# University of Science & Technology, Meghalaya

**Department of Applied Biology**

Programme Outcomes (POs), Programme Specific Outcomes (PSOs) and

Course Outcomes (COs) | **B.Sc. Biotechnology**

Academic Session 2018-19

## Programme outcomes (POs):

Upon completion of the course, Students will be able to:

**PO1**. Understand themselves with basic and advanced knowledge in diverse areas of Biotechnology as the programme covers areas like Molecular Biology, Biochemistry, Microbiology, Immunology, Bioinformatics, Genetic Engineering, Plant and Animal Biotechnology etc.

**PO2**. Understand the potentials and impact of biotechnological innovations on industry, agriculture, environment and their implementation for finding a sustainable solution to the issues pertaining in these sectors.

**PO3**. Design, conduct experiments, analyse and interpret data for investigating problems in biotechnology and allied fields.

**PO4**. Learn advanced lessons in biological processes meant for industrial and other purposes, especially the genetic manipulation of microorganisms for obtaining products that can make human life a better one.

**PO5.** Equip themselves with basic and technical knowledge of biotechnology who can develop concept/product aiming at human welfare and environmental safety.

**PO6.** Modify or upgrade the conventional biological concepts to enhance the productivity of both plant and animal resources.

**PO7.** Undertake any responsibility as an individual and as a team in a multidisciplinary environment.

**PO8.** Develop thorough knowledge in Biotechnology and Allied Fields and will also be ready to engage themselves in lifelong learning.

**PO9.** Develop oral and written communication skills.

**PO10.** Anticipate a challenging and ever-changing career as per the need of industry.

**PO11.** Conduct an independent or collaborative research practice, to discuss results, formulate statements, and write reports.

**PO12**. Apply the knowledge of biotechnology in scientific methods and will be able to design projects for scientific experiments.

## Programme Specific Outcomes (PSOs):

**PSO1.** The objective of the Bachelor's Program in Biotechnology is to increase the understanding of Biological Sciences with the implementation of technology on different living systems like plants, animals and microbes.

**PSO2.** It provides the opportunity in the field of research and engineering sectors such as food technology, nutrition, medicines, health care, forensic sciences etc.

**PSO3.** It increases the understanding of the Cytological, Biochemical and Physiological aspects of living organisms as well as the different technical aspects required for their study.

**PSO4.** It helps in understanding the technical aspects related to the improvement of crop plants and live-stocks and thereby finding a solution to mitigate the problems arise due to population explosion.

**PSO5.** It helps in understanding the potential of biological agents of human interest which can be obtained in the form of product and how some of the microbes are industrially exploited for obtaining such products.

**PSO6.** Students will understand and demonstrate laboratory safety procedures, as well as bioethical standards. The graduate will be aware of the need to constantly improve the professional and personal competencies.

**SEMESTER-I**

## Course Structure:

| Course Code | Course Title | Course Code | Credit | Nature of the Course | Marks Allotted | | |
|---|---|---|---|---|---|---|---|
| | | | | | Internal | End Semester | Total |
| BBT 101 | Biochemistry and Metabolism | **C-1** | **4** | **T** | **30** | **70** | **100** |
| BBT 102 | Cell Biology | **C-2** | **4** | **T** | **30** | **70** | **100** |
| BBT 103 | Communicative English | **AECC-1** | **4** | **P** | **30** | **70** | **100** |
| BBT 104 | Biotechnology and Human Welfare | **GE-1** | **4** | **P** | **30** | **70** | **100** |
| BBT 105 | Practical on Biochemistry & Metabolism and Cell Biology | **P-1** | **4** | **P** | **30** | **70** | **100** |
| **Total** | | | **20** | **-** | **150** | **350** | **500** |

## Course outcomes (COs):

| COURSE CODE | NAME OF THE COURSE | COURSE OUTCOME(COs) |
|---|---|---|
| BBT-101 | Biochemistry and Metabolism | CO1. To understand the chemical basis of cellular life as well as the internal chemistry of biological systems of animals and plants. |
| | | CO2. To get foundational knowledge for higher concepts in the fields of research related to cell biology, molecular biology, genetics, material sciences, regenerative sciences, neuroscience, psychology, kinesiology, etc. |
| | | CO3. To understand the actual chemical concepts of biology through the functioning of various body processes and physiology using bio-molecules. |
| | | CO4. To understand the concept of enzymes, its kinetics and importance in metabolism and other physiological reactions inside the cell. |
| | | CO5. To understand the underlying concept of metabolism of carbohydrates and its importance in animal physiology. |
| BBT-102 | Cell Biology | CO1. To have the concept of cell theory; structural organization and functions of prokaryotic and eukaryotic cells as well as their comparative account. |
| | | CO2. To get an insight into the structural organization and functional roles of important cell organelles including plasma membrane, endoplasmic reticulum, golgi complex, lysosome, peroxisome, vacuoles and mitochondria. |
| | | CO3. To understand the structural organization and functional roles nucleus, the controlling centre of a cell. |
| | | CO4. To understand the structural organization and functional roles of cytoskeleton that gives specific shape and structure to a cell. |
| | | CO5. To get an insight into various stages of cell cycle that regulates proper organization in cellular organisms. |
| | | CO06. It also deals with the abnormalities during cell division process leading to cancer like problem. |
| BEN-711 | Communicative English | CO1. To enhance reading and writing abilities mainly focusing academic and day to day uses. |

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| | | CO2. To develop the idea of grammar usage (determiners, tenses, voice, direct and indirect speech, punctuation, word formation idioms and phrases) in developing communicating skills. |
| | | CO3. To get an insight into the format of official correspondence, Letter (formal and informal), Circular and Notice. |
| | | CO4. To develop the skill in writing Cvs/Resume, Essay, e-mail, Blog, Story and Paragraph which act as a source of communication at different platforms. |
| | | CO5. To develop the skill in writing comprehension and precis that enables the students to understand a particular passage and express opinions in their own language. |
| BBT-104 | Biotechnology and Human Welfare | CO1. To understand biotechnological application in deriving products from plant and animal sources as well as the challenges of extracting compounds in a Comprehensive Product Development Plan. |
| | | CO2. To get an insight in to the Biotechnological application in the field of agricultural including developing genetically modified organism (GMO) and transgenic plants. |
| | | CO3. To understand the biotechnological in understanding and protecting the environment mainly through the development of biodegradable polymer. |
| | | CO4. To get the basics of forensic science in solving crimes, paternity testing using DNA finger printing technique. |
| | | CO5. To explore the scope and role of Medical Biotechnology in healthcare industry such as multiple uses of antibodies and vaccines. |
| BBT-105 | Practical on Biochemistry and Metabolism, Cell Biology and Biotechnology and Human Welfare | CO1. To get the idea of preparing of biochemical solution of different strength including Stock Solution, PPM, Per cent, Normal, Molar and Millimolar solutions. |
| | | CO2. To get an insight into the biochemical methods for the estimation of carbohydrates, proteins and amino acids- both quantitatively and qualitatively. |
| | | It also helps students to develop the idea of separation of plant pigments and amino acids using chromatographic methods of TLC/ Paper chromatography. |
| | | CO3. To understand the different stages of cell division process of mitosis and meiosis– chromosome staining in root tip and flower bud. |

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| | | It also deals with the various other cellular processes like plasmolysis, dialysis etc. |
| | | CO4. To understand the mechanism of fermentation through the production of ethanol using Baker's yeast as a part of industrial application of microbes. |
| | | CO5. To learn the molecular methods of isolation and analysis of DNA from biological samples using agarose gel electrophoresis. |

## PO CO Correlation:

| Course Outcomes | Correlation with Programme Outcomes | | | | | | | | | | | | Correlation with Programme Specific Outcomes | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 10 | PO 12 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
| BBT101#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT101#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT101#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT101#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT101#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT102#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT102#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT102#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT102#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT102#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT104#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT104#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT104#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT104#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT104#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | |
| BBT105#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT105#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT105#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT105#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT105#CO5 | 3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 |

**SEMESTER-II**

## Course Structure:

| Paper Code | Title | Course Code | Credit | Nature | Marks Allotted | | |
|---|---|---|---|---|---|---|---|
| | | | | | Internal | End Semester | Total |
| BBT-201 | Mammalian Physiology | **C-3** | **4** | **T** | **30** | **70** | **100** |
| BBT-202 | Microbial and Plant Physiology | **C-4** | **4** | **T** | **30** | **70** | **100** |
| BBT-203 | Environmental Studies | **AECC-2** | **4** | **P** | **30** | **70** | **100** |
| BBT-204 | Developmental Biology | **GE-2** | **4** | **P** | **30** | **70** | **100** |
| BBT-205 | Practical on Mammalian Physiology and Microbial & Plant Physiology | **P-2** | **4** | **P** | **30** | **70** | **100** |
| **Total** | | | **20** | **-** | **150** | **350** | **500** |

## Course Outcomes (COs):

| COURSE CODE | NAME OF THE COURSE | COURSE OUTCOMES (COs) |
|---|---|---|
| BBT-201 | Mammalian Physiology | CO1. To understand the mechanism of digestion and respiration in human. |
| | | CO2. To understand the composition and circulation mechanism of blood and the working mechanism of heart in this process. |
| | | CO3. To understand the structure of muscles and their contraction and relaxation mechanism. It also gives an insight in to the underlying principle of osmoregulation and modes of excretion. |
| | | CO4. To understand the mechanism of nerve impulse and synaptic conduction associated with the process. |
| | | CO5. To get an insight in to different endocrine glands, their structure and function as well as the types of hormones released by such glands that control various biological activities in human. |

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| BBT-202 | Microbial and Plant Physiology | CO1. To explore the different groups of microbes like chemolithotrophs, hydrogen oxidizers, methanogens etc. based on their environmental adoptation. |
| | | CO2. To understand the different groups of microbes based on their nutritional requirement and mode of nutrition. |
| | | CO3. To understand the stages of photosynthesis mechanism like dark and light reactions in plants and microbes. |
| | | CO4. The course deals with the study of different metabolic processes in plants and microbial growth and development. |
| | | CO5. The principle and mechanism of Nitrogen metabolism and fixation is dealt in this course. Along with this different phytohormones and their functions, and mechanism photoperiodism and also explained. |
| BEV-720 | Environmental Studies | CO1. To get an insight in to the multidisciplinary nature of environmental studies and its importance in other branches of sciences mainly to create public awareness regarding environment. It highlights the natural resources and associated problems in terms of non-renewable sources describing the role of an individual in conservation of natural resources. |
| | | CO2. To have the concept of an ecosystem, it's structure and function with special emphasis on energy flow and ecological succession process. |
| | | CO3. To have an idea about the concept of biodiversity at global, national and local levels; threats to biodiversity and conservation strategies. |
| | | CO4. To get an insight in to the burning issue of environmental pollution describing the concept of pollutants, cause, effects and control measures of air, water, soil, noise, thermal and nuclear pollution. |
| | | CO5. To understand the social issues related to the environment describing human role in biodiversity destruction and its conservation as well as the ethical and legal (Environment Protection Acts) issues related to the environment. |
| BBT-204 | Developmental Biology | CO1.To understand the basics of the process by which the living organisms grow and develop from a single cell. |

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| | | CO2.To acquaint on how continuity of life is maintained from one generation to another which involves genetic control of cell growth and development leading to cell differentiation and morphogenesis. |
| | | CO3. To understand the technical aspects related to artificial insemination and in vitro fertilization. |
| | | CO4. To get an insight in to the process of crop development using breeding approaches that can contribute to the efforts of achieving sustainable food security in times of over population. |
| | | CO5. To have the concept of embryology that can be helpful in early diagnosis and treating diseases at embryonic level. |
| BBT-205 | Practical on Mammalian Physiology and Microbial & Plant Physiology | CO1. To understand the principle and mechanism of blood group determination following slide agglutination. |
| | | CO2. To develop the concept related to estimating RBC count in mammalian blood as well as the normal level of haemoglobin which is a part of common diagnostic system. |
| | | CO3. To learn the principle and procedure of separating photosynthetic pigments by paper chromatography method. |
| | | CO4. To understand the mechanism of symbiosis between rhizobacteria and leguminous plant with the help of root nodules. |
| | | CO5. To study the different phases of growth in microbes as well as the effect of physical factors like pH and temperature on their growth. |

## PO CO Correlation:

| Course Outcomes | Correlation with Programme Outcomes | | | | | | | | | | | | Correlation with Programme Specific Outcomes | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO10** | **PO12** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| BBT201#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT201#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT201#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT201#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT201#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT202#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT202#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT202#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT202#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT202#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT205#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT205#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT205#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT205#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT205#CO5 | 3 | 1 | 0 | 2 | 3 | 1 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |

**SEMESTER-III**

## Course Structure:

| Paper Code | Title | Course Code | Credit | Nature | Marks Allotted | | |
|---|---|---|---|---|---|---|---|
| | | | | | Internal | End Semester | Total |
| BBT-301 | Genetics | **C-5** | **4** | **T** | **30** | **70** | **100** |
| BBT-302 | General Microbiology | **C-6** | **4** | **T** | **30** | **70** | **100** |
| BBT-303 | Chemistry-1 | **C-7** | **4** | **P** | **30** | **70** | **100** |
| BBT-304 | Molecular Diagnostics | **SEC-1** | **4** | **P** | **30** | **70** | **100** |
| BBT-305 | Bioethics and Biosafety | **GE-3** | **4** | **P** | **30** | **70** | **100** |
| BBT-306 | Practical on Genetics, General Microbiology and Chemistry-1 | **P-3** | **4** | **P** | **30** | **70** | **100** |
| **Total** | | | **20** | **-** | **150** | **350** | **500** |

## Course Outcomes (COs):

| COURSE CODE | NAME OF THE COURSE | COURSE OUTCOMES (COs) |
|---|---|---|
| BBT-301 | Genetics | CO1. To understand the concept of gene (basic unit of genetic character) and the basic principle of genetics (inheritance of characters) as well as the concept of how mutation in gene can alter characters in an individual. |
| | | CO2. To familiarize with concept of inheritance of characters from parental line to the offspring following both Mendelian and non-Mendelian pattern. |
| | | CO3. To explore the multifactorial pattern of inheritance including the concept of chromosome structure and variation in chromatin organization. |
| | | CO4. To develop the concepts of linkage, sex determination and sex linked inheritance that helps to understand the different sex influenced diseases in man and their pattern of inheritance. |
| | | CO5. To understand the phenomenon of organellar inheritance, genome evolution and mutation and their influence in hereditary diseases. |
| BBT-302 | General Microbiology | CO1. To explore the fascinating world of microorganism and their role (both beneficial and harmful) in day to day life. |

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| | | It imparts knowledge on the various phases and contribution of different Scientists how Microbiology established itself as a separate branch of Science. |
| | | CO2. To understand the different categories of microbes and sub-microbial groups with their position in the tree of life (classification), their characteristic features and importance. |
| | | CO3. To become familiarize with the different technical aspects [isolation, cultivation, observation (microscopy), and identification] of studying microbes. |
| | | CO4. To get an insight on the existence of microbes in different spheres of the environment and how the microbes are affected/induced in these environments or *vice versa*. |
| | | CO5. To get the basic idea about the industrial application of different microbes for the production of single cell protein, beverages, industrial enzymes and genetically modified (GM) foods. |
| BBT-303 | Chemistry-1 | CO1. To understand the concept of Stereochemistry with the help of Fischer, Newmann and Sawhorse projection and Wedge formulae. |
| | | CO2. To acquaint with various conformations of ethane, butane, ethane-1,2-diol and cyclohexane with reference to relative stability of different conformations in terms of energy difference. |
| | | CO3. To understand the mechanism of addition reactions with the help of hydrogenation, hydrohalogenation, hydroxylation and ozonolysis in alkenes, alkynes, aldehydes and ketones. It also help in understanding the mechanism of substitution and elimination reactions among organic compounds. |
| | | CO4. To understand the mechanism of oxidation reactions occurring in aromatic side chain compounds, alcohols, aldehydes and ketones and the rules governing such mechanisms. |
| | | CO5. To understand the mechanism of catalytic hydrogenation, electrolytic and other reduction reactions occurring in aldeydes, ketones, carboxylic acids and their derivatives and nitro compounds. |
| BBT-304 | Molecular Diagnostics | CO1. To explore the various immunoassays techniques for molecular level diagnosis of diseases and disorders. |
| | | CO2. To understand the different molecular approach for proper diagnosis of different diseases in man. |

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| | | CO3. To understand the resistance mechanisms developed in different microbes against chemotherapeutic agents and their resistance profile. |
| | | CO4. To develop the concept on antimicrobial susceptibility testing methods and to check the antibiotic susceptibility profile of pathogenic microbes. |
| | | CO5. To have the concept on application of latest automated instruments for proper identification of pathogenic microbes. |
| BBT-305 | Bioethics and Biosafety | CO1. To understand the fundamentals of bioethics and ethical issues related to molecular technologies. |
| | | CO2. To have the concept on the ethical issues concerned with clinical trials, medical errors, negligence etc. |
| | | CO3. To understand the safety issues and ethical use of animals in the laboratory. |
| | | CO4. To get an insight into the good laboratory practices in different biological laboratories. |
| | | CO5. To get an insight in to the guidelines and precautions on using radioisotopes in laboratory practices. |
| BBT-306 | Practical on Genetics, General Microbiology and Chemistry-1 | CO1. To understand the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory. Students also learn the basics of preparing common microbial media used for isolation and maintenance of microbial isolates. |
| | | CO2. To get an insight into the laboratory techniques for the isolation and enumeration of microorganisms from different environmental spheres like soil, water and air. |
| | | Students also learn the basics of isolating bacteria in pure cultures by streaking method and determination of bacterial growth curve. |
| | | CO3. To understand the basis of Mendelian principle of inheritance as well as the stages of division in vegetative and reproductive cells. |
| | | CO4. To determine purity of organic compounds by crystallization using polar and non-polar solvents and estimating their optical activity by using polarimeter |
| | | CO5. To learn the use of Kjeldahl apparatus for estimating the melting points of organic compounds. |

## PO CO Correlation:

| Course Outcomes | Correlation with Programme Outcomes | | | | | | | | | | | | Correlation with Programme Specific Outcomes | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO10 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BBT301#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT301#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT301#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT301#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT301#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT302#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT302#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT302#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT302#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT302#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT303#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT303#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT303#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT303#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT303#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT304#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT304#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT304#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT304#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT304#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT305#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT305#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT305#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT305#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT305#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT306#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT306#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |

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| BBT306#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT306#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT306#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |

**SEMESTER-IV**

## Course Structure:

| Paper Code | Title | Course Code | Credit | Nature | Marks Allotted | | |
|---|---|---|---|---|---|---|---|
| | | | | | Internal | End Semester | Total |
| BBT-401 | Molecular Biology | **C-8** | **4** | **T** | **30** | **70** | **100** |
| BBT-402 | Immunology | **C-9** | **4** | **T** | **30** | **70** | **100** |
| BBT-403 | Chemistry-2 | **C-10** | **4** | **P** | **30** | **70** | **100** |
| BBT-404 | Enzymology | **SEC-2** | **4** | **P** | **30** | **70** | **100** |
| BBT-405 | Entrepreneurship Development and IPR | **GE-4** | **4** | **P** | **30** | **70** | **100** |
| BBT-406 | Practical on Molecular Biology, Immunology, Enzymology and Chemistry-2 | **P-4** | **4** | **P** | **30** | **70** | **100** |
| **Total** | | | **P-3** | **-** | **150** | **350** | **500** |

## Course Outcomes (COs):

| COURSE CODE | NAME OF THE COURSE | COURSE OUTCOMES (COs) |
|---|---|---|
| BBT-401 | Molecular Biology | CO1. To get an insight in to the molecular basis of biological activity between biomolecules in the various systems of a cell. |
| | | CO2. To have the basics of DNA, RNA, and proteins; their structure and interactions within the cell to promote growth, division and development. |
| | | CO3. To understand the different mechanism DNA replication adopted in prokaryotic and eukaryotic system. |
| | | It also highlights the factors inducing and inhibiting replication. |
| | | CO4. To get an insight in to the wide range of mechanisms required for the regulation of transcription, translation and expression of gene in prokaryotic and eukaryotic system. |

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| | | CO5. To understand the responses to environmental or physiological changes or alterations of cell function brought about by mutation. It also highlights the molecular basis for cancer and other related abnormalities and the molecular tools and techniques to study such abnormalities. |
| BBT-402 | Immunology | CO1. To familiarize with the concept of non-specific (innate) and specific (acquired) resistance mechanism developed in man against pathogens and other non-self-factors which is the basis of this course. |
| | | CO2. To get an insight into the formation, types, organization and functional specificity of different cellular and organ level components conferring resistance in man. |
| | | CO3.To familiarize with the nature, types and function of antigens that induce immunological response in man and how the product of this response (antibody, B and T cells) help in neutralizing them (agglutination and precipitation reactions). |
| | | It also deals with the different diagnostic and serological approaches for the study of interaction between an antigen and its specific antibody including Widal Test, immunodiffusion, Immuno-electrophoresis, ELISA, RIA etc. |
| | | CO4. To have the concept of different mediators/cell signaling molecules (complement, cytokines: interferons, Interleukins, heamatopoetins and chemokines) associated with immunological responses as well as their biological consequences. |
| | | CO5. To understand the immune disorders (hypersensitivity, autoimmune disorders, oncogenesis etc.) and induced immunity (vaccination) to overcome such abnormalities. |
| BBT-403 | Chemistry-2 | CO1. To understand the structure of molecule following valence bond approach as well as the concept of resonance in various organic and inorganic compounds. It also gives an idea VSEPR model for predicting shapes of molecules and ions containing lone pairs, sigma and pi bonds. |
| | | CO2. To get an idea on various intermolecular forces like van der Waals forces, Hydrogen bonding and their effects on melting point, boiling point and solubility of compounds. |
| | | CO3. To have the concept on transition elements specifically their electronic configuration, variable valency, color, magnetic and |

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| | | catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for with special reference to Mn, Fe and Cu. |
| | | CO4. To understand the concept of Valence Bond Theory with reference to inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu; their structural and stereoisomerism with coordination numbers 4 and 6. |
| | | CO5. To understand the concept of Crystal Field Theory with reference to crystal field effect for weak and strong fields and crystal field stabilization energy. |
| BBT-404 | Enzymology | CO1. To have the concept of different terminologies in understanding enzymes as well as their historical perspective. |
| | | CO2. To familiarize with basics of enzymes, their kinetics, inhibition and their applications in various fields. |
| | | CO3. The course provides the basic understanding of enzyme classification, nomenclature and synthesis. |
| | | CO4. The course highlights the concepts of Enzyme kinetics and mechanism of inhibition, units and underlying principle of measurement of enzyme activity. |
| | | CO5. The students can earn the knowledge of different applications of enzymes in various industry and medical field. |
| BBT-405 | Entrepreneurship Development and IPR | CO1. To have the basic concepts on entrepreneurship that can guide the students for becoming a good entrepreneur as they are ushered to know market, excise and other development processes. |
| | | CO2. To understand of importance of market concept in entrepreneurship. |
| | | CO3. To have knowledge on Intellectual Property in protecting one's idea, concept or a product. |
| | | CO4. To have an understanding on Patent, Geographical indication, Copyright, Trademark, and Trade secret to become aware of protecting innovations and noble work. |
| | | CO5. To gain knowledge on Indian Patent Law, World Trade Organization and its related Intellectual Property provisions. |
| BBT-406 | Practical on Mol. Biology, Immunology, | CO1. To learn the molecular methods of isolation of DNA/RNA from plant animal and microbial sources and their quantification using UV-VIS spectrophotometric analysis. It also helps in learning the method |

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| | Chemistry-2 and Enzymology | of separating of DNA bands by agarose gel electrophoresis on the basis of their molecular weight. |
| | | CO2. To understand the principle and process of blood group determination following slide agglutination test, blood cell count following blood film preparation and immune-diagnostic methods like Radial immunoassay and ELISA. |
| | | CO3. To understand the process of preparations of standard solutions using the concept of primary and secondary standards as well as different units of concentration like molarity, molality, and normality. |
| | | CO4. To familiarize with the process of titrimetric analysis involving Acids-Bases, Redox reactions and Complexometric Titrations. |
| | | CO5. To learn the laboratory method of Isolation and purification of an extracellular enzyme and etermination of Km and Vmax value for that enzyme. |

## PO CO Correlation:

| Course Outcomes | Correlation with Programme Outcomes | | | | | | | | | | | | Correlation with Programme Specific Outcomes | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 10 | PO 12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BBT401#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT401#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT401#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT401#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT401#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT402#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT402#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT402#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT402#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT402#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT403#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT403#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BBT403#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT403#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT403#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT404#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT404#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT404#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT404#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT404#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT405#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT405#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT405#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT405#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT405#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT406#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT406#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT406#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT406#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT406#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |

**SEMESTER-V**

## Course Structure:

| Paper Code | Title | Course Code | Credit | Nature | Marks Allotted | | |
|---|---|---|---|---|---|---|---|
| | | | | | Internal | End Semester | Total |
| BBT-501 | Industrial Fermentations | **C-11** | **4** | **T** | **30** | **70** | **100** |
| BBT-502 | Recombinant DNA Technology | **C-12** | **4** | **T** | **30** | **70** | **100** |
| BBT-503 | Plant Biotechnology | **DSE-1** | **4** | **P** | **30** | **70** | **100** |
| BBT-504 | Bioinformatics and Biostatistics | **DSE-2** | **4** | **P** | **30** | **70** | **100** |
| BBT-505 | Practical on Industrial Fermentations, Recombinant DNA Technology, Bioinformatics and Chemistry 3 | **P-5** | **4** | **P** | **30** | **70** | **100** |
| **Total** | | | **P-4** | **-** | **150** | **350** | **500** |

## Course Outcomes (COs):

| COURSE CODE | NAME OF THE COURSE | COURSE OUTCOMES (COs) |
|---|---|---|
| BBT-501 | Industrial Fermentations | CO1. To have a comparative account on old and recent techniques for screening industrially important microorganisms. |
| | | CO2. To understand the principle and types of bioreactor and their industrial application. |
| | | CO3. To explore the different production approaches for industrial products like organic acid, alcohol, enzymes, single cell protein etc. |
| | | CO4. To understand the principles of food preservation using fermentation processes. Students get acquainted to different kinds of Bioreactors and fermenters used for the purpose. |
| | | CO5. To develop the concept for genetic improvement of industrially useful microbes as well as the process and role of enzyme immobilization in food industries. |
| BBT-502 | Recombinant DNA Technology | CO1. To have the basic concept of rDNA technology as the basis of genetic modification of cellular organisms. |

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| | | CO2. To understand the types, nature and functions of restriction enzymes that act as the mediators of DNA modification during genetic manipulation process. |
| | | It also gives an insight into the concept of different vectors (plasmids, cosmids, phagemids, and artificial chromosome vectors) that act as carrier of DNA fragment between cellular organisms during genetic modification. |
| | | CO3. To understand the methods in molecular cloning process for transformation and delivery of gene with special emphasis on different blotting techniques (Southern, Northern and Western) in hybridization process. |
| | | CO4. To get an insight in to one of the most versatile molecular technique of Polymerized Chain Reaction (PCR); principle, types, applications and different PCR based and PCR independent marker (RAPD, RFLP, AFLP) methods in Molecular Biology. |
| | | It also describes the construction and screening genomic and cDNA libraries. |
| | | CO5. To understand the application of rDNA technology for the production of human therapeutic agents (insulin, HGH, recombinant vaccines) and transgenic crops. |
| BBT-503 | Plant Biotechnology | CO1. To familiarize with the techniques of plant tissue culture, mechanisms of gene transfer and various molecular markers. |
| | | CO2. To deals with different media preparation methods and study the role of micro- and macronutrients, hormones, vitamins, etc. in plant tissue culture. |
| | | CO3. To have the basic understanding of plant tissue culture and its maintenance, callus culture and suspension culture. |
| | | CO4. To understand the various vectorless and vector mediated gene transfer methods in plants improvement. |
| | | CO5. To learn the principle and use of molecular markers, and their applications in Plant Biotechnology as well as to get the insight in to the concept of somaclonal variation, callus cultur, totpotency, hybrid and cybrids. |
| BBT-504 | Bioinformatics and Biostatistics | CO1. To understand the contents and properties of bioinformatics databases; perform text- and sequence-based searches, and analyze and discuss the results in light of molecular biological knowledge. |

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| | | CO2. To learn about the major steps in pair wise and multiple sequence alignment, and execute pair wise sequence alignment by dynamic programming. |
| | | CO3. To learn the techniques of predicting the secondary and tertiary structures of protein sequences. |
| | | CO4. To become familiar with the use of a wide variety of internet applications, biological database that can be applied in solving research problems. |
| | | CO5. To understand the theoretical and practical development of useful tools for automation of complex computer jobs, and making these tools accessible on the network from a Web browser. |
| BBT-505 | Practical on Industrial Fermentation, Recombinant DNA Technology, Plant Biotechnology and Bioinformatics & Biostatistics | CO1. To understand the design and working principle of a fermenter and its use in the industrial production of solvent, enzymes etc.) |
| | | CO2. To acquaint with methods for the isolation of chromosomal DNA from plant and microbial cells, their qualitative and quantitative analysis as well as to become familiar with the technical process of PCR. |
| | | CO3. To learn the preparation of medium used in plant tissue culture and carry out the process like micropropagation and artificial seed preparation. |
| | | CO4. To learn the methods of statistical analysis (like t, f, z and Chi-square test) of different paired and unpaired data |
| | | CO5. To understand the practical aspects of Bioinformatics including<br>a. operating systems like UNIX, LINUX and Windows;<br>b. bioinformatics databases systems like NCBI/ PDB/ DDBJ, Uniprot, PDB;<br>c. sequence retrieval using BLAST and sequence alignment & phylogenetic analysis using clustalW & phylip;<br>d. protein structure prediction using psipred, homology modeling using Swissmodel, and molecular visualization using jmol. |

## PO CO Correlation:

| Course Outcomes | Correlation with Programme Outcomes | | | | | | | | | | | | Correlation with Programme Specific Outcomes | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO10 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BBT501#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT501#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT501#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT501#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT501#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT502#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT502#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT502#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT502#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT502#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT503#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT503#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT503#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT503#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT503#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT504#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT504#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT504#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT504#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT504#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT505#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT505#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT505#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT505#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT505#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |

**SEMESTER-VI**

## Course Structure:

| Paper Code | Title | Course Code | Credit | Nature | Marks Allotted | | |
|---|---|---|---|---|---|---|---|
| | | | | | Internal | End Semester | Total |
| BBT-601 | Bio Analytical Tools | **C-13** | **4** | **T** | **30** | **70** | **100** |
| BBT-602 | Genomics and Proteomics | **C-14** | **4** | **T** | **30** | **70** | **100** |
| BBT-603 | Environmental Biotechnology | **DSE-3** | **4** | **P** | **30** | **70** | **100** |
| BBT-604 | Animal Biotechnology | **DSE-4** | **4** | **P** | **30** | **70** | **100** |
| BBT-605 | Practical on Bio Analytical Tools, Environmental Biotechnology and Plant Biotechnology | **P-6** | **4** | **P** | **30** | **70** | **100** |
| **Total** | | | **20** | **-** | **150** | **350** | **500** |

## Course Outcomes (COs):

| COURSE CODE | NAME OF THE COURSE | COURSE OUTCOMES (COs) |
|---|---|---|
| BBT-601 | Bio Analytical Tools | CO1. To familiarize with the important techniques necessary for the study and prediction of different processes occurring in microbes and other cellular organisms. |
| | | CO2. To understand the importance, principle and types of chromatography techniques and their role in the study of biological system. |
| | | CO3. To develop the concept on principle and types of electrophoretic techniques and their role in the study of biological system. |
| | | CO4. To get an insight in to the principle and types of centrifugation techniques and their role in the study of biological system. It also gives the concept of radioactivity and its application in biochemical and immunological processes. |
| | | CO5. To familiarize with a*dvanced techniques* -Protein Crystallization, MALDI-TOF, Mass Spectrometry, Enzyme and Cell Immobilization which are extensively used in Industrial and R & D sectors. |
| BBT-602 | | CO1. To have the basic concept of Genomics and proteomics. |

| | | |
|---|---|---|
| | Genomics and Proteomics | CO2. To learn different DNA sequencing methods used in sequencing of genome like manual & automated: Maxam & Gilbert and Sangers method. |
| | | CO3. To understand the process of Managing and Distributing Genome Data such as Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. |
| | | CO4. To develop the knowledge of protein structure, function and different methods of analizing proteins using molecular tools and techniques. |
| | | CO5. To get the basics of analytical Proteomics and its application. |
| BBT-603 | Environmental Biotechnology | CO1. To understand the environment around us and the organisms living in normal and extreme conditions of the environment. |
| | | CO2. To learn the utilization of the unique properties microorganisms living in the extreme habitats to remediate degraded environment: such as solid and liquid waste management. |
| | | CO3. To have the concept of bioremediation with special reference to the remediation of heavy metals and oil spills. |
| | | CO4. To get the information on the ethical and safety issues concerned with Biotechnological experiments. |
| | | CO5. To know about intellectual property right (IPR), in protecting one's innovations and unique works. |
| BBT-604 | Animal Biotechnology | CO1. To familiarize with the techniques of animal cell culture, mechanisms of gene transfer and various molecular marker assisted methods in improvement of live-stocks. |
| | | CO2. To have knowledge on different cell culture media and their preparation methods. |
| | | CO3. To explore the biomedical research involving tissue engineering that aims to grow and replace tissue *in-vitro* using stem cell technology. |
| | | CO4. To understand the various vectorless and vector mediated gene transfer methods used in animal cell cloning. |
| | | CO5. To get the basics of artificial insemination and embryo transfer techniques for the improvement of live-stocks. This practical course gives the idea of analytical methods used in biological laboratories, application such methods in solving issues related to the environment |

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| | | as well as the approaches for improving live-stock using technology. After successful completion, this course enables students |
| BBT-605 | Practical on Bio-Analytical Tools, Genomics and Proteomics, Environmental and Animal Biotechnology | CO1. To learn the method of protein analysis under reducing conditions using SDS-polyacrylamide slab gel electrophoresis. |
| | | It also helps in understanding the principle and application of chromatography methods for the identification of amino acids and lipids. |
| | | CO2. To acquaint with the use of SNP databases at NCBI and other sites and OMIM database for the genomics level study. |
| | | CO3. To understand the quality/potability of water through bacteriological analysis of water samples. |
| | | It also deals with the laboratory methods for the estimation of Dissolved Oxygen (DO), Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD) through which the condition of a water body can be determined. |
| | | CO4. To learn the laboratory conditions and the concept of minimal essential growth medium required during animal cell culture. |
| | | CO5. To learn the molecular method for the isolation and quantification of DNA from animal tissue using Agarose Gel Electrophoresis. |
| HVP-760 | Fundamentals of Human Values and Professional Ethics | CO1. To introduce the students about the importance of human values and professional ethics. |
| | | CO2. To understand the ethical concerns in professional and personal space. |

## PO CO Correlation:

| Course Outcomes | Correlation with Programme Outcomes | | | | | | | | | | | | Correlation with Programme Specific Outcomes | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 10** | **PO 12** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| BBT601#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT601#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT601#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT601#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT601#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT602#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT602#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT602#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT602#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT602#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT603#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT603#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT603#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT603#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT603#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT604#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT604#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT604#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT604#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT604#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT605#CO1 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT605#CO2 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT605#CO3 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT605#CO4 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| BBT605#CO5 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 0 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |