**Course Outcomes**

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| **2015 Scheme** | **2017 Scheme** | **2018 Scheme** |
| **15MAT31-Engineering Mathematics-III** | **17MAT31-Engineering Mathematics-III** | **18BT41-Biostatics-(AE)**  CO1:Application of data distribution in biotechnology problems, concepts about histogram, frequency curve  CO2:Describe the abilities of central tendency and importance of statistics in biology  CO3: Applying the concepts of design of experiments by statistical method of analysis  CO4:Illustrste the concept relating to discrete, continuous statistical concepts relating to binominal distribution, Normal distribution and regression analysis  CO5: Study the importance of concepts of t-test, F-test, Chi-square test, ANOVA, factorial design and cluster design |
| **15BT32-Unit Operations-(KMV)**  CO1: Describe the rheological behavior of fluids  CO2: Examine the principle of flow measuring instruments and analyze the application of Bernoulli equation  CO3: Apply the principles of various mechanical operations like size reduction, sedimentation, filtration and mixing.  CO4: Analyze the heat governing laws and explain the about heat transfer equipments  CO5: Evaluation of various mass transfer operations | **17BT32-Unit Operations-(KMV)**  CO1: Describe the rheological behavior of fluids  CO2: Examine the principle of flow measuring instruments and analyze the application of Bernoulli equation  CO3: Apply the principles of various mechanical operations like size reduction, sedimentation, filtration and mixing.  CO4: Analyze the heat governing laws and explain the about heat transfer equipments  CO5: Evaluation of various mass transfer operations | **18BT32-Microbiology-(HPP)**  CO1: Able to learn the classification, structural features and functional aspects of prokaryotic and eukaryotic organism  CO2: Understanding of microbial techniques for isolation, growth and characterization of microbes  CO3: Analyse different types of growth patterns, metabolites and metabolic pathways  CO4: Outline the role of microorganisms towards environmental protection, industrial applications and infectious diseases. |
| **15BT33-Biochemistry-(SG)**  CO1: Explain the basic types of chemical reactions and biomolecules  CO2: Analyze high energy molecules and Photosynthesis reactions  CO3: Illustrate about transport mechanism across the cell membrane and analyze its regulation  CO4: Understand the basic metabolic pathways of CHO, Lipids, amino acid and nucleic acids and analyze their regulations | **17BT33-Biochemistry-(VM)**  CO1: Explain the basic types of chemical reactions and biomolecules  CO2: Analyze high energy molecules and Photosynthesis reactions  CO3: Illustrate about transport mechanism across the cell membrane and analyze its regulation  CO4: Understand the basic metabolic pathways of CHO, Lipids, amino acid and nucleic acids and analyze their regulations | **18BT33-Unit Operation-(KMV)**  CO1: Describe the rheological behavior of fluids  CO2: Examine the principle of flow measuring instruments and analyze the application of Bernoulli equation  CO3: Apply the principles of various mechanical operations like size reduction, sedimentation, filtration and mixing.  CO4: Analyze the heat governing laws and explain the about heat transfer equipments  CO5: Evaluation of various mass transfer operations |
| **15BT34-Microbiology-(RKC)**  CO1: Able to learn the classification, structural features and functional aspects of prokaryotic and eukaryotic organism  CO2: Understanding of microbial techniques for isolation, growth and characterization of microbes  CO3: Analyse different types of growth patterns, metabolites and metabolic pathways  CO4: Outline the role of microorganisms towards environmental protection, industrial applications and infectious diseases.  CO5: Describe the biogeochemical cycles and microbial pollutants present in water soil and air | **17BT34-Microbiology-(BBM)**  CO1: Able to learn the classification, structural features and functional aspects of prokaryotic and eukaryotic organism  CO2: Understanding of microbial techniques for isolation, growth and characterization of microbes  CO3: Analyse different types of growth patterns, metabolites and metabolic pathways  CO4: Outline the role of microorganisms towards environmental protection, industrial applications and infectious diseases.  CO5: Describe the biogeochemical cycles and microbial pollutants present in water soil and air | **18BT34-Introduction to Biomolecules**    CO1: Explain the foundational principles of biomolecules’ structure and their function  CO2: Analyze high energy molecules and Photosynthesis reactions  CO3: Illustrate about transport mechanism across the cell membrane and analyze its regulation |
| **15BT35-Cell biology & Genetics (SC)**  CO1: Generalizing a on contemporary knowledge of cytoskeletal architecture  CO2: Describe cell structure and function  CO3: Understand and analyze the principles and concept of genetics and population genetics  CO4: Appraise inherited disorders on the basis of heredity | **17BT35-Cell biology & Genetics (SC)**  CO1: Generalizing a on contemporary knowledge of cytoskeletal architecture  CO2: Describe cell structure and function  CO3: Understand and analyze the principles and concept of genetics and population genetics  CO4: Appraise inherited disorders on the basis of heredity | **18BT35-Cell biology & Genetics (SC)**  CO1: Generalizing a on contemporary knowledge of cytoskeletal architecture  CO2: Describe cell structure and function  CO3: Understand and analyze the principles and concept of genetics and population genetics  CO4: Appraise inherited disorders on the basis of heredity |
| **15BT36-Basics of computer application**  CO1: Understand C- language with updated tool  CO2: Apply the basic concepts of MATLAB, Internet.  CO3:Use the software with special reference to biotechnological applications | **17BT36-Basics of computer application**  CO1: Understand C- language with updated tool  CO2: Apply the basic concepts of MATLAB, Internet.  CO3:Use the software with special reference to biotechnological applications | **18BT36-Phyton Programming**  CO1: Develop algorithmic solutions to simple computational problems  CO2: Read, write, execute by hand simple Python programs.  CO3: Structure simple Python programs for solving problems.  CO4: Decompose a Python program into functions. |
| **15BTL37-Unit Operation Laboratory**  CO1. Experiments on the basic principles of fluid mechanics and to analyze the flow measurement instruments  CO2. Illustrate the fluid flow problems with the application of momentum and energy equations  CO3. Examine the principles of sedimentation, filtration and mass transfer operations through experimental studies | **17BTL37-Unit Operation Laboratory**  CO1. Experiments on the basic principles of fluid mechanics and to analyze the flow measurement instruments  CO2. Illustrate the fluid flow problems with the application of momentum and energy equations  CO3. Examine the principles of sedimentation, filtration and mass transfer operations through experimental studies | **18BTL37-Microbiological Lab**  CO1. Use different laboratory equipment and instruments for microbiological operations  CO2. Prepare the media and use for the cultivation of the microbes  CO3. Perform laboratory experiments for the isolation, identification and characterization of microorganisms  CO4. Determination and evaluation of microbial load and its control |
| **15BTL38-Microbiological Lab**  CO1. Use different laboratory equipment and instruments for microbiological operations  CO2. Prepare the media and use for the cultivation of the microbes  CO3. Perform laboratory experiments for the isolation, identification and characterization of microorganisms  CO4. Determination and evaluation of microbial load and its control | **17BTL38-Microbiological Lab**  CO1. Use different laboratory equipment and instruments for microbiological operations  CO2. Prepare the media and use for the cultivation of the microbes  CO3. Perform laboratory experiments for the isolation, identification and characterization of microorganisms  CO4. Determination and evaluation of microbial load and its control | **18BTL38-Unit Operation Laboratory**  CO1. Experiments on the basic principles of fluid mechanics and to analyze the flow measurement instruments  CO2. Illustrate the fluid flow problems with the application of momentum and energy equations  CO3. Examine the principles of sedimentation, filtration and mass transfer operations through experimental studies |
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| **15BT41-Biostatistics & Bio modeling-(AHV)**  CO1: Apply the concepts of data distribution in Biotechnology problems-histogram, frequency curve etc.  CO2: Describe about the utilities of statistics and probability to the biological data, suitable curve fitting by other methods.  CO3: Apply the concepts relating to regression correlation, test of hypothesis for t-test and z-test  CO4: Appreciate the concepts of probability, random variables and its distributions  CO5: Perform modeling and simulations experiments for select biological processes using appropriate data | **17BT41-Biostatistics & Bio modeling-(AHV)**  CO1: Apply the concepts of data distribution in Biotechnology problems-histogram, frequency curve etc.  CO2: Describe about the utilities of statistics and probability to the biological data, suitable curve fitting by other methods.  CO3: Apply the concepts relating to regression correlation, test of hypothesis for t-test and z-test  CO4: Appreciate the concepts of probability, random variables and its distributions  CO5: Perform modeling and simulations experiments for select biological processes using appropriate data | **18BT41-Stoichiometry-(KMV)**  CO1: Practice and compute the material balance of three different phases such as solid, liquid and gas  CO2: Illustrate material balance without chemical reaction in various unit operations  CO3: Analyze the material balance involving in chemical reaction  CO4: Calculate the energy balance and heat capacity for different phases and mixtures  CO5: Infer the stoichiometry principles in bioprocess technology |
| **15BT42-Biochemical Thermodynamics**  **(KVM)**  CO1: State & describe the concepts of system, surrounding, process, laws of thermodynamics and entropy.  CO2: Explain the PVT behavior of fluids & gases, equations of state for real gases and heat effects accompanying chemical reactions  CO3. Explain the different thermodynamic properties ,their relations and thermodynamic diagrams  CO4. Determine the partial molar properties & explain criteria of phase, biochemical reaction equilibrium and equilibrium conversion | **17BT42-Biochemical Thermodynamics**  **(AHV)**  **CO1**: Discuss the basic concepts of thermodynamics in process industries  **CO2:** Explain the PVT Behavior and compressibility charts  **CO3:**Illustrate thethermodynamic properties of pure fluids  **CO4:** Compute the properties of solutions and phase equilibria  CO5: Employ the knowledge ofbiochemical energetics – to determine the characteristics of energy rich compounds | **18BT42-Molecular Biology**  **(SC)**  CO1: Explain replication in prokaryotes and Eukaryotes  CO2: Distinguish transcription process in prokaryotes and Eukaryotes  CO3: Illustrate the process of translation in prokaryotes and Eukaryotes  CO4: Analyze gene regulation in prokaryotes and Eukaryotes  CO5: Elaborate significance of genetic recombination and gene mapping in prokaryotes and Eukaryotes |
| **15BT43-Molecular Biology**  **(RKC)**  CO1: Explain replication in prokaryotes and Eukaryotes  CO2: Distinguish transcription process in prokaryotes and Eukaryotes  CO3: Illustrate the process of translation in prokaryotes and Eukaryotes  CO4: Analyze gene regulation in prokaryotes and Eukaryotes  CO5: Elaborate significance of genetic recombination and gene mapping in prokaryotes and Eukaryotes | **17BT43-Molecular Biology (CS)**  CO1: Explain replication in prokaryotes and Eukaryotes  CO2: Distinguish transcription process in prokaryotes and Eukaryotes  CO3: Illustrate the process of translation in prokaryotes and Eukaryotes  CO4: Analyze gene regulation in prokaryotes and Eukaryotes  CO5: Elaborate significance of genetic recombination and gene mapping in prokaryotes and Eukaryotes | **18BT43-Immunotechnology**  CO-1: Discuss the molecular and cellular mechanisms involved in the development and regulation of the  immune response  CO-2: Describe the cause, challenges and treatment for Immune System Pathologies and Dysfunctions.  CO-3: Apply the major immunological laboratory techniques and their application to both clinical analysis  and experimental research |
| **15BT44-Bioprocess Principles and Calculations** **(SD)**  CO1: Practice and compute the material balance of three different phases such as solid, liquid and gas  CO2: Illustrate material balance without chemical reaction in various unit operations  CO3: Analyze the material balance involving in chemical reaction  CO4: Calculate the energy balance and heat capacity for different phases and mixtures  CO5: Infer the stoichiometry principles in bioprocess technology | **17BT44-Bioprocess Principles and Calculations (KMV/KLS)**  CO1: Practice and compute the material balance of three different phases such as solid, liquid and gas  CO2: Illustrate material balance without chemical reaction in various unit operations  CO3: Analyze the material balance involving in chemical reaction  CO4: Calculate the energy balance and heat capacity for different phases and mixtures  CO5: Infer the stoichiometry principles in bioprocess technology | **18BT44-Cell culture techniques**  CO-1: Understand the concepts of laboratory design and equipments for cell culture techniques  CO-2:Correlate between different biological samples and understand the importance of different media in  tissue culture  CO-3: Comprehend the applications of plant, animal and microbial cell culture in industry, healthcare and environment |
| **15BT45-Structural Biology-(BBM)**  CO1: Explain the fundamental principles and function of proteins.  CO2: Describe and apply the foundational principles of macromolecular structure and functions.  CO3: Apply the diverse techniques for the structural elucidation of biomolecules  CO4: Explain and analyze macromolecular interactions and their dynamics. | **17BT45-Structural Biology**  CO1: Explain the fundamental principles and function of proteins.  CO2: Describe and apply the foundational principles of macromolecular structure and functions.  CO3: Apply the diverse techniques for the structural elucidation of biomolecules  CO4: Explain and analyze macromolecular interactions and their dynamics. | **18BT45-Biochemical thermodynamics (AHV)**  **CO1**: Discuss the basic concepts of thermodynamics in process industries  **CO2:** Explain the PVT Behavior and compressibility charts  **CO3:**Illustrate thethermodynamic properties of pure fluids  CO4: Compute the properties of solutions and phase equilibria  CO 05: Employ the knowledge ofbiochemical energetics – to determine the characteristics of energy rich compounds |
| **15BT46-Clinical Biochemistry**  CO1: Discuss the biochemistry and pathophysiology associated with various disorders of metabolism  CO2: Assessment and evaluation of clinical manifestations of organ function test and enzymes involved  CO3: Assess and analyze the clinical manifestations of hormonal disturbances  CO4:Discuss the medical problems associated with blood and mechanism of detoxification | **17BT46-Clinical Biochemistry**  CO1: Discuss the biochemistry and pathophysiology associated with various disorders of metabolism  CO2: Assessment and evaluation of clinical manifestations of organ function test and enzymes involved  CO3: Assess and analyze the clinical manifestations of hormonal disturbances  CO4:Discuss the medical problems associated with blood and mechanism of detoxification | **18BT46-Clinical Biochemistry**  CO1: Understand the basic metabolic pathways of CHO, Lipids, amino acid and nucleic acids and analyze their regulations  CO2: Discuss the biochemistry and pathophysiology associated with various disorders of metabolism and hormonal disturbance  CO3: Assessment and evaluation of clinical manifestations of organ function test and enzymes involved |
| **15BTL47- Cell and Molecular Biology Laboratory**  CO-1: Prepare and analyze the mitotic and meiotic cell divisions  CO-2: Create and interpret somatic cell fusion  CO-3: Generate DNA and run various fragments through electrophoresis | **17BTL47-Cell and Molecular Biology Laboratory**  CO-1: Prepare and analyze the mitotic and meiotic cell divisions  CO-2: Create and interpret somatic cell fusion  CO-3: Generate DNA and run various fragments through electrophoresis | **18BTL47-Biochemistry Laboratory**  CO-1: Demonstrate the basic laboratory mathematics necessary to perform tests, make dilutions, and  prepare buffer solutions  CO-2: Compare/contrast Qualitative and quantitative analysis of various Biomolecules |
| **15BTL48-Clinical Biochemistry lab**  CO-1: Demonstrate the basic laboratory mathematics necessary to perform tests, make dilutions, and  prepare buffer solutions  CO2: Compare/contrast Qualitative and quantitative analysis of various Biomolecules | **17BTL48-Clinical Biochemistry lab**  CO-1: Demonstrate the basic laboratory mathematics necessary to perform tests, make dilutions, and  prepare buffer solutions  CO2: Compare/contrast Qualitative and quantitative analysis of various Biomolecules | **18BTL48- Immuno technology laboratory**  CO-1: Perform the various Immunodiagnostic techniques based on agglutination and precipitation  CO-2: Examination of  qualitative and quantitative analysis such as ELISA, Lymphocytes count and Immunoblot  CO-3: Execution of isolation and purification of antibodies |
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| **15BT51-Bio kinetics and Bio reaction Engineering**  CO-1: Discuss about the different chemical reactions and analysis of experimental reactor data  CO-2: Design of performance equations for the different reactors  CO-3: Discuss the performance and distinguish between the different types of ideal and non-ideal reactors  CO-4: Determine enzyme activity, to study the fundamentals of Microbial growth kinetics and its stoichiometry  CO-5: Describe medium requirements and media formulation for the optimal bio process | **17BT51-Bio kinetics and Bio reaction Engineering**  CO-1: Discuss about the different chemical reactions and analysis of experimental reactor data  CO-2: Design of performance equations for the different reactors  CO-3: Discuss the performance and distinguish between the different types of ideal and non-ideal reactors  CO-4: Determine enzyme activity, to study the fundamentals of Microbial growth kinetics and its stoichiometry  CO-5: Describe medium requirements and media formulation for the optimal bio process | **18BT51-Biobusiness and Entrepreneurship**  **CO-1:** Discussabout the Bio Entrepreneurship  **CO-2:** Illustrate the importance of Business in Agriculture at present era  **CO-3: -** Assess the entrepreneurship opportunity in Industrial Biotechnology  **CO-4:**Infer the project Management, IPR and start up schemes  **CO-5:**Describethe Importance of bioethics, bio safety and Regulatory norms |
| **15BT52-Genetic Engineering and applications**  CO1:Explain & compare the different tools & enzymes used in recombinant DNA  CO2: Illustration of techniques such as PCR, Blotting & construction of libraries  CO3: Differentiate and learn the gene/DNA transfer techniques between & learn the different gene/DNA transfer techniques  CO4:Outline the various methods of producing transgenic organisms and Plants  **CO-5:** Summarize the applications of genetic engineering for the welfare of mankind & society producing transgenic organisms | **17BT52-Genetic Engineering and applications**  CO1:Explain & compare the different tools & enzymes used in recombinant DNA  CO2: Illustration of techniques such as PCR, Blotting & construction of libraries  CO3: Differentiate and learn the gene/DNA transfer techniques between & learn the different gene/DNA transfer techniques  CO4:Outline the various methods  of producing transgenic organisms and Plants  **CO-5:** Summarize the applications of genetic engineering for the welfare of mankind & society | **18BT52 - Chemical reaction engineering**  CO-1: Discuss about the different chemical reactions and analysis of experimental reactor data  CO-2: Design of performance equations for the different reactors  CO-3: Discuss the performance and distinguish between the different types of ideal and non-ideal reactors  CO-4: Determine enzyme activity, to study the fundamentals of Microbial growth kinetics and its stoichiometry  CO-5: Describe medium requirements and media formulation for the optimal bio process |
| **15BT53-Immuno Technology (RKC)**  CO-1: Outline the basic concept of immune system and different types of antibodies  CO-2: Discuss the molecular and cellular mechanisms involved in the development and regulation of the  immune response  CO-3: Explain the types of hypersensitivity and autoimmune diseases  CO-4:  Describe the various methods of transplantation and role of tumor antigens  CO-5: Apply the major immunological laboratory techniques and their application to both clinical analysis and experimental research | **17BT53-Immuno Technology (RNK)**  CO-1: Outline the basic concept of immune system and different types of antibodies  CO-2: Discuss the molecular and cellular mechanisms involved in the development and regulation of the  immune response  CO-3: Explain the types of hypersensitivity and autoimmune diseases  CO-4:  Describe the various methods of transplantation and role of tumor antigens  CO-5: Apply the major immunological laboratory techniques and their application to both clinical analysis and experimental research | **18BT53-Enzyme technology and Biotransformation**  **CO-1:** Explain and apply the knowledge to select appropriate methods for isolation, purification and characterization of enzymes  **CO-2:**Discuss the catalytic action, mechanism & kinetics  **CO-3:** Choose and apply scientific method to the process of enzyme immobilization techniques  **CO-4:** Comprehend the applications of nonconventional media in enzyme catalysis and design the methods for the creation of novel enzymes and biotransformation of drugs  **CO-5:** Explain and apply uses of enzymes in clinical diagnostics and bioprocess industries |
| **15BT54-Bioinformatics**  CO-1: Understand and apply different databases, resource and software tools for sequence alignment  CO-2: Apply and analyze the phylogenetic analysis and different predictive methods for DNA and protein  CO-3: Apply different tools for genomics analysis  CO-4: Design various biomolecules by in-silico tools | **17BT54-Bioinformatics**  CO-1: Understand and apply different databases, resource and software tools for sequence alignment  CO-2: Apply and analyze the phylogenetic analysis and different predictive methods for DNA and protein  CO-3: Apply different tools for genomics analysis  CO-4: Design various biomolecules by in-silico tools | **18BT54-Genomics and Proteomics**  CO-1:Define structural, comparative and functional genomics and proteomics and its uses in various research  Fields  CO2: Summarize on genomics and genome management  CO3: Describe various methods and techniques of Genomics, high throughput DNA sequencing technology, expression profiling, proteome analysis, and its applications |
| **15BT553-Animal Biotechnology**  CO1: Explain the basic principles and techniques in genetic engineering, gene transfer techniques for animals and animal cell lines.  CO:2 Gain knowledege about the recent advances in animal breeding.  CO3: Explain the contribution ‘Functional genomics’ is making and is likely to make in animal biotechnology now and in future.  CO4: Appraise the role of biotechnology in animal science for sustainable eco-system and human welfare. | **17BT553-Animal Biotechnology**  CO1: Explain the basic principles and techniques in genetic engineering, gene transfer techniques for animals and animal cell lines.  CO:2 Gain knowledege about the recent advances in animal breeding.  CO3: Explain the contribution ‘Functional genomics’ is making and is likely to make in animal biotechnology now and in future.  CO4: Appraise the role of biotechnology in animal science for sustainable eco-system and human welfare. | **18BT55-**Bio analytical Techniques  CO1: Define the fundamentals of downstream processing for product recovery  CO2: Understand the requirements for successful operations of analytical techniques  CO3: Apply principles of various analytical devices used in in research and enhance problem solving techniques |
| **15BT563-Biotechnology for Sustainable Environment**  CO 1: Apply reasoning to identify the components of environmental eco systems and effect of pollutant on environment.  CO2: Characterize the various parameters of water , waste water and solid waste from their sources to provide valid conclusions.  CO3: Understand the impact of recovery , recycle of the useful resources from wastes by adopting advanced techniques to demonstrate the need for sustainable development.  CO4: Identify and Demonstrate the knowledege to use suitable equipment for abatement and control of air and noise pollution. | **17BT563-Biotechnology for Sustainable Environment**  CO 1: Apply reasoning to identify the components of environmental eco systems and effect of pollutant on environment.  CO2: Characterize the various parameters of water , waste water and solid waste from their sources to provide valid conclusions.  CO3: Understand the impact of recovery , recycle of the useful resources from wastes by adopting advanced techniques to demonstrate the need for sustainable development.  CO4: Identify and Demonstrate the knowledege to use suitable equipment for abatement and control of air and noise pollution. | **18BT56-Genetic Engineering and Applications**  CO1:Explain & compare the different tools & enzymes used in recombinant DNA  CO2: Illustration of techniques such as PCR, Blotting & construction of libraries  CO3: Differentiate and learn the gene/DNA transfer techniques between & learn the different gene/DNA transfer techniques  CO4:Outline the various methods of producing transgenic organisms and Plants  **CO-5:** Summarize the applications of genetic engineering for the welfare of mankind & society |
| **15BTL57-Genetic Engineering and Immunotechnology laboratory**  CO-1: Perform the various Immunodiagnostic techniques based on agglutination and precipitation  CO-2:Examination of  qualitative and quantitative analysis such as ELISA, Lymphocytes count and Immunoblot  CO-3: Execution of genetic engineering techniques for the isolation of NA, quantification, purity check, amplification and gene cloning. | **17BTL57-Genetic Engineering and Immunotechnology laboratory**  CO-1: Perform the various Immunodiagnostic techniques based on agglutination and precipitation  CO-2:Examination of  qualitative and quantitative analysis such as ELISA, Lymphocytes count and Immunoblot  CO-3: Execution of genetic engineering techniques for the isolation of NA, quantification, purity check, amplification and gene cloning. | **18BTL57-Biokinetics and Enzyme technology Laboratory**  CO1: State and define the nature of the reaction, rate of the reaction, rate constant and enzyme activity  CO2: Compose RTD data in MFR and PFR  CO3: Describe the batch reactor performance |
| **15BTL58-Bioinformatics Laboratory**  CO1:Apply and analyze sequence analysis using different tools  CO2: Apply online resource tools to solve protein structure  CO3: Design and evaluate different biomolecules using online and offline tools | **17BTL58-Bioinformatics Laboratory**  CO1:Apply and analyze sequence analysis using different tools  CO2: Apply online resource tools to solve protein structure  CO3: Design and evaluate different biomolecules using online and offline tools | **18BTL58**  **Genetic Engineering and cell Culture laboratory** |
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| **15BT61-Bio-business and entrepreneurs hip**  **CO-1:** Discuss about the Bio Entrepreneurship  **CO-2:** Illustrate the importance of Business in Agriculture at present era  **CO-3:** Assess the entrepreneurship opportunity in Industrial Biotechnology  **CO-4:** Infer about the Project Management, IPR and start up schemes  **CO-5:** Describethe Importance of bioethics, bio safety and Regulatory norms | **17BT61-Bio-business and entrepreneurs hip**  **CO-1:** Discuss about the Bio Entrepreneurship  **CO-2:** Illustrate the importance of Business in Agriculture at present era  **CO-3:** Assess the entrepreneurship opportunity in Industrial Biotechnology  **CO-4:** Infer about the Project Management, IPR and start up schemes  **CO-5:** Describethe Importance of bioethics, bio safety and Regulatory norms | **18BT61-Process control and Automation**  Understand the basics of process dynamics principles and instrumentation  Study various types of input functions and its response  Perform computational modelling to study different types of controllers  Analyse different control algorithms |
| **15BT62-Bioprocess control and automation**  CO1: Discuss the principles of instrumentation of instruments to measure biochemical parameter  CO2: Analyze the first order system for various inputs(Step, impulse, sinusoidal)  CO3: Examine the different types of controllers and control elements  CO4: Illustrate the second order system for various inputs(Step, impulse, sinusoidal)  CO5: Determine and compute the concept of controller design and its stability | **17BT62-Bioprocess control and automation**  CO1: Describe the practical application of instruments used for measuring physical quantities and chemical quantities by using offline and online measurements    CO2: Analyze the first order system for various inputs(Step, impulse, sinusoidal)  CO3: Compute the second order system with respect to different forcing function and understand concept of damping coefficient  CO4: Illustrate the practical applications of pneumatic control wall, controllers and reduction of flow diagrams  CO5: Determine and compute the concept of controller design and its stability | **18BT62-Bioprocess Equipment design and CAED**  CO1. Analyse and enumerate designing concepts of Double Pipe Heat Exchanger.  CO2. Solve and practice on design of Shell and tube heat exchanger and condenser.  CO3. Examine the concepts of designing Fermenter and packed bed distillation column. |
| **15BT63-Enzyme technology & biotransformation**  **CO -1:** Explain and apply the knowledge to select appropriate methods for isolation, purification and characterization of enzymes  **CO -2:** Discuss the catalytic action, mechanism & kinetics  **CO - 3:**  Choose and apply scientific method to the process of enzyme immobilization techniques  **CO - 4:** Comprehend the applications of nonconventional media in enzyme catalysis and design the methods for the creation of novel enzymes and biotransformation of drugs  **CO - 5:** Explain and apply uses of enzymes in clinical diagnostics and bioprocess industries | **17BT63-Enzyme technology & biotransformation**  **CO-1:** Explain and apply the knowledge to select appropriate methods for isolation, purification and characterization of enzymes  **CO-2:** Discuss the catalytic action, mechanism & kinetics  **CO-3:**  Choose and apply scientific method to the process of enzyme immobilization techniques  **CO-4:** Comprehend the applications of nonconventional media in enzyme catalysis and design the methods for the creation of novel enzymes and biotransformation of drugs  **CO-5:** Explain and apply uses of enzymes in clinical diagnostics and bioprocess industries | **18BT63-Bioinformatics**  CO-1: Understand and apply different databases, resource and software tools for sequence alignment  CO-2: Apply and analyze the phylogenetic analysis and different tools for genomics analysis  CO-3: Apply and analyses different  predictive methods for DNA and protein  CO-4: Design various biomolecules by in-silico tools |
| **15BT64-Bioprocess equipment design & CAED**  CO1. Analyse and enumerate designing concepts of Double Pipe Heat Exchanger.  CO2. Solve and practice on design of Shell and tube heat exchanger and condenser.  CO3. Examine the concepts of designing Fermenter and packed bed distillation column. | **17BT64-Bioprocess equipment design & CAED**  CO1. Analyse and enumerate designing concepts of Double Pipe Heat Exchanger.  CO2. Solve and practice on design of Shell and tube heat exchanger and condenser.  CO3. Examine the concepts of designing Fermenter and packed bed distillation column. | **18BT64X-Professional Elective-I**  18BT641: Food Process Engineering  18BT642: Phyto-Chemistry and Phyto-Harmones  18BT643: Human Physiology |
| **15BT65-Cell Culture Techniques**  CO-1: Understand the concepts of laboratory design and equipments for cell culture techniques  CO-2:Correlate between different biological samples and understand the importance of different media in  tissue culture  CO-3: Comprehend the applications of plant culture in industrial secondary metabolites  CO-4: Explain the applications of animal cell culture in industry and environment  CO-5: Apply and analyze the applications of microbial cell culture in industry and environment | **17BT653-Cell Culture Techniques**  CO-1: Understand the concepts of laboratory design and equipments for cell culture techniques  CO-2:Correlate between different biological samples and understand the importance of different media in  tissue culture  CO-3: Comprehend the applications of plant, animal and microbial cell culture in industry, healthcare and environment | **18BT65X- Open Elective-I**  18BT651: Biology for Engineers  18BT652:Biomaterials  18BT653: Nanobiotechnology |
| **15BT662-Nanobiotechnology**  CO1: Explain nano-biotechnology as an emerging field and its scope  CO2: Apply the principles and application of techniques in characterization of nanomaterials  CO3: Apply nanotechnology in diagnostic, drug delivery system, microfluidic and biomems  CO4: Discuss the application of biological molecules and system in nanotechnology | **17BT662-Nanobiotechnology**  CO1: Define nano-biotechnology as an emerging field and its scope.  CO2: Understand the principles and applications of the technology in various fields. | **18BTL66-Process Control and Automation Laboratory**  CO -1: Comprehend the basics of Instrumentation, classification different input function of automatic process control system  CO-2: Illustrate the characteristics of transducers based on critical process parameters  CO-3: Demonstrate the working of first order systems for tanks connected in series  CO-4: Calculate and analyze the output obtained from different systems and perform theoretical validation  CO-5: Distinguish the effect of offset in different controllers |
| **15BTL67-Bioprocess control & automation laboratory**  CO -1: Comprehend the basics of Instrumentation, classification different input function of automatic process control system  CO-2: Illustrate the characteristics of transducers based on critical process parameters  CO-3: Demonstrate the working of first order systems for tanks connected in series  CO-4: Calculate and analyze the output obtained from different systems and perform theoretical validation  CO-5: Distinguish the effect of offset in different controllers | **17BTL67-Bioprocess control & automation laboratory**  CO -1: Comprehend the basics of Instrumentation, classification different input function of automatic process control system  CO-2: Illustrate the characteristics of transducers based on critical process parameters  CO-3: Demonstrate the working of first order systems for tanks connected in series  CO-4: Calculate and analyze the output obtained from different systems and perform theoretical validation  CO-5: Distinguish the effect of offset in different controllers | **18BTL67-Bioinformatics laboratory**  CO1:Apply and analyze sequence analysis using different tools  CO2: Apply online resource tools to solve protein structure  CO3: Design and evaluate different biomolecules using online and offline tools |
| **15BTL68-Biokinetics and Enzyme technology laboratory**  CO1: State and define the nature of the reaction, rate of the reaction, rate constant and enzyme activity  CO2: Compose RTD data in MFR and PFR  CO3: Describe the batch reactor performance | **15BTL68-Biokinetics and Enzyme technology laboratory**  CO1: State and define the nature of the reaction, rate of the reaction, rate constant and enzyme activity  CO2: Compose RTD data in MFR and PFR  CO3: Describe the batch reactor performance | **18BTMP68-Mini Project** |
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| **15BT71-Fermentation technology**  CO1: Describe the factors affecting Primary and secondary metabolite production and its industrial importance.  CO2: Compute the basic requirements of downstream processing for biochemical product recovery  CO-3: Identify and summarize the effect of change in unit's operations and its impact on the bioprocess  CO-4:Illustrate how emerging technologies would benefit the bio chemical product recovery and outline the process involving in large scale  CO5: Apply product recovery techniques for high-purity protein production | **17BT71-Fermentation technology**  CO1: Describe the factors affecting Primary and secondary metabolite production and its industrial importance.  CO2: Compute the basic requirements of downstream processing for biochemical product recovery  CO-3: Identify and summarize the effect of change in unit's operations and its impact on the bioprocess  CO-4:Illustrate how emerging technologies would benefit the bio chemical product recovery and outline the process involving in large scale  CO5: Apply product recovery techniques for high-purity protein production | **18BT71-Bioprocess Engineering** |
| **15BT72-Genomics & Proteomics**  CO1: Discuss on genome database & genome projects  CO2: Summarize on genomics and genome management  CO3: Describe structural genomics and genome analysis.  CO4: Describe proteomics and proteome analysis | **17BT72-Genomics & Proteomics**  CO1: Discuss on genome database & genome projects  CO2: Summarize on genomics and genome management  CO3: Describe structural genomics and genome analysis.  CO4: Describe proteomics and proteome analysis | **18BT72-Clinical and pharmaceutical Biotechnology**  **18BT73X-Professional Elective-2**  18BT731-Process Equipment & Plant Design  18BT732-Bioreactor Design Concepts  18BT733-Transport Phenomena |
| **15BT73-Plant biotechnology**  CO-1: State the basic concepts of plant tissue culture and their applications, media preparation, tools of genetic engineering in producing transgenic plants (For eg., disease resistant)  CO-2: Describe the applications of plant genetic engineering in production transgenic plants to with stand abiotic and biotic stress and discuss ethical and social issues regarding genetically-modified crops  **CO-3**: Discuss the role, importance & applications of tissue culture in molecular farming  **CO-4**: Explain the mechanism of signal transduction and nitrogen fixation in plants  **CO-5**: Explain the principles, technical requirement, scientific and commercial applications in algal technologies with suitable examples | **17BT73-Plant biotechnology**  CO-1: State the basic concepts of plant tissue culture and their applications, media preparation, tools of genetic engineering in producing transgenic plants (For eg., disease resistant)  CO-2: Describe the applications of plant genetic engineering in production transgenic plants to with stand abiotic and biotic stress and discuss ethical and social issues regarding genetically-modified crops  **CO-3**: Discuss the role, importance & applications of tissue culture in molecular farming  **CO-4**: Explain the mechanism of signal transduction and nitrogen fixation in plants  **CO-5**: Explain the principles, technical requirement, scientific and commercial applications in algal technologies with suitable examples | **18BT74X-Professional Elective-3**  18BT741-Bioethics, Biosafety and IPR  18BT742- Agricultural Biotechnology  18BT743-Tissue Engineering |
| **15BT743-Lab to industrial scaling**  CO-1: Discuss fermentation as a basic biochemical process, types of fermentation and fermentation products  CO-2: Understand and emphasis on scale up media , inoculum and sterilization process  CO-3: Understand the concept of rheology and fermenter design  CO-4:Describe the analytical instruments used in fermenter and biomass estimation  CO-5:Explain and infer the process of upstream and down stream process | **18BT74X-Professional Elective-3**  18BT741-Health Informatics  18BT742- Bioreactor Design Concepts  18BT743-Lab to industrial scaling  18BT744-Food Biotechnology | **18BT75X-Open Elective-B**  18BT751-BT for sustainable Environment  18BT752-Forensic Science  18BT753-Biological data Management |
| **15BT752-Forensic sciences**  CO1: Learn about forensic science as a field of study, discuss about history and development, role and responsibilities of forensic scientist  CO2: Analysis of physical evidence, biological evidence, firearm evidence, and evidence examination  CO3: Investigation, collection and packing of evidence and legal guidelines  CO4: Learn about ethics in forensic science and ethical dilemmas, Application of computers in forensic science  CO5: Characterization of the evidence and interpretation of the crime scenes | **18BT75X-Professional Elective-4**  18BT751-Dairy Biotechnology  18BT752-Forensic Science  18BT753-Molecular Diagnostics  18BT744-Big data Management | **18BTL76-Bioprocess Engineering laboratory** |
| **15BTL76-Fermentation laboratory**  CO1: Demonstrate about Product enrichment operation using different methods.  CO2: Estimate level of secondary metabolites production in fermented broth  CO3: Comprehended analysis of protein | **17BTL76-Fermentation laboratory**  CO1: Describe the techniques involved in downstream process  CO2: Analyze the product identification and separation techniques  CO3: Study the membrane process  CO4: Determine the techniques involved in product enrichment and recovery process  CO5: Comprehended the analysis of biomolecules using various techniques | **18BTP77-Project Work Phase-I** |
| CO1: Describe the techniques involved in downstream process  CO2: Analyze the product identification and separation techniques  CO3: Study the membrane process  CO4: Determine the techniques involved in product enrichment and recovery process  CO5: Comprehended the analysis of biomolecules using various techniques |
| **15BTL77-Plant biotechnology laboratory**  CO-1: Preparation of resources and materials for plant tissue culture  CO-2: Estimation of secondary metabolites and different biomolecules  CO-3: Comprehend the applications of tissue culture | **17BTL77-Plant biotechnology laboratory**  CO-1: Preparation of resources and materials for plant tissue culture  CO-2: Estimation of secondary metabolites and different biomolecules  CO-3: Comprehend the applications of tissue culture | **Internship** |
|  | **17BTP78-Project Work Phase-I + Project Work Seminar** |  |
|  |  |  |
| **15BT81-Clinical & Pharmaceutical Biotechnology**  CO-01: Discuss about pharma industry and drug development  CO-02: Explain the significance of pharmaco-kinetic models, pharmaco-dynamic principles, various dosage forms and formulation  CO-03 :Describe different agents in drug therapy  CO-04: Illustrate Bio therapeutics and stem cells application  CO-05: Comprehend specific applications of pharmaceutical & clinical Biotechnology | **17BT81-Clinical & Pharmaceutical Biotechnology**  CO-01: Discuss about pharma industry and drug development  CO-02: Explain the significance of pharmaco-kinetic models, pharmaco-dynamic principles, various dosage forms and formulation  CO-03 :Describe different agents in drug therapy  CO-04: Illustrate Bio therapeutics and stem cells application  CO-05: Comprehend specific applications of pharmaceutical & clinical Biotechnology | **18BT81-Regulatory Affairs in Biotech Industry**  CO 01: Outline the Regulatory Rules and Guidelines for product development  CO 02: Describe the safety and quality standards in the biotech industry  CO 03: Comprehend the Validation Process in the biotech industry  CO 04: Analyze the Product quality and its Implementation  CO 05: Describe the concepts of Quality Management System |
| **15BT82-Regulatory affairs in Biotech Industry**  CO 01: Outline the Regulatory Rules and Guidelines for product development  CO 02: Describe the safety and quality standards in the biotech industry  CO 03: Comprehend the Validation Process in the biotech industry  CO 04: Analyze the Product quality and its Implementation  CO 05: Describe the concepts of Quality Management System | **17BT82-Regulatory affairs in Biotech Industry**  CO 01: Outline the Regulatory Rules and Guidelines for product development  CO 02: Describe the safety and quality standards in the biotech industry  CO 03: Comprehend the Validation Process in the biotech industry  CO 04: Analyze the Product quality and its Implementation  CO 05: Describe the concepts of Quality Management System | **18BT82X- Professional Elective-4**   1. Environmental biotechnology 2. Industrial Microbiology 3. Marine Biotechnology |
| **15BT833-Environmental Biotechnology**  CO1: Discuss the concepts of pollutants and its accumulation and detoxification  CO2: Explain wastewater treatment process and its application in aerobic and anaerobic treatment  CO3: Illustrate the biodegradation and bioremediation of xenobiotic compounds  CO4: Distinguish the importance of biocatalysts and its mechanism involved in different biological reaction  CO5: Explain the process microbial leaching on metal ores | **17BT83X-Professional Elective-5**  17BT831-Protein engineering Environmental Biotechnology  17BT832-Metabolic Engineering  17BT833-Environmental Biotechnology | **18BTP83- Project Work Phase-2** |
|  | **17BT84-Internship/Professional Practice** | **18BTS84-Technical Seminar** |
|  | **17BTP85-Project Work-II** | **18BTI85-Internship** |
|  | **17BTS86-Seminar on Current trends in Engineering and technology** |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mapping of Course outcomes (COs) and Program Outcomes (POs)** | | | | | | | | | | | | | | | | |
| **Note:** 1 = Slight 2 = Moderate 3 = Good | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| **Course outcomes** | **Program Outcomes** | | | | | | | | | | | | **PSO** | | | |
|  | **PO**  **1** | **PO**  **2** | **PO**  **3** | **PO**  **4** | **PO**  **5** | **PO**  **6** | **PO**  **7** | **PO8** | **PO9** | **PO**  **10** | **PO**  **11** | **PO**  **12** | **POS**  **1** | **POS**  **2** | **POS**  **3** | **POS**  **4** |
| **CO-1** | 3 | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 1 | 2 | 1 |
| **CO-2** | 3 | 2 | 2 | 1 | 2 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0 |
| **CO-3** | 3 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 2 | 0 | 2 | 0 |
| **CO-4** | 3 | 2 | 2 | 1 | 2 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 2 | 1 | 2 | 0 |
| **CO-5** | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 2 | 0 |

**COLLEGE VISION AND MISSION**

**VISION**

The vision of the institution is to create and maintain an enabling learning environment for the students to transform them as thorough professionals to meet diverse professional demands of global environments.

### **MISSION**

## The mission of the institution is to provide quality education to the students to pursue courses in different engineering disciplines and to transform their professional dreams into reality and to offer competent budding professionals to the society.

**DEPARTMENTAL VISION AND MISSION**

**VISION**

To be a Centre of excellence in the field of Biotechnology equipped to create technically strong ethically moral global man power that endeavor for the welfare of mankind.

**MISSION**

Creating state-of-the-art infrastructure for education and research to induct lifelong professional growth and different career avenues for BT engineers in collaboration with industries, research organizations and academia.

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)**

**PEO1:** Students will be lucrative professionals in different sectors of Biotechnology fields with high proficiency in multidisciplinary tasks.

**PEO2**: Operate technically at competent level in concocting problems of biotechnology and utilize the knowledge to develop Biological processes and bio-techniques.

**PEO3:** Students will endure higher education with harmonious combination of the skills of engineering, management &amp; life science.

**PEO4:** Students will inculcate Scio-ethical values, exhibit professionalism, team spirit for lifelong learning and well-being of society and mankind.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**BIOTECHNOLOGY ENGINEERING BOARD**

**BE-CBCS SYLLABUS 2017-18 Scheme**

**B.E Biotechnology Engineering**

**Program Outcomes (POs)**

At the end of the B.E program, students are expected to have developed the following outcomes.

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**Program Specific Outcomes (PSOs)**

**At the end of the B.E Biotechnology engineering program, the students are expected to have developed the following program specific outcomes.**

**PSO1**

The graduates will have the ability to plan, analyse, design, execute andcontribute to the field of biotechnology and allied industries designing ,developing and providing solutions for product/processes/technologydevelopment.

**PSO2**

The graduates of Biotechnology engineering program will have the ability to take up employment, entrepreneurship, research and development for sustainable society.

**PSO3**

The graduates will be able to pursue opportunities for personal and professional growth, higher studies, demonstrate leadership skills and engage in lifelong learning by active participation in the Biotechnology profession.

**PSO4**

The graduates will be able to demonstrate professional integrity and an appreciation of ethical, environmental, regulatory and issues related to Biotechnology.