SHIVAJI UNIVERSITY, KOLHAPUR

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Revised Syllabus for

B.Sc-III Biotechnology

(Optional/Vocational)

To be implemented from June, 2015

SHIVAJI UNIVERSITY, KOLHAPUR
B. Sc- III.
Biotechnology (Optional/Vocational)
Semester-V and VI

Semester V- (Theory)			
Paper No.	**Title of Paper**	**Theory**	**Internal**
Paper- IX	Biochemical Techniques	**40**	**10**
Paper-X	Animal Cell Culture	**40**	**10**
Paper-XI	Bioprocess Engineering	**40**	**10**
Paper-XII	Fermentation technology	**40**	**10**
Semester-VI (Theory)			
Paper No.	**Title of Paper**	**Theory**	**Internal**
Paper-XIII	Plant Biotechnology	**40**	**10**
Paper-XIV	Environmental Biotechnology	**40**	**10**
Paper-XV	Cell Metabolism and Virology	**40**	**10**
Paper-XVI	Gene biotechnology and Bioinformatics	**40**	**10**
Practicals			
Practical-I	Techniques in Plant and Environmental Biotechnology	**50**	**--------**
Practical-II	Techniques in Microbiology and Bioinformatics.	**50**	**--------**
Practical-III	Project(Opt.) / Project and On the Job training(For- Voc.)	**50**	**-------**
Practical-IV	Entrepreneurship and Study tour Report	**50**	**---------**

Pre-revised Syllabus (Upto June,2012)

Semester V- (Theory)			
Paper No.	**Title of Paper**	**Theory**	**Internal**
Paper- IX	Biochemical Techniques	**40**	**10**
Paper-X	Animal Cell Culture	**40**	**10**
Paper-XI	Bioprocess Engineering	**40**	**10**
Paper-XII	Fermentation technology	**40**	**10**
Semester-VI (Theory)			
Paper No.	**Title of Paper**	**Theory**	**Internal**
Paper-XIII	Plant Biotechnology	**40**	**10**
Paper-XIV	Environmental Biotechnology	**40**	**10**
Paper-XV	Cell Metabolism and Virology	**40**	**10**
Paper-XVI	Gene biotechnology and Bioinformatics	**40**	**10**
Practicals			
Practical-I	Techniques in Plant and Environmental Biotechnology	**50**	**--------**
Practical-II	Techniques in Microbiology and Bioinformatics.	**50**	**--------**
Practical-III	Project(Opt.) / Project and On the Job training(For- Voc.)	**50**	**-------**
Practical-IV	Entrepreneurship and Study tour Report	**50**	**---------**

Equivalence for theory papers (From June, 2015)
Sem-V and Sem-VI

Revised Syllabus - Equivalence

Semester V- (Theory)			
Paper No.	**Title of Paper**	**Theory**	**Internal**
Paper- IX	Biochemical Techniques	**40**	**10**
Paper-X	Animal Cell Culture	**40**	**10**
Paper-XI	Bioprocess Engineering	**40**	**10**
Paper-XII	Fermentation technology	**40**	**10**
Semester-VI (Theory)			
Paper No.	**Title of Paper**	**Theory**	**Internal**
Paper-XIII	Plant Biotechnology	**40**	**10**
Paper-XIV	Environmental Biotechnology	**40**	**10**
Paper-XV	Cell Metabolism and Virology	**40**	**10**
Paper-XVI	Gene biotechnology and Bioinformatics	**40**	**10**
Practicals			
Practical-I	Techniques in Plant and Environmental Biotechnology	**50**	**--------**
Practical-II	Techniques in Microbial, Biochemical Technology and Bioinformatics	**50**	**--------**
Practical-III	Project(Opt.) / Project and On the Job training(For- Voc.)	**50**	**-------**
Practical-IV	Entrepreneurship and Study tour Report	**50**	**---------**

Paper No-IX- Biochemical Techniques.

Topic No.	Topic	No of Lectures
	Unit-I	10
1	1.1Cell disruption methods-Grinding, abrasive presses, Enzymatic method, sonication. 1.2 Centrifugation 1.2.1 Introduction and basic principle of sedimentation 1.2.2 Types of centrifuges 1.2.3 Centrifugation- Differential centrifugation, density Gradient centrifugation . 1.3 Separation of proteins by precipitation- 1.3.1 Salt precipitation - Salting out by Ammonium sulphate. 1.3.2 Organic solvent precipitation 1.4 Dialysis	
2	**Unit-II**	10
	2.1 Chromatographic methods – Principle, methodology and applications of 2.1.1 Gel Filtration method 2.1.2 Ion exchange chromatography 2.1.3 Affinity chromatography 2.1.4 Gas liquid chromatography (GLC) 2.1.5 High Performance Liquid chromatography (HPLC)	
3	**Unit-III**	10
	3.1 Electrophoresis 3.1.1. Introduction, types and general principle 3.1.2 Supporting media – (Agarose. poly acryl amide gel) 3.2 Electrophoresis of nucleic acid 3.2.1 Agarose gel electrophoresis of DNA,RNA 3.2.2 DNA sequencing gel 3.2.3 Pulsed field gel electrophoresis 3.3 Electrophoresis of protein 3.3.1 SDS-PAGE electrophoresis- Methodology and applications 3.3.2 Isoelectricfocusing	
4	**Unit-IV**	10
	4.1 Tracer technique. 4.1.1 Introduction – Radioactivity, radioisotopes, types of radiation (α, β, γ), half-life period of radioisotope 4.2 Methods of measurement of radioactivity 4.2.1 Gas ionization 4.2.2 Solvent excitation- Liquid scintillation counter 4.2.3 Autoradiography 4.3 Applications of radioisotopes in biological systems	

References:- 1. Practical Biochemistry principles and techniques – Wilson & Walkar (edi. VI)

2. Protein purification –Robert Scoop

3. Biophysical Chemistry –Nath Upadhyay

4. Textbook of Biotechnology- R.C.Dubey

5. Textbook of Biotechnology- B.D.Singh

Paper-X- Animal Cell Culture

Topic No.	Topic	No of Lectures
	Unit-I	10
1	1.1 Introduction to Animal Cell Culture 1.2 Characteristics of Animal Cell Culture 1.3 Substrates for Cell Growth 1.4 Culture media & their properties.- Natural, Synthetic 1.4.1 Serum containing media 1.4.2 Serum Free Media 1.4.3 Balanced Salt Solution (BSS) 1.4.4 Growth factors promoting proliferation of Animal Cell- EGF, FGF, PDGF, IL-1, IL- 2,NGF,Erytropoeitin 1.5 Sterilization of Glass ware, Reagents ,Culture media. 1.5.1- contamination in ATC 1.5.2- Lab.Orgnization &equipment's in ATC- Positive press unit, Air shower etc. 1.6 Equipment's used in Animal Cell culture – Laminar Air Flow, Homogenizer, Haemocytometer, Inverted microscope, CO2 Incubator	
2	**Unit-II**	10
	2.1 Basic Techniques of Animal Cell Culture 2.1.1 Isolation of Tissue, 2.1.2 Desegregation 2.1.3 Measurement of cell viability, 2.1.4 Maintenance of cell Culture. 2.2 Cell lines-Types of Cell lines- Primary, Secondary, Established 2.3 Scale up of Animal Cell Culture-Assay technique in ATC-Cytotoxicity e.g- Anticancer effect of phytochemicals 2.3.1 Bioreactors of Animal cell culture 2.3.2 Roller Bottle	
3	**Unit-III**	10
	3.1 Organ Culture- Types of organ culture 3.2 Maintenance of Organ culture- Histotypic culture 3.3 Stem cell culture 3.3.1 Types of Stem cells 3.3.2 Transplantation of Stem cells 3.3.3. Applications 3.4 Applications of Animal cell culture	

	3.4.1 In Transplantation 3.4.2 Monoclonal antibody production 3.4.3 Culture based vaccine 3.4.4 Valuable recombinant products 3.4.5 Cloning. 3.4.6 Cell synchronization	
4	**Unit-IV**	10
	4.1 Transfection of Animal cells 4.1.1 Electroporation, microinjection, liposome mediated, gene gun method, virus mediated. 4.1.2 Selection of Transfected cells- Using selective markers- NPT-II, TK, DHFR, XGPRT 4.1.3 Karyotyping 4.2 Transgenic Animals 4.2.1 Production of Transgenic Animals 4.2.2 Examples of Transgenic Animals- sheep, mice. 4.2.3 Applications of Transgenic Animals 4.3 Bioethics of Animal Genetic Engineering.	

References: 1. Animal cell culture- Fresheny.

2. Biotechnology – B.D.Singh.

3. Biotechnology- R.C.Dubey.

4. Gene Biotechnology- S.N.Jogdand.

Paper XI: Bioprocess Engineering

Topic No.	Topic	No of Lectures
	Unit-I	10
1	1.1 Basic design of fermenter 1.2 Construction material used for fermenter 1.3 Accessories associated with fermenter 1.4 Types of fermenters-Tube tower fermenter, bubble cap fermenter, fluidized bed fermenter, air lift fermenter 1.5 Fermentation media. 1.6 Sterilization of fermentation media, equipment& air	
2	**Unit-II**	10
	2.1Screening of industrially important microorganisms 2.1.1 Primary screening 2.1.2 Secondary screening 2.2 Pure culture techniques 2.2.1 Methods of isolation of industrially important microorganisms 2.2.2 Enrichment techniques 2.3 Strain improvement by- 2.3.1Mutation 2.3.2 Genetic engineering 2.3.3 Genetic recombination 2.4 Maintenance of industrially important microorganisms- Culture collection centers in India- NCIM	

3	**Unit-III**	10
	3.1Scale up- Bench studies, pilot studies, industrial scale 3.2 Building of inoculum & pitching. 3.3 Computer application in fermentation technology 3.4 Types of fermentations 3.4.1Continuos fermentation 3.4.2 Batch fermentation 3.4.3 Solid state fermentation	
4	**Unit-IV**	10
	4.1 Downstream processing- Centrifugation, Distillation, Solvent extraction, Filtration, Ultrafiltration, Precipitation, Ion exchange chromatography, Gel filtration, Affinity chromatography, Crystallization & drying 4.2 Assays 4.2.1 Physico-chemical assays- Gravimetric, Spectrophotometric, Chromatographic 4.2.2 Microbiological assays- Diffusion assay, turbido metric assay, metabolic response assay, end point determination assay, enzymatic assay	

References:

1. Comprehensive Biotechnology volume 3 – Murray Moo- Young

2. Basic Biotechnology- Colin Ratledge & Bijon Kritinsen, cambridge university press ,UK

3. Industrial Microbiology - casida

4. Principles of Fermentation technology-Whittekar

5. Industrial Microbiology- Prescott & dunns

6. Industrial Microbiology- A.H.Patel

7. Industrial Microbiology-Pepler & perlman

Paper XII: Fermentation Technology

Topic No.	Topic	No of Lectures
	Unit-I	10
1	1.1 Specific fermentations- 1.1.1 Organic acid –Citric acid 1.1.2 Aminoacid- Lysin 1.1.3 Vinegar 1.1.4 Antibiotic-Penicillin	
2	**Unit-II**	10
	2.1 Specific fermentations- 2.1.1 Vitamin- Vitamin B12 2.1.2 Enzyme-Amylase –Koji Method 2.1.3 Therapeutic agent- L-asparginase 2.1.4 Phytohormone - Gibbrellins 2.1.5 Single cell protein- spirulina	

3	**Unit-III**	10
	3.1 Alcoholic beverages-Wine- Types –White and Red, Beer fermentation 3.2 Cheese fermentation- Cheedar,Swise 3.3 Bread fermentation 3.4 Xanthan gum fermentation 3.5 Lactic acid fermentation	
4	**Unit-IV**	10
	4.1 Fermentation economics 4.2 IPR- introduction 4.2.1-Patents- Introduction, Criteria and process for patenting. 4.2.2 Trademarks 4.2.3 Trade secrets- 4.2.4. Copyrights.	

References: 1. Comprehensive Biotechnology volume 3 – Murray Moo- Young

2. Basic Biotechnology- Colin Ratledge & Bijon Kritinsen, cambridge university press ,UK

3. Industrial Microbiology - casida

4. Principles of Fermentation technology-Whittekar

5. Industrial Microbiology- Prescott &duns

6. Industrial Microbiology- A.H.Patel

7. Industrial Microbiology-Pepler & Perlman

Paper XIII: Plant Biotechnology

Topic No.	Topic	No of Lectures
	Unit-I	10
1	1.1 Introduction - History , concept of cell culture, development of tissue culture, practical applications and recent advances. 1.3 Laboratory organization, Tissue culture media, Aseptic manipulation. 1.4 Different pathways of Clonal propagation	
2	**Unit-II**	10
	2.1 Callus culture technique - Introduction, principle, protocol, factors affecting, morphology, internal structure, genetic variation, applications, limitations. 2.2Somatic Embryogenesis - Introduction, principle, protocol, factors affecting, importance. 2.3 Organogenesis - Introduction, principle, protocol, factors affecting, applications. 2.4- Suspension culture technique - Introduction, principle, protocol, different categories, growth and growth measurement, synchronization, applications, limitations 2.5 Artificial. .seeds - Introduction, method, importance.	
3	**Unit-III**	10
	3.1 Embryo culture - Introduction, principle, protocol, applications 3.2 Haploid production - Protocol for anther and pollen culture,	

	development of androgenic haploids, applications ,advantage of pollen culture over anther culture 3.3 Soma clonal variation - Introduction, selection and isolation of variants.	
4	**Unit-IV**	10
	4.1 Protoplast culture - Introduction, principle, isolation, culture methods, importance. 4.2 Somatic hybridization - Protoplast fusion techniques, selection of hybrids, 4.3-biochemical complementation, visual and morphological methods, cybrid production. 4.4Genetic transformation - Agrobacterium mediated, electroporation, micro projectile, macro injection, pollen mediated, marker genes, expression of transferred genes. 4.5 Practical applications of tissue and organ culture - Application in agriculture, application in horticulture and forestry, applications in industries, transgenic plants.	

References:-

1. Introduction to plant tissue culture-M.K.Razdan

2. Plant tissue culture – Theory & practice- S.S.Bhojwani & M.K.Razdan

3. Crop improvement in biotechnology-H.S.Chawala

4. Plant tissue culture-Kalyankumar dey

5. Textbook of biotechnology- R.C.Dubey

6. Plant tissue culture- U .Kumar.

7. Biotechnology- B.D.Singh

Paper XIV: Environmental Biotechnology

Topic No.	Topic	No of Lectures
	Unit-I	10
1	1.1 Conventional and non conventional fuels and their environmental impacts 1.2 Modern fuels 1.2.1 Methanogenesis and biogas production. 1.2.2 Biohydrogen production 1.2.3 Bioethanol production and Gasohol experiment 1.2.4 Biodisel 1.3 Global environmental problems 1.3.1 Green house effect and global warming 1.3.2 Ozone depletion 1.3.3 U.V radiations 1.3.4 Acid rain	
2	**Unit-II**	10
	2.1 Types of wastes:	

	2.2 Solid waste management 2.2.1 Types of solid waste(hazardous and non hazardous) 2.2.2 Treatment and disposal 2.3.1 Waste water treatment Methods of treatment- a) Primary - (screening, grinding, grit removal, flocculation, sedimentation, flotation, equalization, coagulation, clarification) b) Secondary - (Aerobic-Trickling filters, activated sludge processes, stabilization ponds)(Anaerobic-Up flow anaerobic sludge blanket reactors), c) Tertiary - (Chemical precipitation, 2.3.2-Disposal &recycling of treated waste water.	
3	**Unit-III**	10
	3.1 Bioremediation 3.1.1Definition & types (in-situ & ex-situ) 3.1.2 Bioremediation of hydrocarbons, dyes, heavy metals, pesticides 3.1.3 Bioremediation for Agriculture.-Composting and vermicomposting 3.2 Biopesticides 3.3 Bioaugmentation 3.4 Biosorption 3.5 Bioleaching-Types, chemistry, Bioleaching of Copper & Uranium 3.6 Microbial enhancement of oil recovery 3.7 Phytoremediation	
4	**Unit-IV**	10
	4.1 Biofertilizers 4.1.1 Rhizobial inoculants 4.1.2 Azotobacter inoculants 4.1.3 Azospirillum inoculants 4.1.4 Cyanobacterial inoculants 4.1.5 Phosphate solubilizing bacteria 4.1.6 VAM 4.1.7 Frankia 4.1.4 Azolla 4.2 Methods of Field applications	

References:

1. Environmental biotechnology- Indu Shekhar Thakur.

2. Environmental biotechnology-Chattergy.

3. Environmental biology-Verma & Agarwal.

4. Environmental chemistry-B.K.Sharma.

5. Environmental Pollution- Peavy & Rowe.

6. Environmental problems & solutions- Asthana & Asthana.

7. Environmental science-Siago Canninhham.

8. Environmental biotechnology-S.N.Jogdand.

9. Water engineering- Treatment dispose & reuse-Metcalf & Eddy.

10. Environmental Biotechnology-C.S.K Mishra & Juwarkar

Paper XV : Cell Metabolism and Virology

Topic No.	Topic	No of Lectures
	Unit-I	10
1	1.1- General Metabolism- Introduction, Definition, Reactions of Metabolic Pathways. 1.1.1- Thermodynamic consideration Concepts of Free energy 1.1.2-Methods for study of Metabolic Pathways by using radioisotopes, by using mutants, in vitro studies. 1.2– Metabolism of Carbohydrate 1.2.1- Carbohydrate metabolism- Reactions, Energetics Significance, of- Glycolysis 1.2.2- Reactions, significance of Pentose Phospate Pathway 1.2.3- Reactions & Energetics of TCA Cycle.	
2	**Unit-II**	10
	2.1 Lipid Metabolism 2.1.1 Biosynthesis of Saturated Fatty acid- Palmitic Acid 2.1.2 β-Oxidation of Fatty acid - Palmitic Acid 2.2 – Respiratory ElectronTransport Chain 2.2.1 Components of ETC 2.2.2 Flow of electrons, Redox values. Mechanism of ATP generation – Chemical coupling hypothesis , Chemiosmotic hypothesis.	
3	**Unit-III**	10
	3.1- Urea Cycle- Reactions & Significance. 3.2-Protein and Nucleotide Metabolism.	
4	**Unit-IV**	10
	4.1 Virology-Inroduction.Types on the basis of Host & Nucleic acid 4.2 General Characteristics of Viruses. 4.3- General Structures of Viruses- TMV, Adeno virus, T4 Bacteriophage 4.4- Reproduction of Viruses- 4.4.1- Adeno virus 4.4.2- Bacteriophages- T4, λ- Phage 4.5- Isolation & Cultivation of Plant & Animal Viruses- Tissue culture & Embryonated Eggs	

References:

1. Biochemistry – Lubert Strayer.

2. Principles of Biochemistry- Lehninger.

3. Virology- Luria & Delbruck. 4. Fundamentals of Biochemistry- J.L.Jain S.Chand

Paper XVI: Gene biotechnology and Bioinformatics

Topic No.	Topic	No of Lectures
	Unit-I	10
1	1.1 Techniques in gene biotechnology- DNA Finger printing (DNA profiling) 1.1.1 Introduction 1.1.2 Genetic markers 1.1.3 Uses of Minisatellites & Microsatellites' 1.1.4 Multilocus and single locus probes 1.1.1 Scheme for DNA Finger printing 1.1.6 Applications 1.2-Chromosome walking and jumping	
2	**Unit-II**	10
	2.1Gene targeting 2.2 Human gene therapy 2.2.1 Introduction 2.2.2 Types of gene therapy- 1. Somatic gene 2. Germ Line 3. Enhancement 4. Eugenic genetic engineering. 2.2.3 Methods for gene transfer –virus vector,non-viral approach 2.2.4 Limitations and requirement in gene therapy 2.3 Antisense therapy- Introduction, principle, applications.	
3	**Unit-III**	10
	. 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, National Centre for Biotechnology Information(NCBI), National Library of Medicine (NLM), and National Institute of Health (NIH), EBI, Sequence retrieval system (SRS):- Entrez, DBGet	
4	**Unit-IV**	10
	Genomics:- Human Genome Project (HGP)- Goal and applications, final draft of HGP Genome databases:- Introduction, Databases, Data, Nucleic acid sequence database, Gene Bank, EMBL, DDBJ 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 modeling databank (MMDB). CATH, SCOP, PdbSum	

References: 1.Gene Biotechnology -S.N.Jogdand
2.Gene Manipulation – Old and Primrose
3. Introduction to Bioinformatics – Rastogi. 4. Introduction to Bioinformatics- T. K. Attwood.
5. Bioinformatics methods and applications by S. C. Rastogi, N. Mendiratta, P.Rastogi.
6.. Principle of bioinformatics by p. shanmughavel.

Practical- I: Techniques in Plant and Environmental Biotechnology

Sr. no	Name of the Practical	30 P
1	Preparation of stock Solutions & media- Minor Expt.	2
2	Callus culture technique- Initiation of culture, callus morphology-Major	2
3	Suspension culture technique – Initiation, growth measurement-Minor	2
4	Initiation of anther culture-Minor	2
5	Synthetic seed production-Minor	2
6	Initiation of micropropagation- Shoot tip or axillary bud culture technique-Major	2
7	Subculture & multiplication of culture-Minor	2
8	Root differentiation-Minor	2
09	Determination of BOD of sewage –Major	2
10	Determination of COD of sewage –Minor	2
11	Isolation of *Rhizobium* from root nodules-Major	1
12	Isolation of PSB from soil-Major	2
13	Isolation of *Azotobacter* from soil-Major.	2
14	Isolation of *Xanthomonas* from infected citrus fruits.-Major	2
15	Preparation of Biofertilizer using Azotobacter, Rhizobium,PSB-Minor	2

Practical- II: Techniques in Microbial, Biochemical Technology and Bioinformatics

Sr. no	Name of the Practical	30 P
1	Bioassay of penicillin –Major	2
2	Bioassay of Vitamin B-12 –Major	2
3	Immobilization of yeast(*Saccharomyce scerevisiae*) cells, production of ethanol by using immobilized yeast cells and determination of alcohol content by specific gravity method-Minor	2
4	Screening of Amylase Producers from Soil, Production of bacterial amylase by submerged culture method & estimation of amylase by DNSA method.-Major	2
5	Production of Xanthan gum using Xanthomonas.-Major	2
6	Estimation of citric acid by Titrimetric method-Minor	2
7	Isolation of Vit-B12 requiring mutants.-Major	2
8	Determination of molecular weight of DNA-Minor	2
9	Browsing and understanding NCBI Web page,Introduction to literature database- PubMed-Minor	2
10	Exploring protein sequence database-Introduction	2

	proteindatabank(PDB) &RasMol to visualize 3D structure of protein-Minor	
11	Exploring Nucleic acid sequence database,Understanding Human genome project.-Minor	1
12	Purification of proteins by gel filtration-chromatography-Minor	2
13	Purification of Proteins by Ion exchange chromatography.-Minor	2
14	Transformation of *E. coli*.-Major	2
15	Isolation of *E. coli* phages-Major	2
16	Determination of α- Amylase inhibition activity of protein isolated from plant seed.(Amaranths/Rajgira seed)	2

Practical Examination:-

A) The practical examination will be conducted on three (3) consecutive days for not less than 4 1/2 hours on each day of the practical exanimation.

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 year. Candidates are to produce their journal at the time of practical examination. Candidates have to visit at least two (2) places of Biotechnological interest (Pharmaceutical industry, Dairy, Research institutes etc.) and satisfactorily complete project work, job training, and entrepreneurship as per 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.

Practical III:
For Vocational Biotechnology- 1. Project
2. On Job Training Report
For Optional biotechnology – Project

Practical IV:
Entrepreneurship
Study Tour Report

Practical Question paper pattern:

Practical III: Techniques in Plant and Environmental Biotechnology

Q.1 Major Experiment	20 Marks
Q.2 Minor Experiment	10 Marks
Q.3 Spotting	10 Marks
Q.4 Journal	5 Marks
Q.5 Oral	5 Marks

Practical IV: Techniques in Microbiology and Bioinformatics

Q.1 Major Experiment	20 Marks
Q.2 Minor Experiment	10 Marks
Q.3 Spotting	10 Marks
Q.4 Journal	5 Marks
Q.5 Oral	5 Marks

Practical V:-
For Vocational Biotechnology-
Project -35 Marks
On Job Training Report- 15 Marks

For optional biotechnology –
Project 50 Marks

Practical VI
Entrepreneurship 35 Marks
Study Tour Report 15

Nature of Question papers (Theory)

COMMON NATURE OF QUESTION FOR THEORY PAPER MENTIONED SPERATELY: