biofertilizer –** Definition ,Principle , Mass production and field application – *Rhizobium, Azotobacter, Azospirullum, Acetobacter, Azolla, Cyanobacteria,* PSB, VAM. Carrier Based Inoculum types **Biopesticide –** Definition, production and applications of Bacterial, fungal, viral and Plant origin Biopesticides.	**15**

References :

1) **Biotechnology – U. Satyanarayana**
2) **A textbook of plant breeding – B.D. Singh**
3) **Medical biotechnology – S. N. Jogdand**
4) **Advances in Biotechnology- S.N.Jogadand**
5) **Introduction to plant breeding – R. C. Chaudhary**
6) **A textbook of Biotechnology - R. C. Dubey**
7) **Pharmaceutical Biotechnology – S. P. Vyas ,V. K. Dixit**
8) **Biotchnology – 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 – Volume 57**
13) **Cell and Developmental Biotechnology.-Raj narian Desikar**
14) **Agricultutre application of Microbiology- Neeelima Rajvaidya.**

DSE-1354-E- Bio safety, Bioethics and Intellectual Property Rights Credit 2

Topic No.		Lectures 30
	Credit I	
1	**Bioethics** **Basic Principles of Bioethics**; Overview of National Regulations of Bioethics and Overview of National Regulations of Bioethics and International considerations. **Regulatory bodies for Bioethics in India** * Role of Institutional Ethical Committee * Role of Institutional Ethical Committee * Bioethics in Plants, Animals and Microbial Genetic engineering **Biosafety** * Introduction to Biosafety. * Concepts, symbols and significance in experimental biological sciences. International laws on Biosafety * Levels of Biosafety (BSL-1 to 3) for Specific microorganisms. * Introduction to Biological Safety Cabinets. * Introduction to the concept of containment level and Good Laboratory Practices (GLP).	**15**
	Credit II	
2	**Intellectual Property Rights.** *Introduction to Intellectual Property Rights (IPR) and Indian Patent Law. *World Trade Organization and its related intellectual Property provisions. *Intellectual property and its legal protection in research ***Significance of IPR in Biotechnology**; Budapest Treaty; , Protection of GMOs *Tools of IPR and terminologies in IPR-Patent, Copyright, *Trademarks and Trade secrets. *Geographical Indications (with examples)	**15**

References:-

Reference:

1. IPR, Biosafety and Bioethics, DeepaGoel and ShominiParashar, Pearson; 1 edition (1 January 2013)

2. Diane O. Fleming; Debra A. Long; Biological Safety: Principles and Practices, ASM Press; 4th edition, 20062.

3. Nancy Ann SilbergeldJecker; Albert R. Jonsen; Robert A. Pearlman; Bioethics: Introduction to History, Methods, and Practice; Jones & Bartlett Publishers; II edition, 2007

4. Lim Li Ching; TerjeTraavik; Biosafety First: Holistic Approaches to Risk and Uncertainty in Genetic Engineering and Genetically Modified Organisms; Tapir Academic Press, 2007

5. 21st Century Complete Guide to Biosafety and Biosecurity (CD-ROM): by U.S. Government, Publisher: Progressive Management, 2004

6. Wadehra, B.L. Law Relating To Intellectual Property, (2011), Fifth Edition, Universal Law Publishing Co.Pvt. Ltd.

7. GanguliPrabuddh, Intellectual Property Rights , (2001), Tata McGraw-Hill Publishing

8.Matthew Rimmer, Intellectual Property and Biotechnology: Biological Inventions (2008)

9. Kshitij Kumar Singh, Biotechnology and Intellectual Property Rights: Legal and Social Implications Springer (India) (2014)

10. Bioethics: the basics, Alastair V. Campbell, Routledge; 2 edition

11. Burgess J. (1985) An Introduction to Plant Cell Development (Cambridge Univ Press, UK)

12. Taiz L, Zeiger E (2010) – Plant physiology (Sinauer Associates, USA).

13. Sharma HP (2009) – Plant embryology: Classical and experimental (alpha sci)

14. Steeves TA & Sussex IM (2004) – Patterns in plant development. (Cambridge Univ Press, Cambridge, New York)

Semester - VI

DSE-1351-F- Advances in Genetic Engineering Credit 2

Topic No.		Lectures 30
	Credit I	
1	**Isolation of Gene** Isolation desired gene from DNA, Isolation of specific gene with PCR, cDNA and genomic library. Screening of libraries- immunological screening and colony or plaque hybridization. **PCR and its application** Primer designing, Fidelity of thermostable enzymes. Steps in PCR reaction, Types of PCR – RT-PCR, real time PCR, touchdown 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 Bar code. **DNA Bar-coding Principle and Application**	**15**
	Credit II	
2	**Cloning methodologies** **Construction of plasmid** – e. g. Somatostatin, Insertion of foreign DNA into host cells, Agrobacterium mediated gene transfer, Transformation, Transfection. **Chemical methods**- $CaCl_2$ precipitation, poly cation mediated gene transfer. **Physical methods**- Liposome, microinjection, electroporation, and biolistics transfer. **Screening of recombinants**- Direct selection, Insertional inactivation selection, Blue white selection, Expression based screening (HART) Fluorescent Activated Cell Sorter. Human Recombinant Proteins- Erythropoietin and HGH. **Application of r-DNA technology** Production of transgenic- knockout mice, **In medicines** –Insulin and Somatostatin, Introduction to Gene Silencing, Principle of Si-RNA and Si- RNA technology **Molecular Markers** Introduction – Morphological , Biochemical, Molecular Markers- RFLP, RAPD, AFLP.	**15**

References :

1. **Molecular Biotechnology – Principles & applications of Recombinent DNA : Glick B. R. & Padtranak**
2. **Gene cloning & manipulating – Christopher**
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12. **Protein Biotechnology – M. Philopse**
13. **Molecular Biotechnology – Principle & practices by Channarayappa**
14. **Biotechnology – R. C. Dubey**
15. **Molecular cloning (Vol I, II, III) – Sambrook and Russel**

DSE-1352-F- Food and Microbial Biotechnology Credit 2

Topic No.		Lectures 30
	Credit I	
1	**Microbial Production of Industrial product** **Microbial Production of** - Edible mushroom, Single Cell Protein- Spirulina, Yeast **Pharma product-** Antibiotics - Penicillin, **Organic products** - Citric acid, Vitamins (B_{12}), Amino acids- Lysine, **Industrial Enzyme** - amylase –koji fermentation **Fermented Foods and Beverages** Nutraceutical Dairy Products – Cheese, Probiotic – Homo and Heterolactic fermentation, Bakery Products – Bread , Fermented Pickles – Sauerkraut, Beverages – Beer, Wine (Red table and white table), Champagne	**15**
	Credit II	
2	**Food Spoilage, preservation & toxicity** Types of spoilage- Physical, Chemical and Biological (auto and microbial), Preservation methods- High and Low temperatures, Controlled atmosphere and Anerobiosis, Radiations and Asepsis, Chemical preservatives (Salt, sugar, organic acids, SO_2, NO_2). Food Toxicity – Mycotoxin (Aflatoxin), Exotoxin (*Staphylococcal*), Neurotoxin (Botulinum), Food borne illness- Shigellosis, Amoebiosis, Aspergillosis. **Fermentation economics** Contribution of various expense heads to a process (Recurring and non-recurring expenditure) citing any suitable example **Quality Assurance of fermentation product:** Detection and quantification of the product by physicochemical, biological and enzymatic methods, Sterility testing,	**15**

References :

1. **Text Book of Biotechnology – Dr. H. K. Das**
2. **Industrial Microbiology & Biotechnology – Arnold L.**
3. **Fermentation Technology – Jayanto Acharekar**
4. **Basic Biotechnology – Colin and Bjrorn**
5. **Frontiers in Microbial Biotechnology – Bisel P.S.**
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8. **Bioprocess Engineering : Principles – Nielson T. and Villadeson J.**
9. **Industrial Microbology- L.E. Casida**
10. **Fermentation Biotechnology- H.A. Modi**
11. **Industrial Microbiology- A.H.Patel**
12. **Food Biotechnology- Varun Mehta**

DSE-1353-F- Application of Biotechnology in Health Credit 2

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 mice and their applications, Transgenic cattle. **Vaccines- Principle and Practices** Concept and types of vaccine, Subunit vaccines- Hepatitis B vaccine, Foot and Mouth disease Vaccine, AIDS Vaccine, DNA Vaccines, Edible Vaccines, Recombinant vaccines- Cholera Vaccine, Vaccinia Virus Vaccine. Bioreporters: immunosensors and Environmental Sensors	**15**
	Credit II	
2	**Monoclonal Antibodies-** Introduction, Hybridoma Technology, Applications- Diagnostics , Therapeutics , Protein purification and Abzymes. **Biosensors-** Introduction, Principle, Types (Amperometric, Thermometric, Optical biosensor, Immuno biosensor), Applications **Gene Therapy –** Introduction , Approaches-*ex vivo* (Therapy for Adenosine deaminase deficiency) *and in vivo* gene therapy (Gene therapy strategy for cancer), Antigene and antisense therapy , antisense therapy for cancer **Public health** Introduction, DNA sample preparation, Methods of Diagnosis – Nucleic acid hybridization (Radioactive and Non radio detection). Detection of infectious disease (Tuberculosis, Malaria, AIDS, Chaga's) Detection of genetic diseases (cystic fibrosis, Sickle cell Anemia, Huntington's, DMD). Types of Epidemic, Pandemic Endemic diseases with at least one example.	**15**

References:

1) Biotechnology – U. Satyanarayana

2) A textbook of plant breeding – B.D. Singh

3) Medical biotechnology – S. N. Jogdand

4) Advances in Biotechnology- S.N.Jogadand

5) Introduction to plant breeding – R. C. Chaudhary

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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 – Volume 57

13) Cell and Developmental Biotechnology.-Raj narian Desikar

14) Text Book of Bryophytes, Pteridophytes, Gymnosperms, and Paleobotany- Subramurti.

15) Agricultutre application of Microbiology- Neeelima Rajvaidya .

DSE-1354-F- Bioinformatics Credit 2

Topic No.		Lectures 30
	Credit I	
1	**Introduction to Bioinformatics** **History of bioinformatics:** Multidisciplinary approach of bioinformatics, Computers in Biology and Medicines, Internet, and related programs; Networking HTTP, HTML, WAN, LAN, MAN, applications in communication. **Introduction to Genomics**: Introduction, Databases, Data, Nucleic acid sequence database, Gene Bank, EMBL, DDBJ. Sequence retrieval system (SRS): Entrez, DBGet. **Human Genome Project (HGP),** Goal and applications, final draft of HGP (complete information resources covered). **Literature Database: Pub Med and Pub Med central** **Introduction to Proteomics:** Primary Protein sequences databases, Secondary sequences Databases, Structural Databases related to proteins (PDB, , MMDB, CATH, SCOP)	**15**
	Credit II	
2	**Sequence Alignment and Phylogenetic analysis** **Sequence Alignment**: Pair wise sequence alignment, Multiple sequence alignment, Local and Global sequence alignment. **Phylogenetic analysis**: Introduction: Definition of phylogenetic tree, nodes, internodes, root, tree, styles; cladogram, phenogram, curvogram0, Steps involved in construction of phylogenetic tree **Phylogenetic analysis tools:** ClustalW. **Drug designing** **Structure-based drug designing:** Introduction; Structure-based drug designing approaches, Target Identification and Validation, homology modeling, active site analysis and pharmacophore mapping, and Molecular Docking. **Ligand-based drug designing:** Introduction; Ligand-based drug designing approaches, Lead Designing, combinatorial chemistry, High Throughput Screening (HTS), Chemical libraries, ADME property.	**15**

References:

1. **Bioinformatics methods and applications. S. C. Rastogi, N. Mendiratta, P.Rastogi.**
2. **Principle of bioinformatics. P. Shanmughavel.**
3. **Computational Drug Designing. 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-Smith D. J.**
6. **A textbook of bioinformatics. Sharma, Munjal, Shankar.**

DSE-1355- (Practical- VIII) - Techniques in Genetic Engineering and Bioinformatics

Sr. No.	Practical		
	Techniques in Genetic engineering and Bioinformatics Major Practical's		
1.	Calculation of molecular size of digested DNA	01	Major
2.	Western blotting technique	01	Major
3.	Southern blotting technique	01	Major
4.	C-DNA cloning by Reverse Transcription RT- PCR	01	Major
5	Protein analysis by RASMOL	01	Major
6.	Phylogenetic Tree using Clustal W.	01	Major
7.	Pair wise and Multiple sequence alignment.	01	Major
	Techniques in Genetic engineering and Bioinformatics Minor Practical's		
1.	DNA Amplification by PCR	01	Minor
2.	Ligation of DNA	01	Minor
3	Construction of restriction map of plasmid DNA	01	Minor
4	PUBMED and PUBMED Central database	01	Minor
5	Getting the gene sequences from primary DNA sequence.	01	Minor
6	Getting the Protein sequences from Protein Database.	01	Minor
7	Calculation of PI/MW of protein.	01	Minor
8	**Local Industrial Visit (within 100 km distance)- Genetic Engineering Lab**		

DSE-1356 (Practical- IX) - Techniques in Industrial Biotechnology

Sr. No.	Practicals		
1	Primary screening of amylase producers by Replica Plate technique	01	Major
2	Screening and isolation of antibiotic producing organism from soil (Crowded plate/ Giant colony method).	01	Major
3	Production and partial purification of enzyme (Amylase)	01	Major
4	Study of Immobilization of enzyme (Amylase).		
5	Production of alcohol and estimation by colorimetric method (Potassium Dichromate).	02	Major
6	Production of sauerkraut.	01	Minor
7	Mushroom Cultivation.	01	Minor
8	Production, Recovery and estimation of Citric Acid	01	Minor
9	Bioassay) a of Primary metabolite (Growth factor)	01	Major
10	(Bioassay) a of Secondary metabolite (Antibiotic)	01	Major
11	Isolation and identification of spoilage causing pathogen from spoiled foods.(Salmonella and Staphylococci)	02	Major
12	Analysis of Milk - a) Isolation of Lactic acid bacteria from dairy product.	01	Major
	b) SPC of milk	01	Major
	c) MBRT	01	Minor
13	**Local Industrial Visit (within 100 km distance)- Wine Industry/ Food Processing Industry/Fermentation unit.**		

DSE-1357- (Practical- X) - Techniques in Agricultural and Health Biotechnology

Sr. No.	Practicals	15	
1	Isolation of *Azotobacter*	01	Major
2	Isolation of *Rhizobium* from root nodules	01	Major
3	Isolation of PSB from soil.	01	Major
4	Production of Biofertilizer- *Azotobacter* /*Rhizobium*	01	Major
5	Isolation of *Bacillus Agrobacterium* Spp	01	Minor
6	Antibiotic sensitivity test using paper disc method	01	Minor
7	Determination of Minimum inhibitory Concentration (MIC) of antibacterial compound.	01	Minor
8	*Agrobacterium* mediated transformation in (dicot) plants	01	Minor
9	Isolation of Blood genomic DNA	01	Minor
10	RAPD analysis	01	Major
11	RFLP analysis	01	Major
12	Study of Protoplast fusion and regeneration	01	Minor

DSE-1358- (Practical- XI)- Project Work

Guidelines –

1. Projects can be performed in group (maximum 2) or individually.
2. Selection of the Project topic and allotment of project supervisor.
3. Preparation of Project Execution Plan: Time and Resource Allocation
4. Separate practical session should be organized for preparation of following topics—
   a) Selection of problem, preparation of synopsis. b) Introduction. c) Review of literature d) Materials and Methodology e) Result and discussion f) Bibliography.
5. Guidance by the Project Supervisor, for the self-study of relevant course topics and concepts by the student.
6. Self-study and reference work of relevant topics and concepts by the student.
7. The Project Work must involve practical work (wet lab.) related to selected discipline
8. Students are expected to work on "Project Work" for about 10 periods per week.
9. The project work must be allotted individually.
10. 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.
11. 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.
12. Submission Process: Student should prepare 2 copies of the Project Report. At the beginning, the respective Project Supervisor must approve both copies positively before university examination. Then respective Head or Coordinator approves both copies of the Project Report.
13. 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 out 20 and the external examiner (appointed by university), who will assign marks out of 30, Thus the total will be out of 50 marks.
14. Theory, practical and project report shall form separate heads of passing.

Practical Examination:

The practical examination will be scheduled as given below; practical exanimation should be conducted for minimum 5 hours on each day.

For practical examination of :

DSE-1355-Techniques in Genetic Engineering and Bioinformatics

DSE-1356- Techniques in Industrial Biotechnology

DSE-1357-Techniques in Agricultural and Health Biotechnology examination will be conducted in 3 consecutive days each.

DSE-1358- Project

Project separate 2 examiners should be appointed and conducted in 2 consecutive days.

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 project work and entrepreneurship 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.

Nature of Practical Exam Question Paper- 50 Marks

DSE-1355- Techniques in Genetic Engineering and Bioinformatics

Q.1 Major Experiment - 20 Marks
Q2 Minor Experiment - 10 Marks
Q3 Viva Voice- 05marks
Q4 Spotting - 05 Marks (5 spots- each carry one mark)
Q5 Journal and Practical Note book- 05 and 05 marks total = 10 marks
Total = 50 marks

DSE-1356- Techniques in Industrial Biotechnology

Q.1 Major Experiment 20 Marks
Q.2 Minor Experiment 10 Marks
Q.3 Spotting 05 Marks (5 spots- each carry one marks)
Q.4 Tour Report 05 Marks
Q.5 Journal/Notebook 10 Marks
Total = 50 marks

DSE-1357- Techniques in Agricultural and Health Biotechnology

Q.1 Major Experiment 20 Marks
Q.2 Minor Experiment 10 Marks
Q.3 Spotting 05 Marks (5 spots- each carry one marks)
Q.4 viva voice 05 Marks
Q.5 Journal/notebook 10 Marks
Total = 50 marks

DSE-1358- Project

Q.1 Internal Examination 20 Marks
A) Regularity and sincerity 10 Marks
B) Research aptitude 10 Marks
Q.2 External Examination 30 Marks
A) Project report 05 Marks
B) Review of Literature 05 Marks
C) Material & Methods 05 Marks
D) Result & Discussion 05 Marks
E) Presentation 05 Marks
F) Viva-Voce 05 Marks
Total = 50 marks

Annual Practicals of Total = 200 marks

Seat Number	_____

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR

Semester: _____ Examination: _____

Class: _____ Subject: _____Paper No: _____

Subject Code: _____Q. Paper Code:_____

Date:_____

Time:_____ **Total Marks: 35**

Instructions: - 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labeled diagram wherever necessary.

Q1 A. Choose the correct alternative and rewrite the following sentences: 5 Marks

(i)
(ii)
(iii)
(iv)
(v)

Q1 B. Fill in the Blanks 2 Marks

(i)
(ii)

Q2 Attempt any two of the following (two out of three) 16 marks

(i)
(ii)
(iii)

Q3 Attempt any four of the following (four out of six) 12 marks

(i)
(ii)
(iii)
(iv)
(v)
(vi)

Nature of Theory Question Paper- 40 Marks		
Q. No. 1	**Multiple Choice based objective type question (four options for each question be given)**	**05 Marks**
Q.No.2	**Fill in the Blanks**	**02 Marks**
Q. No. 2	**Attempt any two of the following (out of three)**	**16 Marks**
Q. No. 3	**Attempt any four of the following (4 out of 6)**	**12 Marks**
	Total	**35 Marks**

Internal Marks evaluation – for 15 Marks in the form of either of the following as Short answer/ one-word answer Assignment/ short note/ MCQ/ long answer/Seminar/Fill In the Blanks etc. Minimum Qualify 6 M for Internal Exam.

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