



**R.P. Gogate College of Arts & Science and
R.V. Jogalekar College of Commerce
(Autonomous), Ratnagiri**

**Syllabus for
T. Y. B. Sc. Biotechnology Programme
Semester V and VI**

**Under Choice Based Credit System (CBCS)
To be implemented from the Academic Year
2023 - 2024**

Name of Programme	B. Sc. Biotechnology
Level	UG
No. of Semesters	06
Year of Implementation	2023 – 24
Programme Specific Outcomes (PSO)	<ol style="list-style-type: none"> 1. To impart skills in handling the cultures of micro – organisms. 2. To impart the knowledge of molecular biology techniques. 3. To impart the skills of Science communication. 4. To impart knowledge of society and make students aware about the Problems in society. 5. To understand basic principles of research methodology and identify a research problem. 6. To gain critical thinking and analytical skills to understand new diagnostic methods. 7. To write a business plan. 8. To design strategies for successful implementation of ideas.
Relevance of PSOs to the local, regional, national, and global developmental needs	<p>Biotechnology is important at Global, Regional and local level. The significance of Biotechnology identified at all these levels and it is relevant to everyday life. The curriculum design of B. Sc. Biotechnology programme helps in understanding various concepts in detail. This programme includes hands on skills and knowledge of the different techniques related to molecular biology, tissue culture, basic chemistry and basic microbiology. This also involves the knowledge of problems in society. The application part is taken care of so that the learner shall be able to connect the phenomena around him with the curriculum. This programme also imparts the research values among the learners. The hard and softs skills acquired during the completion of this programme shall make him employable.</p>

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40 % marks in the first part and by conducting the Semester End Examinations of 60 % marks in the second part.

Standard of Passing

The learner to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment & Semester End Examination. The learner shall obtain minimum of 40% marks (i. e. 16 out of 40) in the Internal Assessment and 40% marks in Semester End Examination (i. e. 24 out of 60) separately, to pass the course and minimum of Letter Grade “P” in the project component, wherever applicable to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment and Semester End Examination together.

Performance Grading:

Letter Grades and Grade Points

Semester GPA/ Program CGPA Semester/Program	% of Marks	Alpha-Sign / Letter Grade Result
9.00-10.00	90.0 -100	O (Outstanding)
$8.00 \leq 9.00$	$80.0 \leq 90.0$	A+ (Excellent)
$7.00 \leq 8.00$	$70.0 \leq 80.0$	A (Very Good)
$6.00 \leq 7.00$	$60.0 \leq 70.0$	B+ (Good)
$5.50 \leq 6.00$	$55.0 \leq 60.0$	B (Above Average)
$5.00 \leq 5.50$	$50.0 \leq 55.0$	C (Average)
$4.00 \leq 5.00$	$40.0 \leq 50.0$	P (Pass)
Below 4.00	Below 40	F (Fail)
Ab (Absent)	-	Absent

SMART Criteria for Course Outcomes:

Specific: Each course outcome is specific, outlining the knowledge and skills students are expected to acquire in relation to the specific topics covered.

Measurable: Each outcome can be measured through assessments, tests, or projects to determine the level of understanding and proficiency achieved by the students.

Achievable: The outcomes are achievable within the duration of the course, considering the number of lectures allocated to each topic.

Relevant: The outcomes are relevant to the subject of financial services and capital market, addressing important concepts, types, and mechanisms involved.

Time-bound: The outcomes are expected to be achieved by the end of the course, providing a clear timeline for assessment and evaluation.

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Cell Biology
Course Code	USBT501
Class	T. Y. B. Sc.
Semester	V
No. of Credits	2.5
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

- CO1 - To impart the knowledge of cell cycle.
 CO2 – To provide the insight of cell signalling.
 CO3 – To gain the knowledge of developmental biology.
 CO4 – To impart the knowledge of cancer biology.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Cell cycle	Cell cycle Introduction: Prokaryotic and Eukaryotic- 3 Lectures ; The Early Embryonic Cell Cycle and the Role of MPF- 4 Lectures ; Yeasts and the Molecular Genetics of Cell-Cycle Control – 4 Lectures ; Apoptosis, Cell-Division Controls in Multicellular Animals- 4 Lectures	15
II	Cell signalling	Cell signalling and signal transduction: Introduction General Principles of Cell Signalling - 3 Lectures ; Signalling via G-Protein-linked Cell-Surface Receptors - 3 Lectures ; Signalling via Enzyme-linked Cell-Surface Receptors - 3 Lectures ; Target-Cell Adaptation, The Logic of Intracellular - 3 Lectures ; Signalling: Lessons from Computer-based "Neural Networks"- 3 Lectures	15

III	Developmental Biology	Overview of how the modern era of developmental biology emerged through multidisciplinary approaches - 5 Lectures ; Stages of development- zygote, blastula, gastrula, neurula cell fate & commitment – potency- concept of embryonic stem cells, differential gene expression, terminal differentiation ,lineages of three germ layers, fate map - 6 Lectures ; Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development Pattern formation-- axis specification, positional identification (regional specification), Morphogenetic movements, Model organisms in Developmental biology – 4 Lectures	15
IV	Cancer Biology	Cancer: Introduction, Cancer as a Microevolutionary Process - 4 Lectures ; The Molecular Genetics of Cancer - 6 Lectures ; Cancer and Virus Cancer diagnosis and chemotherapy - 5 Lectures	15

Learning Resources recommended:

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA
5. Developmental Biology; Scott Gilbert; 9th Edition

Evaluation Pattern

A. Internal Evaluation

Method	Marks
Class Test/ Online Examination	20
Assignment	10
Overall Performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Unit I questions 12 M
2	II	Unit II questions 12 M
3	III	Unit III questions 12 M
4	IV	Unit IV questions 12 M
5	All Units	Short notes (03 out of 04) 12 M

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Medical Microbiology and Instrumentation
Course Code	USBT502
Class	T. Y. B. Sc.
Semester	V
No. of Credits	2.5
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 – To impart the knowledge of medical microbiology.

CO2 – To provide the insight of the various skills and instrumentation.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Virology	Introduction to viruses-Position in biological spectrum; Virus properties - 2 Lectures ; General structure of viruses Baltimore Classification and Taxonomy (ICTV) - 2 Lectures ; Cultivation of viruses - 2 Lectures ; Reproduction of ds DNA phages Hepatitis /ss RNA (influenza), animal viruses and plant (TMV) virus – 4 Lectures ; Virus purification and assays - 2 Lectures ; Cytocidal infections and cell damage - 2 Lectures ; Viroids and Prions – 1 Lecture	15
II	Chemotherapeutic drugs	Discovery and Design of antimicrobial agents - 1 Lecture ; Classification of Antibacterial agents, Selective toxicity, MIC, MLC – 2 Lectures Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides:	15

		<p>Vancomycin; Polypeptides: Bacitracin -2 Lectures Injury to Plasma membrane: Polymyxin – 1 Lecture; Inhibition of protein synthesis Aminoglycosides, Tetracyclines Chloramphenicol, Macrolides- Erythromycin- 2 Lectures; Inhibition of Nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole - 2 lectures; Antimetabolites: Sulphonamides, Trimethoprim - 1 lecture; Drug Resistance: Mechanism, Origin and transmission of drug resistance – 1 lecture; Use and misuse of antimicrobial agents - 1 lecture; Antifungal drugs, Antiviral drugs – 2 lectures</p>	
III	Spectroscopy	<p>Principle, instrumentation, working and applications of: Fluorescence Spectroscopy – 3 Lectures Luminometry - 3 Lectures Light scattering spectroscopy - 3 Lectures Infrared Spectroscopy - 3 Lectures Atomic absorption Spectroscopy - 3 Lectures</p>	15
IV	Bioanalytical techniques	<p>Principle, working and applications of: Affinity chromatography - 2 Lectures Ion-exchange chromatography - 2 Lectures Molecular (size) exclusion chromatography - 2 Lectures; HPLC - Method development and validation- 3 Lectures; Isotopes in Biology: Nature of radioactivity - 1 Lecture; Detection Techniques using GM counter, Scintillation counter, autoradiography - 4 Lectures; Applications of Tracer techniques in Biology - 1 Lecture</p>	15

Learning Resources recommended:

1. Principles and techniques in biochemistry and molecular biology (2010), Keith Wilson and John Walker, 7th edition, Cambridge University Press
2. Biophysics (2002) Vasantha Pattabhi and N. Gautham, Kluwer Academic Publishers
3. Physical Biochemistry: principles and applications, 2nd edition (2009), David Sheehan, John Wiley & Sons Ltd
4. HPLC method validation for pharmaceuticals: a review (2013), Harshad V. Paithankar, International Journal of Universal Pharmacy and Bio Sciences 2(4): July-August.
5. Mim's Medical Microbiology 5th edition
6. Microbiology by Prescott Harley and Klein 5th edition Mc Graw Hill
7. Medical Microbiology Jawetz,E., Brooks,G.E, Melnick,J.L., Butel,J.S Adelberg E. A 18th edition
8. Medical Microbiology by Patrick Murray 5th edition
9. Foundations In Microbiology by Talaro and Talaro Third edition W.C Brown
10. Understanding Viruses by Teri Shors

Evaluation Pattern

A. Internal Evaluation

Method	Marks
Class Test/ Online Examination	20
Assignment	10
Overall Performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Unit I questions 12 M
2	II	Unit II questions 12 M
3	III	Unit III questions 12 M
4	IV	Unit IV questions 12 M
5	All Units	Short notes (03 out of 04) 12 M

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Genomes and Molecular Biology
Course Code	USBT503
Class	T. Y. B. Sc.
Semester	V
No. of Credits	2.5
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 – To impart the knowledge of genetic engineering of plants and animals.

CO2 – To provide the skills in molecular biology tools, gene sequencing and editing.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Genetic engineering of plants	Genetic engineering of plants; Methodology. Plant transformation with the Ti plasmid of <i>A. tumefaciens</i> , Ti plasmid derived vector system - 4 Lectures ; Transgenic plants: Physical methods of transferring genes to plants : electroporation, microprojectile bombardment, liposome mediated, protoplast fusion- 5 Lectures ; Vectors for plant cells - 4 Lectures ; Improvement of seed quality protein - 2 Lectures	15
II	Transgenic animals	Transgenic mice- methodology- retroviral method, DNA microinjection, ES method - 5 Lectures ; genetic manipulation with cre-loxP - 2 Lectures ; Vectors for animal cells – 2 Lectures ; Transgenic animals recombination system – 2 Lectures ; Cloning livestock by nuclear transfer – 2 Lectures ; Green	15

		Fluorescent Protein - 1 Lectures ; Transgenic fish – 1 Lectures	
III	Tools in molecular biology	Cloning vectors-Plasmids (pUC series), Cosmids, phagemids M13, shuttle vectors, YAC vectors, expression vectors pET - 4 Lectures ; Gene cloning-Isolation and purification of DNA; Isolation of gene of interest: Restriction digestion, electrophoresis, blotting, cutting, and joining DNA, methods of gene transfer in prokaryotes and eukaryotes - 3 Lectures ; Recombinant selection and screening methods: genetic, immunochemical, Southern and Western analysis, nucleic acid hybridization, HART,HRT- 2 Lectures ; Expression of cloned DNA molecules and maximization of expression - 2 Lectures ; Cloning strategies-genomic DNA libraries, cDNA libraries, chromosome walking and jumping – 4 Lectures	15
IV	Gene sequencing and editing	Maxam Gilbert's method, Sanger's dideoxy method, Automated DNA sequencing, Pyrosequencing - 6 Lectures ; Human genome mapping and its implications in health and disease - 3 Lectures ; RNAi, ZNF(Zinc finger nucleases), TALENS(Transcription Activator Like Effector Nucleases), CRISPER/Cas system(Clustered Regularly Interspersed Repeats) - 6 Lectures	15

Learning Resources recommended:

1. iGenetics A Molecular Approach 3rd Edition Peter J. Russell.
2. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
3. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M.
4. Biotechnology 3rd Edition S.S. Purohit.
5. Genomes 3rd Edition T.A. Brown.
6. Biotechnology B.D. Singh.
7. Gene Cloning and DNA Analysis 6th Edition T.A. Brown.
8. Genomics Cantor C.R., and Smith C.L. John Wiley & Sons. (1999)

Evaluation Pattern**A. Internal Evaluation**

Method	Marks
Class Test/ Online Examination	20
Assignment	10
Overall Performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Unit I questions 12 M
2	II	Unit II questions 12 M
3	III	Unit III questions 12 M
4	IV	Unit IV questions 12 M
5	All Units	Short notes (03 out of 04) 12 M

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Marine Biotechnology
Course Code	USBT504
Class	T. Y. B. Sc.
Semester	V
No. of Credits	2.5
Nature	Theory/ Practical / Project / other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 – To impart the knowledge of marine Biotechnology.

CO2 – To acquire the significance of marine functional foods, nutraceuticals, drugs, enzymes.

CO3 – To gain the role of marine bioresources in cosmetics.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Marine Biotechnology – Introduction and Bioprospecting	Introduction to Marine Biotechnology- 1 lecture ; The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystems. Hydrothermal vents- 4 lectures ; Bioprospecting, Marine Microbial Habitats and Their Biotechnologically relevant Microorganisms- 2 lectures ; Methods for Microbial Bioprospecting in Marine Environments - 2 lectures ; Biotechnological Potential of Marine Microbes - 1 lecture ; Bioactive compounds from other Marine Organisms: fungi, Microalgae, Seaweeds, Actinomycetes, sponges - 5 lectures	15
II	Marine drugs and enzymes	Drugs from Marine organisms: Pharmaceutical compounds from marine flora and fauna - marine	15

		toxins, antiviral and antimicrobial agents – 4 lectures; Approved Marine Drugs as Pharmaceuticals – 2 lecture; Marine Natural products and its Challenges – 2 lectures; Marine Microbial Enzymes- Marine Extremozymes and Their Significance, Current Use of Marine Microbial Enzymes – 7 lectures.	
III	Marine functional foods and nutraceuticals	Marine Functional Foods: Marine Sources as Healthy Foods or Reservoirs of Functional Ingredients - 3 lectures; Marine-Derived Ingredients with Biological Properties- 3 lectures; Functional Foods Incorporating Marine-Derived Ingredients - 2 lectures; Marine Nutraceuticals : Marine Bioactives as Potential Nutraceuticals, Functional Carbohydrates, Polyunsaturated Fatty Acids- 3 lectures; Carotenoids, Soluble Calcium, Fish Collagen and Gelatin, Marine Probiotics - 4 lectures.	15
IV	Marine Bioresources and Cosmetics	Marine Bioresources, Marine Secondary Metabolites, Marine Proteins, Marine Lipids- 4 lectures; Cosmetics from Marine Sources: Scenario of Marine Sources in the Cosmetic Industry, Cosmetics: Definition and Regulations, Cosmeceuticals , Target Organs and Cosmetics Delivery Systems, Components of Cosmetics, Major Functions of Some Marine Components in Cosmetics and Cosmeceuticals , Treatments Based on Marine Resources , Products Based on Marine Resources - 11 lectures.	15

Learning Resources recommended:

1. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.
2. Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds- CRC Press_Taylor& Francis (2017)
3. R. S. K. Barnes, R. N. Hughes (auth.)-An Introduction to Marine Ecology, Third Edition Wiley-Blackwell (1999)
4. Blanca Hernández-Ledesma, Miguel Herrero-Bioactive Compounds from Marine Foods-Plant and Animal Sources-Wiley-Blackwell (2013)
5. Fabio Rindi, Anna Soler-Vila, Michael D. Guiry (auth.), Maria Hayes (eds.)-Marine Bioactive Compounds_ Sources, Characterization and Applications-Springer US (2012)
6. W. Evans-Trease and Evans Pharmacognosy 15th ed.-Saunders (2010)

Evaluation Pattern**A. Internal Evaluation**

Method	Marks
Class Test/ Online Examination	20
Assignment	10
Overall Performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Unit I questions 12 M
2	II	Unit II questions 12 M
3	III	Unit III questions 12 M
4	IV	Unit IV questions 12 M
5	All Units	Short notes (03 out of 04) 12 M

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Applied Component – Biosafety
Course Code	USACBT501
Class	T. Y. B. Sc.
Semester	V
No. of Credits	02
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 – To impart the knowledge of Biosafety practices.

CO2 – To provide the knowledge about detection and testing of contaminants.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Introduction to biosafety	Introduction - 1 lecture Biological Risk Assessment, Hazardous Characteristics of an Agent- 2 lectures ; Genetically modified agent hazards – 1 lecture ; Cell cultures - 1 lecture ; Hazardous Characteristics of Laboratory Procedures – 1 lecture ; Potential Hazards Associated with Work Practices – 2 lectures ; Safety Equipment and Facility Safeguards - 2 lectures ; Pathogenic risk and management - 2 lectures	15
II	GLP	Concept of GLP- 1 lectures ; Practicing GLP- 1 lecture ; Guidelines to GLP - 2 lectures ; Documentation of Laboratory work - 1 lectures ; Preparation of SOPs - 2 lectures ; Calibration records - 1 lectures ; Validation of methods - 1 lectures ; Documentation of results – 1 lecture ; Audits & Audit reports - 1 lecture .	15
III	Detection and testing of contaminants	Microbial Contamination in food and pharma product - 3 lectures ;	15

		Some common microbial contaminants - 3 lectures; Microbiological Assays for pharmaceutical products - 4 lectures; Regulatory Microbiological testing in pharmaceuticals - 3 lectures.	
IV	Biosafety in Biotechnology	Concepts on biosafety in Biotechnology - 2 lectures; Regulating rDNA technology - 2 lectures; Regulating food and food ingredients - 3 lectures; Genetically engineered crops, livestock Bioethics - 3 lectures; Contemporary issues in Bioethics - 2 lectures.	15

Learning Resources recommended:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.
2. Biosafety in Microbiological and Biomedical Laboratories - 5th Edition, L. Casey Chosewood Deborah E. Wilson U.S. Department of Health and Human Services Centers for Disease Control and Prevention National Institutes of Health.
3. Molecular Biotechnology –Principles and Applications of Recombinant DNA Glick, B.R, Pasternak, J.J Patten, C.L 3rd edition ASM press

Evaluation Pattern

A. Internal Evaluation

Method	Marks
Class Test/ Online Examination	20
Assignment	10
Overall Performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Unit I questions 12 M
2	II	Unit II questions 12 M
3	III	Unit III questions 12 M
4	IV	Unit IV questions 12 M
5	All Units	Short notes (03 out of 04) 12 M

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals of USBT501 and USBT502
Course Code	USBTP501
Class	T. Y. B. Sc.
Semester	V
No. of Credits	03
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 - To impart knowledge and hands on experience of the various practicals related to cell biology.

CO2 - To impart knowledge and hands on experience of the various practicals related to medical microbiology and instrumentation.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practical	<ol style="list-style-type: none"> 1. Separation of components from a mixture using Affinity chromatography (Kit may be used) 2. Separation of components from a mixture using ion exchange chromatography (Kit may be used) 3. Separation of components from a mixture using Size exclusion chromatography (Kit may be used) 4. HPLC method validation. 5. MIC and MLC of any one antibiotic 6. Antibiotic sensitivity test using agar cup method 7. Antibiotic sensitivity test using paper disc method 8. Antibiotic sensitivity test using ditch method. 9. Book review (Emperor of all Maladies) 	72
Demonstration Practical	Chick embryo candling and inoculation methods Demonstration experiment	
Visit	Cancer Biology: (Field visit and 2 page report in the journal)	

Learning Resources recommended:

1. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
2. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
3. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA
4. Developmental Biology; Scott Gilbert; 9th Edition
5. Principles and techniques in biochemistry and molecular biology (2010), Keith Wilson and John Walker, 7th edition, Cambridge University Press
6. HPLC method validation for pharmaceuticals: a review (2013), Harshad V. Paithankar, International Journal of Universal Pharmacy and Bio Sciences 2(4): July-August.
7. Mim's Medical Microbiology 5th edition
8. Microbiology by Prescott Harley and Klein 5th edition Mc Graw Hill

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
TY Practical	3 experiments of 2 hrs duration	06 hrs	60 M (01 Paper) (20 M for 1 Experiment, 25 M for 1 Experiment, 15 M for 1 Experiment,)	40 M (10 M for Journal, 10 M for Book Review, 10 M for viva, 05 M Identification/Spotting, 05 M for overall performance)	100

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals of USBT503 and USBT504
Course Code	USBTP502
Class	T. Y. B. Sc.
Semester	V
No. of Credits	03
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 - To impart knowledge and hands on experience of the various practicals related to genomes and molecular biology.

CO2 - To impart knowledge and hands on experience of the various practicals related to marine Biotechnology.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practical	1. Transformation in <i>E. coli</i> . 2. Genomic DNA Extraction: Animal cells. 3. Restriction enzyme digestion and ligation (Kit may be used). 4. Gradient plate technique 5. Bacterial gene expression (Kit may be used). 6. Study of any 5 marine bacteria and algae (Macro and micro) 7. DPPH assay for antioxidant extracted from marine algae 8. Extraction of carotenoids from marine algae/Bacteria/Fungi 9. Extraction and estimation of Gelatin / Collagen. 10. Extraction of alkaloids from marine organisms and their separation by TLC.	72
Demonstration Practical	1. Phage titration: Demonstration 2. Polymerase chain reaction. Demonstration	

Learning Resources recommended:

1. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
2. Gene Cloning and DNA Analysis 6th Edition T.A. Brown.

3. Genomics Cantor C.R., and Smith C.L. John Wiley & Sons. (1999)
4. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.
5. Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds- CRC Press Taylor & Francis (2017)
6. R. S. K. Barnes, R. N. Hughes (auth.)-An Introduction to Marine Ecology, Third Edition Wiley-Blackwell (1999)

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
TY Practical	3 experiments of 2 hrs duration	06 hrs	60 M (01 Paper) (20 M for 1 Experiment, 25 M for 1 Experiment, 15 M for 1 Experiment)	40 M (10 M for Journal, 10 M for viva, 15 M for Identification/Spotting, 05 M for overall performance)	100

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals of USACBT501
Course Code	USACBTP503
Class	T. Y. B. Sc.
Semester	V
No. of Credits	02
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 - To impart knowledge and hands on experience of the various practicals related to biosafety.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practical	1. Validation of micropipette, measuring cylinders, colorimeters 2. Calibration of pH meter and weighing balance 3. Vitamin B12 bioassay 4. Testing for adulterants in food; ex. Starch in milk 5. Making SOP for any 2 major laboratory instruments 6. Sterility of injectables	48

Learning Resources recommended:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.
2. Biosafety in Microbiological and Biomedical Laboratories - 5th Edition, L. Casey Chosewood Deborah E. Wilson U.S. Department of Health and Human Services Centers for Disease Control and Prevention National Institutes of Health.
3. Molecular Biotechnology –Principles and Applications of Recombinant DNA Glick, B.R, Pasternak, J.J Patten, C.L 3rd edition ASM press

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
TY Practical (AC)	4 experiments of 1.5 hrs duration	6 hrs	60 M (20 M each for 2 Experiments, 10 M each for 2 Experiments)	40 M (10 M for Journal, 10 M for SOP Writing, 10 M for Viva, 05 M for Identification, 05 M for overall performance)	100

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Biochemistry
Course Code	USBT601
Class	T. Y. B. Sc.
Semester	V
No. of Credits	2.5
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 – To impart the knowledge of protein biochemistry and metabolism.

CO2 – To provide the insight of endocrinology and nutrition.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Protein Biochemistry	Protein structure: Protein Tertiary and Quaternary Structures - 2 Lectures ; Protein Denaturation and Folding – 3 Lectures ; Protein Function: Reversible Binding of a Protein to a Ligand: Oxygen Binding Proteins – 2 Lectures ; Complementary Interactions between Proteins and Ligands: Immunoglobulins – 1 Lecture ; Protein Interactions Modulated by Chemical Energy: Actin, Myosin, and Molecular Motors - 3 Lectures ; Protein purification – 4 Lectures .	15
II	Metabolism	Carbohydrate biosynthesis and its regulation: Peptidoglycan in Bacteria - 2 Lectures ; Starch and sucrose in Plants - 4 Lectures ; Glycogen in Animals - 4 Lectures ; Biosynthesis and regulation of Cholesterol, Atherosclerosis – 5 Lectures .	15
III	Endocrinology	Mechanism of action of group I and II hormones- 1 Lecture ; Structure,	15

		storage, release, transport, biochemical functions and disorders associated with hormones secreted by Hypothalamus - 1 Lecture ; Anterior Pituitary gland - GH, stimulating hormones) - 1 Lecture ; Posterior Pituitary gland – oxytocin and vasopressin - 1 Lecture ; Thyroid gland – Thyroxine, calcitonin – 2 Lectures ; Parathyroid gland – PTH - 1 Lecture ; Adrenal medulla – epinephrine and norepinephrine - 1 Lecture ; Adrenal cortex – Glucocorticoids – 1 Lecture ; Pancreas – insulin and glucagon – 2 Lectures ; Female Gonads – estrogen and progesterone - 2 Lectures ; Male gonads – testosterone- 1 Lecture ; Placenta – hCG - 1 Lecture .	
IV	Nutrition	Minerals and Vitamins; Dietary sources, bioactive form, functions and disorders associated with fat soluble (A D E K) and water soluble vitamins- 7 Lectures ; Minerals - physiological and biochemical functions of principal and trace elements. – 7 Lectures ; Malnutrition – Over nutrition (obesity) and PEM (Kwashiorkor and Marasmus)- 1 Lecture .	15

Learning Resources recommended:

1. Lehninger, principles of biochemistry, 4th edition (2005), David Nelson and Michael Cox W.H. Freeman and Company, New York.
2. Biochemistry, 4th edition (2010), Voet and Voet, John Wiley and sons, USA
3. Harper's Illustrated Biochemistry, 27th edition, RK Murray, DK Granner, PA Mayes and VW Rodwell, McGraw Hills publication.

4. Biochemistry, 4th edition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd

5. Nutrition Science, 6th edition (2017), Srilakshmi, new age international publishers.

Evaluation Pattern

A. Internal Evaluation

Method	Marks
Class Test/ Online Examination	20
Assignment	10
Overall Performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Unit I questions 12 M
2	II	Unit II questions 12 M
3	III	Unit III questions 12 M
4	IV	Unit IV questions 12 M
5	All Units	Short notes (03 out of 04) 12 M

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Industrial Microbiology
Course Code	USBT602
Class	T. Y. B. Sc.
Semester	V
No. of Credits	2.5
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 – To impart the knowledge of dairy technology.

CO2 – To gain the detailing of fermentation processes.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Dairy technology	Milk: Normal flora, changes in raw milk - 2 lectures ; Enumeration - 1 lecture ; Factors affecting bacteriological quality - 1 lecture ; Dairy technology Preservation methods - 2 lectures ; Pasteurization- 1 lecture ; Starter Cultures - 2 lectures ; Fermented products-Production process and spoilage of Cheese: Swiss and Cheddar - 2 lectures ; Butter - 2 lectures ; Yogurt - 1 lectures and Buttermilk - 1 lecture .	15
II	Down-stream processing (DSP)	Introduction of DSP - 2 lectures ; Foam separation - 1 lecture ; Types of Precipitation - 1 lecture ; Filtration 2 lectures , Centrifugation - 1 lecture ; Chromatography in DSP - 2 lectures ; Cell disruption-physical and chemical methods - 2 lectures ; Solvent recovery, Membrane processes - 1 lecture ; Drying – 1 lecture ; Crystallization and Whole broth	15

		processing - 2 lectures.	
III	Fermentation process	Introduction to Inoculum development - 2 lectures ; Bacterial and fungal inoculum development with one example each - 3 lectures , scale up, scale down - 2 lectures ; Production of: Streptomycin – 1 lecture ; Protease – 1 lecture ; Mushroom - 1 lecture ; Glutamic acid - 1 lecture ; Lysine – 1 lecture , ethanol production 1 lecture Semi-synthetic Penicillin 1 lecture , Biotransformation - 1 lecture.	15
IV	QA-QC	Concept of GMP- 1 Lectures ; Requirements of GMP implementation - 2 Lectures ; Documentation of GMP practices – 2 Lectures ; Regulatory certification of GMP - 2 Lectures ; Quality Control (QC): Concept of QC - 2 Lectures ; Requirements for implementing QC - 2 Lectures ; QA concepts: Concept of QA - 2 Lectures ; Requirements for implementing - 2 Lectures.	15

Learning Resources recommended:

1. Applied Dairy Microbiology Elmer H Marth and James L Steele MerceL Dekker Inc New York, 2nd edition
2. Microbial Technology Peppler,H.J and Perlman,D 2nd Academic Press Practicals
3. Industrial Microbiology Prescott and Dunn CBS publishers
4. Dairy technology by Yadav and Grower
5. Fermentation technology by Stanbury and Whittkar
6. Pharmaceutical Microbiology by Russel and Hugo

Evaluation Pattern

A. Internal Evaluation

Method	Marks
Class Test/ Online Examination	20
Assignment	10
Overall Performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Unit I questions 12 M
2	II	Unit II questions 12 M
3	III	Unit III questions 12 M
4	IV	Unit IV questions 12 M
5	All Units	Short notes (03 out of 04) 12 M

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Pharmacology and Neurochemistry
Course Code	USBT603
Class	T. Y. B. Sc.
Semester	V
No. of Credits	2.5
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 – To impart the knowledge of general principles of pharmacology.

CO2 – To provide the knowledge of neurochemistry.

CO3 – To gain the knowledge of basic and regulatory toxicology.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	General principles of pharmacology	Mechanism of drug action - 2 Lectures ; drug receptors and biological responses – 2 Lectures ; second-messenger systems, the chemistry of drug–receptor binding – 2 Lectures ; dose–response relationship: therapeutic index - 3 Lectures ; ED, LD, - 2 Lectures ; Potency and Intrinsic Activity – 2 Lectures ; Drug antagonism – 2 Lectures .	15
II	Drug absorption and distillation	Absorption of drugs from the alimentary tract - 2 Lectures ; factors affecting rate of gastrointestinal absorption – 2 Lectures ; absorption of drugs from lungs - 1 Lecture ; skin - 1 Lecture ; absorption of drugs after parenteral administration factors influencing drug distribution – 2 Lectures ; binding of drugs to plasma proteins – 2 Lectures ; Physiological barriers to drug distribution – 3 Lectures .	15

III	Basic toxicology and regulatory toxicology	Background Definitions - 1 Lectures ; Causation: degrees of certainty Classification - 1 Lectures ; Causes Allergy in response to drugs Effects of prolonged administration: chronic organ toxicity - 2 Lectures ; Adverse effects on reproduction - 1 Lecture ; Poisons: Deliberate and accidental self-poisoning Principles of treatment Poison-specific measures General measures - 2 Lectures ; Specific poisonings: cyanide, methanol, ethylene glycol, hydrocarbons, volatile solvents, heavy metals, - 3 Lectures ; herbicides and pesticides, - 2 Lectures ; biological substances (overdose of medicinal drugs is dealt with under individual agents) - 1 Lecture ; Incapacitating agents: drugs used for torture - 1 Lecture ; Nonmedical use of drugs - 1 Lecture.	15
IV	Neurochemistry	Anatomy and functioning of the brain - 2 Lectures ; Neuronal pathways - 2 Lectures ; Propagation of nerve impulses - 2 Lectures ; Neuronal excitation and inhibition - 3 Lectures ; Synapses and gap junctions - 3 Lectures ; Action of Neuro toxins and neurotransmitters - 3 Lectures.	15

Learning Resources recommended:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Modern Pharmacology with clinical Applications Craig, C.R, Stitzel, R. E 5th edition
3. Clinical Pharmacology Bennet, PN, Brown, M.J, Sharma, P 11th edition Elsevier
4. Biochemistry Metzler, D.E Elsevier

Evaluation Pattern

A. Internal Evaluation

Method	Marks
Class Test/ Online Examination	20
Assignment	10
Overall Performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Unit I questions 12 M
2	II	Unit II questions 12 M
3	III	Unit III questions 12 M
4	IV	Unit IV questions 12 M
5	All Units	Short notes (03 out of 04) 12 M

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Environmental Biotechnology
Course Code	USBT604
Class	T. Y. B. Sc.
Semester	V
No. of Credits	2.5
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

- CO1 – To impart the knowledge of renewable sources of energy.
 CO2 – To understand the industrial effluent treatment.
 CO3 – To gain knowledge about wastewater treatments.
 CO4 – To provide the understanding of hazardous waste management.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Renewable sources of energy	Energy sources renewable – solar energy, wind power, geothermal energy and hydropower, biomass energy - 5 Lectures ; Biogas technology- biogas plant & types, biodigester. Biogas- composition, production and factors affecting production, uses – 5 Lectures ; Biofuels – ethanol production. Microbial hydrogen production Biodiesel, Petrocrops - 5 Lectures	15
II	Industrial effluent treatment	Biological processes for industrial effluent treatment, aerobic biological treatment- activated sludge process, CASP, advanced activated sludge processes (any two) Biological filters, RBC, FBR - 5 Lectures ; Anaerobic biological treatment- contact digesters, packed bed reactors, anaerobic baffled digesters,	15

		UASB - 3 Lectures ; Solid waste treatment - 2 Lectures ; pollution indicators & biosensors - 2 Lectures ; biodegradation of xenobiotics- persistent compounds, chemical properties influencing biodegradability, microorganisms in biodegradation - 2 Lectures ; Use of immobilized enzymes or microbial cells for treatment - 1 Lecture .	
III	Wastewater treatment	Wastewater treatment- introduction, biological treatment, impact of pollutants on biotreatment, use of packaged organisms and genetically engineered organisms in waste treatment – 5 Lectures ; Heavy metal pollution – sources, microbial systems for heavy metal accumulation, techniques used for heavy metal removal – 5 Lectures ; biosorption by bacteria, fungi and algae, factors affecting biosorption limitations of biosorption - 5 Lectures .	15
IV	Hazardous waste management	Biodegradation of waste from tanning industry - 2 Lectures ; petroleum industry - 2 Lectures ; paper & pulp industry - 2 Lectures ; Dairy – 2 Lectures ; Distillery - 2 Lectures ; Dye – 1 Lecture ; Antibiotic industry - 2 Lectures ; Removal of oil spillage & grease deposits – 2 Lectures .	15

Learning Resources recommended:

1. Environmental Biotechnology Allan Scragg Oxford University press
2. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur IK International
3. Environmental Biotechnology (Industrial pollution management) S.N. Jogdand Himalaya Publishing House

Evaluation Pattern

A. Internal Evaluation

Method	Marks
Class Test/ Online Examination	20
Assignment	10
Overall Performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Unit I questions 12 M
2	II	Unit II questions 12 M
3	III	Unit III questions 12 M
4	IV	Unit IV questions 12 M
5	All Units	Short notes (03 out of 04) 12 M

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Applied Component – Agribiotechnology
Course Code	USACBT601
Class	T. Y. B. Sc.
Semester	V
No. of Credits	02
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 – To impart the knowledge of precision agriculture and agricultural systems.

CO2 – To provide understanding of plant stress biology.

CO3 – To explore the significance of molecular markers in plant breeding.

CO4 – To gain knowledge about the importance of biofertilizers and biopesticides.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Precision agriculture and agricultural systems	Introduction to Agriculture and Agriculture systems- 1 Lecture ; Green-house Technology-- Types of green house, importance, functions and features of green house, Design criteria and calculation - 2 Lectures ; Construction material, covering material and its characteristics, growing media, green house irrigation system. Nutrient management - 3 Lectures ; Greenhouse heating, cooling and shedding and ventilation system, Computer controlled environment – 3 Lectures ;; Phytotrons, fertigation and roof system - 1 Lecture ; Precision Cultivation- tools, sensors for information acquisition - 2 Lectures .	15
II	Plant stress biology	Abiotic stress – Physiological and molecular responses of plants to water stress, salinity stress,	15

		temperature stress – heat and cold, Photooxidative stress, stress perception and stress signalling pathways, Ionic and osmotic homeostasis, reactive oxygen species scavenging- 4 Lectures; Biotic stress - plant interaction with bacterial, viral and fungal pathogens, plant responses to pathogen– biochemical and molecular basis of host-plant resistance , toxins of fungi and bacteria , systemic and induced resistance –pathogen derived resistance, signalling - 8 Lectures.	
III	Molecular markers in plant breeding	Genetic markers in plant breeding - Classical markers, DNA markers (RFLP, RAPD, AFLP, SSR, SNP)- 4 Lectures; Application of Molecular Markers to Plant Breeding [quantitative trait locus (QTL) mapping] - 4 Lectures; Plant DNA Barcoding- Barcoding Markers (matK, rbcL, ITS, tmHpsbA), steps, recent advances, Benefits, Limitations - 4 Lectures.	15
IV	Biofertilizers and biopesticides	Biofertilizer: Nitrogen-fixing Rhizobacteria - Symbiotic Nitrogen Fixers - 2 Lectures; Non-symbiotic Nitrogen Fixers Plant Growth Promoting Microorganisms- Phosphate- Solubilizing Microbes (PSM), Phytohormones and Cytokinins, Induced Systemic Resistance- 2 Lectures; Plant Growth Promotion by Fungi-- Mycorrhizae Arbuscular Mycorrhizae Ectomycorrhizae - 2 Lectures; Microbial Inoculants -- Inocula, Carriers, and Applications, Monoculture and Co-culture Inoculant Formulations Biocontrol, Polymicrobial Inoculant Formulations- 3 Lectures; Biopesticides – types, Bacillus	15

		thuringiensis, insect viruses and entomopathogenic fungi (characteristics, physiology, mechanism of action and application) - 3 Lectures.	
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Learning Resources recommended:

1. M. Ajmal Ali, G. Gyulai, F. Al-Hemaid -Plant DNA Barcoding and Phylogenetics, LAP Lambert Academic Publishing (2015)
2. P. Parvatha Reddy (auth.)-Sustainable Crop Protection under Protected Cultivation-Springer Singapore (2016)
3. S.B. Anderson (ed.), Plant Breeding from Laboratories to Fields, InTech, 2013
4. Henry Leung, Subhas Chandra Mukhopadhyay (eds.) - Intelligent Environmental Sensing (2015, Springer International Publishing)
5. Travis R. Glare, Maria E. Moran-Diez - Microbial-Based Biopesticides_ Methods and Protocols (2016, Humana Press)
6. Altieri, Miguel A.Farrell, John G-Agroecology- The Science of Sustainable Agriculture, Second Edition-CRC Press (2018)
7. Arie Altman, Paul Michael Hasegawa-Plant Biotechnology and Agriculture_ Prospects for the 21st Century-Academic Press (2011)

Evaluation Pattern

A. Internal Evaluation

Method	Marks
Class Test/ Online Examination	20
Assignment	10
Overall Performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Unit I questions 12 M
2	II	Unit II questions 12 M
3	III	Unit III questions 12 M
4	IV	Unit IV questions 12 M
5	All Units	Short notes (03 out of 04) 12 M

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals of USBT601 and USBT602
Course Code	USBTP601
Class	T. Y. B. Sc.
Semester	V
No. of Credits	03
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 - To impart the knowledge and hands on experience of the various practicals related to biochemistry.

CO2 - To impart the knowledge and hands on experience of the various practicals related to industrial microbiology.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practicals	1. Estimation of Milk protein-Pynes method 2. Microbial analysis of Milk by MBRT and RRT 3. Phosphatase test in Milk 4. DMC of milk sample 5. Isolation of Normal flora from Milk and curd 6. Determination of blood glucose levels for detection of diabetes mellitus. 7. Determination of serum cholesterol (total, HDL and LDL ratio) 8. Estimation vitamin C by DCPIP method from food samples.	72

Learning Resources recommended:

1. Harper's Illustrated Biochemistry, 27th edition, RK Murray, DK Granner, PA Mayes and VW Rodwell, McGraw Hills publication.
2. Biochemistry, 4nd edition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd
3. Nutrition Science, 6th edition (2017), Srilakshmi, new age international publishers.
4. Applied Dairy Microbiology Elmer H Marth and James L Steele MerceL Dekker Inc New York, 2nd edition

5. Industrial Microbiology Prescott and Dunn CBS publishers

6. Dairy technology by Yadav and Grower

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
TY Practical	3 experiments of 2 hrs duration	06 hrs	60 M (01 Paper) (20 M for 1 Experiment, 25 M for 1 Experiment, 15 M for 1 Experiment)	40 M (10 M for Journal, 10 M for viva, 15 M for Identification/Spotting, 05 M for overall performance)	100

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals of USBT603 and USBT604
Course Code	USBTP602
Class	T. Y. B. Sc.
Semester	V
No. of Credits	03
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 - To impart knowledge and hands on experience of the various practicals related to pharmacology, neurochemistry, environmental Biotechnology.

CO2 – To improve skills in writing the research outcomes in the form of thesis dissertation.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practical	1. LD 50, ED 50 evaluation using suitable models e.g. daphnia 2. Study the effect of heavy metals on the growth of bacteria. 3. Determination of Total Solids from an effluent sample. 4. Study of physico-chemical (pH, color, turbidity, BOD, COD) parameters of any one industrial effluent sample	72
Demonstration	Estimation of chromium from Effluents (Demonstration)	
Visit	Visit to ETP/ CET	

Learning Resources recommended:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Modern Pharmacology with clinical Applications Craig, C.R, Stitzel, R.E 5th edition
3. Clinical Pharmacology Bennet, PN, Brown, M.J, Sharma, P 11th edition Elsevier
4. Biochemistry Metzler, D.E Elsevier
5. Environmental Biotechnology Allan Scragg Oxford University press
6. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur
IK International

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
TY Practical	3 experiments of 2 hrs duration	06 hrs	60 M (01 Paper) (20 M for 1 Experiment, 25 M for 1 Experiment, 15 M for 1 Experiment)	40 M (10 M for Journal, 10 M for viva, 15 M for Identification/Spotting, 05 M for overall performance)	100

Syllabus for T. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals of USACBT601
Course Code	USACBTP603
Class	T. Y. B. Sc.
Semester	V
No. of Credits	02
Nature	Theory/ Practical/ Project/ other (please specify)
Type	Core/ Elective

Course Outcomes:

CO1 - To impart knowledge and hands on experience of the various practicals related to agribiotechnology.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practical	1. Isolation of Rhizobium 2. Isolation of Azotobacter 3. Isolation of Phosphate solubilizing bacteria 4. Study of effect of abiotic stress on plants. 6. Rapid screening tests for abiotic stress tolerance (drought, - PEG, Mannitol & salinity NaCl) 7. Estimation of antioxidants and antioxidant enzymes - Ascorbate, Catalase and Peroxidase	48
Demonstration	RAPD analysis demonstration experiment	
Visit	Visit to green house facility and submission of field visit report.	


Learning Resources recommended:

1. M. Ajmal Ali, G. Gyulai, F. Al-Hemaid -Plant DNA Barcoding and Phylogenetics, LAP Lambert Academic Publishing (2015)
2. P. Parvatha Reddy (auth.)-Sustainable Crop Protection under Protected Cultivation-Springer Singapore (2016)
3. S.B. Anderson (ed.), Plant Breeding from Laboratories to Fields, InTech, 2013

4. Henry Leung, Subhas Chandra Mukhopadhyay (eds.) - Intelligent Environmental Sensing (2015, Springer International Publishing)
5. Travis R. Glare, Maria E. Moran-Diez - Microbial-Based Biopesticides_ Methods and Protocols (2016, Humana Press)
6. Altieri, Miguel A. Farrell, John G. Agroecology- The Science of Sustainable Agriculture, Second Edition-CRC Press (2018)
7. Arie Altman, Paul Michael Hasegawa-Plant Biotechnology and Agriculture_ Prospects for the 21st Century-Academic Press (2011)

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
TY Practical (AC)	4 experiments of 1.5 hrs duration	6 hrs	60 M (20 M each for 2 Experiments, 10 M each for 2 Experiments)	40 M (10 M for Journal, 10 M for Viva, 10 M for Identification, 10 M for overall performance)	100


 (Rashmi A. Bhave)
 The Chairperson, BoS