

**Swami Ramanand Teerth Marathwada University, Nanded.**

**FACULTY OF SCIENCE AND TECHNOLOGY**

**B.Sc. (Biotechnology) Vocational Third Year (CBCS Pattern)  
[Syllabus effective from 2018-19 onwards]**

Semester	Course No.	Name of the Course	Instruction Hrs/ week	Total period	Internal Evaluation	Marks of Semester	Total Marks	Credits
V	DECBT I (Section A)	Plant Tissue Culture (P-XII)	03	45	10	40	50	2
	DECBT I [(Section B) Elective]	Environmental Biotechnology (P-XIII)	03	45	10	40	50	2
	DECCBTP I [DECBT I & II (Section A)]	Practical's based on P- XII & PXIV(P-XV)	04	10 Practical	10	40	50	2
	DECBTP II [DECBT I& IV (Section B)]	SEC III (1 Skill/ optional)			15×3 = 45	-	-	(02)*
VI	DECBT II (Section A)	Plant transgenesis (P-XIV)	03	45	10	40	50	2
	DECBT II [(Section B) Elective]	Bioresource Technology (P-XV)	03	45	10	40	50	2
	DECBTP II [DECBT I & II (Section B)]	Practical's based on P- XIII & P- XIV (P- XVII)	04	10 Practical	10	40	50	2
	DECBTP II(Section B)	SEC IV (Project))			50	-	50	(2)*
<b>Total credits semester V and VI</b>								<b>12(04)*</b>

**Swami Ramanand Teerth Marathwada University, Nanded**  
**Choice Base Credit System (CBCS) Pattern**  
**B.Sc Third Year (Semester V)**  
**Semester Pattern effective from June 2018**  
**Biotechnology (Vocational)**

### **Salient Features**

B. Sc. Third year Biotechnology syllabus is designed to serve the need of Choice Based Credit System (CBCS) course structure to orient and practically train students in the field of Biotechnology. The course consists of skill enhancement course in enzyme technology and Environmental contamination and abatement. The first discipline specific elective course in plant tissue culture is based on micropropagation, germplasm conservation, haploid production, somatic hybridization that will help students to understand different techniques in plant tissue culture and its advantages over traditional methods of propagation. The second discipline specific elective course in environmental biotechnology will help students to understand recent environment related issues and its relation to biotechnology. The third discipline specific elective course in plant transgenesis includes transgenic plants,  $R_i$  &  $T_i$  plasmids, Mechanism of DNA transfer. This course will introduce the students to transgenic plants that are the important step forward in the production of agricultural crops that are modified to contain specific characters like resistant to drought, pests etc. The fourths course discipline specific elective in Bioresource technology consists of Biodegradation, Biopesticides, Bioremediation and Biofuel. The course will acquaint students with training of wider range of technologies and various elements such as biomass, biological waste treatment, bioenergy, biodegradation, bioresource systems analysis, bioremediation etc.

Skill enhancement course in enzyme technology is well suited to understand production, purification and application of industrial enzymes. The other course in Environmental contamination and abatement Skill enhancement course will help to understand global problems like pollution and biomedical waste treatment their control through biotechnological practices.

### **Utility**

The syllabus of B. Sc. Third year Biotechnology vocational course will train the students in field of Plant tissue culture, Environmental Biotechnology, Plant transgenesis and Bioresource technology. The syllabus will also help students to understand and combat environment related issues through biotechnology. Bioresource technology will acquaint students with utilization of biological resources for welfare of human being and to understand and apply this knowledge for carrier selection. The courses in Skill enhancement will provide additional opportunity for a student to develop skills of interest in this field of study for better employability.

### **Learning objectives**

1. To impart knowledge of basic and applied biotechnology
2. The objective of this course is to have a firm foundation and an insight into the fundamentals of biotechnology.
3. To design the curriculum that enable students to face NET, SET, GATE, UPSC and other competitive examinations successfully.
4. To make the students aware of recent global issues related to environment and agriculture.
5. To make the students aware of technological advances in the field of environment agriculture, enzymes, bioresources.
6. To make the students to proficient in skills in the different applied areas of biotechnology.

### **Prerequisite**

The course is offered for a student registered for undergraduate programme in the faculty of Science and Technology who had primary knowledge and training in the field of basic biological, chemical, mathematical and physical sciences and interested to gain additional advanced knowledge in the field of biotechnology.

**Swami Ramanand Teerth Marathwada University, Nanded**  
**Choice Base Credit System (CBCS) Pattern**  
**B.Sc Third Year (Semester V)**  
**Semester Pattern effective from June 2018**  
**Biotechnology (Vocational) DECBT I (Section A)**  
**Plant Tissue Culture (P I)**

Maximum Marks: 50

Periods: 45

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**Unit-I (13 Periods)**

Introduction to *in vitro* methods. History of tissue culture Techniques. Beginning of *in vitro* cultures in our country Terms and definitions. Concept of Totipotency. Sterilization techniques. Types of nutrient medium. Callus and Suspension cultures.

Shoot Regeneration, Events during shoot regeneration, factors affecting shoot bud regeneration. Somatic embryogenesis. factors affecting somatic embryogenesis

**Unit-II (12 periods)**

Micro propagation. Introduction, meristem culture, stages of micro propagation, nutrient media and culture environment for culture initiation and shoot multiplication, Applications of micro propagation, advantages of micro propagation.

Production of virus free plants. Shoot meristem culture.

Germplasm conservation. Introduction and importance of germplasm conservation. Improved methods of cryopreservation,

**Unit-III (10Periods)**

Haploid production. Introduction, Definitions, Androgenesis, pathways of early development, pollen dimorphism, factors affecting Androgenesis, Pollen culture.

Gynogenesis, haploid plants from interspecific crosses. Applications of Haploids. Embryo culture, preparation of embryos for culture, Applications of embryo culture. Embryo Rescue.

**Unit-IV (10 Periods)**

Somatic Hybridization. Introduction Protoplast isolation. Enzyme activities, plant tissues, protoplast Purification, protoplast culture, Protoplast fusion.

Selection of Hybrid cells. Visual markers, fluorescent dyes, complementation, transgenic selectable markers, culture of Entire Fusion mixture.

Applications in crop improvement.

**Text & References:**

1. Elements of Biotechnology. P.K. Gupta
2. Plant biotechnology - B.D.Singh
3. An introduction to Plant biotechnology –H.S. Chawla.
4. An introduction to Plant tissue culture – A.K.Razdhan
5. Biotechnology - B.D.Singh
6. Introduction to plant tissue culture – M.K. Razdan
7. Plant tissue culture : Theory and practice- S.S. Bhojawani and M.K.Razdan

**B. Sc. THIRD YEAR BIOTECHNOLOGY (VOCATIONAL)**  
**Choice Base Credit System (CBCS) Pattern**  
**SEMESTER – V**  
**DECBT I (Section B)**  
**ENVIRONMENTAL BIOTECHNOLOGY (P II)**

**Maximum Marks – 50**

**Periods – 45**

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**Unit-I (10Periods)**

Environment Basic concepts & issues Introduction to environmental biotechnology Physical environment, biotic environment Biotic and abiotic interactions.

**Unit-II (10Periods)**

Concept of habitat and Niche

Nature of communities, Ecological succession Renewable and non-renewable resources.

Biodiversity; status monitoring and documentation.

**Unit-III (13Periods)**

Modern fuels and their environmental impacts: Methanogenic bacteria and biogas production, Conversion of sugars to ethanol. The gasohol experiment.

Environmental pollution; global environmental change, greenhouse effect, Ozone depletion, Ultraviolet Radiation, Acid Rain, Biotechnological approaches for management.

**Unit-IV (12Periods)**

Principles of conservation, major approaches to management Concept of Biofertilizers (Rhizobium and Azatobactor) Treatment of municipal waste and industrial effluents.

Solid waste : sources & Management (Composting, Vermiculture).

**Text & References:**

1. Environmental Biotechnology – Indu shekharThakur
  2. Environmental Chemistry – B.K.Sharma
  3. Biotechnology – B.D.Singh
  4. Waste water engineering – Metcalf and Eddy
  5. Ecology and Environment - P.D Sharma
- Ecology – Odum

**B. Sc THIED YEAR BIOTECHNOLOGY (VOCATIONAL)**  
**Choice Base Credit System (CBCS) Pattern**  
**SEMESTER – VI**  
**DECBT II (Section A)**  
**PLANT TRANSGENESIS (P I)**

**Maximum Marks – 50**

**Periods – 45**

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**Unit-I (10Periods)**

Introduction to transgenic plants. Advantages and Disadvantages.

Applications of transgenic plants. Gene constructs. A typical plant gene, promoters/enhancers Reporter genes, selectable markers, scorable markers, problems imposed by antibiotic resistance genes

**Unit-II (10 Periods)**

Vectors for the production of transgenic plants.

Plant virus vectors. Cauliflower mosaic virus, Gemini viruses, Tobacco mosaic virus, brome mosaic virus. Plasmid vectors. Introduction to *A.tumefaciens*. Tumor formation on plants using *A.tumefaciens* (monocots Vs Dicots). Root - formation using *A.rhizogenes*. Practical application of genetic transformation. Basis of tumor formation, hairy root, features of Ri & Ti plasmids.

**Unit-III (13 Periods)**

Mechanism of DNA transfer, role of virulence genes, use of Ti & Ri as vectors

Binary vectors, use of reporter genes, methods of nuclear transformation, viral vectors and their applications.

Multiple gene transfers vector less or direct gene transfer, particle bombardment, Electroporation, microinjection, transformation of monocots.

**Unit-IV (12 Periods)**

Plant transgene action.

Herbicide resistance. Glyphosate action, strategies for glyphosate action.

Insect resistance The crystal proteins, Toxic action of crystal proteins, expression of crystal proteins in plants.

Virus resistance,. Virus coat protein gene, cDNA of satellite RNA, defective viral genomes, Antisense RNA approach, Ribozyme mediated protection.

Drought resistance, pest resistance, long shelf life of fruits and flowers. Chloroplast transformation, advantages.

Plant secondary metabolites, industrial enzymes, biodegradable plastic, poly hydroxyl butyrate, edible vaccines.

**Text & References:**

1. Biotechnology - B.D.Singh
2. Plant Biotechnology – B.D.Singh
3. Biotechnology – P.K.Gupta
4. Introduction to plant tissue culture – M.K. Razdan
5. Plant tissue culture: Theory and practice- S.S. Bhojwani and M.K.Razdan

**B. Sc. THIRD YEAR BIOTECHNOLOGY (VOCATIONAL)**  
**Choice Base Credit System (CBCS) Pattern**  
**SEMESTER – VI**  
**DECBT II (Section B)**  
**BIORESOURCE TECHNOLOGY (P II)**

**Maximum Marks – 50**

**Periods – 45**

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**Unit-I (10 Periods)**

Biodegradation; Definition and Concept, Aerobic and anaerobic degradation pathways  
Biodegradation of Hydrocarbon with suitable example.

**UNIT II (10 periods)**

Xenobiotic Degradation; Pesticide degradation-principle with suitable example Herbicide degradation-principle with suitable example  
Biopesticides , *Thuringiensis* toxin as a natural pesticides. Biological control of other insects swarming the agricultural fields..

**Unit-III (12 Periods)**

Bioremediation; Definition, and concept, methods of bioremediation (Insitu and Exsitu methods).  
Applications of bioremediation  
Phytoremediation ; Definition ,concept and types

**Unit-IV (13 Periods)**

Biofuel and biodiesel  
Biabsorption technology, Mushroom Production on agrowaste, Vermicomposting, GMF-advantages and disadvantages  
Biomass; Composition of biomass, types of biomass, biomass conversion

**Text & References:**

1. Environmental Biotechnology – Indu shekharThakur
2. Environmental Chemistry – B.K.Sharma
3. Biotechnology – B.D.Singh
4. Environmental Chemistry – A.K.De
5. Introduction to Biodeterioration – D.Allsopp and seal  
Biotechnology – R. C Dubey

**B.Sc. THIRD YEAR, BIOTECHNOLOGY ( VOCATIONAL)**  
**Choice Base Credit System (CBCS) Pattern**  
**DECBT – I (Section A)**  
**PRACTICALS BASED ON THEORY PAPERS OF DECBT-I & DECBT- II (Section A)**  
**Plant tissue culture & Plant transgenesis**

Practical –16

Maximum Marks – 50

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Practical 1 : Equipments and other requirements in plant tissue culture laboratory.

Practical 2 : preparation of MS & white's media.

Practical 3 : preparation of root & shoot induction media.

Practical 4 : preparation sugarcane tissue culture media.

Practical 5 : preparation of embryo culture media.

Practical 6 : sterilization of explants.

Practical 7 : Initiation of callus.

Practical 8 : organogenesis of cultured leaf disc of banana.

Practical 9 :Tissue culture of cereals.

Practical 10 : Embryo culture of papaya.

Practical 11 : Preparation of synthetic seeds.

Practical 12 : Isolation of Plasmid

Practical 13 : Plant Transformation

Practical 14 : preparation of competent cells

Practical 15 : Agarose gel electrophoresis.

Practical 16 :cytological examination of regenerated plants

Practical 17 : *Agrobacterium* culture & selection of transformants

**B.Sc. THIRD YEAR, BIOTECHNOLOGY (VOCATIONAL)  
Choice Base Credit System (CBCS) Pattern DECBTP- II (Section B)  
PRACTICALS BASED ON THEORY PAPERS OF  
(DECBT I & DECBT II) (Section B)**

**Environment Biotechnology & Bioresource technology**

Practical – 17

Maximum Marks – 50

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Practical 1 : Estimation of calcium content of water sample.

Practical 2 : Estimation of  $\text{mg}^{++}$  ions in water.

Practical 3 : Enrichment & isolation of hydrocarbon degraders.

Practical 4 : Walkey & Blakey modified method for estimation of organic matter.

Practical 5 : Biological oxygen demand.

Practical 6 : Chemical oxygen demand

Practical 7 : Estimation of Nitrate in drinking water

Practical 8 : Determination of chlorides in water

Practical 9 : Test for the degradation of aromatic Hydrocarbons bacteria.

Practical 10 : Estimation of amount of  $\text{Co}_2$  present in water.

Practical 11 : Estimation of dissolved oxygen.

Practical 12 : Qualitative analysis of water(MPN). Practical

Practical 13 : Total alkalinity of water sample.

Practical 14 : Estimation of amount of acidity.

Practical 15 : Hardness of water sample by EDTA method.

Practical 16 : Isolation of Rhizobium and Azotobacter spp.

Practical 17 : Production of Biofertilizers (Rhizobium and Azotobacter)



**Swami Ramanand Teerth Marathwada University, Nanded**  
**Choice Base Credit System (CBCS) Pattern**  
**Semester Pattern effective from June 2018**  
**B.Sc Third Year Biotechnology (Vocational) Semester V**  
**DECBTP- II**

**SEC III (1 Skill / optional): Enzyme Technology**

**Unit I- Introduction to Enzymes**

General introduction:- Nomenclature and Classification of Enzymes, structure of enzyme.

**Practical**

1. Isolation of Amylase producers
2. Isolation of protease producer

**Unit II- Enzyme Kinetics**

Mechanism of enzyme catalysis

Michaelis Menten equation,

**Practical**

1. Determination of  $K_m$  &  $V_{max}$
2. Effect of temperature on Enzyme kinetics
3. Effect of pH on Enzyme kinetics

**Unit III**

**Production & Application of Industrial Enzymes**

Production & Applications of Pectinase, Amylase and Proteases

**Practical**

1. Production and Purification of amylase
2. Production and Purification of Proteases.
3. Production and Purification of Pectinase

**Unit IV**

**Clinical enzymes**

Production, purification and Applications

enzymes:- , Asperginase and

Beta-Lactamase,

**Practicals**

1. Production and purification of Asperginase
2. Production and purification of Beta-Lactamase

**References ;**

1. Principles of Biochemistry - Lehninger , Nelson, Cox, CBS publishers
2. Biochemistry- U Satyanarayana
3. Biochemistry- J.L Jain, S. Chand Publication
4. Advanced biotechnology – R.C Dubey, S. Chand Publication

**Swami Ramanand Teerth Marathwada University, Nanded**  
**B.Sc Third Year Biotechnology (Vocational) Semester V**  
**Choice Base Credit System (CBCS) Pattern**  
**Semester Pattern effective from June 2018**  
**DECBTP- II**

**SEC III (1 Skill / optional) : Environmental Contamination & Abatement**

**Unit - I**

Types of pollutions; Air ,Water and Soil causes and its effects

**Practicals :**

1. Microbial examination of water.
2. Determination of TS, TSS and TDS of drinking water.

**Unit - II**

Methods for the measurement of pollution.  
Biotechnological approaches for the control of pollution.

**Practicals :**

1. Chemical analysis of soil.
2. Isolation of heavy metal degrading bacteria from soil.

**Unit – III**

Microorganisms involved in bioremediation  
Monitoring of bioremediation.  
Superbug for bioremediation.

**Practicals :**

1. Isolation of hydrocarbon degraders from soil.
2. Isolation of plasmid from hydrocarbon degrader.

**Unit –IV**

Introduction, Definition, classification & Sources of Biomedical waste.  
Biomedical waste management process.

**Practicals :**

1. Collection of Biomedical waste
2. Disposal of Biomedical waste by physical chemical & Biological methods.

**References;**

1. Environmental Biotechnology Indushekar Thakur- -I K International
2. Text book of Environmental Biotechnology P. Mohapatra- -I K International
3. Environmental Biotechnology by Alan Scragg. Pearson Education Limited.
4. Advanced biotechnology – R.C Dubey, S. Chand Publication

SKELETON OF QUESTION PAPER  
**B.Sc. THIRD YEAR BIOTECHNOLOGY (VOCATIONAL)**  
Choice Base Credit System (CBCS) Pattern  
**SEMESTER-V DECBT – I**  
**PLANT TISSUE CULTURE / ENVIRONMENTAL BIOTECHNOLOGY**  
**Time: Two hours      Maximum Marks: 40**

- Note: - (i) Attempt all questions  
(ii) All questions carry equal marks  
(iii) Draw neat and well labeled diagrams wherever necessary

Q.1. Attempt any four out of six

- a)
- b)
- c)
- d)
- e)
- f)

(Based on Unit I, II, III, and IV )                      (04X2)                      08

Q.2. Attempt any two of the following

- a)
- b)
- c)

(Based on Unit I, and II)                      (04X2)                      08

Q.3. Attempt any one of the following

- a)
- b)

(Based on unit I and II) (08X1)                      08

Q.4. Attempt any two of the following

- a)
- b)
- c)

(Based on Unit III and IV)                      (04X2)                      08

Q.5. Attempt any one of the following

- a)
- b)

(Based on unit III and IV)                      (08X1)                      08

**SKELETON OF QUESTION PAPER**  
**B.Sc. THIRD YEAR BIOTECHNOLOGY (VOCATIONAL)**  
**Choice Base Credit System (CBCS) Pattern**  
**SEMESTER- VI DECBT – II**  
**PLANT TRANSGENESIS/ BIORESOURCE TECHNOLOGY**

*Time: Two hours*      *Maximum Marks: 40*

- Note: - (i) Attempt all questions  
(ii) All questions carry equal marks  
(iii) Draw neat and well labeled diagrams wherever necessary

Q.1. Attempt any four out of six  
a)  
b)  
c)  
d)  
e)  
f)  
(Based on Unit I, II, III, and IV )      (04X2)      08

Q.2. Attempt any two of the following  
a)  
b)  
c)  
(Based on Unit I, and II)      (04X2)      08

Q.3. Attempt any one of the following  
a)  
b)  
(Based on unit I and II) (08X1)      08

Q.4. Attempt any two of the following  
a)  
b)  
c)  
(Based on Unit III and IV)      (04X2)      08

Q.5. Attempt any one of the following  
a)  
b)  
(Based on unit III and IV)      (08X1)      08

PROFORMA FOR PRACTICAL EXAMINATION  
SWAMI RAMANAND TREETH MARATHWADA UNIVERSITY, NANDED

Faculty of Science

**Choice Base Credit System (CBCS) Pattern**

B. Sc. III year Vocational Biotechnology Practical Examination

DECBTP-I Annual Pattern

PRACTICAL PAPER-XVI: BASED ON THEORY PAPERS-XII & XIV

Time: Four hours (for two consecutive days)      Marks: 40

Q 1) Major Question	(Plant tissue culture)	10
Q 2) Major Question	(Plant tissue culture)	05
Q 3) Major Question	(Plant transgenesis)	10
Q 4) Major Question	(Plant transgenesis)	05

PROFORMA FOR PRACTICAL EXAMINATION  
SWAMI RAMANAND TREETH MARATHWADA UNIVERSITY, NANDED

Faculty of Science

**Choice Base Credit System (CBCS) Pattern**

B. Sc. III year Vocational Biotechnology Practical Examination

DECBTP-II Annual Pattern

PRACTICAL PAPER-XVII: BASED ON THEORY PAPERS-XIII & XV

Practical's based on P- XIII & P-XIV (P- XVII)

Time: Four hours (for two consecutive days)      Marks: 40

Q 1) Major Question (Environmental Biotechnology)	10
Q 2) Major Question (Environmental Biotechnology)	10
Q 3) Major Question (Bioresource technology)	10
Q 4) Major Question (Bioresource technology)	10